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RE REGULATORY RECORD

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DIGITALLY VERIFIED RECORD

TRINITY
CONSULTANCY

STABILITY CERTIFICATE

Dated – 08-10-2025

The detailed engineering and structure design of the Proposed Construction of RCC roof Residential Building with Stilit Floor (Parking), First Floor, Second Floor, Third Floor & Fourth Floor + 5 Floors, T.S.No. 313/3G, 313/5, 313/6 & 313/7, Ward No.5, Block No.7, Velapadi Village, Vellore City Municipal Corporation, Vellore Taluk, Vellore District. has been done by me/us based on the report of geotechnical investigation (soil test) done by Trinity Consultancy Report No. TC_022_20222023 Dated – 17.11.2023 and considering the functional requirement of the building.

2. It is certified that among other factors, the proposed building has been designed to resist earthquake. I/We have checked various parameters and found that the proposed building would be safe.

3. I/We further certify that:

(i) The minimum grade of concrete is **M25.**

(ii) The design and analysis have been done using the code of practice for plain and reinforced concrete as per IS 456, design loads as per IS Codes No **875 Part – I, Part – II, Part – III & Part IV** and design of earthquake resistant structure as per IS Code No **1893: 2016.**

4. The building will be safe and sound when used for the purpose for which it is designed.

Stamp and Signature

Er. ARUN. E, M.Tech(Stru. Engg.)., A.I.V.,
Structural Engineer Grade-I (SE),
Reg. No. SE / GR-I / Feb-2025 / 003
TRINITY CONSULTANCY,
No. 25/1, Lakshmana Mudaliar Street,
Sainathapuram, Vellore - 632 001.
Cell No.: 98404 91020

Encl.: Structural Design Calculation

GOVERNMENT OF TAMIL NADU
TOWN AND COUNTRY PLANNING DEPARTMENT

Joint Director, District Town and Country Planning Office, Vellore District
IInd Floor, Ex-service Men Welfare Building,
Fort Round Road, Opposite to Periyar Park,
Vellore - 632 001 Phone No: 0416-2225344
Website: www.tn.gov.in/dtcp
Mail ID: ddtcpvlr9@gmail.com

Roc No: 2024071916721/2024/VD3 ***Dated: 06.02.2025***

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that, **Thiru E.ARUN** has enrolled as **Structural Engineer Grade – *I* (SE)** with Joint Director, District Town and Country Planning Office - Vellore District, who has the qualification of M.Tech in Structural Engineering and experience in the relevant field for 10 years.

He has been given the Registration No. **SE/Gr-I/Feb-2025/003** on **22.05.2024**. He shall be required to comply with the duties and responsibilities prescribed by the Government of Tamil Nadu in Part V, "Registration of Professionals", Tamil Nadu Combined Development and Building Rules, 2019 approved vide G.O.(Ms) No.18, MAWS (MA1) Department, Dated: 04.02.2019.

This Registration is valid upto **21.05.2029**

Joint Director,
District Town and Country Planning office,
Vellore District.



மாவட்ட நகர் ஊரமைப்பு அலுவலகம்
06 FEB 2025
வேலூர்.

To
Thiru. E.Arun,
No.27/14, Lakshmana mudaliyar street,
Sainathapuram,
Vellore – 632 001.

FOOTING DESIGN CALCULATIONS

Project Name	:	RAJ N RAM APARTMENTS
Client Name	:	Mr. P.G. Purushothaman, Mr. P.G. Devarajan, Mr.P.G. Rukmangadhan
Engineer Name	:	Mr. S.Magesh Kumar
Design File	:	Y:\E TABS\MAGESH-VELLORE\2.RAJ N RAM APRTMENTS\RCDC\FOOTING-35T-10-04-2025.rcdx
Analysis File	:	E:\BHARGA~1\BHARGA~1\MAGESH~1 \20FBD~1.KVP\ETABS\KVPRES~1.MDB
Analysis Last Modified	:	08-10-2025 01:00:07 PM

Definitions:

1.	α	=	Coefficient of Thermal Expansion
2.	ε1	=	Strain at level considered, Calculated ignoring the stiffening of the concrete in tension zone
3.	εm	=	Average steel strain at level considered
4.	ρact	=	Percentage steel provided
5.	ρcrit	=	Percentage steel critical as per code
6.	A	=	Plan area of footing base
7.	Acr	=	Distance from the point considered to the surface of the nearest longitudinal bar
8.	AstPrv	=	Area of tensile reinforcement provided
9.	Astrqd	=	Area of tensile reinforcement required
10.	Asv	=	Area of shear reinforcement required
11.	AsvPrv	=	Area of shear reinforcement provided
12.	A1	=	Bearing area of footing at slope of 1:2
13.	A2	=	C/s Area of column
14.	B	=	Width of footing base
15.	Beff	=	Effective width of footing
16.	BoffB	=	Footing offset along B below column in plan
17.	BoffT	=	Footing offset along B above column in plan
18.	B1	=	Width of sloped footing at top
19.	ColOff	=	Column offset in sloped footing
20.	D	=	Depth of footing
21.	Deff	=	Effective Depth of footing
22.	Df	=	Depth of founding layer
23.	Dw	=	Ground water level
24.	Ec	=	Modulus of elasticity of concrete
25.	Es	=	Modulus of elasticity of steel
26.	Foss	=	Safety factor against sliding
27.	Fosu	=	Safety factor against uplift
28.	Fst	=	Stress in steel
29.	L	=	Length of footing base
30.	Leff	=	Effective length of footing
31.	LoffL	=	Footing offset along L on left side of column
32.	LoffR	=	Footing offset along L on right side of column
33.	L1	=	Length of sloped footing at top

34. Mx = Bending Moment along column D
35. Mx' = Bending Moment along column D due to odd shaped column
36. Mex = Eccentricity moment along column D
37. Mxx = Total Bending Moment along column D (Mx + Mx' + Mex)
38. My = Bending Moment along column B
39. My' = Bending Moment along column B due to odd shaped column
40. Mey = Eccentricity moment along column B
41. Myy = Total Bending Moment along column B (My + My' + Mey)
42. Muy = Factored moment along column B
43. Muy' = Factored Moment along column B due to odd shaped column
44. Mux = Factored moment along column D
45. Mux' = Factored Moment along column D due to odd shaped column
46. Netdown = Net downward load
47. OB = Maximum permissible offset on bottom side of column in plan
48. OL = Maximum permissible offset on left side of column in plan
49. OR = Maximum permissible offset on right side of column in plan
50. OT = Maximum permissible offset on top side of column in plan
51. P = Axial load for footing sizing
52. P1 = Soil pressure at corner 1
53. P2 = Soil pressure at corner 2
54. P3 = Soil pressure at corner 3
55. P4 = Soil pressure at corner 4
56. Pdelta = Column Load to be transferred by reinforcement
57. Pt = Calculated percentage tensile reinforcement
58. Pu = Factored axial load
59. q = Surcharge Load
60. sp = Spacing Between bars at outer most layer
61. SPu = Upward Soil Pressure
62. SPuL = Upward Soil Pressure from left
63. SPuR = Upward Soil Pressure from right
64. SPuB = Upward Soil Pressure from bottom
65. SPuT = Upward Soil Pressure from top
66. Tc = Design shear strength of concrete
67. Temp1 = Peak Hydration temperature
68. Temp2 = Seasonal Temperature Variations
69. Tv = Nominal shear stress
70. Vu = Design shear force
71. Vus = Strength of shear reinforcement

72.	Vx	=	Shear along major axis
73.	Vy	=	Shear along minor axis
74.	Waterpr	=	Upward water pressure
75.	Waterup	=	Upward force due to water
76.	Wcr	=	Surface Crack Width
77.	WFoot	=	Add. Wt. due to difference in concrete and soil density
78.	WFootc	=	Weight of footing and column with concrete density
79.	WSoil	=	Weight of soil covering footing area
80.	Zx	=	Section modulus of footing base along L
81.	Zy	=	Section modulus of footing base along B

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	:	FC1	
Column No	:	C1,C2	(230 mm X 600 mm)
Analysis No	:	C3,C1	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	

Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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 : Average pressure

Footing Type : Pad

Footing Size (L x B x D) : 1550mm X 1200mm X 375mm

Without considering Effect of Water Table

Footing Self Wt., F1	=	17.44	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	17.44	kN
Offset Along L (Loff)	=	475	mm
Offset Along B (Boff)	=	485	mm

Check For Maximum Soil Pressure:

Critical Column No	=	C1	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	618.41	kN
P	=	Pcomb + W1	
P	=	635.85	kN
Mx	=	-13.59	kNm
My	=	2.24	kNm
P/A	=	341.86	kN/sqm
Mx/Zx	=	-28.28	kN/sqm
My/Zy	=	6.01	kN/sqm
Maximum Soil Pressure	=	376.15	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Column No	=	C1	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	618.41	kN
P	=	Pcomb + W1	

P	=	635.85	kN
Mx	=	-13.59	kNm
My	=	2.24	kNm
P/A	=	341.86	kN/sqm
Mx/Zx	=	-28.28	kN/sqm
My/Zy	=	6.01	kN/sqm
Minimum Soil Pressure	=	307.56	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Column No	=	C1	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	927.62	kN
Mux	=	-20.38	kNm
Muy	=	3.36	kNm
P/A	=	498.72	kN/sqm
Mx/Zx	=	-42.42	kN/sqm
My/Zy	=	9.02	kN/sqm
Deff	=	327	mm
Beff	=	1200	mm
SPu	=	541.14	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	73.26	kNm
Pt	=	0.138	%
Ast Rqd (BM)	=	540	sqmm
Ast Prv (Distributed Across Total Width)	=	5 - T12 @ 300	
	=	565	sqmm

Bottom Reinforcement Along B:

Critical Column No	=	C1	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	927.62	kN
Mux	=	-20.38	kNm
Muy	=	3.36	kNm
P/A	=	498.72	kN/sqm
Mx/Zx	=	-42.42	kN/sqm
My/Zy	=	9.02	kN/sqm
Deff	=	311	mm
Leff	=	1550	mm
SPu	=	507.74	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	92.56	kNm

Pt	=	0.147	%
Ast Rqd (BM)	=	711	sqmm
Ast Prv (Distributed Across Total Length)	=	7 - T12 @ 260	
	=	792	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face

	=	327	mm
Critical Column No	=	C1	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	927.62	kN
Mux	=	-20.38	kNm
Muy	=	3.36	kNm
P/A	=	498.72	kN/sqm
Mx/Zx	=	-42.42	kN/sqm
My/Zy	=	9.02	kN/sqm
Deff	=	327	mm
Beff	=	1200	mm
SPu	=	541.14	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	96.11	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.24	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	311	mm
Critical Column No	=	C1	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	927.62	kN
Mux	=	-20.38	kNm
Muy	=	3.36	kNm
P/A	=	498.72	kN/sqm
Mx/Zx	=	-42.42	kN/sqm
My/Zy	=	9.02	kN/sqm
Deff	=	311	mm
Leff	=	1550	mm
SPu	=	507.74	kN/sqm

Vu	=	SPu X (Boff - d) X L	
	=	136.94	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.28	N/sqmm
Tc	=	0.29	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	160	mm
Critical Column No	=	C2	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	935.82	kN
Mux	=	-1.34	kNm
Muy	=	0.61	kNm
P/A	=	503.13	kN/sqm
Mx/Zx	=	-2.8	kN/sqm
My/Zy	=	1.65	kN/sqm
Deff	=	319	mm
Leff	=	919	mm
Beff	=	549	mm
Punching Perimeter	=	2936	mm
Punching Area	=	936584	sqmm
SPu	=	Average Pressure	
	=	503.13	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	681.97	kN
Tv	=	Vu / Punching Area	
	=	0.728	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Column No	=	C2	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	935.82	kN
A2	=	0.14	sqm
A1	=	3.63	sqm
Base Area	=	1.86	sqm
A1	>	Base Area	
Thus, A1	=	1.86	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	3.645	

Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC3	
Column No	:	C3	(230 mm X 600 mm)
Analysis No	:	C6	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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	:	Average pressure	

Footing Type	:	Pad	
Footing Size (L x B x D)	:	1250mm X 900mm X 300mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	8.44	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	8.44	kN
Offset Along L (Loff)	=	325	mm
Offset Along B (Boff)	=	335	mm

Check For Maximum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	356.97	kN
P	=	Pcomb + W1	
P	=	365.41	kN
Mx	=	-8.59	kNm

My	=	1.23	kNm
P/A	=	324.81	kN/sqm
Mx/Zx	=	-36.67	kN/sqm
My/Zy	=	7.29	kN/sqm
Maximum Soil Pressure	=	368.77	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	356.97	kN
P	=	Pcomb + W1	
P	=	365.41	kN
Mx	=	-8.59	kNm
My	=	1.23	kNm
P/A	=	324.81	kN/sqm
Mx/Zx	=	-36.67	kN/sqm
My/Zy	=	7.29	kN/sqm
Minimum Soil Pressure	=	280.85	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	535.46	kN
Mux	=	-12.89	kNm
Muy	=	1.84	kNm
P/A	=	475.96	kN/sqm
Mx/Zx	=	-55	kN/sqm
My/Zy	=	10.93	kN/sqm
Deff	=	252	mm
Beff	=	900	mm
SPu	=	530.97	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	25.24	kNm
Pt	=	0.143	%
Ast Rqd (BM)	=	324	sqmm
Ast Prv (Distributed Across Total Width)	=	4 - T12 @ 300	
	=	452	sqmm

Bottom Reinforcement Along B:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	535.46	kN

Mux	=	-12.89	kNm
Muy	=	1.84	kNm
P/A	=	475.96	kN/sqm
Mx/Zx	=	-55	kN/sqm
My/Zy	=	10.93	kN/sqm
Deff	=	236	mm
Leff	=	1250	mm
SPu	=	486.9	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	34.15	kNm
Pt	=	0.153	%
Ast Rqd (BM)	=	450	sqmm
Ast Prv (Distributed Across Total Length)	=	6 - T12 @ 300	
	=	679	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face

	=	252	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	535.46	kN
Mux	=	-12.89	kNm
Muy	=	1.84	kNm
P/A	=	475.96	kN/sqm
Mx/Zx	=	-55	kN/sqm
My/Zy	=	10.93	kN/sqm
Deff	=	252	mm
Beff	=	900	mm
SPu	=	530.97	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	34.88	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.15	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	236	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	535.46	kN

Mux	=	-12.89	kNm
Muy	=	1.84	kNm
P/A	=	475.96	kN/sqm
Mx/Zx	=	-55	kN/sqm
My/Zy	=	10.93	kN/sqm
Deff	=	236	mm
Leff	=	1250	mm
SPu	=	486.9	kN/sqm
Vu	=	SPu X (Boff - d) X L	
	=	60.25	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.20	N/sqmm
Tc	=	0.29	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	122	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	535.46	kN
Mux	=	-12.89	kNm
Muy	=	1.84	kNm
P/A	=	475.96	kN/sqm
Mx/Zx	=	-55	kN/sqm
My/Zy	=	10.93	kN/sqm
Deff	=	244	mm
Leff	=	844	mm
Beff	=	474	mm
Punching Perimeter	=	2636	mm
Punching Area	=	643184	sqmm
SPu	=	Average Pressure	
	=	475.96	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	345.05	kN
Tv	=	Vu / Punching Area	
	=	0.536	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	535.46	kN

A2	=	0.14	sqm
A1	=	2.57	sqm
Base Area	=	1.13	sqm
A1	>	Base Area	
Thus, A1	=	1.13	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	2.841	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC4	
Column No	:	C4	(230 mm X 600 mm)
Analysis No	:	C5	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	kN/sqm
Permissible SBC Increase for EQ	=	0	%
Permissible SBC Increase for Wind	=	0	%
Live Load Reduction	=	0	%
Design cross section by	:	Average pressure	
Footing Type	:	Step , 2 Steps	
Footing Size (L x B x D)	:		
Step 1.	:	1950mm X 1600mm X 350mm	
Step 2.	:	1250mm X 800mm X 250mm	

Without considering Effect of Water Table

Footing Self Wt., F1	=	33.55	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	33.55	kN
Offset Along L (Loff)			
Step 1.	=	675	mm

Step 2.	=	325	mm
Offset Along B (Boff)			
Step 1.	=	685	mm
Step 2.	=	285	mm

Check For Maximum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	1105.72	kN
P	=	Pcomb + W1	
P	=	1139.27	kN
Mx	=	-9.74	kNm
My	=	1.39	kNm
P/A	=	365.15	kN/sqm
Mx/Zx	=	-9.61	kN/sqm
My/Zy	=	1.67	kN/sqm
Maximum Soil Pressure	=	376.43	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	1105.72	kN
P	=	Pcomb + W1	
P	=	1139.27	kN
Mx	=	-9.74	kNm
My	=	1.39	kNm
P/A	=	365.15	kN/sqm
Mx/Zx	=	-9.61	kN/sqm
My/Zy	=	1.67	kN/sqm
Minimum Soil Pressure	=	353.87	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	1658.58	kN
Mux	=	-14.62	kNm
Muy	=	2.08	kNm
P/A	=	531.6	kN/sqm
Mx/Zx	=	-14.41	kN/sqm
My/Zy	=	2.5	kN/sqm
Deff	=	552	mm

Beff	=	800	mm
SPu	=	546.01	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	199.02	kNm
Pt	=	0.207	%
Ast Rqd (BM)	=	912	sqmm
Ast Prv (Distributed Across Total Width)	=	9 - T12 @ 200	
	=	1018	sqmm

Bottom Reinforcement Along B:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	1658.58	kN
Mux	=	-14.62	kNm
Muy	=	2.08	kNm
P/A	=	531.6	kN/sqm
Mx/Zx	=	-14.41	kN/sqm
My/Zy	=	2.5	kN/sqm
Deff	=	536	mm
Leff	=	1250	mm
SPu	=	534.1	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	244.35	kNm
Pt	=	0.178	%
Ast Rqd (BM)	=	1194	sqmm
Ast Prv (Distributed Across Total Length)	=	11 - T12 @ 195	
	=	1244	sqmm

Stepwise Design For Shear:

Step 1

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face			
	=	302	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	350	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	-14.62	kNm
Muy	=	2.08	kNm
P/A	=	531.6	kN/sqm
Mx/Zx	=	-14.41	kN/sqm
My/Zy	=	2.5	kN/sqm
Critical Section Lies In Step	=	1	

C/S Area	=	483200	sqmm
Deff	=	286	mm
SPu	=	546.01	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	41.93	kN
Tv	=	0.09	N/sqmm
Tc	=	0.33	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	286	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	400	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1658.58	kN
Mux	=	-14.62	kNm
Muy	=	2.08	kNm
P/A	=	531.6	kN/sqm
Mx/Zx	=	-14.41	kN/sqm
My/Zy	=	2.5	kN/sqm

Critical Section Lies In Step	=	1	
C/S Area	=	557700	sqmm
Deff	=	286	mm
SPu	=	534.1	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	118.73	kN
Tv	=	0.21	N/sqmm
Tc	=	0.31	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face			
	=	147	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1658.58	kN
Mux	=	-14.62	kNm
Muy	=	2.08	kNm
P/A	=	531.6	kN/sqm
Mx/Zx	=	-14.41	kN/sqm
My/Zy	=	2.5	kN/sqm
Spu	=	Average Pressure	
	=	531.6	kN/sqm

Beff	=	1094	mm
Leff	=	1544	mm
Punching Perimeter	=	5276	mm
Punching Area	=	1689136	sqmm
Deff	=	294	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	760.64	kN
Tv	=	Vu / Punching Area	
	=	0.49	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Step 2

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face			
	=	552	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	675	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	-14.62	kNm
Muy	=	2.08	kNm
P/A	=	531.6	kN/sqm
Mx/Zx	=	-14.41	kN/sqm
My/Zy	=	2.5	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	483200	sqmm
Deff	=	536	mm
SPu	=	546.01	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	107.45	kN
Tv	=	0.22	N/sqmm
Tc	=	0.33	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	536	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	685	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1658.58	kN
Mux	=	-14.62	kNm
Muy	=	2.08	kNm

P/A	=	531.6	kN/sqm
Mx/Zx	=	-14.41	kN/sqm
My/Zy	=	2.5	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	557700	sqmm
Deff	=	536	mm
SPu	=	534.1	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	155.18	kN
Tv	=	0.28	N/sqmm
Tc	=	0.31	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face

	=	272	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1658.58	kN
Mux	=	-14.62	kNm
Muy	=	2.08	kNm
P/A	=	531.6	kN/sqm
Mx/Zx	=	-14.41	kN/sqm
My/Zy	=	2.5	kN/sqm
Spu	=	Average Pressure	
	=	531.6	kN/sqm
Beff	=	774	mm
Leff	=	1144	mm
Punching Perimeter	=	3836	mm
Punching Area	=	2086784	sqmm
Deff	=	544	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	1187.88	kN
Tv	=	Vu / Punching Area	
	=	0.57	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1658.58	kN

A2	=	0.14	sqm
A1	=	7.89	sqm
Base Area	=	3.12	sqm
A1	>	Base Area	
Thus, A1	=	3.12	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	4.7208	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC5	
Column No	:	C5	(230 mm X 600 mm)
Analysis No	:	C4	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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	:	Average pressure	

Footing Type	:	Pad	
Footing Size (L x B x D)	:	1750mm X 1400mm X 450mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	27.56	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	27.56	kN
Offset Along L (Loff)	=	575	mm
Offset Along B (Boff)	=	585	mm

Check For Maximum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	859.52	kN
P	=	Pcomb + W1	
P	=	887.08	kN
Mx	=	-8.58	kNm
My	=	-0.98	kNm
P/A	=	362.07	kN/sqm
Mx/Zx	=	-12.01	kN/sqm
My/Zy	=	-1.72	kN/sqm
Maximum Soil Pressure	=	375.81	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	859.52	kN
P	=	Pcomb + W1	
P	=	887.08	kN
Mx	=	-8.58	kNm
My	=	-0.98	kNm
P/A	=	362.07	kN/sqm
Mx/Zx	=	-12.01	kN/sqm
My/Zy	=	-1.72	kN/sqm
Minimum Soil Pressure	=	348.34	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	1289.28	kN
Mux	=	-12.87	kNm
Muy	=	-1.48	kNm
P/A	=	526.24	kN/sqm
Mx/Zx	=	-18.01	kN/sqm
My/Zy	=	-2.58	kN/sqm
Deff	=	402	mm
Beff	=	1400	mm
SPu	=	544.25	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	125.96	kNm

Pt	=	0.134	%
Ast Rqd (BM)	=	756	sqmm
Ast Prv (Distributed Across Total Width)	=	7 - T12 @ 235	
	=	792	sqmm

Bottom Reinforcement Along B:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1289.28	kN
Mux	=	-12.87	kNm
Muy	=	-1.48	kNm
P/A	=	526.24	kN/sqm
Mx/Zx	=	-18.01	kN/sqm
My/Zy	=	-2.58	kN/sqm
Deff	=	386	mm
Leff	=	1750	mm
SPu	=	528.82	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	158.35	kNm
Pt	=	0.145	%
Ast Rqd (BM)	=	979	sqmm
Ast Prv (Distributed Across Total Length)	=	9 - T12 @ 220	
	=	1018	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face			
	=	402	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1289.28	kN
Mux	=	-12.87	kNm
Muy	=	-1.48	kNm
P/A	=	526.24	kN/sqm
Mx/Zx	=	-18.01	kN/sqm
My/Zy	=	-2.58	kN/sqm
Deff	=	402	mm
Beff	=	1400	mm
SPu	=	544.25	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	131.82	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.23	N/sqmm
Tc	=	0.27	N/sqmm

Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	386	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1289.28	kN
Mux	=	-12.87	kNm
Muy	=	-1.48	kNm
P/A	=	526.24	kN/sqm
Mx/Zx	=	-18.01	kN/sqm
My/Zy	=	-2.58	kN/sqm
Deff	=	386	mm
Leff	=	1750	mm
SPu	=	528.82	kN/sqm
Vu	=	SPu X (Boff - d) X L	
	=	184.16	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.27	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	197	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1289.28	kN
Mux	=	-12.87	kNm
Muy	=	-1.48	kNm
P/A	=	526.24	kN/sqm
Mx/Zx	=	-18.01	kN/sqm
My/Zy	=	-2.58	kN/sqm
Deff	=	394	mm
Leff	=	994	mm
Beff	=	624	mm
Punching Perimeter	=	3236	mm
Punching Area	=	1274984	sqmm
SPu	=	Average Pressure	
	=	526.24	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	962.88	kN
Tv	=	Vu / Punching Area	

	=	0.755	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1289.28	kN
A2	=	0.14	sqm
A1	=	4.87	sqm
Base Area	=	2.45	sqm
A1	>	Base Area	
Thus, A1	=	2.45	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	4.1833	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC6	
Column No	:	C6,C7	(230 mm X 600 mm)
Analysis No	:	C2,C7	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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	:	Average pressure	
Footing Type	:	Pad	
Footing Size (L x B x D)	:	1500mm X 1150mm X 375mm	

Without considering Effect of Water Table

Footing Self Wt., F1	=	16.17	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	16.17	kN
Offset Along L (Loff)	=	450	mm
Offset Along B (Boff)	=	460	mm

Check For Maximum Soil Pressure:

Critical Column No	=	C7	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	596.66	kN
P	=	Pcomb + W1	
P	=	612.83	kN
Mx	=	-13.79	kNm
My	=	3.22	kNm
P/A	=	355.26	kN/sqm
Mx/Zx	=	-31.99	kN/sqm
My/Zy	=	9.73	kN/sqm
Maximum Soil Pressure	=	396.98	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Column No	=	C7	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	596.66	kN
P	=	Pcomb + W1	
P	=	612.83	kN
Mx	=	-13.79	kNm
My	=	3.22	kNm
P/A	=	355.26	kN/sqm
Mx/Zx	=	-31.99	kN/sqm
My/Zy	=	9.73	kN/sqm
Minimum Soil Pressure	=	313.55	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Column No	=	C7	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	894.99	kN
Mux	=	-20.69	kNm

Muy	=	4.82	kNm
P/A	=	518.83	kN/sqm
Mx/Zx	=	-47.98	kN/sqm
My/Zy	=	14.59	kN/sqm
Deff	=	327	mm
Beff	=	1150	mm
SPu	=	566.81	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	66	kNm
Pt	=	0.138	%
Ast Rqd (BM)	=	518	sqmm
Ast Prv (Distributed Across Total Width)	=	5 - T12 @ 290	
	=	565	sqmm

Bottom Reinforcement Along B:

Critical Column No	=	C7	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	894.99	kN
Mux	=	-20.69	kNm
Muy	=	4.82	kNm
P/A	=	518.83	kN/sqm
Mx/Zx	=	-47.98	kN/sqm
My/Zy	=	14.59	kN/sqm
Deff	=	311	mm
Leff	=	1500	mm
SPu	=	533.42	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	84.65	kNm
Pt	=	0.145	%
Ast Rqd (BM)	=	675	sqmm
Ast Prv (Distributed Across Total Length)	=	6 - T12 @ 300	
	=	679	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face			
	=	327	mm
Critical Column No	=	C7	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	894.99	kN
Mux	=	-20.69	kNm
Muy	=	4.82	kNm

P/A	=	518.83	kN/sqm
Mx/Zx	=	-47.98	kN/sqm
My/Zy	=	14.59	kN/sqm
Deff	=	327	mm
Beff	=	1150	mm
SPu	=	566.81	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	80.18	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.21	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	311	mm
Critical Column No	=	C7	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	894.99	kN
Mux	=	-20.69	kNm
Muy	=	4.82	kNm
P/A	=	518.83	kN/sqm
Mx/Zx	=	-47.98	kN/sqm
My/Zy	=	14.59	kN/sqm
Deff	=	311	mm
Leff	=	1500	mm
SPu	=	533.42	kN/sqm
Vu	=	SPu X (Boff - d) X L	
	=	119.22	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.26	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	160	mm
Critical Column No	=	C7	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	894.99	kN
Mux	=	-20.69	kNm
Muy	=	4.82	kNm

P/A	=	518.83	kN/sqm
Mx/Zx	=	-47.98	kN/sqm
My/Zy	=	14.59	kN/sqm
Deff	=	319	mm
Leff	=	919	mm
Beff	=	549	mm
Punching Perimeter	=	2936	mm
Punching Area	=	936584	sqmm
SPu	=	Average Pressure	
	=	518.83	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	633.22	kN
Tv	=	Vu / Punching Area	
	=	0.676	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Column No	=	C7	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	894.99	kN
A2	=	0.14	sqm
A1	=	3.63	sqm
Base Area	=	1.73	sqm
A1	>	Base Area	
Thus, A1	=	1.73	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	3.5153	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC8	
Column No	:	C8,C9	(230 mm X 600 mm)
Analysis No	:	C11,C10	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	

Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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	:	Average pressure	

Footing Type	:	Pad	
Footing Size (L x B x D)	:	1400mm X 1050mm X 350mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	12.86	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	12.86	kN
Offset Along L (Loff)	=	400	mm
Offset Along B (Boff)	=	410	mm

Check For Maximum Soil Pressure:

Critical Column No	=	C9	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	563.88	kN
P	=	Pcomb + W1	
P	=	576.74	kN
Mx	=	0.19	kNm
My	=	0.33	kNm
P/A	=	392.34	kN/sqm
Mx/Zx	=	0.56	kN/sqm
My/Zy	=	1.29	kN/sqm
Maximum Soil Pressure	=	394.19	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Column No	=	C8	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	526.64	kN

P	=	Pcomb + W1	
P	=	539.5	kN
Mx	=	-7.97	kNm
My	=	0.67	kNm
P/A	=	367.01	kN/sqm
Mx/Zx	=	-23.25	kN/sqm
My/Zy	=	2.62	kN/sqm
Minimum Soil Pressure	=	341.14	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Column No	=	C9	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	845.81	kN
Mux	=	0.29	kNm
Muy	=	0.5	kNm
P/A	=	575.38	kN/sqm
Mx/Zx	=	0.84	kN/sqm
My/Zy	=	1.94	kN/sqm
Deff	=	302	mm
Beff	=	1050	mm
SPu	=	576.22	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	48.4	kNm
Pt	=	0.139	%
Ast Rqd (BM)	=	441	sqmm
Ast Prv (Distributed Across Total Width)	=	5 - T12 @ 300	
	=	565	sqmm

Bottom Reinforcement Along B:

Critical Column No	=	C9	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	845.81	kN
Mux	=	0.29	kNm
Muy	=	0.5	kNm
P/A	=	575.38	kN/sqm
Mx/Zx	=	0.84	kN/sqm
My/Zy	=	1.94	kN/sqm
Deff	=	286	mm
Leff	=	1400	mm
SPu	=	577.32	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	

	=	67.93	kNm
Pt	=	0.147	%
Ast Rqd (BM)	=	588	sqmm
Ast Prv (Distributed Across Total Length)	=	6 - T12 @ 280	
	=	679	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face

	=	302	mm
Critical Column No	=	C9	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	845.81	kN
Mux	=	0.29	kNm
Muy	=	0.5	kNm
P/A	=	575.38	kN/sqm
Mx/Zx	=	0.84	kN/sqm
My/Zy	=	1.94	kN/sqm
Deff	=	302	mm
Beff	=	1050	mm
SPu	=	576.22	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	59.29	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.19	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	286	mm
Critical Column No	=	C9	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	845.81	kN
Mux	=	0.29	kNm
Muy	=	0.5	kNm
P/A	=	575.38	kN/sqm
Mx/Zx	=	0.84	kN/sqm
My/Zy	=	1.94	kN/sqm
Deff	=	286	mm
Leff	=	1400	mm

SPu	=	577.32	kN/sqm
Vu	=	SPu X (Boff - d) X L	
	=	100.22	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.25	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	147	mm

Critical Column No	=	C9	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	845.81	kN
Mux	=	0.29	kNm
Muy	=	0.5	kNm
P/A	=	575.38	kN/sqm
Mx/Zx	=	0.84	kN/sqm
My/Zy	=	1.94	kN/sqm
Deff	=	294	mm
Leff	=	894	mm
Beff	=	524	mm
Punching Perimeter	=	2836	mm
Punching Area	=	833784	sqmm
SPu	=	Average Pressure	
	=	575.38	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	576.27	kN
Tv	=	Vu / Punching Area	
	=	0.691	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Column No	=	C9	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	845.81	kN
A2	=	0.14	sqm
A1	=	3.26	sqm
Base Area	=	1.47	sqm
A1	>	Base Area	
Thus, A1	=	1.47	
Modification Factor	=	SquareRoot(A1/A2) < = 2	

SquareRoot(A1/A2)	=	3.2404	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC10	
Column No	:	C10,C14,C18,C22 (230 mm X 600 mm)	
Analysis No	:	C8,C14,C15,C20	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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	:	Average pressure	

Footing Type	:	Pad	
Footing Size (L x B x D)	:	1650mm X 1300mm X 425mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	22.79	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	22.79	kN
Offset Along L (Loff)	=	525	mm
Offset Along B (Boff)	=	535	mm

Check For Maximum Soil Pressure:

Critical Column No	=	C22	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	748.81	kN
P	=	Pcomb + W1	

P	=	771.60	kN
Mx	=	-13.55	kNm
My	=	-0.21	kNm
P/A	=	359.72	kN/sqm
Mx/Zx	=	-22.98	kN/sqm
My/Zy	=	-0.46	kN/sqm
Maximum Soil Pressure	=	383.15	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Column No	=	C10	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	709.45	kN
P	=	Pcomb + W1	
P	=	732.24	kN
Mx	=	-11.15	kNm
My	=	0.57	kNm
P/A	=	341.37	kN/sqm
Mx/Zx	=	-18.91	kN/sqm
My/Zy	=	1.22	kN/sqm
Minimum Soil Pressure	=	321.25	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Column No	=	C22	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1123.22	kN
Mux	=	-20.33	kNm
Muy	=	-0.32	kNm
P/A	=	523.64	kN/sqm
Mx/Zx	=	-34.46	kN/sqm
My/Zy	=	-0.69	kN/sqm
Deff	=	377	mm
Beff	=	1300	mm
SPu	=	558.11	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	99.99	kNm
Pt	=	0.135	%
Ast Rqd (BM)	=	663	sqmm
Ast Prv (Distributed Across Total Width)	=	6 - T12 @ 260	

	=	679	sqmm

Bottom Reinforcement Along B:

Critical Column No	=	C22	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1123.22	kN
Mux	=	-20.33	kNm
Muy	=	-0.32	kNm
P/A	=	523.64	kN/sqm
Mx/Zx	=	-34.46	kN/sqm
My/Zy	=	-0.69	kN/sqm
Deff	=	361	mm
Leff	=	1650	mm
SPu	=	524.33	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	123.81	kNm
Pt	=	0.141	%
Ast Rqd (BM)	=	842	sqmm
Ast Prv (Distributed Across Total Length)	=	8 - T12 @ 240	
	=	905	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face			
	=	377	mm
Critical Column No	=	C22	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1123.22	kN
Mux	=	-20.33	kNm
Muy	=	-0.32	kNm
P/A	=	523.64	kN/sqm
Mx/Zx	=	-34.46	kN/sqm
My/Zy	=	-0.69	kN/sqm
Deff	=	377	mm
Beff	=	1300	mm
SPu	=	558.11	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	107.38	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.22	N/sqmm
Tc	=	0.27	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	361	mm
Critical Column No	=	C22	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1123.22	kN
Mux	=	-20.33	kNm
Muy	=	-0.32	kNm
P/A	=	523.64	kN/sqm
Mx/Zx	=	-34.46	kN/sqm
My/Zy	=	-0.69	kN/sqm
Deff	=	361	mm
Leff	=	1650	mm
SPu	=	524.33	kN/sqm
Vu	=	SPu X (Boff - d) X L	
	=	150.54	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.25	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	184	mm
Critical Column No	=	C22	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1123.22	kN
Mux	=	-20.33	kNm
Muy	=	-0.32	kNm
P/A	=	523.64	kN/sqm
Mx/Zx	=	-34.46	kN/sqm
My/Zy	=	-0.69	kN/sqm
Deff	=	369	mm
Leff	=	969	mm
Beff	=	599	mm
Punching Perimeter	=	3136	mm
Punching Area	=	1157184	sqmm
SPu	=	Average Pressure	
	=	523.64	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	819.28	kN

Tv	=	Vu / Punching Area	
	=	0.708	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Column No	=	C22	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1123.22	kN
A2	=	0.14	sqm
A1	=	4.44	sqm
Base Area	=	2.15	sqm
A1	>	Base Area	
Thus, A1	=	2.15	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	3.9188	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC11	
Column No	:	C11,C23	(230 mm X 600 mm)
Analysis No	:	C9,C19	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	kN/sqm
Permissible SBC Increase for EQ	=	0	%
Permissible SBC Increase for Wind	=	0	%
Live Load Reduction	=	0	%
Design cross section by	:	Average pressure	
Footing Type	:	Step , 2 Steps	
Footing Size (L x B x D)	:		

Step 1.	:	2200mm X 1850mm X 400mm	
Step 2.	:	1300mm X 950mm X 300mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	49.96	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	49.96	kN
Offset Along L (Loff)			
Step 1.	=	800	mm
Step 2.	=	350	mm
Offset Along B (Boff)			
Step 1.	=	810	mm
Step 2.	=	360	mm

Check For Maximum Soil Pressure:

Critical Column No	=	C11	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	1482.81	kN
P	=	Pcomb + W1	
P	=	1532.78	kN
Mx	=	2.94	kNm
My	=	-0.23	kNm
P/A	=	376.6	kN/sqm
Mx/Zx	=	1.97	kN/sqm
My/Zy	=	-0.19	kN/sqm
Maximum Soil Pressure	=	378.76	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Column No	=	C23	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	1423.57	kN
P	=	Pcomb + W1	
P	=	1473.53	kN
Mx	=	-13.8	kNm
My	=	-2.13	kNm
P/A	=	362.05	kN/sqm
Mx/Zx	=	-9.25	kN/sqm
My/Zy	=	-1.69	kN/sqm
Minimum Soil Pressure	=	351.11	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Column No	=	C11	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2224.22	kN
Mux	=	4.41	kNm
Muy	=	-0.35	kNm
P/A	=	546.49	kN/sqm
Mx/Zx	=	2.95	kN/sqm
My/Zy	=	-0.28	kN/sqm
Deff	=	652	mm
Beff	=	950	mm
SPu	=	549.45	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	325.27	kNm
Pt	=	0.199	%
Ast Rqd (BM)	=	1230	sqmm
Ast Prv (Distributed Across Total Width)	=	11 - T12 @ 185	
	=	1244	sqmm

Bottom Reinforcement Along B:

Critical Column No	=	C11	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2224.22	kN
Mux	=	4.41	kNm
Muy	=	-0.35	kNm
P/A	=	546.49	kN/sqm
Mx/Zx	=	2.95	kN/sqm
My/Zy	=	-0.28	kN/sqm
Deff	=	636	mm
Leff	=	1300	mm
SPu	=	546.77	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	394.61	kNm
Pt	=	0.184	%
Ast Rqd (BM)	=	1524	sqmm
Ast Prv (Distributed Across Total Length)	=	14 - T12 @ 170	
	=	1583	sqmm

Stepwise Design For Shear:

Step 1

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face			
	=	352	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	450	mm
Critical Column No	=	C11	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	4.41	kNm
Muy	=	-0.35	kNm
P/A	=	546.49	kN/sqm
Mx/Zx	=	2.95	kN/sqm
My/Zy	=	-0.28	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	651200	sqmm
Deff	=	336	mm
SPu	=	549.45	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	99.61	kN
Tv	=	0.15	N/sqmm
Tc	=	0.33	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	336	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	450	mm
Critical Column No	=	C11	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2224.22	kN
Mux	=	4.41	kNm
Muy	=	-0.35	kNm
P/A	=	546.49	kN/sqm
Mx/Zx	=	2.95	kN/sqm
My/Zy	=	-0.28	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	739200	sqmm
Deff	=	336	mm
SPu	=	546.77	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	137.13	kN
Tv	=	0.19	N/sqmm

Tc	=	0.31	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face

	=	172	mm
Critical Column No	=	C11	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2224.22	kN
Mux	=	4.41	kNm
Muy	=	-0.35	kNm
P/A	=	546.49	kN/sqm
Mx/Zx	=	2.95	kN/sqm
My/Zy	=	-0.28	kN/sqm
Spu	=	Average Pressure	
	=	546.49	kN/sqm
Beff	=	1294	mm
Leff	=	1644	mm
Punching Perimeter	=	5876	mm
Punching Area	=	2127336	sqmm
Deff	=	344	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	1061.65	kN
Tv	=	Vu / Punching Area	
	=	0.53	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Step 2

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face

	=	652	mm

Footing Offset From Next Step / Column Face (StLoff)

	=	800	mm
Critical Column No	=	C11	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	4.41	kNm
Muy	=	-0.35	kNm
P/A	=	546.49	kN/sqm

Mx/Zx	=	2.95	kN/sqm
My/Zy	=	-0.28	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	651200	sqmm
Deff	=	636	mm
SPu	=	549.45	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	150.44	kN
Tv	=	0.23	N/sqmm
Tc	=	0.33	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	636	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	810	mm
Critical Column No	=	C11	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2224.22	kN
Mux	=	4.41	kNm
Muy	=	-0.35	kNm
P/A	=	546.49	kN/sqm
Mx/Zx	=	2.95	kN/sqm
My/Zy	=	-0.28	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	739200	sqmm
Deff	=	636	mm
SPu	=	546.77	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	209.3	kN
Tv	=	0.28	N/sqmm
Tc	=	0.31	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face			
	=	322	mm
Critical Column No	=	C11	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2224.22	kN

Mux	=	4.41	kNm
Muy	=	-0.35	kNm
P/A	=	546.49	kN/sqm
Mx/Zx	=	2.95	kN/sqm
My/Zy	=	-0.28	kN/sqm
Spu	=	Average Pressure	
	=	546.49	kN/sqm
Beff	=	874	mm
Leff	=	1244	mm
Punching Perimeter	=	4236	mm
Punching Area	=	2727984	sqmm
Deff	=	644	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	1630.04	kN
Tv	=	Vu / Punching Area	
	=	0.6	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Column No	=	C11	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2224.22	kN
A2	=	0.14	sqm
A1	=	10.3	sqm
Base Area	=	4.07	sqm
A1	>	Base Area	
Thus, A1	=	4.07	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	5.3918	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016
Footing No	:	FC12
Column No	:	C12 (230 mm X 600 mm)
Analysis No	:	C13

Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	

Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	kN/sqm
Permissible SBC Increase for EQ	=	0	%
Permissible SBC Increase for Wind	=	0	%
Live Load Reduction	=	0	%

Design cross section by : Average pressure

Footing Type	:	Step , 2 Steps
Footing Size (L x B x D)	:	
Step 1.	:	2500mm X 2150mm X 475mm
Step 2.	:	1400mm X 1050mm X 300mm

Without considering Effect of Water Table

Footing Self Wt., F1	=	74.85	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	74.85	kN
Offset Along L (Loff)			
Step 1.	=	950	mm
Step 2.	=	400	mm
Offset Along B (Boff)			
Step 1.	=	960	mm
Step 2.	=	410	mm

Check For Maximum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	1953.05	kN
P	=	Pcomb + W1	
P	=	2027.90	kN
Mx	=	16.75	kNm
My	=	-0.06	kNm
P/A	=	377.28	kN/sqm
Mx/Zx	=	7.48	kN/sqm
My/Zy	=	-0.03	kN/sqm
Maximum Soil Pressure	=	384.79	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	1953.05	kN
P	=	Pcomb + W1	
P	=	2027.9	kN
Mx	=	16.75	kNm
My	=	-0.06	kNm
P/A	=	377.28	kN/sqm
Mx/Zx	=	7.48	kN/sqm
My/Zy	=	-0.03	kN/sqm
Minimum Soil Pressure	=	369.77	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	2929.57	kN
Mux	=	25.13	kNm
Muy	=	-0.09	kNm
P/A	=	545.04	kN/sqm
Mx/Zx	=	11.22	kN/sqm
My/Zy	=	-0.05	kN/sqm
Deff	=	727	mm
Beff	=	1050	mm
SPu	=	556.26	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	539.67	kNm
Pt	=	0.238	%
Ast Rqd (BM)	=	1815	sqmm
Ast Prv (Distributed Across Total Width)	=	17 - T12 @ 135	
	=	1923	sqmm

Bottom Reinforcement Along B:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	2929.57	kN
Mux	=	25.13	kNm
Muy	=	-0.09	kNm
P/A	=	545.04	kN/sqm
Mx/Zx	=	11.22	kN/sqm
My/Zy	=	-0.05	kN/sqm
Deff	=	711	mm

Leff	=	1400	mm
SPu	=	545.08	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	627.94	kNm
Pt	=	0.216	%
Ast Rqd (BM)	=	2147	sqmm
Ast Prv (Distributed Across Total Length)	=	19 - T12 @ 140	
	=	2149	sqmm

Stepwise Design For Shear:

Step 1

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face			
	=	427	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	550	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	25.13	kNm
Muy	=	-0.09	kNm
P/A	=	545.04	kN/sqm
Mx/Zx	=	11.22	kN/sqm
My/Zy	=	-0.05	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	918050	sqmm
Deff	=	411	mm
SPu	=	556.26	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	147.1	kN
Tv	=	0.16	N/sqmm
Tc	=	0.35	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	411	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	550	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2929.57	kN
Mux	=	25.13	kNm
Muy	=	-0.09	kNm
P/A	=	545.04	kN/sqm
Mx/Zx	=	11.22	kN/sqm

My/Zy	=	-0.05	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	1027500	sqmm
Deff	=	411	mm
SPu	=	545.08	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	189.42	kN
Tv	=	0.18	N/sqmm
Tc	=	0.34	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face

	=	210	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2929.57	kN
Mux	=	25.13	kNm
Muy	=	-0.09	kNm
P/A	=	545.04	kN/sqm
Mx/Zx	=	11.22	kN/sqm
My/Zy	=	-0.05	kN/sqm
Spu	=	Average Pressure	
	=	545.04	kN/sqm
Beff	=	1469	mm
Leff	=	1819	mm
Punching Perimeter	=	6576	mm
Punching Area	=	2672111	sqmm
Deff	=	419	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	1473.17	kN
Tv	=	Vu / Punching Area	
	=	0.53	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Step 2

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face

	=	727	mm

Footing Offset From Next Step / Column Face (StLoff)

	=	950	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5	

(SIDL) +1.5 (Live)

Mux	=	25.13	kNm
Muy	=	-0.09	kNm
P/A	=	545.04	kN/sqm
Mx/Zx	=	11.22	kN/sqm
My/Zy	=	-0.05	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	918050	sqmm
Deff	=	711	mm
SPu	=	556.26	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	266.7	kN
Tv	=	0.29	N/sqmm
Tc	=	0.35	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	711	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	960	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2929.57	kN
Mux	=	25.13	kNm
Muy	=	-0.09	kNm
P/A	=	545.04	kN/sqm
Mx/Zx	=	11.22	kN/sqm
My/Zy	=	-0.05	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	1027500	sqmm
Deff	=	711	mm
SPu	=	545.08	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	339.31	kN
Tv	=	0.33	N/sqmm
Tc	=	0.34	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face			
	=	360	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	

Pu	=	2929.57	kN
Mux	=	25.13	kNm
Muy	=	-0.09	kNm
P/A	=	545.04	kN/sqm
Mx/Zx	=	11.22	kN/sqm
My/Zy	=	-0.05	kN/sqm
Spu	=	Average Pressure	
	=	545.04	kN/sqm
Beff	=	949	mm
Leff	=	1319	mm
Punching Perimeter	=	4536	mm
Punching Area	=	3261384	sqmm
Deff	=	719	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	2247.33	kN
Tv	=	Vu / Punching Area	
	=	0.69	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2929.57	kN
A2	=	0.14	sqm
A1	=	12.32	sqm
Base Area	=	5.38	sqm
A1	>	Base Area	
Thus, A1	=	5.38	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	6.1991	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Area	Factor X Column
	=	2484	kN
Concrete Bearing Capacity	<	Pu, Hence Provide Dowel Bars.	
Depth Available (Ldav)	=	689	mm
Ld factor	=	72.5	
Using 12mm bars			
Ld required	=	870	mm
Transfer Efficiency	=	0.79	

Ast Required	=	1293.39	sqmm
No Of 12mm Bars	=	12-T12	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC13	
Column No	:	C13	(230 mm X 600 mm)
Analysis No	:	C12	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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	:	Average pressure	

Footing Type	:	Pad	
Footing Size (L x B x D)	:	1750mm X 1400mm X 450mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	27.56	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	27.56	kN
Offset Along L (Loff)	=	575	mm
Offset Along B (Boff)	=	585	mm

Check For Maximum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	875.67	kN
P	=	Pcomb + W1	
P	=	903.23	kN
Mx	=	7.27	kNm
My	=	0.88	kNm
P/A	=	368.67	kN/sqm
Mx/Zx	=	10.17	kN/sqm

My/Zy	=	1.53	kN/sqm
Maximum Soil Pressure	=	380.37	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	875.67	kN
P	=	Pcomb + W1	
P	=	903.23	kN
Mx	=	7.27	kNm
My	=	0.88	kNm
P/A	=	368.67	kN/sqm
Mx/Zx	=	10.17	kN/sqm
My/Zy	=	1.53	kN/sqm
Minimum Soil Pressure	=	356.96	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	1313.51	kN
Mux	=	10.9	kNm
Muy	=	1.31	kNm
P/A	=	536.12	kN/sqm
Mx/Zx	=	15.26	kN/sqm
My/Zy	=	2.3	kN/sqm
Deff	=	402	mm
Beff	=	1400	mm
SPu	=	551.38	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	127.61	kNm
Pt	=	0.134	%
Ast Rqd (BM)	=	756	sqmm
Ast Prv (Distributed Across Total Width)	=	7 - T12 @ 235	
	=	792	sqmm

Bottom Reinforcement Along B:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	1313.51	kN
Mux	=	10.9	kNm
Muy	=	1.31	kNm
P/A	=	536.12	kN/sqm

Mx/Zx	=	15.26	kN/sqm
My/Zy	=	2.3	kN/sqm
Deff	=	386	mm
Leff	=	1750	mm
SPu	=	538.42	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	161.23	kNm
Pt	=	0.148	%
Ast Rqd (BM)	=	997	sqmm
Ast Prv (Distributed Across Total Length)	=	9 - T12 @ 220	
	=	1018	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face

	=	402	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1313.51	kN
Mux	=	10.9	kNm
Muy	=	1.31	kNm
P/A	=	536.12	kN/sqm
Mx/Zx	=	15.26	kN/sqm
My/Zy	=	2.3	kN/sqm
Deff	=	402	mm
Beff	=	1400	mm
SPu	=	551.38	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	133.54	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.24	N/sqmm
Tc	=	0.27	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	386	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1313.51	kN
Mux	=	10.9	kNm
Muy	=	1.31	kNm
P/A	=	536.12	kN/sqm

Mx/Zx	=	15.26	kN/sqm
My/Zy	=	2.3	kN/sqm
Deff	=	386	mm
Leff	=	1750	mm
SPu	=	538.42	kN/sqm
Vu	=	SPu X (Boff - d) X L	
	=	187.51	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.28	N/sqmm
Tc	=	0.29	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	197	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1313.51	kN
Mux	=	10.9	kNm
Muy	=	1.31	kNm
P/A	=	536.12	kN/sqm
Mx/Zx	=	15.26	kN/sqm
My/Zy	=	2.3	kN/sqm
Deff	=	394	mm
Leff	=	994	mm
Beff	=	624	mm
Punching Perimeter	=	3236	mm
Punching Area	=	1274984	sqmm
SPu	=	Average Pressure	
	=	536.12	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	980.97	kN
Tv	=	Vu / Punching Area	
	=	0.769	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1313.51	kN
A2	=	0.14	sqm
A1	=	4.87	sqm
Base Area	=	2.45	sqm

A1	>	Base Area	
Thus, A1	=	2.45	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	4.1833	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC15	
Column No	:	C15,C19	(230 mm X 600 mm)
Analysis No	:	C31,C16	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	kN/sqm
Permissible SBC Increase for EQ	=	0	%
Permissible SBC Increase for Wind	=	0	%
Live Load Reduction	=	0	%
Design cross section by	:	Average pressure	
Footing Type	:	Step , 2 Steps	
Footing Size (L x B x D)	:		
Step 1.	:	1900mm X 1550mm X 350mm	
Step 2.	:	1200mm X 750mm X 225mm	

Without considering Effect of Water Table

Footing Self Wt., F1	=	30.83	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	30.83	kN
Offset Along L (Loff)			
Step 1.	=	650	mm
Step 2.	=	300	mm
Offset Along B (Boff)			
Step 1.	=	660	mm

Step 2.	=	260	mm

Check For Maximum Soil Pressure:

Critical Column No	=	C19	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	1098.82	kN
P	=	Pcomb + W1	
P	=	1129.65	kN
Mx	=	4.92	kNm
My	=	-1.02	kNm
P/A	=	383.58	kN/sqm
Mx/Zx	=	5.28	kN/sqm
My/Zy	=	-1.34	kN/sqm
Maximum Soil Pressure	=	390.2	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Column No	=	C15	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	1006.86	kN
P	=	Pcomb + W1	
P	=	1037.7	kN
Mx	=	-2.2	kNm
My	=	-1.17	kNm
P/A	=	352.36	kN/sqm
Mx/Zx	=	-2.36	kN/sqm
My/Zy	=	-1.54	kN/sqm
Minimum Soil Pressure	=	348.45	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Column No	=	C19	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1648.23	kN
Mux	=	7.38	kNm
Muy	=	-1.53	kNm
P/A	=	559.67	kN/sqm
Mx/Zx	=	7.92	kN/sqm
My/Zy	=	-2.01	kN/sqm
Deff	=	527	mm

Beff	=	750	mm
SPu	=	567.59	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	185.85	kNm
Pt	=	0.217	%
Ast Rqd (BM)	=	857	sqmm
Ast Prv (Distributed Across Total Width)	=	8 - T12 @ 225	
	=	905	sqmm

Bottom Reinforcement Along B:

Critical Column No	=	C19	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1648.23	kN
Mux	=	7.38	kNm
Muy	=	-1.53	kNm
P/A	=	559.67	kN/sqm
Mx/Zx	=	7.92	kN/sqm
My/Zy	=	-2.01	kN/sqm
Deff	=	511	mm
Leff	=	1200	mm
SPu	=	561.68	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	232.43	kNm
Pt	=	0.183	%
Ast Rqd (BM)	=	1122	sqmm
Ast Prv (Distributed Across Total Length)	=	10 - T12 @ 215	
	=	1131	sqmm

Stepwise Design For Shear:

Step 1

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face			
	=	302	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	350	mm
Critical Column No	=	C19	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	7.38	kNm
Muy	=	-1.53	kNm
P/A	=	559.67	kN/sqm
Mx/Zx	=	7.92	kN/sqm

My/Zy	=	-2.01	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	468100	sqmm
Deff	=	286	mm
SPu	=	567.59	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	42.23	kN
Tv	=	0.09	N/sqmm
Tc	=	0.34	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	286	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	400	mm
Critical Column No	=	C19	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1648.23	kN
Mux	=	7.38	kNm
Muy	=	-1.53	kNm
P/A	=	559.67	kN/sqm
Mx/Zx	=	7.92	kN/sqm
My/Zy	=	-2.01	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	543400	sqmm
Deff	=	286	mm
SPu	=	561.68	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	121.66	kN
Tv	=	0.22	N/sqmm
Tc	=	0.31	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face			
	=	147	mm
Critical Column No	=	C19	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1648.23	kN
Mux	=	7.38	kNm

Muy	=	-1.53	kNm
P/A	=	559.67	kN/sqm
Mx/Zx	=	7.92	kN/sqm
My/Zy	=	-2.01	kN/sqm
Spu	=	Average Pressure	
	=	559.67	kN/sqm
Beff	=	1044	mm
Leff	=	1494	mm
Punching Perimeter	=	5076	mm
Punching Area	=	1559736	sqmm
Deff	=	294	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	775.29	kN
Tv	=	Vu / Punching Area	
	=	0.52	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Step 2

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face			
	=	527	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	650	mm
Critical Column No	=	C19	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	7.38	kNm
Muy	=	-1.53	kNm
P/A	=	559.67	kN/sqm
Mx/Zx	=	7.92	kN/sqm
My/Zy	=	-2.01	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	468100	sqmm
Deff	=	511	mm
SPu	=	567.59	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	108.21	kN
Tv	=	0.23	N/sqmm
Tc	=	0.34	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	511	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	660	mm
Critical Column No	=	C19	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1648.23	kN
Mux	=	7.38	kNm
Muy	=	-1.53	kNm
P/A	=	559.67	kN/sqm
Mx/Zx	=	7.92	kN/sqm
My/Zy	=	-2.01	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	543400	sqmm
Deff	=	511	mm
SPu	=	561.68	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	159.01	kN
Tv	=	0.29	N/sqmm
Tc	=	0.31	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face			
	=	260	mm
Critical Column No	=	C19	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1648.23	kN
Mux	=	7.38	kNm
Muy	=	-1.53	kNm
P/A	=	559.67	kN/sqm
Mx/Zx	=	7.92	kN/sqm
My/Zy	=	-2.01	kN/sqm
Spu	=	Average Pressure	
	=	559.67	kN/sqm
Beff	=	749	mm
Leff	=	1119	mm
Punching Perimeter	=	3736	mm
Punching Area	=	1938984	sqmm
Deff	=	519	mm

Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	1179.15	kN
Tv	=	Vu / Punching Area	
	=	0.61	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Column No	=	C19	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1648.23	kN
A2	=	0.14	sqm
A1	=	7.34	sqm
Base Area	=	2.95	sqm
A1	>	Base Area	
Thus, A1	=	2.95	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	4.5904	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC16	
Column No	:	C16	(230 mm X 600 mm)
Analysis No	:	C17	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	kN/sqm
Permissible SBC Increase for EQ	=	0	%
Permissible SBC Increase for Wind	=	0	%
Live Load Reduction	=	0	%

Design cross section by	:	Average pressure	
Footing Type	:	Step , 2 Steps	
Footing Size (L x B x D)	:		
Step 1.	:	1950mm X 1600mm X 350mm	
Step 2.	:	1250mm X 800mm X 250mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	33.55	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	33.55	kN
Offset Along L (Loff)			
Step 1.	=	675	mm
Step 2.	=	325	mm
Offset Along B (Boff)			
Step 1.	=	685	mm
Step 2.	=	285	mm

Check For Maximum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	1148.67	kN
P	=	Pcomb + W1	
P	=	1182.22	kN
Mx	=	-6.04	kNm
My	=	-4.49	kNm
P/A	=	378.92	kN/sqm
Mx/Zx	=	-5.96	kN/sqm
My/Zy	=	-5.39	kN/sqm
Maximum Soil Pressure	=	390.27	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	1148.67	kN
P	=	Pcomb + W1	
P	=	1182.22	kN
Mx	=	-6.04	kNm
My	=	-4.49	kNm
P/A	=	378.92	kN/sqm
Mx/Zx	=	-5.96	kN/sqm
My/Zy	=	-5.39	kN/sqm

Minimum Soil Pressure	=	367.56	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1723	kN
Mux	=	-9.06	kNm
Muy	=	-6.73	kNm
P/A	=	552.24	kN/sqm
Mx/Zx	=	-8.94	kN/sqm
My/Zy	=	-8.09	kN/sqm
Deff	=	552	mm
Beff	=	800	mm
SPu	=	561.18	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	204.55	kNm
Pt	=	0.207	%
Ast Rqd (BM)	=	912	sqmm
Ast Prv (Distributed Across Total Width)	=	9 - T12 @ 200	
	=	1018	sqmm

Bottom Reinforcement Along B:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	1723	kN
Mux	=	-9.06	kNm
Muy	=	-6.73	kNm
P/A	=	552.24	kN/sqm
Mx/Zx	=	-8.94	kN/sqm
My/Zy	=	-8.09	kN/sqm
Deff	=	536	mm
Leff	=	1250	mm
SPu	=	560.34	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	256.35	kNm
Pt	=	0.178	%
Ast Rqd (BM)	=	1194	sqmm
Ast Prv (Distributed Across Total Length)	=	11 - T12 @ 195	
	=	1244	sqmm

Stepwise Design For Shear:

Step 1

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face			
	=	302	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	350	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	-9.06	kNm
Muy	=	-6.73	kNm
P/A	=	552.24	kN/sqm
Mx/Zx	=	-8.94	kN/sqm
My/Zy	=	-8.09	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	483200	sqmm
Deff	=	286	mm
SPu	=	561.18	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	43.1	kN
Tv	=	0.09	N/sqmm
Tc	=	0.33	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	286	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	400	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1723	kN
Mux	=	-9.06	kNm
Muy	=	-6.73	kNm
P/A	=	552.24	kN/sqm
Mx/Zx	=	-8.94	kN/sqm
My/Zy	=	-8.09	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	557700	sqmm
Deff	=	286	mm
SPu	=	560.34	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	124.56	kN
Tv	=	0.22	N/sqmm
Tc	=	0.31	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face

	=	147	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1723	kN
Mux	=	-9.06	kNm
Muy	=	-6.73	kNm
P/A	=	552.24	kN/sqm
Mx/Zx	=	-8.94	kN/sqm
My/Zy	=	-8.09	kN/sqm
Spu	=	Average Pressure	
	=	552.24	kN/sqm
Beff	=	1094	mm
Leff	=	1544	mm
Punching Perimeter	=	5276	mm
Punching Area	=	1689136	sqmm
Deff	=	294	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	790.18	kN
Tv	=	Vu / Punching Area	
	=	0.51	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Step 2

<u>One Way Shear Along L:</u>

Critical Section @ Deff from Next Step / Column Face

	=	552	mm

Footing Offset From Next Step / Column Face (StLoff)

	=	675	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	-9.06	kNm
Muy	=	-6.73	kNm
P/A	=	552.24	kN/sqm
Mx/Zx	=	-8.94	kN/sqm
My/Zy	=	-8.09	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	483200	sqmm
Deff	=	536	mm
SPu	=	561.18	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	

	=	110.44	kN
Tv	=	0.23	N/sqmm
Tc	=	0.33	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face

	=	536	mm

Footing Offset From Next Step / Column Face (StLoff)

	=	685	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1723	kN
Mux	=	-9.06	kNm
Muy	=	-6.73	kNm
P/A	=	552.24	kN/sqm
Mx/Zx	=	-8.94	kN/sqm
My/Zy	=	-8.09	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	557700	sqmm
Deff	=	536	mm
SPu	=	560.34	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	162.81	kN
Tv	=	0.29	N/sqmm
Tc	=	0.31	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face

	=	272	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1723	kN
Mux	=	-9.06	kNm
Muy	=	-6.73	kNm
P/A	=	552.24	kN/sqm
Mx/Zx	=	-8.94	kN/sqm
My/Zy	=	-8.09	kN/sqm
Spu	=	Average Pressure	
	=	552.24	kN/sqm
Beff	=	774	mm
Leff	=	1144	mm
Punching Perimeter	=	3836	mm
Punching Area	=	2086784	sqmm

Deff	=	544	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	1234.01	kN
Tv	=	Vu / Punching Area	
	=	0.59	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1723	kN
A2	=	0.14	sqm
A1	=	7.89	sqm
Base Area	=	3.12	sqm
A1	>	Base Area	
Thus, A1	=	3.12	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	4.7208	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC17	
Column No	:	C17	(230 mm X 600 mm)
Analysis No	:	C29	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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 : Average pressure

Footing Type	:	Pad	
Footing Size (L x B x D)	:	1600mm X 1250mm X 400mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	20.00	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	20	kN
Offset Along L (Loff)	=	500	mm
Offset Along B (Boff)	=	510	mm

Check For Maximum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	717.42	kN
P	=	Pcomb + W1	
P	=	737.42	kN
Mx	=	2.2	kNm
My	=	0.32	kNm
P/A	=	368.71	kN/sqm
Mx/Zx	=	4.13	kN/sqm
My/Zy	=	0.78	kN/sqm
Maximum Soil Pressure	=	373.61	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	717.42	kN
P	=	Pcomb + W1	
P	=	737.42	kN
Mx	=	2.2	kNm
My	=	0.32	kNm
P/A	=	368.71	kN/sqm
Mx/Zx	=	4.13	kN/sqm
My/Zy	=	0.78	kN/sqm
Minimum Soil Pressure	=	363.8	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1076.12	kN
Mux	=	3.3	kNm
Muy	=	0.49	kNm
P/A	=	538.06	kN/sqm
Mx/Zx	=	6.19	kN/sqm
My/Zy	=	1.17	kN/sqm
Deff	=	352	mm
Beff	=	1250	mm
SPu	=	544.25	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	85.04	kNm
Pt	=	0.136	%
Ast Rqd (BM)	=	600	sqmm
Ast Prv (Distributed Across Total Width)	=	6 - T12 @ 250	
	=	679	sqmm

Bottom Reinforcement Along B:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	1076.12	kN
Mux	=	3.3	kNm
Muy	=	0.49	kNm
P/A	=	538.06	kN/sqm
Mx/Zx	=	6.19	kN/sqm
My/Zy	=	1.17	kN/sqm
Deff	=	336	mm
Leff	=	1600	mm
SPu	=	539.23	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	112.2	kNm
Pt	=	0.148	%
Ast Rqd (BM)	=	797	sqmm
Ast Prv (Distributed Across Total Length)	=	8 - T12 @ 230	
	=	905	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face			
	=	352	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1076.12	kN

Mux	=	3.3	kNm
Muy	=	0.49	kNm
P/A	=	538.06	kN/sqm
Mx/Zx	=	6.19	kN/sqm
My/Zy	=	1.17	kN/sqm
Deff	=	352	mm
Beff	=	1250	mm
SPu	=	544.25	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	100.69	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.23	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	336	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1076.12	kN
Mux	=	3.3	kNm
Muy	=	0.49	kNm
P/A	=	538.06	kN/sqm
Mx/Zx	=	6.19	kN/sqm
My/Zy	=	1.17	kN/sqm
Deff	=	336	mm
Leff	=	1600	mm
SPu	=	539.23	kN/sqm
Vu	=	SPu X (Boff - d) X L	
	=	150.12	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.28	N/sqmm
Tc	=	0.29	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	172	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1076.12	kN
Mux	=	3.3	kNm

Muy	=	0.49	kNm
P/A	=	538.06	kN/sqm
Mx/Zx	=	6.19	kN/sqm
My/Zy	=	1.17	kN/sqm
Deff	=	344	mm
Leff	=	944	mm
Beff	=	574	mm
Punching Perimeter	=	3036	mm
Punching Area	=	1044384	sqmm
SPu	=	Average Pressure	
	=	538.06	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	784.57	kN
Tv	=	Vu / Punching Area	
	=	0.751	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1076.12	kN
A2	=	0.14	sqm
A1	=	4.03	sqm
Base Area	=	2	sqm
A1	>	Base Area	
Thus, A1	=	2	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	3.7796	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC20	
Column No	:	C20	(230 mm X 600 mm)
Analysis No	:	C18	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	

Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	kN/sqm
Permissible SBC Increase for EQ	=	0	%
Permissible SBC Increase for Wind	=	0	%
Live Load Reduction	=	0	%
Design cross section by	:	Average pressure	
Footing Type	:	Step , 2 Steps	
Footing Size (L x B x D)	:		
Step 1.	:	2200mm X 1850mm X 400mm	
Step 2.	:	1300mm X 950mm X 300mm	

Without considering Effect of Water Table

Footing Self Wt., F1	=	49.96	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	49.96	kN
Offset Along L (Loff)			
Step 1.	=	800	mm
Step 2.	=	350	mm
Offset Along B (Boff)			
Step 1.	=	810	mm
Step 2.	=	360	mm

Check For Maximum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	1394.96	kN
P	=	Pcomb + W1	
P	=	1444.92	kN
Mx	=	42.79	kNm
My	=	-3.37	kNm
P/A	=	355.02	kN/sqm
Mx/Zx	=	28.67	kN/sqm
My/Zy	=	-2.68	kN/sqm
Maximum Soil Pressure	=	386.37	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING
Critical Load Combination	=	[1] : (Dead) +(SIDL) +

		(Live)	
Pcomb	=	1394.96	kN
P	=	Pcomb + W1	
P	=	1444.92	kN
Mx	=	42.79	kNm
My	=	-3.37	kNm
P/A	=	355.02	kN/sqm
Mx/Zx	=	28.67	kN/sqm
My/Zy	=	-2.68	kN/sqm
Minimum Soil Pressure	=	323.66	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	2092.44	kN
Mux	=	64.18	kNm
Muy	=	-5.05	kNm
P/A	=	514.11	kN/sqm
Mx/Zx	=	43.01	kN/sqm
My/Zy	=	-4.02	kN/sqm
Deff	=	652	mm
Beff	=	950	mm
SPu	=	557.12	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	329.82	kNm
Pt	=	0.199	%
Ast Rqd (BM)	=	1230	sqmm
Ast Prv (Distributed Across Total Width)	=	11 - T12 @ 185	
	=	1244	sqmm

Bottom Reinforcement Along B:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	2092.44	kN
Mux	=	64.18	kNm
Muy	=	-5.05	kNm
P/A	=	514.11	kN/sqm
Mx/Zx	=	43.01	kN/sqm
My/Zy	=	-4.02	kN/sqm
Deff	=	636	mm
Leff	=	1300	mm
SPu	=	518.14	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	

	=	373.94	kNm
Pt	=	0.184	%
Ast Rqd (BM)	=	1524	sqmm
Ast Prv (Distributed Across Total Length)	=	14 - T12 @ 170	
	=	1583	sqmm

Stepwise Design For Shear:

Step 1

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face

	=	352	mm

Footing Offset From Next Step / Column Face (StLoff)

	=	450	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	64.18	kNm
Muy	=	-5.05	kNm
P/A	=	514.11	kN/sqm
Mx/Zx	=	43.01	kN/sqm
My/Zy	=	-4.02	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	651200	sqmm
Deff	=	336	mm
SPu	=	557.12	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	101.01	kN
Tv	=	0.16	N/sqmm
Tc	=	0.33	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face

	=	336	mm

Footing Offset From Next Step / Column Face (StLoff)

	=	450	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2092.44	kN
Mux	=	64.18	kNm
Muy	=	-5.05	kNm
P/A	=	514.11	kN/sqm
Mx/Zx	=	43.01	kN/sqm
My/Zy	=	-4.02	kN/sqm
Critical Section Lies In Step	=	1	

C/S Area	=	739200	sqmm
Deff	=	336	mm
SPu	=	518.14	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	129.95	kN
Tv	=	0.18	N/sqmm
Tc	=	0.31	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face

	=	172	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2092.44	kN
Mux	=	64.18	kNm
Muy	=	-5.05	kNm
P/A	=	514.11	kN/sqm
Mx/Zx	=	43.01	kN/sqm
My/Zy	=	-4.02	kN/sqm
Spu	=	Average Pressure	
	=	514.11	kN/sqm
Beff	=	1294	mm
Leff	=	1644	mm
Punching Perimeter	=	5876	mm
Punching Area	=	2127336	sqmm
Deff	=	344	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	998.75	kN
Tv	=	Vu / Punching Area	
	=	0.49	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Step 2

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face

	=	652	mm

Footing Offset From Next Step / Column Face (StLoff)

	=	800	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	64.18	kNm

Muy	=	-5.05	kNm
P/A	=	514.11	kN/sqm
Mx/Zx	=	43.01	kN/sqm
My/Zy	=	-4.02	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	651200	sqmm
Deff	=	636	mm
SPu	=	557.12	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	152.54	kN
Tv	=	0.23	N/sqmm
Tc	=	0.33	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	636	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	810	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2092.44	kN
Mux	=	64.18	kNm
Muy	=	-5.05	kNm
P/A	=	514.11	kN/sqm
Mx/Zx	=	43.01	kN/sqm
My/Zy	=	-4.02	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	739200	sqmm
Deff	=	636	mm
SPu	=	518.14	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	198.34	kN
Tv	=	0.27	N/sqmm
Tc	=	0.31	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face			
	=	322	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2092.44	kN
Mux	=	64.18	kNm
Muy	=	-5.05	kNm

P/A	=	514.11	kN/sqm
Mx/Zx	=	43.01	kN/sqm
My/Zy	=	-4.02	kN/sqm
Spu	=	Average Pressure	
	=	514.11	kN/sqm
Beff	=	874	mm
Leff	=	1244	mm
Punching Perimeter	=	4236	mm
Punching Area	=	2727984	sqmm
Deff	=	644	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	1533.47	kN
Tv	=	Vu / Punching Area	
	=	0.56	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2092.44	kN
A2	=	0.14	sqm
A1	=	10.3	sqm
Base Area	=	4.07	sqm
A1	>	Base Area	
Thus, A1	=	4.07	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	5.3918	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC21	
Column No	:	C21,C24,C28 (230 mm X 600 mm)	
Analysis No	:	C30,C32,C28	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm

Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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	:	Average pressure	

Footing Type	:	Pad	
Footing Size (L x B x D)	:	1550mm X 1200mm X 400mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	18.60	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	18.6	kN
Offset Along L (Loff)	=	475	mm
Offset Along B (Boff)	=	485	mm

Check For Maximum Soil Pressure:

Critical Column No	=	C28	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	639.56	kN
P	=	Pcomb + W1	
P	=	658.16	kN
Mx	=	8.2	kNm
My	=	-0.59	kNm
P/A	=	353.85	kN/sqm
Mx/Zx	=	17.07	kN/sqm
My/Zy	=	-1.59	kN/sqm
Maximum Soil Pressure	=	372.51	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Column No	=	C24	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	

Pcomb	=	356.80	kN
P	=	Pcomb + W1	
P	=	375.4	kN
Mx	=	3.64	kNm
My	=	3.43	kNm
P/A	=	201.83	kN/sqm
Mx/Zx	=	7.57	kN/sqm
My/Zy	=	9.23	kN/sqm
Minimum Soil Pressure	=	185.03	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Column No	=	C28	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	959.34	kN
Mux	=	12.31	kNm
Muy	=	-0.89	kNm
P/A	=	515.78	kN/sqm
Mx/Zx	=	25.61	kN/sqm
My/Zy	=	-2.39	kN/sqm
Deff	=	352	mm
Beff	=	1200	mm
SPu	=	541.38	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	73.29	kNm
Pt	=	0.136	%
Ast Rqd (BM)	=	576	sqmm
Ast Prv (Distributed Across Total Width)	=	6 - T12 @ 240	
	=	679	sqmm

Bottom Reinforcement Along B:

Critical Column No	=	C28	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	959.34	kN
Mux	=	12.31	kNm
Muy	=	-0.89	kNm
P/A	=	515.78	kN/sqm
Mx/Zx	=	25.61	kN/sqm
My/Zy	=	-2.39	kN/sqm
Deff	=	336	mm
Leff	=	1550	mm
SPu	=	518.16	kN/sqm

Mu	=	SPu X L X Boff X Boff / 2	
	=	94.46	kNm
Pt	=	0.143	%
Ast Rqd (BM)	=	744	sqmm
Ast Prv (Distributed Across Total Length)	=	7 - T12 @ 260	
	=	792	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face

	=	352	mm
Critical Column No	=	C28	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	959.34	kN
Mux	=	12.31	kNm
Muy	=	-0.89	kNm
P/A	=	515.78	kN/sqm
Mx/Zx	=	25.61	kN/sqm
My/Zy	=	-2.39	kN/sqm
Deff	=	352	mm
Beff	=	1200	mm
SPu	=	541.38	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	79.91	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.19	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	336	mm
Critical Column No	=	C28	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	959.34	kN
Mux	=	12.31	kNm
Muy	=	-0.89	kNm
P/A	=	515.78	kN/sqm
Mx/Zx	=	25.61	kN/sqm
My/Zy	=	-2.39	kN/sqm
Deff	=	336	mm

Leff	=	1550	mm
SPu	=	518.16	kN/sqm
Vu	=	SPu X (Boff - d) X L	
	=	119.67	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.23	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	172	mm
Critical Column No	=	C28	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	959.34	kN
Mux	=	12.31	kNm
Muy	=	-0.89	kNm
P/A	=	515.78	kN/sqm
Mx/Zx	=	25.61	kN/sqm
My/Zy	=	-2.39	kN/sqm
Deff	=	344	mm
Leff	=	944	mm
Beff	=	574	mm
Punching Perimeter	=	3036	mm
Punching Area	=	1044384	sqmm
SPu	=	Average Pressure	
	=	515.78	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	679.87	kN
Tv	=	Vu / Punching Area	
	=	0.651	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Column No	=	C28	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	959.34	kN
A2	=	0.14	sqm
A1	=	4.03	sqm
Base Area	=	1.86	sqm
A1	>	Base Area	
Thus, A1	=	1.86	

Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	3.645	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC25	
Column No	:	C25	(230 mm X 600 mm)
Analysis No	:	C21	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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	:	Average pressure	

Footing Type	:	Pad	
Footing Size (L x B x D)	:	1700mm X 1350mm X 450mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	25.82	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	25.82	kN
Offset Along L (Loff)	=	550	mm
Offset Along B (Boff)	=	560	mm

Check For Maximum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	811.10	kN

P	=	Pcomb + W1	
P	=	836.92	kN
Mx	=	-16.01	kNm
My	=	-0.25	kNm
P/A	=	364.67	kN/sqm
Mx/Zx	=	-24.61	kN/sqm
My/Zy	=	-0.49	kN/sqm
Maximum Soil Pressure	=	389.77	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	811.10	kN
P	=	Pcomb + W1	
P	=	836.92	kN
Mx	=	-16.01	kNm
My	=	-0.25	kNm
P/A	=	364.67	kN/sqm
Mx/Zx	=	-24.61	kN/sqm
My/Zy	=	-0.49	kN/sqm
Minimum Soil Pressure	=	339.57	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	1216.65	kN
Mux	=	-24.01	kNm
Muy	=	-0.38	kNm
P/A	=	530.13	kN/sqm
Mx/Zx	=	-36.92	kN/sqm
My/Zy	=	-0.73	kN/sqm
Deff	=	402	mm
Beff	=	1350	mm
SPu	=	567.05	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	115.79	kNm
Pt	=	0.134	%
Ast Rqd (BM)	=	729	sqmm
Ast Prv (Distributed Across Total Width)	=	7 - T12 @ 225	
	=	792	sqmm

Bottom Reinforcement Along B:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1216.65	kN
Mux	=	-24.01	kNm
Muy	=	-0.38	kNm
P/A	=	530.13	kN/sqm
Mx/Zx	=	-36.92	kN/sqm
My/Zy	=	-0.73	kN/sqm
Deff	=	386	mm
Leff	=	1700	mm
SPu	=	530.86	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	141.51	kNm
Pt	=	0.14	%
Ast Rqd (BM)	=	918	sqmm
Ast Prv (Distributed Across Total Length)	=	9 - T12 @ 215	
	=	1018	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face

	=	402	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1216.65	kN
Mux	=	-24.01	kNm
Muy	=	-0.38	kNm
P/A	=	530.13	kN/sqm
Mx/Zx	=	-36.92	kN/sqm
My/Zy	=	-0.73	kN/sqm
Deff	=	402	mm
Beff	=	1350	mm
SPu	=	567.05	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	113.30	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.21	N/sqmm
Tc	=	0.27	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	386	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1216.65	kN
Mux	=	-24.01	kNm
Muy	=	-0.38	kNm
P/A	=	530.13	kN/sqm
Mx/Zx	=	-36.92	kN/sqm
My/Zy	=	-0.73	kN/sqm
Deff	=	386	mm
Leff	=	1700	mm
SPu	=	530.86	kN/sqm
Vu	=	SPu X (Boff - d) X L	
	=	157.03	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.24	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	197	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1216.65	kN
Mux	=	-24.01	kNm
Muy	=	-0.38	kNm
P/A	=	530.13	kN/sqm
Mx/Zx	=	-36.92	kN/sqm
My/Zy	=	-0.73	kN/sqm
Deff	=	394	mm
Leff	=	994	mm
Beff	=	624	mm
Punching Perimeter	=	3236	mm
Punching Area	=	1274984	sqmm
SPu	=	Average Pressure	
	=	530.13	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	887.83	kN
Tv	=	Vu / Punching Area	
	=	0.696	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1216.65	kN
A2	=	0.14	sqm
A1	=	4.87	sqm
Base Area	=	2.3	sqm
A1	>	Base Area	
Thus, A1	=	2.3	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	4.0532	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC26	
Column No	:	C26	(230 mm X 600 mm)
Analysis No	:	C22	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	kN/sqm
Permissible SBC Increase for EQ	=	0	%
Permissible SBC Increase for Wind	=	0	%
Live Load Reduction	=	0	%
Design cross section by	:	Average pressure	
Footing Type	:	Step , 2 Steps	
Footing Size (L x B x D)	:		
Step 1.	:	2100mm X 1750mm X 400mm	
Step 2.	:	1200mm X 850mm X 225mm	

Without considering Effect of Water Table

Footing Self Wt., F1	=	42.49	kN

Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	42.49	kN
Offset Along L (Loff)			
Step 1.	=	750	mm
Step 2.	=	300	mm
Offset Along B (Boff)			
Step 1.	=	760	mm
Step 2.	=	310	mm

Check For Maximum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	1369.35	kN
P	=	Pcomb + W1	
P	=	1411.84	kN
Mx	=	-4.81	kNm
My	=	0.47	kNm
P/A	=	384.17	kN/sqm
Mx/Zx	=	-3.74	kN/sqm
My/Zy	=	0.44	kN/sqm
Maximum Soil Pressure	=	388.35	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	1369.35	kN
P	=	Pcomb + W1	
P	=	1411.84	kN
Mx	=	-4.81	kNm
My	=	0.47	kNm
P/A	=	384.17	kN/sqm
Mx/Zx	=	-3.74	kN/sqm
My/Zy	=	0.44	kN/sqm
Minimum Soil Pressure	=	379.99	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2054.02	kN
Mux	=	-7.21	kNm
Muy	=	0.71	kNm

P/A	=	558.92	kN/sqm
Mx/Zx	=	-5.61	kN/sqm
My/Zy	=	0.66	kN/sqm
Deff	=	577	mm
Beff	=	850	mm
SPu	=	564.52	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	277.85	kNm
Pt	=	0.24	%
Ast Rqd (BM)	=	1178	sqmm
Ast Prv (Distributed Across Total Width)	=	11 - T12 @ 175	
	=	1244	sqmm

Bottom Reinforcement Along B:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	2054.02	kN
Mux	=	-7.21	kNm
Muy	=	0.71	kNm
P/A	=	558.92	kN/sqm
Mx/Zx	=	-5.61	kN/sqm
My/Zy	=	0.66	kN/sqm
Deff	=	561	mm
Leff	=	1200	mm
SPu	=	559.58	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	339.38	kNm
Pt	=	0.219	%
Ast Rqd (BM)	=	1471	sqmm
Ast Prv (Distributed Across Total Length)	=	14 - T12 @ 165	
	=	1583	sqmm

Stepwise Design For Shear:

Step 1

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face			
	=	352	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	450	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	-7.21	kNm
Muy	=	0.71	kNm

P/A	=	558.92	kN/sqm
Mx/Zx	=	-5.61	kN/sqm
My/Zy	=	0.66	kN/sqm

Critical Section Lies In Step	=	1	
C/S Area	=	616000	sqmm
Deff	=	336	mm
SPu	=	564.52	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	96.82	kN
Tv	=	0.16	N/sqmm
Tc	=	0.35	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	336	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	450	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2054.02	kN
Mux	=	-7.21	kNm
Muy	=	0.71	kNm
P/A	=	558.92	kN/sqm
Mx/Zx	=	-5.61	kN/sqm
My/Zy	=	0.66	kN/sqm

Critical Section Lies In Step	=	1	
C/S Area	=	705600	sqmm
Deff	=	336	mm
SPu	=	559.58	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	133.96	kN
Tv	=	0.19	N/sqmm
Tc	=	0.34	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face			
	=	172	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2054.02	kN
Mux	=	-7.21	kNm
Muy	=	0.71	kNm
P/A	=	558.92	kN/sqm

Mx/Zx	=	-5.61	kN/sqm
My/Zy	=	0.66	kN/sqm
Spu	=	Average Pressure	
	=	558.92	kN/sqm
Beff	=	1194	mm
Leff	=	1544	mm
Punching Perimeter	=	5476	mm
Punching Area	=	1843536	sqmm
Deff	=	344	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	1023.64	kN
Tv	=	Vu / Punching Area	
	=	0.54	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Step 2

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face			
	=	577	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	750	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	-7.21	kNm
Muy	=	0.71	kNm
P/A	=	558.92	kN/sqm
Mx/Zx	=	-5.61	kN/sqm
My/Zy	=	0.66	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	616000	sqmm
Deff	=	561	mm
SPu	=	564.52	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	170.91	kN
Tv	=	0.28	N/sqmm
Tc	=	0.35	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	561	mm
Footing Offset From Next Step / Column Face (StLoff)			

	=	760	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2054.02	kN
Mux	=	-7.21	kNm
Muy	=	0.71	kNm
P/A	=	558.92	kN/sqm
Mx/Zx	=	-5.61	kN/sqm
My/Zy	=	0.66	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	705600	sqmm
Deff	=	561	mm
SPu	=	559.58	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	233.85	kN
Tv	=	0.33	N/sqmm
Tc	=	0.34	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face

	=	284	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2054.02	kN
Mux	=	-7.21	kNm
Muy	=	0.71	kNm
P/A	=	558.92	kN/sqm
Mx/Zx	=	-5.61	kN/sqm
My/Zy	=	0.66	kN/sqm
Spu	=	Average Pressure	
	=	558.92	kN/sqm
Beff	=	799	mm
Leff	=	1169	mm
Punching Perimeter	=	3936	mm
Punching Area	=	2239584	sqmm
Deff	=	569	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	1531.98	kN
Tv	=	Vu / Punching Area	
	=	0.68	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	2054.02	kN
A2	=	0.14	sqm
A1	=	8.46	sqm
Base Area	=	3.68	sqm
A1	>	Base Area	
Thus, A1	=	3.68	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	5.127	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC27	
Column No	:	C27	(230 mm X 600 mm)
Analysis No	:	C27	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	kN/sqm
Permissible SBC Increase for EQ	=	0	%
Permissible SBC Increase for Wind	=	0	%
Live Load Reduction	=	0	%
Design cross section by	:	Average pressure	
Footing Type	:	Step , 2 Steps	
Footing Size (L x B x D)	:		
Step 1.	:	2000mm X 1650mm X 375mm	
Step 2.	:	1200mm X 850mm X 225mm	

Without considering Effect of Water Table

Footing Self Wt., F1	=	36.67	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	36.67	kN
Offset Along L (Loff)			
Step 1.	=	700	mm
Step 2.	=	300	mm
Offset Along B (Boff)			
Step 1.	=	710	mm
Step 2.	=	310	mm

Check For Maximum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	1236.44	kN
P	=	Pcomb + W1	
P	=	1273.12	kN
Mx	=	-6.71	kNm
My	=	0.04	kNm
P/A	=	385.79	kN/sqm
Mx/Zx	=	-6.1	kN/sqm
My/Zy	=	0.05	kN/sqm
Maximum Soil Pressure	=	391.94	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	1236.44	kN
P	=	Pcomb + W1	
P	=	1273.12	kN
Mx	=	-6.71	kNm
My	=	0.04	kNm
P/A	=	385.79	kN/sqm
Mx/Zx	=	-6.1	kN/sqm
My/Zy	=	0.05	kN/sqm
Minimum Soil Pressure	=	379.65	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1854.66	kN
Mux	=	-10.06	kNm

Muy	=	0.06	kNm
P/A	=	562.02	kN/sqm
Mx/Zx	=	-9.15	kN/sqm
My/Zy	=	0.07	kN/sqm
Deff	=	552	mm
Beff	=	850	mm
SPu	=	571.16	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	230.89	kNm
Pt	=	0.217	%
Ast Rqd (BM)	=	1017	sqmm
Ast Prv (Distributed Across Total Width)	=	9 - T12 @ 210	
	=	1018	sqmm

Bottom Reinforcement Along B:

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Liv e)	
Pu	=	1854.66	kN
Mux	=	-10.06	kNm
Muy	=	0.06	kNm
P/A	=	562.02	kN/sqm
Mx/Zx	=	-9.15	kN/sqm
My/Zy	=	0.07	kN/sqm
Deff	=	536	mm
Leff	=	1200	mm
SPu	=	562.09	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	283.35	kNm
Pt	=	0.199	%
Ast Rqd (BM)	=	1279	sqmm
Ast Prv (Distributed Across Total Length)	=	12 - T12 @ 185	
	=	1357	sqmm

Stepwise Design For Shear:

Step 1

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face			
	=	327	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	400	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	-10.06	kNm

Muy	=	0.06	kNm
P/A	=	562.02	kN/sqm
Mx/Zx	=	-9.15	kN/sqm
My/Zy	=	0.07	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	539550	sqmm
Deff	=	311	mm
SPu	=	571.16	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	68.8	kN
Tv	=	0.13	N/sqmm
Tc	=	0.34	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face

	=	311	mm

Footing Offset From Next Step / Column Face (StLoff)

	=	400	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1854.66	kN
Mux	=	-10.06	kNm
Muy	=	0.06	kNm
P/A	=	562.02	kN/sqm
Mx/Zx	=	-9.15	kN/sqm
My/Zy	=	0.07	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	622000	sqmm
Deff	=	311	mm
SPu	=	562.09	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	100.05	kN
Tv	=	0.16	N/sqmm
Tc	=	0.33	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face

	=	160	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1854.66	kN
Mux	=	-10.06	kNm
Muy	=	0.06	kNm

P/A	=	562.02	kN/sqm
Mx/Zx	=	-9.15	kN/sqm
My/Zy	=	0.07	kN/sqm
Spu	=	Average Pressure	
	=	562.02	kN/sqm
Beff	=	1169	mm
Leff	=	1519	mm
Punching Perimeter	=	5376	mm
Punching Area	=	1775711	sqmm
Deff	=	319	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	856.68	kN
Tv	=	Vu / Punching Area	
	=	0.5	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Step 2

One Way Shear Along L:

Critical Section @ Deff from Next Step / Column Face			
	=	552	mm
Footing Offset From Next Step / Column Face (StLoff)			
	=	700	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Mux	=	-10.06	kNm
Muy	=	0.06	kNm
P/A	=	562.02	kN/sqm
Mx/Zx	=	-9.15	kN/sqm
My/Zy	=	0.07	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	539550	sqmm
Deff	=	536	mm
SPu	=	571.16	kN/sqm
Vu	=	SPu X (StLoff - Deff) X B	
	=	139.48	kN
Tv	=	0.26	N/sqmm
Tc	=	0.34	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ Deff from Next Step / Column Face			
	=	536	mm

Footing Offset From Next Step / Column Face (StLoff)

	=	710	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1854.66	kN
Mux	=	-10.06	kNm
Muy	=	0.06	kNm
P/A	=	562.02	kN/sqm
Mx/Zx	=	-9.15	kN/sqm
My/Zy	=	0.07	kN/sqm
Critical Section Lies In Step	=	1	
C/S Area	=	622000	sqmm
Deff	=	536	mm
SPu	=	562.09	kN/sqm
Vu	=	SPu X (StBoff - Deff) X L	
	=	195.61	kN
Tv	=	0.31	N/sqmm
Tc	=	0.33	N/sqmm
Tv	<	Tc	

Design For Punching Shear

Critical Section @ d/2 from Next Step / Column Face

	=	272	mm
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1854.66	kN
Mux	=	-10.06	kNm
Muy	=	0.06	kNm
P/A	=	562.02	kN/sqm
Mx/Zx	=	-9.15	kN/sqm
My/Zy	=	0.07	kN/sqm
Spu	=	Average Pressure	
	=	562.02	kN/sqm
Beff	=	774	mm
Leff	=	1144	mm
Punching Perimeter	=	3836	mm
Punching Area	=	2086784	sqmm
Deff	=	544	mm
Vu	=	SPu X ((L X B)-(Leff X Beff)	
	=	1357.02	kN
Tv	=	Vu / Punching Area	
	=	0.65	N/sqmm
Tc	=	0.99	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1854.66	kN
A2	=	0.14	sqm
A1	=	7.89	sqm
Base Area	=	3.3	sqm
A1	>	Base Area	
Thus, A1	=	3.3	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	4.855	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC29	
Column No	:	C29,C32	(230 mm X 600 mm)
Analysis No	:	C23,C26	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	
Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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	:	Average pressure	
Footing Type	:	Pad	
Footing Size (L x B x D)	:	1450mm X 1100mm X 350mm	

Without considering Effect of Water

Table

Footing Self Wt., F1	=	13.96	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	13.96	kN
Offset Along L (Loff)	=	425	mm
Offset Along B (Boff)	=	435	mm

Check For Maximum Soil Pressure:

Critical Column No	=	C29	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	533.18	kN
P	=	Pcomb + W1	
P	=	547.13	kN
Mx	=	-4.31	kNm
My	=	-6.17	kNm
P/A	=	343.03	kN/sqm
Mx/Zx	=	-11.19	kN/sqm
My/Zy	=	-21.11	kN/sqm
Maximum Soil Pressure	=	375.33	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Column No	=	C29	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	533.18	kN
P	=	Pcomb + W1	
P	=	547.13	kN
Mx	=	-4.31	kNm
My	=	-6.17	kNm
P/A	=	343.03	kN/sqm
Mx/Zx	=	-11.19	kN/sqm
My/Zy	=	-21.11	kN/sqm
Minimum Soil Pressure	=	310.73	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Column No	=	C29	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	799.76	kN
Mux	=	-6.47	kNm

Muy	=	-9.26	kNm
P/A	=	501.42	kN/sqm
Mx/Zx	=	-16.78	kN/sqm
My/Zy	=	-31.66	kN/sqm
Deff	=	302	mm
Beff	=	1100	mm
SPu	=	518.2	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	51.48	kNm
Pt	=	0.139	%
Ast Rqd (BM)	=	462	sqmm
Ast Prv (Distributed Across Total Width)	=	5 - T12 @ 275	
	=	565	sqmm

Bottom Reinforcement Along B:

Critical Column No	=	C29	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	799.76	kN
Mux	=	-6.47	kNm
Muy	=	-9.26	kNm
P/A	=	501.42	kN/sqm
Mx/Zx	=	-16.78	kN/sqm
My/Zy	=	-31.66	kN/sqm
Deff	=	286	mm
Leff	=	1450	mm
SPu	=	533.08	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	
	=	73.13	kNm
Pt	=	0.147	%
Ast Rqd (BM)	=	610	sqmm
Ast Prv (Distributed Across Total Length)	=	6 - T12 @ 290	
	=	679	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face			
	=	302	mm
Critical Column No	=	C29	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	799.76	kN
Mux	=	-6.47	kNm
Muy	=	-9.26	kNm

P/A	=	501.42	kN/sqm
Mx/Zx	=	-16.78	kN/sqm
My/Zy	=	-31.66	kN/sqm
Deff	=	302	mm
Beff	=	1100	mm
SPu	=	518.2	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	70.11	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.21	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	286	mm
Critical Column No	=	C29	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	799.76	kN
Mux	=	-6.47	kNm
Muy	=	-9.26	kNm
P/A	=	501.42	kN/sqm
Mx/Zx	=	-16.78	kN/sqm
My/Zy	=	-31.66	kN/sqm
Deff	=	286	mm
Leff	=	1450	mm
SPu	=	533.08	kN/sqm
Vu	=	SPu X (Boff - d) X L	
	=	115.17	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.28	N/sqmm
Tc	=	0.29	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	147	mm
Critical Column No	=	C29	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	799.76	kN
Mux	=	-6.47	kNm
Muy	=	-9.26	kNm

P/A	=	501.42	kN/sqm
Mx/Zx	=	-16.78	kN/sqm
My/Zy	=	-31.66	kN/sqm
Deff	=	294	mm
Leff	=	894	mm
Beff	=	524	mm
Punching Perimeter	=	2836	mm
Punching Area	=	833784	sqmm
SPu	=	Average Pressure	
	=	501.42	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	564.87	kN
Tv	=	Vu / Punching Area	
	=	0.677	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Column No	=	C29	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	799.76	kN
A2	=	0.14	sqm
A1	=	3.26	sqm
Base Area	=	1.6	sqm
A1	>	Base Area	
Thus, A1	=	1.6	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	3.3806	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area	
	=	2484	kN
Concrete Bearing Capacity	>	Pu, Hence Safe.	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC30	
Column No	:	C30,C31	(230 mm X 600 mm)
Analysis No	:	C24,C25	
Concrete Grade	:	M20	N/sqmm
Steel Grade	:	Fe500	N/sqmm
Clear Cover	:	40	mm
Df	:	3 M	

Dw	:	0 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	350	kN/sqm
Gross Bearing Capacity	=	404	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	:	Average pressure	

Footing Type	:	Pad	
Footing Size (L x B x D)	:	1800mm X 1450mm X 475mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	30.99	kN
Soil Weight, S1	=	0.00	kN
Total Weight, W1	=	F1 + S1	
	=	30.99	kN
Offset Along L (Loff)	=	600	mm
Offset Along B (Boff)	=	610	mm

Check For Maximum Soil Pressure:

Critical Column No	=	C31	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) +(Live)	
Pcomb	=	968.54	kN
P	=	Pcomb + W1	
P	=	999.53	kN
Mx	=	-0.62	kNm
My	=	-0.13	kNm
P/A	=	382.96	kN/sqm
Mx/Zx	=	-0.79	kN/sqm
My/Zy	=	-0.2	kN/sqm
Maximum Soil Pressure	=	383.95	kN/sqm
Allowable Soil Pressure	=	(1 X 350) + 54	kN/sqm
	=	404	kN/sqm

Check For Minimum Soil Pressure:

Critical Column No	=	C30	
Critical Analysis Load Combination	=	FOOTING	
Critical Load Combination	=	[1] : (Dead) +(SIDL) + (Live)	
Pcomb	=	865.49	kN

P	=	Pcomb + W1	
P	=	896.49	kN
Mx	=	-6.82	kNm
My	=	-0.92	kNm
P/A	=	343.48	kN/sqm
Mx/Zx	=	-8.71	kN/sqm
My/Zy	=	-1.46	kN/sqm
Minimum Soil Pressure	=	333.31	kN/sqm
	>	0	

Design For Bending:

Bottom Reinforcement Along L:

Critical Column No	=	C31	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1452.8	kN
Mux	=	-0.93	kNm
Muy	=	-0.19	kNm
P/A	=	556.63	kN/sqm
Mx/Zx	=	-1.18	kN/sqm
My/Zy	=	-0.3	kN/sqm
Deff	=	427	mm
Beff	=	1450	mm
SPu	=	557.81	kN/sqm
Mu	=	SPu X B X Loff X Loff / 2	
	=	145.59	kNm
Pt	=	0.133	%
Ast Rqd (BM)	=	827	sqmm
Ast Prv (Distributed Across Total Width)	=	8 - T12 @ 210	
	=	905	sqmm

Bottom Reinforcement Along B:

Critical Column No	=	C31	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1452.8	kN
Mux	=	-0.93	kNm
Muy	=	-0.19	kNm
P/A	=	556.63	kN/sqm
Mx/Zx	=	-1.18	kN/sqm
My/Zy	=	-0.3	kN/sqm
Deff	=	411	mm
Leff	=	1800	mm
SPu	=	556.93	kN/sqm
Mu	=	SPu X L X Boff X Boff / 2	

	=	186.51	kNm
Pt	=	0.146	%
Ast Rqd (BM)	=	1083	sqmm
Ast Prv (Distributed Across Total Length)	=	10 - T12 @ 200	
	=	1131	sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face

	=	427	mm
Critical Column No	=	C31	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1452.8	kN
Mux	=	-0.93	kNm
Muy	=	-0.19	kNm
P/A	=	556.63	kN/sqm
Mx/Zx	=	-1.18	kN/sqm
My/Zy	=	-0.3	kN/sqm
Deff	=	427	mm
Beff	=	1450	mm
SPu	=	557.81	kN/sqm
Vu	=	SPu X (Loff - d) X B	
	=	139.93	kN
Tv	=	Vu / (Beff X Deff)	
	=	0.23	N/sqmm
Tc	=	0.27	N/sqmm
Tv	<	Tc	

One Way Shear Along B:

Critical Section @ d from Column Face

	=	411	mm
Critical Column No	=	C31	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1452.8	kN
Mux	=	-0.93	kNm
Muy	=	-0.19	kNm
P/A	=	556.63	kN/sqm
Mx/Zx	=	-1.18	kN/sqm
My/Zy	=	-0.3	kN/sqm
Deff	=	411	mm
Leff	=	1800	mm

SPu	=	556.93	kN/sqm
Vu	=	SPu X (Boff - d) X L	
	=	199.49	kN
Tv	=	Vu / (Leff X Deff)	
	=	0.27	N/sqmm
Tc	=	0.28	N/sqmm
Tv	<	Tc	

Design For Punching Shear:

Critical Section @ d/2 from Column Face

	=	210	mm
Critical Column No	=	C31	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1452.8	kN
Mux	=	-0.93	kNm
Muy	=	-0.19	kNm
P/A	=	556.63	kN/sqm
Mx/Zx	=	-1.18	kN/sqm
My/Zy	=	-0.3	kN/sqm
Deff	=	419	mm
Leff	=	1019	mm
Beff	=	649	mm
Punching Perimeter	=	3336	mm
Punching Area	=	1397784	sqmm
SPu	=	Average Pressure	
	=	556.63	kN/sqm
Vu	=	SPu X ((L X B)-(Leff X Beff))	
	=	1084.69	kN
Tv	=	Vu / Punching Area	
	=	0.776	N/sqmm
Tc	=	0.988	N/sqmm
Tv	<	Tc	

Load Transfer Check For Load Transfer From Column To Footing

Critical Column No	=	C31	
Critical Load Combination	=	[3] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Pu	=	1452.8	kN
A2	=	0.14	sqm
A1	=	5.33	sqm
Base Area	=	2.61	sqm
A1	>	Base Area	
Thus, A1	=	2.61	
Modification Factor	=	SquareRoot(A1/A2) < = 2	

SquareRoot(A1/A2)	=	4.3177
Thus, Modification Factor	=	2
Concrete Bearing Capacity	=	0.45 X Fck X Modification Factor X Column Area
	=	2484 kN
Concrete Bearing Capacity	>	Pu, Hence Safe.

COLUMN DESIGN CALCULATIONS

Project Name	:	RAJ N RAM APARTMENTS
Client Name	:	Mr. P.G. Purushothaman, Mr. P.G. Devarajan, Mr.P.G. Rukmangadhan
Engineer Name	:	Mr. S.Magesh Kumar
Design File	:	Y:\E TABS\MAGESH-VELLORE\2. RAJ N RAM APARTMENTS\RCDC\COLUMN-10-04-2024.rcdx
Analysis File	:	E:\BHARGA~1\BHARGA~1\MAGESH~1\20FBD~1.KVP\ETABS\KVPRES~1.MDB
Analysis Last Modified	:	10-04-2024 01:00:07 PM

Definitions Of Terms:

All forces in units kN and m

All reinforcement details like area, spacing are mm

Grade Of steel for 6 mm dia. bars is Fe250. It is irrespective of the grade of steel defined by user in column design.

Neutral axis angle for resultant design moment is with respect to local major axis.

1	β	=	Stiffness proportion factor at joint (column stiffness/sum of stiffness of all members connected at joint)
2	Δu	=	Elastically computed first order lateral deflection. (Relative deflections)
3	ε1	=	Strain at level considered, Calculated ignoring the stiffening of the concrete in tension zone
4	εm	=	Average steel strain at level considered
5	acr	=	Distance from the point considered to the surface of the nearest longitudinal bar
6	Ag	=	Gross area of the column cross section
7	Aeff	=	Effective area of column / wall considered for shear check in sqmm
8	Ak	=	Area of confined concrete core
9	Ash	=	Area of link cross section
10	b	=	Effective Width of Column in mm
11	beff	=	Effective Width of Column in mm
12	B	=	Width / Smaller Dimension of Column in mm
13	d	=	Effective Depth of Column in mm
14	deff	=	Effective Depth of Column in mm
15	D	=	Depth / Larger Dimension of Column OR Diameter of Circular Column in mm
16	Dk	=	Diameter Of core measured to the outside of circular link
17	Ec	=	Modulus of elasticity of concrete
18	Es	=	Modulus of elasticity of steel
19	FcPerm	=	Permissible Stress in Concrete required in N/ (sqmm)
20	Fst	=	Stress in steel
21	FstPerm	=	Permissible Stress in Steel required in N/ (sqmm)
22	Fck	=	Characteristic compressive strength of concrete cube in N/sqmm
23	Fy	=	Yield Stress Of Steel in N/sqmm

24	h	=	Longer dimension of rectangular link measured to its outer face
25	Hu	=	Total lateral force acting within the story(Story shear)
26	Hs	=	Height of the story (Floor height)
27	k	=	Reduction factor for slenderness moments
28	Max	=	Additional moment due to slenderness about major axis (Along D)
29	May	=	Additional moment due to slenderness about minor axis (Along B)
30	Mminx	=	Moment due to minimum eccentricity along D
31	Mminy	=	Moment due to minimum eccentricity along B
32	Muv	=	Moment capacity of web portion of wall as per clause 9.4.2 and Annes A of IS 13920 - 2016
33	Mux	=	Factored moment Along D (Momemt About Major Axis)
34	Muy	=	Factored moment Along B (Momemt About Minor Axis)
35	MCap	=	Moment capacity of section for NA angle at design Pu
36	MRes	=	Resultant design moment at angle to local major axis
37	Pb	=	Axial capacity of column along B as defined in 39.7.1.1
38	Pd	=	Axial capacity of column along D as defined in 39.7.1.1
39	Pu	=	Factored axial force
40	Puz	=	Axial load on column as defined in 39.6
41	Pu_Total	=	Sum of Axial loads on all column in the story (Gravity Load)
42	Q	=	Stability Index (factor for checking sway/ non sway condition for a given story)
43	S	=	Link Spacing
44	Shear Strength Enhancement Factor	=	Multiplying factor for shear strength of concrete as per 40.2.2
45	Vur	=	Factored resultant shear force acting on the column
46	Vux	=	Factored shear force Along B
47	Vuy	=	Factored shear force Along D
48	Wcr	=	Surface Crack Width
49	WcrPerm	=	Permissible Crack Width required in mm
50	β	=	It is a Neutral Axis angle corresponding to load angle to find out MCap

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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.	:	C1	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm

Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C3	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	893.47	kN
Mux	=	34.19	kNm
Muy	=	-10.93	kNm
Vux	=	6.8	kN
Vuy	=	-24.76	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	17.87	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	

= 11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	34.19	---	34.19	0	34.19
Minor Axis - Muy	-10.93	17.87	-17.87	0	-17.87

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	893.47	kN
Mux	=	34.19	kNm
Muy	=	-17.87	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	27.59	deg
MRes	=	38.58	kNm
MCap	=	106.87	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.36 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-24.7647	6.803
Pu (kN)	893.47	893.47
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1944	0.0616
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	

	2.0518	2.214
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C1	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm

Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C3	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	715.37	kN
Mux	=	-76.2	kNm
Muy	=	20.95	kNm
Vux	=	13.56	kN
Vuy	=	-46.31	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	17.96	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-76.2	17.96	-76.2	0	-76.2
Minor Axis - Muy	20.95	---	20.95	0	20.95

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	715.37	kN
Mux	=	-76.2	kNm
Muy	=	20.95	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	15.37	deg
MRes	=	79.03	kNm
MCap	=	129.95	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.61 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-46.3058	13.56
Pu (kN)	702.18	702.18
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3634	0.1228
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.8266	1.954

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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C1	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm

Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C3	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	520.96	kN
Mux	=	-62.29	kNm
Muy	=	18.94	kNm
Vux	=	12.77	kN
Vuy	=	-41.53	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	13.08	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-62.29	13.08	-62.29	0	-62.29
Minor Axis - Muy	18.94	---	18.94	0	18.94

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	520.96	kN
Mux	=	-62.29	kNm
Muy	=	18.94	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	16.92	deg
MRes	=	65.1	kNm
MCap	=	134.11	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.49 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-41.5318	12.7714
Pu (kN)	507.77	507.77
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3259	0.1157
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5977	1.6899
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C1	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm

Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C3	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	325.89	kN
Mux	=	-63.31	kNm
Muy	=	19.66	kNm
Vux	=	13.07	kN
Vuy	=	-40.93	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	8.18	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-63.31	8.18	-63.31	0	-63.31
Minor Axis - Muy	19.66	---	19.66	0	19.66

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	325.89	kN
Mux	=	-63.31	kNm
Muy	=	19.66	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	17.25	deg
MRes	=	66.29	kNm
MCap	=	128.68	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.52 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-40.9338	13.0688
Pu (kN)	312.7	312.7
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3213	0.1184
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3681	1.4249
Shear Strength Enhancement Factor (Tensile Force)	-	-

Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3681	1.4249
Enhanced shear strength, Tc-e (N/sqmm)	0.551	0.5739
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C1	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm

Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C3	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	130.06	kN
Mux	=	-66.86	kNm
Muy	=	20.45	kNm
Vux	=	14.1	kN
Vuy	=	-50.14	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	3.26	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

				Mslndx	**Mdesign-**

Direction	Manalysis	Mmin (Abs)	Mdesign	(Abs)	final
	A	B	C	E	F
Major Axis - Mux	-66.86	3.26	-66.86	0	-66.86
Minor Axis - Muy	20.45	---	20.45	0	20.45

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	130.06	kN
Mux	=	-66.86	kNm
Muy	=	20.45	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	17	deg
MRes	=	69.91	kNm
MCap	=	110.28	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.63 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-50.1447	14.1003
Pu (kN)	116.87	116.87
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3935	0.1277
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1376	1.1588
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength	1.5	1.5

Enhancement Factor (max)		
Shear Strength Enhancement Factor	1.1376	1.1588
Enhanced shear strength, Tc-e (N/sqmm)	0.4582	0.4667
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C2	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm

No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C1	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	935.81	kN
Mux	=	-1.35	kNm
Muy	=	0.61	kNm
Vux	=	1.12	kN
Vuy	=	3.1	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	18.72	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	0, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F

Major Axis - Mux	-1.35	---	-1.35	0	-1.35
Minor Axis - Muy	0.61	18.72	18.72	0	18.72

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	935.81	kN
Mux	=	-1.35	kNm
Muy	=	18.72	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	85.87	deg
MRes	=	18.76	kNm
MCap	=	44.2	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.42 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	17.4224	3.9641
Pu (kN)	904.34	904.34
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1367	0.0359
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.0646	2.2287
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength	1.5	1.5

Enhancement Factor		
Enhanced shear strength, Tc-e (N/sqmm)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C2	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	

Column Type	:	UnBraced
Minimum eccentricity check	:	One Axis at a Time
Code defined D/B ratio	:	4
D/B Ratio	:	2.61 <= 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C1	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	721.67	kN
Mux	=	52.2	kNm
Muy	=	10.82	kNm
Vux	=	6.96	kN
Vuy	=	34.68	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	14.43	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	52.2	---	52.2	0	52.2
Minor Axis - Muy	10.82	14.43	14.43	0	14.43

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	721.67	kN
Mux	=	52.2	kNm
Muy	=	14.43	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	15.46	deg
MRes	=	54.15	kNm
MCap	=	129.5	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.42 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	34.6791	6.9578
Pu (kN)	708.48	708.48
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2722	0.063
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.834	1.9626
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	0.6041	0.6041

strength, Tc-e (N/sqmm)		
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C2	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	

Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C1	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	526.47	kN
Mux	=	44.69	kNm
Muy	=	9.4	kNm
Vux	=	6.28	kN
Vuy	=	31.27	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	10.53	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	44.69	---	44.69	0	44.69
Minor Axis - Muy	9.4	10.53	10.53	0	10.53

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	526.47	kN
Mux	=	44.69	kNm
Muy	=	10.53	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	13.26	deg
MRes	=	45.92	kNm
MCap	=	136.84	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.34 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	31.2719	6.2848
Pu (kN)	513.28	513.28
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2454	0.0569
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.6042	1.6974
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)	0.6041	0.6041

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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C2	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C1	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	331.63	kN
Mux	=	46.35	kNm
Muy	=	9.81	kNm
Vux	=	6.67	kN
Vuy	=	29.96	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	8.32	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	46.35	8.32	46.35	0	46.35
Minor Axis - Muy	9.81	---	9.81	0	9.81

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	331.63	kN
Mux	=	46.35	kNm
Muy	=	9.81	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	11.95	deg
MRes	=	47.38	kNm
MCap	=	132.8	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.36 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	29.9585	6.6743
Pu (kN)	318.44	318.44
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2351	0.0605
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3749	1.4327
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3749	1.4327
Enhanced shear strength, Tc-e (N/sqmm)	0.5537	0.577
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C2	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C1	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	137.02	kN
Mux	=	52.21	kNm
Muy	=	8.33	kNm
Vux	=	5.04	kN
Vuy	=	38.14	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	3.44	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	52.21	3.44	52.21	0	52.21
Minor Axis - Muy	8.33	---	8.33	0	8.33

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	137.02	kN
Mux	=	52.21	kNm
Muy	=	8.33	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	9.06	deg
MRes	=	52.87	kNm
MCap	=	115.28	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.46 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	38.1418	5.0394
Pu (kN)	123.83	123.83
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2993	0.0456
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1458	1.1682
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1458	1.1682
Enhanced shear strength, Tc-e (N/sqmm)	0.4615	0.4705
Design shear check	Tv < Tc x Enhancement factor	Tv < Tc x Enhancement factor
Shear Links Design	**Shear Links Not**	**Shear Links Not**

	Required	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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C3	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C6	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	521.01	kN
Mux	=	-14.81	kNm
Muy	=	3.24	kNm
Vux	=	3.59	kN
Vuy	=	-8.8	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	10.42	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-14.81	---	-14.81	0	-14.81
Minor Axis - Muy	3.24	10.42	10.42	0	10.42

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	521.01	kN
Mux	=	-14.81	kNm
Muy	=	10.42	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	35.13	deg
MRes	=	18.11	kNm
MCap	=	113.77	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.16 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-10.4504	4.7462
Pu (kN)	535.45	535.45
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.082	0.043
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.6303	1.7275
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C3	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C6

Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	418.47	kN
Mux	=	-29.03	kNm
Muy	=	11.61	kNm
Vux	=	7.64	kN
Vuy	=	-17.23	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	10.5	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-29.03	10.5	-29.03	0	-29.03
Minor Axis - Muy	11.61	---	11.61	0	11.61

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	418.47	kN
Mux	=	-29.03	kNm
Muy	=	11.61	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	21.8	deg
MRes	=	31.26	kNm
MCap	=	128.24	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.24 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-17.2339	7.644
Pu (kN)	405.28	405.28
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1353	0.0692
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.4771	1.5506
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.4771	1.5
Enhanced shear strength, Tc-e (N/sqmm)	0.5949	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C3	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C6
		[1] : 1.5 (Dead) +1.5 (SIDL)

Load Combination	=	+1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	308.2	kN
Mux	=	-27.17	kNm
Muy	=	11.47	kNm
Vux	=	7.81	kN
Vuy	=	-17.73	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	7.74	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-27.17	7.74	-27.17	0	-27.17
Minor Axis - Muy	11.47	---	11.47	0	11.47

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	308.2	kN
Mux	=	-27.17	kNm
Muy	=	11.47	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	22.88	deg
MRes	=	29.49	kNm
MCap	=	122.59	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.24 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-17.727	7.8133
Pu (kN)	295.01	295.01
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1391	0.0708
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3473	1.4008
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3473	1.4008
Enhanced shear strength, Tc-e (N/sqmm)	0.5426	0.5642
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C3	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C6
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Critical Location	=	Bottom Joint	
Pu	=	194.29	kN
Mux	=	-28.49	kNm
Muy	=	12.36	kNm
Vux	=	8.17	kN
Vuy	=	-18.43	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	4.88	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-28.49	4.88	-28.49	0	-28.49
Minor Axis - Muy	12.36	---	12.36	0	12.36

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	194.29	kN
Mux	=	-28.49	kNm
Muy	=	12.36	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	23.45	deg
MRes	=	31.05	kNm
MCap	=	112.95	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.27 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-18.4317	8.1748
Pu (kN)	181.1	181.1
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1447	0.074
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.2132	1.2461
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.2132	1.2461
Enhanced shear strength, Tc-e (N/sqmm)	0.4886	0.5019
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C3	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C6
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Critical Location	=	Bottom Joint

Pu	=	77.12	kN
Mux	=	-31.19	kNm
Muy	=	14.08	kNm
Vux	=	10.06	kN
Vuy	=	-24.18	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	1.94	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-31.19	1.94	-31.19	0	-31.19
Minor Axis - Muy	14.08	---	14.08	0	14.08

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	77.12	kN
Mux	=	-31.19	kNm
Muy	=	14.08	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	24.29	deg
MRes	=	34.22	kNm
MCap	=	98.3	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.35 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-24.1783	10.0578
Pu (kN)	63.93	63.93
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1898	0.0911
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.0753	1.0869
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.0753	1.0869
Enhanced shear strength, Tc-e (N/sqmm)	0.4331	0.4377
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C4	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C5	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1658.57	kN

Mux	=	-14.6	kNm
Muy	=	2.07	kNm
Vux	=	3.34	kN
Vuy	=	-10.26	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	33.17	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	0, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-14.6	---	-14.6	0	-14.6
Minor Axis - Muy	2.07	33.17	33.17	0	33.17

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1658.57	kN

Mux	=	-14.6	kNm
Muy	=	33.17	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.46	
Reinforcement Provided	=	10-T16	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	66.25	deg
MRes	=	36.24	kNm
MCap	=	38.5	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.94 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-14.2152	14.2717
Pu (kN)	1616.41	1616.41
Deff , Beff (mm)	552	182
Aeff (sqmm)	126960	109200
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.112	0.1307
Pt (%)	0.728	0.728
Design shear strength, Tc (N/sqmm)	0.5539	0.5539
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.9098	3.2203
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)	0.8308	0.8308
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	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C4	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C5	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1277.53	kN
Mux	=	-46.78	kNm
Muy	=	41.67	kNm

Vux	=	26.98	kN
Vuy	=	-28.83	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	32.07	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-46.78	32.07	-46.78	0	-46.78
Minor Axis - Muy	41.67	---	41.67	0	41.67

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1277.53	kN
Mux	=	-46.78	kNm

Muy	=	41.67	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.07	
Reinforcement Provided	=	4-T16 + 6-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	41.7	deg
MRes	=	62.65	kNm
MCap	=	83.52	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.75 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-28.828	26.9821
Pu (kN)	1264.34	1264.34
Deff , Beff (mm)	552	182
Aeff (sqmm)	126960	109200
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2271	0.2471
Pt (%)	0.537	0.537
Design shear strength, Tc (N/sqmm)	0.4923	0.4923
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.4938	2.7367
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)	0.7385	0.7385
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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C4	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C5	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	929.85	kN
Mux	=	-43.81	kNm
Muy	=	37.43	kNm
Vux	=	25.12	kN

Vuy	=	-28.96	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	23.34	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-43.81	23.34	-43.81	0	-43.81
Minor Axis - Muy	37.43	---	37.43	0	37.43

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	929.85	kN
Mux	=	-43.81	kNm
Muy	=	37.43	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	40.51	deg
MRes	=	57.62	kNm
MCap	=	89.64	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.64 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-28.9638	25.1219
Pu (kN)	916.66	916.66
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2273	0.2276
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.0791	2.2455
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)	0.6041	0.6041
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	
	=	3	mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C4	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C5	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	586.1	kN
Mux	=	-45.75	kNm
Muy	=	38.04	kNm
Vux	=	25.21	kN
Vuy	=	-29.93	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	14.71	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-45.75	14.71	-45.75	0	-45.75
Minor Axis - Muy	38.04	---	38.04	0	38.04

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	586.1	kN
Mux	=	-45.75	kNm
Muy	=	38.04	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	39.74	deg
MRes	=	59.5	kNm
MCap	=	106.47	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.56 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-29.9277	25.2062
Pu (kN)	572.91	572.91
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2349	0.2283
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.6744	1.7784
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm

Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C4	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C5	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	245.17	kN
Mux	=	-48.95	kNm
Muy	=	39.64	kNm
Vux	=	27.39	kN
Vuy	=	-35.92	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	6.15	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-48.95	6.15	-48.95	0	-48.95
Minor Axis - Muy	39.64	---	39.64	0	39.64

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	245.17	kN
Mux	=	-48.95	kNm
Muy	=	39.64	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	39	deg
MRes	=	62.99	kNm
MCap	=	99.04	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.64 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-35.9233	27.3913
Pu (kN)	231.98	231.98
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2819	0.2481
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.2731	1.3152
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.2731	1.3152
Enhanced shear strength, Tc-e (N/sqmm)	0.5128	0.5297
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm

Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C5	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C4	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1253.96	kN
Mux	=	-1.43	kNm
Muy	=	4.27	kNm
Vux	=	-2.28	kN
Vuy	=	-2.53	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	25.08	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-1.43	---	-1.43	0	-1.43
Minor Axis - Muy	4.27	25.08	25.08	0	25.08

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1253.96	kN
Mux	=	-1.43	kNm
Muy	=	25.08	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66

Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	86.73	deg
MRes	=	25.12	kNm
MCap	=	26.37	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.95 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-2.5252	-2.2754
Pu (kN)	1253.96	1253.96
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0198	0.0206
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.4762	2.7038
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C5	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C4	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	977.99	kN
Mux	=	5.61	kNm
Muy	=	5.67	kNm
Vux	=	-5.46	kN
Vuy	=	-7.86	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	19.56	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	5.61	---	5.61	0	5.61
Minor Axis - Muy	5.67	19.56	19.56	0	19.56

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	977.99	kN
Mux	=	5.61	kNm
Muy	=	19.56	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66
Reinforcement Provided	=	8-T12
Load Angle	=	Tan^{-1}(Muy/Mux)

	=	73.99	deg
MRes	=	20.35	kNm
MCap	=	46.6	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.44 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-7.8642	-5.4628
Pu (kN)	977.99	977.99
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0617	0.0495
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.1513	2.3288
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C5	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C4	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	705.46	kN
Mux	=	6.96	kNm
Muy	=	5.64	kNm
Vux	=	-5.36	kN
Vuy	=	-7.82	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	14.11	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	6.96	---	6.96	0	6.96
Minor Axis - Muy	5.64	14.11	14.11	0	14.11

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	705.46	kN
Mux	=	6.96	kNm
Muy	=	14.11	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	63.74	deg

MRes	=	15.73	kNm
MCap	=	66.48	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.24 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-7.8242	-5.3579
Pu (kN)	705.46	705.46
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0614	0.0485
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.8305	1.9585
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C5	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C4	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	446.48	kN
Mux	=	-11.84	kNm
Muy	=	-8.24	kNm
Vux	=	-5.54	kN
Vuy	=	-7.52	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30

	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	8.93	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-11.84	---	-11.84	0	-11.84
Minor Axis - Muy	-8.24	8.93	-8.93	0	-8.93

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	446.48	kN
Mux	=	-11.84	kNm
Muy	=	-8.93	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	37.02	deg
MRes	=	14.83	kNm
MCap	=	110.54	kNm

Capacity Ratio	=	MRes/ MCap
	=	0.13 <= 1

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-7.5154	-5.5356
Pu (kN)	433.29	433.29
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.059	0.0501
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5101	1.5887
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---

Spacing	175	---	---	175	---

General Data

Column No.	:	C5	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C4	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	175.63	kN
Mux	=	-11.16	kNm
Muy	=	-8.3	kNm
Vux	=	-5.3	kN
Vuy	=	-8.44	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm

Mminx	=	Pu x Minimum Eccentricity	
	=	4.41	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-11.16	4.41	-11.16	0	-11.16
Minor Axis - Muy	-8.3	---	-8.3	0	-8.3

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	175.63	kN
Mux	=	-11.16	kNm
Muy	=	-8.3	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	$Tan^{-1}(Muy/Mux)$	
	=	36.63	deg
MRes	=	13.91	kNm
MCap	=	96.83	kNm
Capacity Ratio	=	MRes/ MCap	

= 0.14 <= 1

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-8.4442	-5.3031
Pu (kN)	162.43	162.43
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0663	0.048
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1912	1.2207
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1912	1.2207
Enhanced shear strength, Tc-e (N/sqmm)	0.4798	0.4917
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C6	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C2	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	890.65	kN
Mux	=	-3.21	kNm
Muy	=	0.24	kNm
Vux	=	1.42	kN
Vuy	=	1.04	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	17.81	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)
Column Is Unbraced Along D			
Slenderness Check Along D:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	
Column Is Unbraced Along B			
Slenderness Check Along B:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	0, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-3.21	---	-3.21	0	-3.21
Minor Axis - Muy	0.24	17.81	17.81	0	17.81

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	890.65	kN
Mux	=	-3.21	kNm
Muy	=	17.81	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	79.77	deg
MRes	=	18.1	kNm
MCap	=	46.78	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.39 <= 1	

Shear Calculation	Along D	Along B

Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	7.3223	-3.0774
Pu (kN)	861.63	861.63
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0575	0.0279
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.0143	2.1707
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C6	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C2	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	688.46	kN
Mux	=	21.8	kNm
Muy	=	-9.54	kNm
Vux	=	-6.21	kN
Vuy	=	15.52	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	13.77	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	21.8	---	21.8	0	21.8
Minor Axis - Muy	-9.54	13.77	-13.77	0	-13.77

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	688.46	kN
Mux	=	21.8	kNm
Muy	=	-13.77	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	32.27	deg
MRes	=	25.79	kNm
MCap	=	114.21	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.23 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	15.5178	-6.2088
Pu (kN)	675.27	675.27
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1218	0.0562
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.7949	1.9175
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C6	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C2	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	504.88	kN
Mux	=	19.74	kNm
Muy	=	-8.67	kNm
Vux	=	-5.8	kN
Vuy	=	14.27	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	10.1	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	19.74	---	19.74	0	19.74
Minor Axis - Muy	-8.67	10.1	-10.1	0	-10.1

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	504.88	kN
Mux	=	19.74	kNm
Muy	=	-10.1	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	27.09	deg
MRes	=	22.17	kNm
MCap	=	124.03	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.18 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	14.2724	-5.8009

Pu (kN)	491.69	491.69
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.112	0.0525
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5788	1.6681
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C6
Level	:	FIRST To SECOND

Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C2	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	322.05	kN
Mux	=	20.84	kNm
Muy	=	-9.1	kNm
Vux	=	-6.15	kN
Vuy	=	13.62	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	8.08	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	20.84	8.08	20.84	0	20.84
Minor Axis - Muy	-9.1	---	-9.1	0	-9.1

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	322.05	kN
Mux	=	20.84	kNm
Muy	=	-9.1	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	$Tan^{-1}(Muy/Mux)$	
	=	23.59	deg
MRes	=	22.74	kNm
MCap	=	122.79	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.19 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	13.6152	-6.1462
Pu (kN)	308.86	308.86

Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1069	0.0557
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3636	1.4196
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3636	1.4196
Enhanced shear strength, Tc-e (N/sqmm)	0.5492	0.5718
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C6
Level	:	SECOND To THIRD
Frame Type	=	Non-Ductile

Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C2	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	139.51	kN
Mux	=	24.31	kNm
Muy	=	-8.39	kNm
Vux	=	-4.93	kN
Vuy	=	17.92	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	3.5	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	24.31	3.5	24.31	0	24.31
Minor Axis - Muy	-8.39	---	-8.39	0	-8.39

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	139.51	kN
Mux	=	24.31	kNm
Muy	=	-8.39	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	19.05	deg
MRes	=	25.72	kNm
MCap	=	110	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.23 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	17.9197	-4.9343
Pu (kN)	126.31	126.31
Deff , Beff (mm)	554	184

Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1406	0.0447
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1487	1.1716
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1487	1.1716
Enhanced shear strength, Tc-e (N/sqmm)	0.4627	0.4719
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C7
Level	:	Base To STILT
Frame Type	=	Non-Ductile
Response Reduction Factor	=	3

Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C7	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	862.99	kN
Mux	=	23.67	kNm
Muy	=	-18.52	kNm
Vux	=	11.25	kN
Vuy	=	-17.16	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	21.66	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	

Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	23.67	21.66	23.67	0	23.67
Minor Axis - Muy	-18.52	---	-18.52	0	-18.52

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	862.99	kN
Mux	=	23.67	kNm
Muy	=	-18.52	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	$Tan^{-1}(Muy/Mux)$	
	=	38.04	deg
MRes	=	30.05	kNm
MCap	=	97.46	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.31 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-17.1788	11.2516
Pu (kN)	894.98	862.99
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400

Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1348	0.1019
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.0536	2.1725
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C7
Level	:	STILT To GROUND
Frame Type	=	Non-Ductile
Response Reduction Factor	=	3
Design Code	=	IS 456 : 2000 + IS 13920 : 2016

Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C7	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	691.06	kN
Mux	=	-56.97	kNm
Muy	=	34.58	kNm
Vux	=	22.22	kN
Vuy	=	-33.98	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	17.35	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D

	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-56.97	17.35	-56.97	0	-56.97
Minor Axis - Muy	34.58	---	34.58	0	34.58

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	691.06	kN
Mux	=	-56.97	kNm
Muy	=	34.58	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	31.25	deg
MRes	=	66.64	kNm
MCap	=	115.39	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.58 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-33.9752	22.2214
Pu (kN)	677.87	677.87
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)

Tv (N/sqmm)	0.2666	0.2013
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.798	1.921
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C7	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm

Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C7	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	506	kN
Mux	=	-45.51	kNm
Muy	=	30.17	kNm
Vux	=	20.31	kN
Vuy	=	-30.48	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	12.7	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-45.51	12.7	-45.51	0	-45.51
Minor Axis - Muy	30.17	---	30.17	0	30.17

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	506	kN
Mux	=	-45.51	kNm
Muy	=	30.17	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	33.54	deg
MRes	=	54.6	kNm
MCap	=	115.9	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.47 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-30.4819	20.315
Pu (kN)	492.81	492.81
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2392	0.184

Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5801	1.6696
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C7	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm

Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C7	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	321	kN
Mux	=	-45.99	kNm
Muy	=	30.94	kNm
Vux	=	20.46	kN
Vuy	=	-28.63	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	8.06	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-45.99	8.06	-45.99	0	-45.99
Minor Axis - Muy	30.94	---	30.94	0	30.94

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	321	kN
Mux	=	-45.99	kNm
Muy	=	30.94	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	33.93	deg
MRes	=	55.43	kNm
MCap	=	110.51	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.5 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-28.6333	20.4568
Pu (kN)	307.8	307.8
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2247	0.1853

Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3623	1.4182
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3623	1.4182
Enhanced shear strength, Tc-e (N/sqmm)	0.5487	0.5712
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C7	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm

Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C7	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	136.16	kN
Mux	=	-53.45	kNm
Muy	=	32.11	kNm
Vux	=	22.09	kN
Vuy	=	-43.32	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	3.42	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-53.45	3.42	-53.45	0	-53.45
Minor Axis - Muy	32.11	---	32.11	0	32.11

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	136.16	kN
Mux	=	-53.45	kNm
Muy	=	32.11	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	30.99	deg
MRes	=	62.36	kNm
MCap	=	99.26	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.63 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-43.3185	22.0883
Pu (kN)	122.97	122.97
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.34	0.2001

Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1448	1.1671
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1448	1.1671
Enhanced shear strength, Tc-e (N/sqmm)	0.4611	0.4701
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C8	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm

Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C11	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	789.96	kN
Mux	=	-11.96	kNm
Muy	=	1.01	kNm
Vux	=	-2.04	kN
Vuy	=	-0.7	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	15.8	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	0, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-11.96	---	-11.96	0	-11.96
Minor Axis - Muy	1.01	15.8	15.8	0	15.8

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	789.96	kN
Mux	=	-11.96	kNm
Muy	=	15.8	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	52.87	deg
MRes	=	19.82	kNm
MCap	=	80.56	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.25 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-13.0001	6.3935
Pu (kN)	763.07	763.07
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.102	0.0579
Pt (%)	0.328	0.328
Design shear strength,	0.4028	0.4028

Tc (N/sqmm)		
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.8983	2.0368
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C8	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm

Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C11	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	615.64	kN
Mux	=	-44.83	kNm
Muy	=	20.42	kNm
Vux	=	13.63	kN
Vuy	=	-26.92	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	15.45	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-44.83	15.45	-44.83	0	-44.83
Minor Axis - Muy	20.42	---	20.42	0	20.42

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	615.64	kN
Mux	=	-44.83	kNm
Muy	=	20.42	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	24.49	deg
MRes	=	49.26	kNm
MCap	=	125.86	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.39 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-26.9199	13.6338
Pu (kN)	602.45	602.45
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2113	0.1235
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028

Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.7092	1.8185
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C8	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm

Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C11	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	448.11	kN
Mux	=	-36.91	kNm
Muy	=	21.11	kNm
Vux	=	14.28	kN
Vuy	=	-24.22	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	11.25	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	

Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-36.91	11.25	-36.91	0	-36.91
Minor Axis - Muy	21.11	---	21.11	0	21.11

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	448.11	kN
Mux	=	-36.91	kNm
Muy	=	21.11	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	29.77	deg
MRes	=	42.52	kNm
MCap	=	120.29	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.35 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-24.2189	14.2845
Pu (kN)	434.92	434.92
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1901	0.1294
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength	1 + 3 x Pu / (B x D x Fck)	

Enhancement Factor (Compressive Force)		
	1.512	1.5909
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C8	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm

Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C11	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	275.66	kN
Mux	=	-36.79	kNm
Muy	=	22.94	kNm
Vux	=	15.51	kN
Vuy	=	-23.63	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	6.92	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	

= 11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-36.79	6.92	-36.79	0	-36.79
Minor Axis - Muy	22.94	---	22.94	0	22.94

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	275.66	kN
Mux	=	-36.79	kNm
Muy	=	22.94	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	31.95	deg
MRes	=	43.36	kNm
MCap	=	110.34	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.39 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-23.6324	15.5054
Pu (kN)	262.46	262.46
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1855	0.1404
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	

	1.309	1.3566
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.309	1.3566
Enhanced shear strength, Tc-e (N/sqmm)	0.5272	0.5464
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C8	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm

Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C11	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	98.58	kN
Mux	=	-39.64	kNm
Muy	=	22.26	kNm
Vux	=	14.3	kN
Vuy	=	-28.35	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	2.47	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-39.64	2.47	-39.64	0	-39.64
Minor Axis - Muy	22.26	---	22.26	0	22.26

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	98.58	kN
Mux	=	-39.64	kNm
Muy	=	22.26	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	29.31	deg
MRes	=	45.47	kNm
MCap	=	96.5	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.47 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-28.354	14.2968
Pu (kN)	85.39	85.39
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2225	0.1295
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1005	1.116

Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1005	1.116
Enhanced shear strength, Tc-e (N/sqmm)	0.4432	0.4495
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C9	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm

Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C10	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	845.81	kN
Mux	=	0.29	kNm
Muy	=	0.5	kNm
Vux	=	0.81	kN
Vuy	=	0.27	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	16.92	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	0, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	0.29	---	0.29	0	0.29
Minor Axis - Muy	0.5	16.92	16.92	0	16.92

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	845.81	kN
Mux	=	0.29	kNm
Muy	=	16.92	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	89.02	deg
MRes	=	16.92	kNm
MCap	=	48.05	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.35 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	12.5483	0.8149
Pu (kN)	817.03	845.8
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0985	0.0074
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.9618	2.1492
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C9	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm

Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C10	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	659.34	kN
Mux	=	35.9	kNm
Muy	=	2.02	kNm
Vux	=	1.39	kN
Vuy	=	24.26	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	13.19	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

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

	A	B	C	E	F
Major Axis - Mux	35.9	---	35.9	0	35.9
Minor Axis - Muy	2.02	13.19	13.19	0	13.19

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	659.34	kN
Mux	=	35.9	kNm
Muy	=	13.19	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	20.17	deg
MRes	=	38.24	kNm
MCap	=	128.7	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.3 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	24.2634	1.3899
Pu (kN)	646.15	646.15
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1904	0.0126
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.7607	1.8779
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C9	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	

Column Type	:	UnBraced
Minimum eccentricity check	:	One Axis at a Time
Code defined D/B ratio	:	4
D/B Ratio	:	2.61 <= 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C10	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	486.65	kN
Mux	=	30.77	kNm
Muy	=	2.41	kNm
Vux	=	1.64	kN
Vuy	=	21.52	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	9.73	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	30.77	---	30.77	0	30.77
Minor Axis - Muy	2.41	9.73	9.73	0	9.73

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	486.65	kN
Mux	=	30.77	kNm
Muy	=	9.73	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	17.55	deg
MRes	=	32.27	kNm
MCap	=	133.4	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.24 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	21.5225	1.6361
Pu (kN)	473.46	473.46
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1689	0.0148
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5574	1.6433
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	0.6041	0.6041

strength, Tc-e (N/sqmm)		
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C9	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	

Code defined D/B ratio	:	4
D/B Ratio	:	2.61 <= 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C10	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	313.52	kN
Mux	=	32.38	kNm
Muy	=	2.85	kNm
Vux	=	2.01	kN
Vuy	=	21.71	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	6.27	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	32.38	---	32.38	0	32.38
Minor Axis - Muy	2.85	6.27	6.27	0	6.27

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	313.52	kN
Mux	=	32.38	kNm
Muy	=	6.27	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	10.96	deg
MRes	=	32.98	kNm
MCap	=	132.25	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.25 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	21.7068	2.0089
Pu (kN)	300.33	300.33
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1704	0.0182
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3536	1.4081
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3536	1.4081
Enhanced shear strength, Tc-e (N/sqmm)	0.5452	0.5671

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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C9	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C10	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	139.53	kN
Mux	=	32.63	kNm
Muy	=	2.69	kNm
Vux	=	1.79	kN
Vuy	=	22.82	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	3.5	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	32.63	3.5	32.63	0	32.63
Minor Axis - Muy	2.69	---	2.69	0	2.69

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	139.53	kN
Mux	=	32.63	kNm
Muy	=	2.69	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	4.89	deg
MRes	=	32.75	kNm
MCap	=	117.09	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.28 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	22.8175	1.7918
Pu (kN)	126.34	126.34
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1791	0.0162
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1487	1.1717
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1487	1.1717
Enhanced shear strength, Tc-e (N/sqmm)	0.4627	0.4719
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C10	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C8	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1027.98	kN
Mux	=	35.34	kNm
Muy	=	-10.4	kNm
Vux	=	6.42	kN
Vuy	=	-23.88	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	20.56	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	35.34	---	35.34	0	35.34
Minor Axis - Muy	-10.4	20.56	-20.56	0	-20.56

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1027.98	kN
Mux	=	35.34	kNm
Muy	=	-20.56	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	30.19	deg
MRes	=	40.89	kNm
MCap	=	91.75	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.45 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-23.8779	6.4173
Pu (kN)	1027.98	1027.98
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1874	0.0581
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.2101	2.3967
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C10	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C8	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	822.43	kN
Mux	=	-77.6	kNm
Muy	=	19.12	kNm
Vux	=	12.31	kN
Vuy	=	-47.44	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	20.64	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-77.6	20.64	-77.6	0	-77.6
Minor Axis - Muy	19.12	---	19.12	0	19.12

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	822.43	kN
Mux	=	-77.6	kNm
Muy	=	19.12	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	13.84	deg
MRes	=	79.93	kNm
MCap	=	123.88	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.65 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-47.4359	12.3084
Pu (kN)	809.24	809.24
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3723	0.1115
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.9526	2.0995
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C10	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C8

Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	602.1	kN
Mux	=	-64.55	kNm
Muy	=	16.72	kNm
Vux	=	11.23	kN
Vuy	=	-43.47	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	15.11	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-64.55	15.11	-64.55	0	-64.55
Minor Axis - Muy	16.72	---	16.72	0	16.72

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	602.1	kN
Mux	=	-64.55	kNm
Muy	=	16.72	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	14.52	deg
MRes	=	66.68	kNm
MCap	=	135.24	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.49 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-43.4698	11.2287
Pu (kN)	588.91	588.91
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3412	0.1017
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.6933	1.8001
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C10	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C8
		[1] : 1.5 (Dead) +1.5 (SIDL)

Load Combination	=	+1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	380.52	kN
Mux	=	-65.86	kNm
Muy	=	17.28	kNm
Vux	=	11.51	kN
Vuy	=	-41.54	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	9.55	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-65.86	9.55	-65.86	0	-65.86
Minor Axis - Muy	17.28	---	17.28	0	17.28

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	380.52	kN
Mux	=	-65.86	kNm
Muy	=	17.28	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	14.71	deg
MRes	=	68.09	kNm
MCap	=	133.01	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.51 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-41.5383	11.5118
Pu (kN)	367.33	367.33
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.326	0.1043
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.4324	1.4991
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.4324	1.4991
Enhanced shear strength, Tc-e (N/sqmm)	0.5769	0.6038
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C10	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C8
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Critical Location	=	Bottom Joint	
Pu	=	157.85	kN
Mux	=	-75.83	kNm
Muy	=	17.45	kNm
Vux	=	11.67	kN
Vuy	=	-58.55	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	3.96	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-75.83	3.96	-75.83	0	-75.83
Minor Axis - Muy	17.45	---	17.45	0	17.45

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	157.85	kN
Mux	=	-75.83	kNm
Muy	=	17.45	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	12.96	deg
MRes	=	77.82	kNm
MCap	=	116.01	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.67 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-58.5477	11.6743
Pu (kN)	144.66	144.66
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.4595	0.1057
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1703	1.1965
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1703	1.1965
Enhanced shear strength, Tc-e (N/sqmm)	0.4714	0.4819
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C11	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C9
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Critical Location	=	Bottom Joint

Pu	=	2224.22	kN
Mux	=	4.41	kNm
Muy	=	-0.35	kNm
Vux	=	3.89	kN
Vuy	=	2.99	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	44.48	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	0, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	4.41	---	4.41	0	4.41
Minor Axis - Muy	-0.35	44.48	-44.48	0	-44.48

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	2224.22	kN
Mux	=	4.41	kNm
Muy	=	-44.48	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	3.3	
Reinforcement Provided	=	8-T25 + 2-T20	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	84.34	deg
MRes	=	44.7	kNm
MCap	=	55.78	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.8 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	19.5024	-8.1646
Pu (kN)	2179.7	2179.7
Deff , Beff (mm)	547.5	177.5
Aeff (sqmm)	125925	106500
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1549	0.0767
Pt (%)	1.65	1.65
Design shear strength, Tc (N/sqmm)	0.7389	0.7389
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	3.5964	4.07
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)	1.1083	1.1083
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	

	=	6.25	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	320	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C11	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C9	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1708.61	kN
Mux	=	56.36	kNm

Muy	=	-24.46	kNm
Vux	=	-15.88	kN
Vuy	=	36.89	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	34.17	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	56.36	---	56.36	0	56.36
Minor Axis - Muy	-24.46	34.17	-34.17	0	-34.17

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1708.61	kN
Mux	=	56.36	kNm

Muy	=	-34.17	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.78	
Reinforcement Provided	=	4-T20 + 6-T16	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	31.23	deg
MRes	=	65.91	kNm
MCap	=	90.17	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.73 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	36.8851	-15.8802
Pu (kN)	1695.42	1695.42
Deff , Beff (mm)	550	180
Aeff (sqmm)	126500	108000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2916	0.147
Pt (%)	0.892	0.892
Design shear strength, Tc (N/sqmm)	0.5974	0.5974
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	3.0104	3.3547
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)	0.896	0.896
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	
	=	5	mm

Criterion for spacing of normal

links

Min. Longitudinal Bar dia X 16	=	256	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C11	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C9	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1249.86	kN
Mux	=	46.4	kNm
Muy	=	-22.21	kNm
Vux	=	-14.89	kN

Vuy	=	32.26	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	25	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	46.4	---	46.4	0	46.4
Minor Axis - Muy	-22.21	25	-25	0	-25

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1249.86	kN
Mux	=	46.4	kNm
Muy	=	-25	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	28.32	deg
MRes	=	52.7	kNm
MCap	=	62.99	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.84 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	32.2582	-14.8854
Pu (kN)	1236.67	1236.67
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2532	0.1348
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.4558	2.6803
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm

Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C11	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C9	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	792.8	kN
Mux	=	47.18	kNm
Muy	=	-22.51	kNm
Vux	=	-14.97	kN
Vuy	=	30.73	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	19.9	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	47.18	19.9	47.18	0	47.18
Minor Axis - Muy	-22.51	---	-22.51	0	-22.51

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	792.8	kN
Mux	=	47.18	kNm
Muy	=	-22.51	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	25.5	deg
MRes	=	52.28	kNm
MCap	=	116.32	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.45 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	30.7343	-14.9662
Pu (kN)	779.6	779.6
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2412	0.1356
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.9178	2.0592
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm

Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C11	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C9	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	337.77	kN
Mux	=	50.74	kNm
Muy	=	-23.09	kNm
Vux	=	-15.59	kN
Vuy	=	38.14	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	8.48	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	50.74	8.48	50.74	0	50.74
Minor Axis - Muy	-23.09	---	-23.09	0	-23.09

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	337.77	kN
Mux	=	50.74	kNm
Muy	=	-23.09	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	24.47	deg
MRes	=	55.75	kNm
MCap	=	122.68	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.45 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	38.1389	-15.595
Pu (kN)	324.58	324.58
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2993	0.1413
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3821	1.441
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3821	1.441
Enhanced shear strength, Tc-e (N/sqmm)	0.5567	0.5804
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C12	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	750	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	3.26 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C13	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	2929.56	kN
Mux	=	25.08	kNm
Muy	=	-0.1	kNm
Vux	=	4.2	kN
Vuy	=	23.8	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	58.59	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	0, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	0, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	25.08	---	25.08	0	25.08
Minor Axis - Muy	-0.1	58.59	-58.59	0	-58.59

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	2929.56	kN
Mux	=	25.08	kNm
Muy	=	-58.59	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	3
Reinforcement Provided	=	8-T25 + 4-T20

Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	66.83	deg
MRes	=	63.73	kNm
MCap	=	77.68	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.82 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	37.7101	4.1989
Pu (kN)	2888.35	2929.56
Deff , Beff (mm)	697.5	177.5
Aeff (sqmm)	160425	133125
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2351	0.0315
Pt (%)	1.502	1.502
Design shear strength, Tc (N/sqmm)	0.7165	0.7165
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	3.7007	4.3009
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)	1.0748	1.0748
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	
	=	6.25	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	320	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C12	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	750	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	3.26 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C13	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	2323.69	kN
Mux	=	120.12	kNm
Muy	=	-10.31	kNm
Vux	=	-6.21	kN
Vuy	=	77.33	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	46.47	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	3.4, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	120.12	---	120.12	0	120.12
Minor Axis - Muy	-10.31	46.47	-46.47	0	-46.47

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	2323.69	kN
Mux	=	120.12	kNm
Muy	=	-46.47	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	2.19
Reinforcement Provided	=	12-T20
Load Angle	=	Tan^{-1}(Muy/Mux)

	=	21.15	deg
MRes	=	128.8	kNm
MCap	=	164.44	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.78 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	77.3302	-6.2092
Pu (kN)	2310.5	2310.5
Deff , Beff (mm)	700	180
Aeff (sqmm)	161000	135000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.4803	0.046
Pt (%)	1.093	1.093
Design shear strength, Tc (N/sqmm)	0.6425	0.6425
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	3.1526	3.5672
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)	0.9638	0.9638
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	
	=	5	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	320	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C12	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	750	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	3.26 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C13	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1762.47	kN
Mux	=	100.56	kNm
Muy	=	-5.76	kNm
Vux	=	-3.6	kN
Vuy	=	68.95	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	35.25	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	3.4, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	100.56	---	100.56	0	100.56
Minor Axis - Muy	-5.76	35.25	-35.25	0	-35.25

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1762.47	kN
Mux	=	100.56	kNm
Muy	=	-35.25	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.99	
Reinforcement Provided	=	4-T16 + 8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	19.32	deg

MRes	=	106.56	kNm
MCap	=	116.27	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.92 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	68.9494	-3.6013
Pu (kN)	1749.27	1749.27
Deff , Beff (mm)	702	182
Aeff (sqmm)	161460	136500
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.427	0.0264
Pt (%)	0.495	0.495
Design shear strength, Tc (N/sqmm)	0.4767	0.4767
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.6251	2.9223
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)	0.7151	0.7151
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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C12	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	750	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	3.26 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C13	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1206.77	kN
Mux	=	105.96	kNm
Muy	=	-4.78	kNm
Vux	=	-3.33	kN
Vuy	=	70.3	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30

	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	24.14	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	3.4, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	105.96	---	105.96	0	105.96
Minor Axis - Muy	-4.78	24.14	-24.14	0	-24.14

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1206.77	kN
Mux	=	105.96	kNm
Muy	=	-24.14	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.79	
Reinforcement Provided	=	12-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	12.83	deg
MRes	=	108.67	kNm
MCap	=	185.33	kNm

Capacity Ratio	=	MRes/ MCap
	=	0.59 <= 1

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	70.3025	-3.3304
Pu (kN)	1193.58	1193.58
Deff , Beff (mm)	704	184
Aeff (sqmm)	161920	138000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.4342	0.0241
Pt (%)	0.393	0.393
Design shear strength, Tc (N/sqmm)	0.4343	0.4343
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.1057	2.2974
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)	0.6514	0.6514
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---

Spacing	175	---	---	175	---

General Data

Column No.	:	C12	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	750	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	3.26 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C13	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	659.47	kN
Mux	=	111.95	kNm
Muy	=	-0.06	kNm
Vux	=	1.94	kN
Vuy	=	79.93	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	

	=	13.19	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	3.4, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	111.95	---	111.95	0	111.95
Minor Axis - Muy	-0.06	13.19	-13.19	0	-13.19

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	659.47	kN
Mux	=	111.95	kNm
Muy	=	-13.19	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.52	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	6.72	deg
MRes	=	112.72	kNm
MCap	=	206.36	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.55 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	79.9315	1.9411
Pu (kN)	646.28	646.28
Deff , Beff (mm)	704	184
Aeff (sqmm)	161920	138000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.4936	0.0141
Pt (%)	0.262	0.262
Design shear strength, Tc (N/sqmm)	0.3666	0.3666
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5987	1.7025
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)	0.5499	0.5499
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C13	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C12	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1287.9	kN
Mux	=	6.11	kNm
Muy	=	8.07	kNm
Vux	=	7.65	kN
Vuy	=	15.32	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	25.76	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	6.11	---	6.11	0	6.11
Minor Axis - Muy	8.07	25.76	25.76	0	25.76

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1287.9	kN
Mux	=	6.11	kNm
Muy	=	25.76	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	76.65	deg
MRes	=	26.47	kNm
MCap	=	26.89	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.98 <= 1	

Shear Calculation	Along D	Along B
Critical Load	[1] : 1.5 (Dead) +1.5	[1] : 1.5 (Dead) +1.5

Combination	(SIDL) +1.5 (Live)	(SIDL) +1.5 (Live)
Design shear force, Vu (kN)	28.8406	7.6459
Pu (kN)	1313.5	1274.71
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2263	0.0693
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.5463	2.7319
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C13	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C12	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1048.78	kN
Mux	=	47.11	kNm
Muy	=	21.7	kNm
Vux	=	14.13	kN
Vuy	=	31.91	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	26.32	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	47.11	26.32	47.11	0	47.11
Minor Axis - Muy	21.7	---	21.7	0	21.7

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1048.78	kN
Mux	=	47.11	kNm
Muy	=	21.7	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	24.73	deg
MRes	=	51.86	kNm
MCap	=	93.89	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.55 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	31.9063	14.1271
Pu (kN)	1035.59	1035.59
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2504	0.128
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.2191	2.407
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C13	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C12	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	806.65	kN
Mux	=	46.36	kNm
Muy	=	20.06	kNm
Vux	=	13.51	kN
Vuy	=	33	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	20.25	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	46.36	20.25	46.36	0	46.36
Minor Axis - Muy	20.06	---	20.06	0	20.06

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	806.65	kN
Mux	=	46.36	kNm
Muy	=	20.06	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	23.4	deg
MRes	=	50.52	kNm
MCap	=	117.52	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.43 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	32.9996	13.5068
Pu (kN)	793.46	793.46
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.259	0.1223
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.9341	2.0781
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C13	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C12	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	563.88	kN
Mux	=	44.79	kNm
Muy	=	20.25	kNm
Vux	=	13.33	kN
Vuy	=	26.39	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	14.15	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	44.79	14.15	44.79	0	44.79
Minor Axis - Muy	20.25	---	20.25	0	20.25

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	563.88	kN
Mux	=	44.79	kNm
Muy	=	20.25	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	24.32	deg
MRes	=	49.16	kNm
MCap	=	127.14	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.39 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	26.3942	13.3293
Pu (kN)	550.69	550.69
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2071	0.1207
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.6483	1.7482
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C13	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C12	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	305.17	kN
Mux	=	-99.54	kNm
Muy	=	-19.35	kNm
Vux	=	16.48	kN
Vuy	=	66.69	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	7.66	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-99.54	7.66	-99.54	0	-99.54
Minor Axis - Muy	-19.35	---	-19.35	0	-19.35

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	305.17	kN
Mux	=	-99.54	kNm
Muy	=	-19.35	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	11	deg
MRes	=	101.4	kNm
MCap	=	131.73	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.77 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	66.6924	16.4817
Pu (kN)	305.17	305.17
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.5234	0.1493
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3593	1.4146
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3593	1.4146
Enhanced shear strength, Tc-e (N/sqmm)	0.5475	0.5698
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C14	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C14	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1082.58	kN
Mux	=	39.66	kNm
Muy	=	8.06	kNm
Vux	=	-5.09	kN
Vuy	=	-25.4	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	21.65	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	39.66	---	39.66	0	39.66
Minor Axis - Muy	8.06	21.65	21.65	0	21.65

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1082.58	kN
Mux	=	39.66	kNm
Muy	=	21.65	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	28.63	deg
MRes	=	45.18	kNm
MCap	=	86.61	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.52 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-25.4034	-5.0921

Pu (kN)	1082.58	1082.58
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1994	0.0461
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.2744	2.4709
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C14
Level	:	STILT To GROUND

Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C14	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	862.7	kN
Mux	=	-83.85	kNm
Muy	=	-14.89	kNm
Vux	=	-9.59	kN
Vuy	=	-51.07	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	17.25	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-83.85	---	-83.85	0	-83.85
Minor Axis - Muy	-14.89	17.25	-17.25	0	-17.25

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	862.7	kN
Mux	=	-83.85	kNm
Muy	=	-17.25	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	11.63	deg
MRes	=	85.6	kNm
MCap	=	122.04	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.7 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-51.0689	-9.5907
Pu (kN)	849.51	849.51
Deff , Beff (mm)	554	184

Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.4008	0.0869
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2	2.1542
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C14
Level	:	GROUND To FIRST
Frame Type	=	Non-Ductile
Response Reduction Factor	=	3

Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C14	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	630.54	kN
Mux	=	-67.34	kNm
Muy	=	-13.07	kNm
Vux	=	-8.76	kN
Vuy	=	-45.18	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	15.83	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	

Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-67.34	15.83	-67.34	0	-67.34
Minor Axis - Muy	-13.07	---	-13.07	0	-13.07

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	630.54	kN
Mux	=	-67.34	kNm
Muy	=	-13.07	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	10.98	deg
MRes	=	68.6	kNm
MCap	=	136.99	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.5 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-45.1821	-8.7581
Pu (kN)	617.35	617.35
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400

Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3546	0.0793
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.7267	1.8388
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C14
Level	:	FIRST To SECOND
Frame Type	=	Non-Ductile
Response Reduction Factor	=	3
Design Code	=	IS 456 : 2000 + IS 13920 : 2016

Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C14	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	397.66	kN
Mux	=	-69.75	kNm
Muy	=	-13.47	kNm
Vux	=	-9.06	kN
Vuy	=	-44.85	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	9.98	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D

	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-69.75	9.98	-69.75	0	-69.75
Minor Axis - Muy	-13.47	---	-13.47	0	-13.47

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	397.66	kN
Mux	=	-69.75	kNm
Muy	=	-13.47	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	10.93	deg
MRes	=	71.04	kNm
MCap	=	136.1	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.52 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-44.8518	-9.0616
Pu (kN)	384.47	384.47
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)

Tv (N/sqmm)	0.352	0.0821
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.4526	1.5224
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.4526	1.5
Enhanced shear strength, Tc-e (N/sqmm)	0.5851	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C14	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm

Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C14	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	164.54	kN
Mux	=	-75.06	kNm
Muy	=	-12.28	kNm
Vux	=	-7.61	kN
Vuy	=	-53.98	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	4.13	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-75.06	4.13	-75.06	0	-75.06
Minor Axis - Muy	-12.28	---	-12.28	0	-12.28

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	164.54	kN
Mux	=	-75.06	kNm
Muy	=	-12.28	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	9.29	deg
MRes	=	76.05	kNm
MCap	=	118.47	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.64 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-53.9842	-7.6051
Pu (kN)	151.35	151.35
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.4237	0.0689

Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1782	1.2056
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1782	1.2056
Enhanced shear strength, Tc-e (N/sqmm)	0.4745	0.4856
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C15	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm

Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C31	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1510.29	kN
Mux	=	-3.3	kNm
Muy	=	-1.78	kNm
Vux	=	9.86	kN
Vuy	=	-2.92	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	30.21	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	0, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-3.3	---	-3.3	0	-3.3
Minor Axis - Muy	-1.78	30.21	-30.21	0	-30.21

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1510.29	kN
Mux	=	-3.3	kNm
Muy	=	-30.21	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.33	
Reinforcement Provided	=	8-T16 + 2-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	83.77	deg
MRes	=	30.39	kNm
MCap	=	34.23	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.89 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-5.0014	-17.1295
Pu (kN)	1474.56	1474.56
Deff , Beff (mm)	552	182
Aeff (sqmm)	126960	109200
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0394	0.1569
Pt (%)	0.665	0.665
Design shear strength,	0.5349	0.5349

Tc (N/sqmm)		
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.7422	3.0255
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)	0.8023	0.8023
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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C15	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm

Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C31	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1168.74	kN
Mux	=	-15.45	kNm
Muy	=	-51	kNm
Vux	=	-32.84	kN
Vuy	=	-9.55	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	23.37	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	

Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-15.45	---	-15.45	0	-15.45
Minor Axis - Muy	-51	23.37	-51	0	-51

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1168.74	kN
Mux	=	-15.45	kNm
Muy	=	-51	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.33	
Reinforcement Provided	=	8-T16 + 2-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	73.15	deg
MRes	=	53.29	kNm
MCap	=	59.14	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.9 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-9.5547	-32.836
Pu (kN)	1155.55	1155.55
Deff , Beff (mm)	552	182
Aeff (sqmm)	126960	109200
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0753	0.3007
Pt (%)	0.665	0.665
Design shear strength, Tc (N/sqmm)	0.5349	0.5349
Shear Strength	1 + 3 x Pu / (B x D x Fck)	

Enhancement Factor (Compressive Force)		
	2.3652	2.5873
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)	0.8023	0.8023
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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C15	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm

Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C31	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	845.25	kN
Mux	=	-12.59	kNm
Muy	=	-43.4	kNm
Vux	=	-29.22	kN
Vuy	=	-8.73	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	16.9	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-12.59	---	-12.59	0	-12.59
Minor Axis - Muy	-43.4	16.9	-43.4	0	-43.4

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	845.25	kN
Mux	=	-12.59	kNm
Muy	=	-43.4	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	73.82	deg
MRes	=	45.19	kNm
MCap	=	51.45	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.88 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-8.7269	-29.218
Pu (kN)	832.06	832.06
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0685	0.2647
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.9795	2.1305

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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C15	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm

Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C31	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	522.21	kN
Mux	=	-13.38	kNm
Muy	=	-44.48	kNm
Vux	=	-29.72	kN
Vuy	=	-8.65	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	13.11	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-13.38	13.11	-13.38	0	-13.38
Minor Axis - Muy	-44.48	---	-44.48	0	-44.48

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	522.21	kN
Mux	=	-13.38	kNm
Muy	=	-44.48	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	73.26	deg
MRes	=	46.44	kNm
MCap	=	57	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.81 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-8.6534	-29.7168
Pu (kN)	509.02	509.02
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0679	0.2692
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5992	1.6916
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C15	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm

Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C31	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	198.32	kN
Mux	=	-14.7	kNm
Muy	=	-42.63	kNm
Vux	=	-27.94	kN
Vuy	=	-10.54	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	4.98	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-14.7	4.98	-14.7	0	-14.7
Minor Axis - Muy	-42.63	---	-42.63	0	-42.63

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	198.32	kN
Mux	=	-14.7	kNm
Muy	=	-42.63	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	70.98	deg
MRes	=	45.09	kNm
MCap	=	53.39	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.84 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-10.5366	-27.9373
Pu (kN)	185.12	185.12
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0827	0.2531
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.2179	1.2515
Shear Strength Enhancement Factor (Tensile Force)	-	-

Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.2179	1.2515
Enhanced shear strength, Tc-e (N/sqmm)	0.4905	0.5041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C16	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm

Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C17	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1723	kN
Mux	=	-9.06	kNm
Muy	=	-6.73	kNm
Vux	=	-42.42	kN
Vuy	=	0.55	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	34.46	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	0, Column Not Slender Along B	

Calculation of Design Moment

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

	A	B	C	E	F
Major Axis - Mux	-9.06	---	-9.06	0	-9.06
Minor Axis - Muy	-6.73	34.46	-34.46	0	-34.46

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1723	kN
Mux	=	-9.06	kNm
Muy	=	-34.46	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.78	
Reinforcement Provided	=	4-T20 + 6-T16	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	75.27	deg
MRes	=	35.63	kNm
MCap	=	41.48	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.86 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-11.7699	-42.4152
Pu (kN)	1687.39	1722.99
Deff , Beff (mm)	550	180
Aeff (sqmm)	126500	108000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.093	0.3927
Pt (%)	0.892	0.892
Design shear strength, Tc (N/sqmm)	0.5974	0.5974
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	3.0009	3.393
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)	0.896	0.896
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	
	=	5	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	256	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C16	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	

Column Type	:	UnBraced
Minimum eccentricity check	:	One Axis at a Time
Code defined D/B ratio	:	4
D/B Ratio	:	2.61 <= 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C17	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1422.21	kN
Mux	=	-42.12	kNm
Muy	=	-4.83	kNm
Vux	=	-3.11	kN
Vuy	=	-24.56	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	28.44	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-42.12	---	-42.12	0	-42.12
Minor Axis - Muy	-4.83	28.44	-28.44	0	-28.44

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1422.21	kN
Mux	=	-42.12	kNm
Muy	=	-28.44	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.07	
Reinforcement Provided	=	4-T16 + 6-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	34.03	deg
MRes	=	50.83	kNm
MCap	=	71.06	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.72 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-24.563	-3.1148
Pu (kN)	1409.02	1409.02
Deff , Beff (mm)	552	182
Aeff (sqmm)	126960	109200
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1935	0.0285
Pt (%)	0.537	0.537
Design shear strength, Tc (N/sqmm)	0.4923	0.4923
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.6647	2.9355
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	0.7385	0.7385

strength, Tc-e (N/sqmm)		
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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C16	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	

Code defined D/B ratio	:	4
D/B Ratio	:	2.61 <= 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C17	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1140.99	kN
Mux	=	-32.6	kNm
Muy	=	-4.57	kNm
Vux	=	-3.13	kN
Vuy	=	-22.22	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	22.82	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-32.6	---	-32.6	0	-32.6
Minor Axis - Muy	-4.57	22.82	-22.82	0	-22.82

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1140.99	kN
Mux	=	-32.6	kNm
Muy	=	-22.82	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	34.99	deg
MRes	=	39.8	kNm
MCap	=	73.98	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.54 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-22.2187	-3.1342
Pu (kN)	1127.8	1127.8
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1744	0.0284
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.3277	2.5323
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)	0.6041	0.6041

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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C16	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C17	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	846.45	kN
Mux	=	5.13	kNm
Muy	=	-0.15	kNm
Vux	=	-1.02	kN
Vuy	=	-12.49	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	16.93	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	5.13	---	5.13	0	5.13
Minor Axis - Muy	-0.15	16.93	-16.93	0	-16.93

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	846.45	kN
Mux	=	5.13	kNm
Muy	=	-16.93	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	73.15	deg
MRes	=	17.69	kNm
MCap	=	51.89	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.34 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-12.4905	-1.0243
Pu (kN)	846.45	846.45
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.098	0.0093
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.9965	2.1501
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)	0.6041	0.6041
Design shear check	Tv < Tc x Enhancement factor	Tv < Tc x Enhancement factor
Shear Links Design	**Shear Links Not**	**Shear Links Not**

	Required	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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C16	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C17	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	575.57	kN
Mux	=	79.23	kNm
Muy	=	32.38	kNm
Vux	=	-20.4	kN
Vuy	=	-50.63	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	14.45	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	79.23	14.45	79.23	0	79.23
Minor Axis - Muy	32.38	---	32.38	0	32.38

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	575.57	kN
Mux	=	79.23	kNm
Muy	=	32.38	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	22.23	deg
MRes	=	85.59	kNm
MCap	=	129.08	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.66 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-50.6274	-20.3974
Pu (kN)	575.57	575.57
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3973	0.1848
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.6776	1.782
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C17	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C29	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1076.11	kN
Mux	=	3.29	kNm
Muy	=	0.48	kNm
Vux	=	5.08	kN
Vuy	=	3.82	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	21.52	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	0, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	3.29	---	3.29	0	3.29
Minor Axis - Muy	0.48	21.52	21.52	0	21.52

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1076.11	kN
Mux	=	3.29	kNm
Muy	=	21.52	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	81.3	deg
MRes	=	21.77	kNm
MCap	=	38.44	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.57 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-10.1064	-6.7842
Pu (kN)	1040.62	1040.62
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0793	0.0615
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.225	2.4139
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C17	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C29
		[1] : 1.5 (Dead) +1.5 (SIDL)

Load Combination	=	+1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	856.02	kN
Mux	=	-28.75	kNm
Muy	=	-19.54	kNm
Vux	=	-12.95	kN
Vuy	=	-18.67	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	21.49	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-28.75	21.49	-28.75	0	-28.75
Minor Axis - Muy	-19.54	---	-19.54	0	-19.54

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	856.02	kN
Mux	=	-28.75	kNm
Muy	=	-19.54	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	34.2	deg
MRes	=	34.77	kNm
MCap	=	102.57	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.34 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-18.6675	-12.9534
Pu (kN)	842.82	842.82
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1465	0.1173
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.9922	2.1451
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C17	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C29
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Critical Location	=	Bottom Joint	
Pu	=	658.29	kN
Mux	=	-27.92	kNm
Muy	=	-19.03	kNm
Vux	=	-13.15	kN
Vuy	=	-19.16	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	16.52	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-27.92	16.52	-27.92	0	-27.92
Minor Axis - Muy	-19.03	---	-19.03	0	-19.03

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	658.29	kN
Mux	=	-27.92	kNm
Muy	=	-19.03	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	34.28	deg
MRes	=	33.79	kNm
MCap	=	112.74	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.3 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-19.1586	-13.1518
Pu (kN)	645.09	645.09
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1504	0.1191
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.7594	1.8765
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C17	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C29
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Critical Location	=	Bottom Joint

Pu	=	461.19	kN
Mux	=	-27.79	kNm
Muy	=	-18.68	kNm
Vux	=	-11.69	kN
Vuy	=	-17.1	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	11.58	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-27.79	11.58	-27.79	0	-27.79
Minor Axis - Muy	-18.68	---	-18.68	0	-18.68

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	461.19	kN
Mux	=	-27.79	kNm
Muy	=	-18.68	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	33.91	deg
MRes	=	33.49	kNm
MCap	=	115.12	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.29 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-17.1019	-11.6899
Pu (kN)	448	448
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1342	0.1059
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5274	1.6087
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C17	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C29	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	250.36	kN

Mux	=	42.38	kNm
Muy	=	35.69	kNm
Vux	=	-25.76	kN
Vuy	=	-31.62	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	6.28	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	42.38	6.28	42.38	0	42.38
Minor Axis - Muy	35.69	---	35.69	0	35.69

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	250.36	kN
Mux	=	42.38	kNm
Muy	=	35.69	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	40.1	deg
MRes	=	55.41	kNm
MCap	=	97.87	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.57 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-31.6247	-25.7556
Pu (kN)	250.36	250.36
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2482	0.2333
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.2947	1.3402
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.2947	1.3402
Enhanced shear strength, Tc-e (N/sqmm)	0.5215	0.5398
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	

	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C18	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C15	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1040.53	kN
Mux	=	35.77	kNm

Muy	=	-7.37	kNm
Vux	=	4.54	kN
Vuy	=	-22.72	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	20.81	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	35.77	---	35.77	0	35.77
Minor Axis - Muy	-7.37	20.81	-20.81	0	-20.81

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1040.53	kN
Mux	=	35.77	kNm

Muy	=	-20.81	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	30.19	deg
MRes	=	41.38	kNm
MCap	=	90.31	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.46 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-22.7197	4.5403
Pu (kN)	1040.53	1040.53
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1783	0.0411
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.2249	2.4138
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)	0.6041	0.6041
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	
	=	3	mm

Criterion for spacing of normal

links

Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C18	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C15	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	831.22	kN
Mux	=	-76.02	kNm
Muy	=	13.42	kNm
Vux	=	8.67	kN

Vuy	=	-46.48	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	16.62	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-76.02	---	-76.02	0	-76.02
Minor Axis - Muy	13.42	16.62	16.62	0	16.62

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	831.22	kN
Mux	=	-76.02	kNm
Muy	=	16.62	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	12.34	deg
MRes	=	77.82	kNm
MCap	=	124.24	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.63 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-46.4812	8.6665
Pu (kN)	818.02	818.02
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3648	0.0785
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.963	2.1114
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm

Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C18	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C15	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	607.06	kN
Mux	=	-62.86	kNm
Muy	=	11.87	kNm
Vux	=	7.93	kN
Vuy	=	-41.98	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	12.14	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-62.86	---	-62.86	0	-62.86
Minor Axis - Muy	11.87	12.14	12.14	0	12.14

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	607.06	kN
Mux	=	-62.86	kNm
Muy	=	12.14	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	10.93	deg
MRes	=	64.02	kNm
MCap	=	137.64	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.47 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-41.9817	7.9341
Pu (kN)	593.87	593.87
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3295	0.0719
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.6991	1.8069
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C18	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C15	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	382.07	kN
Mux	=	-64.75	kNm
Muy	=	12.52	kNm
Vux	=	8.48	kN
Vuy	=	-41.64	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	9.59	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-64.75	9.59	-64.75	0	-64.75
Minor Axis - Muy	12.52	---	12.52	0	12.52

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	382.07	kN
Mux	=	-64.75	kNm
Muy	=	12.52	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66

Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	10.95	deg
MRes	=	65.95	kNm
MCap	=	135.54	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.49 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-41.6444	8.4824
Pu (kN)	368.88	368.88
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3268	0.0768
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.4342	1.5012
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.4342	1.5
Enhanced shear strength, Tc-e (N/sqmm)	0.5777	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C18	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C15	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	156.19	kN
Mux	=	-69.59	kNm
Muy	=	10.57	kNm
Vux	=	6.22	kN
Vuy	=	-49.94	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	3.92	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-69.59	3.92	-69.59	0	-69.59
Minor Axis - Muy	10.57	---	10.57	0	10.57

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	156.19	kN
Mux	=	-69.59	kNm
Muy	=	10.57	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66
Reinforcement Provided	=	8-T12

Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	8.64	deg
MRes	=	70.38	kNm
MCap	=	117.76	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.6 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-49.9395	6.2191
Pu (kN)	143	143
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3919	0.0563
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1683	1.1943
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1683	1.1943
Enhanced shear strength, Tc-e (N/sqmm)	0.4706	0.481
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C19	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C16	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1648.22	kN
Mux	=	7.38	kNm
Muy	=	-1.5	kNm
Vux	=	-12.72	kN
Vuy	=	2.94	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	32.96	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	0, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	7.38	---	7.38	0	7.38
Minor Axis - Muy	-1.5	32.96	-32.96	0	-32.96

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1648.22	kN
Mux	=	7.38	kNm
Muy	=	-32.96	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.78
Reinforcement Provided	=	4-T20 + 6-T16
Load Angle	=	Tan^{-1}(Muy/Mux)

	=	77.38	deg
MRes	=	33.78	kNm
MCap	=	44.64	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.76 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	21.04	-12.723
Pu (kN)	1615.14	1648.22
Deff , Beff (mm)	550	180
Aeff (sqmm)	126500	108000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1663	0.1178
Pt (%)	0.892	0.892
Design shear strength, Tc (N/sqmm)	0.5974	0.5974
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.9152	3.2892
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)	0.896	0.896
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	
	=	5	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	256	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C19	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C16	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1265.96	kN
Mux	=	61.23	kNm
Muy	=	13.67	kNm
Vux	=	8.16	kN
Vuy	=	39.94	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	25.32	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	61.23	---	61.23	0	61.23
Minor Axis - Muy	13.67	25.32	25.32	0	25.32

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1265.96	kN
Mux	=	61.23	kNm
Muy	=	25.32	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.91	
Reinforcement Provided	=	4-T16 + 4-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	22.46	deg

MRes	=	66.26	kNm
MCap	=	91.43	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.72 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	39.9421	8.1631
Pu (kN)	1252.76	1252.76
Deff , Beff (mm)	552	182
Aeff (sqmm)	126960	109200
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3146	0.0748
Pt (%)	0.455	0.455
Design shear strength, Tc (N/sqmm)	0.4609	0.4609
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.4801	2.7208
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)	0.6913	0.6913
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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C19	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C16	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	924.79	kN
Mux	=	49.98	kNm
Muy	=	8.68	kNm
Vux	=	6.04	kN
Vuy	=	34.65	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30

	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	18.5	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	49.98	---	49.98	0	49.98
Minor Axis - Muy	8.68	18.5	18.5	0	18.5

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	924.79	kN
Mux	=	49.98	kNm
Muy	=	18.5	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	20.31	deg
MRes	=	53.3	kNm
MCap	=	110.57	kNm

Capacity Ratio	=	MRes/ MCap
	=	0.48 <= 1

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	34.6521	6.0428
Pu (kN)	911.59	911.59
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.272	0.0547
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.0731	2.2386
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---

Spacing	175	---	---	175	---

General Data

Column No.	:	C19	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C16	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	583.07	kN
Mux	=	52.47	kNm
Muy	=	9.63	kNm
Vux	=	6.2	kN
Vuy	=	35.12	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	

	=	11.66	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	52.47	---	52.47	0	52.47
Minor Axis - Muy	9.63	11.66	11.66	0	11.66

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	583.07	kN
Mux	=	52.47	kNm
Muy	=	11.66	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	12.53	deg
MRes	=	53.75	kNm
MCap	=	137.09	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.39 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	35.1179	6.2025
Pu (kN)	569.88	569.88
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2756	0.0562
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.6709	1.7743
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C19	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C16	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	243.51	kN
Mux	=	52.18	kNm
Muy	=	12.19	kNm
Vux	=	9.48	kN
Vuy	=	36.44	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	6.11	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)
Column Is Unbraced Along D			
Slenderness Check Along D:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	
Column Is Unbraced Along B			
Slenderness Check Along B:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	52.18	6.11	52.18	0	52.18
Minor Axis - Muy	12.19	---	12.19	0	12.19

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	243.51	kN
Mux	=	52.18	kNm
Muy	=	12.19	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	13.15	deg
MRes	=	53.58	kNm
MCap	=	125.36	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.43 <= 1	

Shear Calculation	Along D	Along B

Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	36.4385	9.4764
Pu (kN)	230.32	230.32
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.286	0.0858
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.2711	1.3129
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.2711	1.3129
Enhanced shear strength, Tc-e (N/sqmm)	0.512	0.5288
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C20	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	750	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	3.26 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C18	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	2068.23	kN
Mux	=	-154.44	kNm
Muy	=	38.83	kNm
Vux	=	-22.87	kN
Vuy	=	82.56	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	41.36	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	3.4, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-154.44	---	-154.44	0	-154.44
Minor Axis - Muy	38.83	41.36	41.36	0	41.36

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	2068.23	kN
Mux	=	-154.44	kNm
Muy	=	41.36	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.92	
Reinforcement Provided	=	8-T20 + 4-T16	
Load Angle	=	$Tan^{-1}(Muy/Mux)$	
	=	14.99	deg
MRes	=	159.88	kNm
MCap	=	193.34	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.83 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	82.561	-22.8691
Pu (kN)	2068.23	2068.23
Deff , Beff (mm)	700	180
Aeff (sqmm)	161000	135000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.5128	0.1694
Pt (%)	0.962	0.962
Design shear strength, Tc (N/sqmm)	0.6138	0.6138
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.9269	3.298
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)	0.9207	0.9207
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	
	=	5	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	256	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C20	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	750	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	3.26 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C18	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1608.93	kN
Mux	=	271.1	kNm
Muy	=	-77.73	kNm
Vux	=	-51.84	kN
Vuy	=	171.42	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	30.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	48.43	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	3.4, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	271.1	48.43	271.1	0	271.1
Minor Axis - Muy	-77.73	---	-77.73	0	-77.73

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1608.93	kN
Mux	=	271.1	kNm
Muy	=	-77.73	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	2.19	
Reinforcement Provided	=	12-T20	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	16	deg
MRes	=	282.02	kNm
MCap	=	288.65	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.98 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	171.4152	-51.8426
Pu (kN)	1595.74	1595.74
Deff , Beff (mm)	700	180
Aeff (sqmm)	161000	135000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	1.0647	0.384
Pt (%)	1.093	1.093
Design shear strength, Tc (N/sqmm)	0.6425	0.6425
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.4867	2.773
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)	0.9638	0.9638
Design shear check	Tv > Tc x Enhancement factor	Tv < Tc x Enhancement factor
Shear Links Design	**Shear Links Required**	**Shear Links Not Required**
Pt %	1.093	-
Shear resisted by concrete Vc (kN)	(Tc-e) x (B x Deff)	-
	155.17	-
Shear to be resisted by shear reinforcement = Vus (kN)	Vu - Vc	
	16.24	-
Area of shear reinforcement required, Asv (sqmm)	(Vus x 1000) / (Deff x 0.87 x Fy)	(Vus x 1000) / (Beff x 0.87 x Fy)
	64.27	-
Master Link Rebar (mm)	8	-
Number of legs provided	2	-
Spacing of links reqd (mm)	1564	-
Spacing of links prvd, Sv (mm)	200	-
Asv Provided (sqmm)	502.65	-

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	
	=	5	mm

Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	320	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C20	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	750	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	3.26 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C18	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1191.36	kN
Mux	=	221.58	kNm
Muy	=	-78.35	kNm

Vux	=	-52.35	kN
Vuy	=	152.33	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	30.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	35.86	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	3.4, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	221.58	35.86	221.58	0	221.58
Minor Axis - Muy	-78.35	---	-78.35	0	-78.35

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1191.36	kN
Mux	=	221.58	kNm

Muy	=	-78.35	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.19	
Reinforcement Provided	=	8-T16 + 4-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	19.47	deg
MRes	=	235.02	kNm
MCap	=	236.37	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.99 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	152.3313	-52.3452
Pu (kN)	1178.17	1178.17
Deff , Beff (mm)	702	182
Aeff (sqmm)	161460	136500
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.9435	0.3835
Pt (%)	0.597	0.597
Design shear strength, Tc (N/sqmm)	0.5132	0.5132
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.0945	2.2947
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)	0.7698	0.7698
Design shear check	Tv > Tc x Enhancement factor	Tv < Tc x Enhancement factor
Shear Links Design	**Shear Links Required**	**Shear Links Not Required**
Pt %	0.597	-
Shear resisted by concrete Vc (kN)	(Tc-e) x (B x Deff)	-
	124.3	-
Shear to be resisted by shear reinforcement = Vus (kN)	Vu - Vc	
	28.04	-
Area of shear reinforcement required,	(Vus x 1000) / (Deff x 0.87 x Fy)	(Vus x 1000) / (Beff x 0.87 x Fy)

Asv (sqmm)		
	110.61	-
Master Link Rebar (mm)	8	-
Number of legs provided	2	-
Spacing of links reqd (mm)	908	-
Spacing of links prvd, Sv (mm)	175	-
Asv Provided (sqmm)	574.46	-

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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C20	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	750	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm

No Of Floors	=	1
No Of Columns In Group	=	1
Column Type	:	UnBraced
Minimum eccentricity check	:	One Axis at a Time
Code defined D/B ratio	:	4
D/B Ratio	:	3.26 <= 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C18	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	779.9	kN
Mux	=	229.58	kNm
Muy	=	-77.75	kNm
Vux	=	-51.37	kN
Vuy	=	148.25	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	30.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	23.47	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	3.4, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

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

	A	B	C	E	F
Major Axis - Mux	229.58	23.47	229.58	0	229.58
Minor Axis - Muy	-77.75	---	-77.75	0	-77.75

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	779.9	kN
Mux	=	229.58	kNm
Muy	=	-77.75	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.99	
Reinforcement Provided	=	4-T16 + 8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	18.71	deg
MRes	=	242.39	kNm
MCap	=	255.93	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.95 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	148.2493	-51.3735
Pu (kN)	766.7	766.7
Deff , Beff (mm)	702	182
Aeff (sqmm)	161460	136500
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.9182	0.3764
Pt (%)	0.495	0.495
Design shear strength, Tc (N/sqmm)	0.4767	0.4767
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.7123	1.8425
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)	0.7151	0.7151
Design shear check	Tv > Tc x Enhancement factor	Tv < Tc x Enhancement factor
Shear Links Design	**Shear Links Required**	**Shear Links Not Required**
Pt %	0.495	-
Shear resisted by concrete Vc (kN)	(Tc-e) x (B x Deff)	-
	115.45	-
Shear to be resisted by shear reinforcement = Vus (kN)	Vu - Vc	
	32.8	-
Area of shear reinforcement required, Asv (sqmm)	(Vus x 1000) / (Deff x 0.87 x Fy)	(Vus x 1000) / (Beff x 0.87 x Fy)
	129.39	-
Master Link Rebar (mm)	8	-
Number of legs provided	2	-
Spacing of links reqd (mm)	776	-
Spacing of links prvd, Sv (mm)	175	-
Asv Provided (sqmm)	574.46	-

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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C20	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	750	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	3.26 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C18	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	366.25	kN
Mux	=	273.91	kNm
Muy	=	-99.18	kNm
Vux	=	-74.28	kN
Vuy	=	212.6	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	30.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	11.02	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	3.4, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	273.91	11.02	273.91	0	273.91
Minor Axis - Muy	-99.18	---	-99.18	0	-99.18

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	366.25	kN
Mux	=	273.91	kNm
Muy	=	-99.18	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.66	
Reinforcement Provided	=	4-T20 + 8-T16	
Load Angle	=	$Tan^{-1}(Muy/Mux)$	
	=	19.9	deg
MRes	=	291.31	kNm
MCap	=	334.21	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.87 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	212.6032	-74.2791
Pu (kN)	353.06	353.06
Deff , Beff (mm)	700	180
Aeff (sqmm)	161000	135000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	1.3205	0.5502
Pt (%)	0.83	0.83
Design shear strength, Tc (N/sqmm)	0.5817	0.5817
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3289	1.3923
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3289	1.3923
Enhanced shear strength, Tc-e (N/sqmm)	0.7731	0.8099
Design shear check	Tv > Tc x Enhancement factor	Tv < Tc x Enhancement factor
Shear Links Design	**Shear Links Required**	**Shear Links Not Required**
Pt %	0.83	-
Shear resisted by concrete Vc (kN)	(Tc-e) x (B x Deff)	-
	122.41	-
Shear to be resisted by shear reinforcement = Vus (kN)	Vu - Vc	
	90.19	-
Area of shear reinforcement required, Asv (sqmm)	(Vus x 1000) / (Deff x 0.87 x Fy)	(Vus x 1000) / (Beff x 0.87 x Fy)
	356.86	-
Master Link Rebar (mm)	8	-
Number of legs provided	2	-
Spacing of links reqd (mm)	281	-
Spacing of links prvd, Sv (mm)	200	-
Asv Provided (sqmm)	502.65	-

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	
	=	5	mm

Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	256	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C21	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C30	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	827.58	kN
Mux	=	-27.03	kNm
Muy	=	-8.81	kNm

Vux	=	5.75	kN
Vuy	=	16.98	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	16.55	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-27.03	---	-27.03	0	-27.03
Minor Axis - Muy	-8.81	16.55	-16.55	0	-16.55

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	827.58	kN
Mux	=	-27.03	kNm
Muy	=	-16.55	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	31.48	deg
MRes	=	31.69	kNm
MCap	=	107.64	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.29 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	16.9786	-48.215
Pu (kN)	827.58	860.02
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1332	0.4367
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.9742	2.1685
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)	0.6041	0.6041
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	
	=	3	mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C21	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C30	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	684.1	kN
Mux	=	55.91	kNm
Muy	=	14.08	kNm
Vux	=	7.44	kN
Vuy	=	36	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	17.17	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	55.91	17.17	55.91	0	55.91
Minor Axis - Muy	14.08	---	14.08	0	14.08

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	684.1	kN
Mux	=	55.91	kNm
Muy	=	14.08	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	14.14	deg
MRes	=	57.66	kNm
MCap	=	132.54	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.44 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	35.9955	7.4415
Pu (kN)	670.91	670.91
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2825	0.0674
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.7898	1.9116
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm

Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C21	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C30	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	509.21	kN
Mux	=	48.47	kNm
Muy	=	4.21	kNm
Vux	=	2.91	kN
Vuy	=	32.45	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	10.18	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	48.47	---	48.47	0	48.47
Minor Axis - Muy	4.21	10.18	10.18	0	10.18

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	509.21	kN
Mux	=	48.47	kNm
Muy	=	10.18	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	11.87	deg
MRes	=	49.53	kNm
MCap	=	137.71	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.36 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	32.4451	2.9068
Pu (kN)	496.02	496.02
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2546	0.0263
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5839	1.6739
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C21	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C30	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	331.04	kN
Mux	=	44.92	kNm
Muy	=	1.74	kNm
Vux	=	-0.17	kN
Vuy	=	28.38	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	6.62	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	44.92	---	44.92	0	44.92
Minor Axis - Muy	1.74	6.62	6.62	0	6.62

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	331.04	kN
Mux	=	44.92	kNm
Muy	=	6.62	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66
Reinforcement Provided	=	8-T12

Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	8.38	deg
MRes	=	45.41	kNm
MCap	=	134.54	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.34 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	28.3802	-0.1655
Pu (kN)	317.85	317.85
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2227	0.0015
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3742	1.4319
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3742	1.4319
Enhanced shear strength, Tc-e (N/sqmm)	0.5535	0.5767
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C21	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C30	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	130.91	kN
Mux	=	-62.59	kNm
Muy	=	-13.53	kNm
Vux	=	7.65	kN
Vuy	=	46.81	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	3.29	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-62.59	3.29	-62.59	0	-62.59
Minor Axis - Muy	-13.53	---	-13.53	0	-13.53

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	130.91	kN
Mux	=	-62.59	kNm
Muy	=	-13.53	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66
Reinforcement Provided	=	8-T12

Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	12.19	deg
MRes	=	64.03	kNm
MCap	=	113.29	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.57 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	46.8124	7.6467
Pu (kN)	130.91	130.91
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3674	0.0693
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1541	1.1779
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1541	1.1779
Enhanced shear strength, Tc-e (N/sqmm)	0.4648	0.4744
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C22	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C20	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1086.73	kN
Mux	=	36.4	kNm
Muy	=	6.21	kNm
Vux	=	-3.85	kN
Vuy	=	-22.23	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	21.73	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	36.4	---	36.4	0	36.4
Minor Axis - Muy	6.21	21.73	21.73	0	21.73

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1086.73	kN
Mux	=	36.4	kNm
Muy	=	21.73	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66
Reinforcement Provided	=	8-T12
Load Angle	=	Tan^{-1}(Muy/Mux)

	=	30.84	deg
MRes	=	42.4	kNm
MCap	=	84.24	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.5 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-22.2258	-3.8531
Pu (kN)	1086.73	1086.73
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1744	0.0349
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.2793	2.4765
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C22	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C20	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	868.87	kN
Mux	=	-75.82	kNm
Muy	=	-11.79	kNm
Vux	=	-7.59	kN
Vuy	=	-46.65	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	17.38	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-75.82	---	-75.82	0	-75.82
Minor Axis - Muy	-11.79	17.38	-17.38	0	-17.38

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	868.87	kN
Mux	=	-75.82	kNm
Muy	=	-17.38	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	12.91	deg

MRes	=	77.79	kNm
MCap	=	120.73	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.64 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-46.6476	-7.5871
Pu (kN)	855.68	855.68
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3661	0.0687
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.0073	2.1626
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C22	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C20	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	635.39	kN
Mux	=	-64.82	kNm
Muy	=	-10.15	kNm
Vux	=	-6.78	kN
Vuy	=	-43.06	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30

	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	12.71	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-64.82	---	-64.82	0	-64.82
Minor Axis - Muy	-10.15	12.71	-12.71	0	-12.71

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	635.39	kN
Mux	=	-64.82	kNm
Muy	=	-12.71	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	11.09	deg
MRes	=	66.05	kNm
MCap	=	136.76	kNm

Capacity Ratio	=	MRes/ MCap
	=	0.48 <= 1

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-43.0564	-6.7841
Pu (kN)	622.2	622.2
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3379	0.0614
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.7325	1.8454
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---

Spacing	175	---	---	175	---

General Data

Column No.	:	C22	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C20	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	401.1	kN
Mux	=	-66.47	kNm
Muy	=	-10.47	kNm
Vux	=	-7.1	kN
Vuy	=	-43.06	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm

Mminx	=	Pu x Minimum Eccentricity	
	=	10.07	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-66.47	10.07	-66.47	0	-66.47
Minor Axis - Muy	-10.47	---	-10.47	0	-10.47

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	401.1	kN
Mux	=	-66.47	kNm
Muy	=	-10.47	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	8.95	deg
MRes	=	67.29	kNm
MCap	=	137.2	kNm
Capacity Ratio	=	MRes/ MCap	

= 0.49 <= 1

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-43.0616	-7.1013
Pu (kN)	387.91	387.91
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3379	0.0643
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.4567	1.5271
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.4567	1.5
Enhanced shear strength, Tc-e (N/sqmm)	0.5867	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C22	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C20	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	165.45	kN
Mux	=	-70.55	kNm
Muy	=	-8.55	kNm
Vux	=	-4.67	kN
Vuy	=	-50.49	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	

	=	4.15	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-70.55	4.15	-70.55	0	-70.55
Minor Axis - Muy	-8.55	---	-8.55	0	-8.55

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	165.45	kN
Mux	=	-70.55	kNm
Muy	=	-8.55	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	6.91	deg
MRes	=	71.06	kNm
MCap	=	119.54	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.59 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-50.4862	-4.6739
Pu (kN)	152.25	152.25
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3962	0.0423
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1792	1.2069
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1792	1.2069
Enhanced shear strength, Tc-e (N/sqmm)	0.475	0.4861
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C23	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C19	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	2121.03	kN
Mux	=	-10.11	kNm
Muy	=	-9.28	kNm
Vux	=	-10.76	kN
Vuy	=	-12.46	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	42.42	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-10.11	---	-10.11	0	-10.11
Minor Axis - Muy	-9.28	42.42	-42.42	0	-42.42

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	2121.03	kN
Mux	=	-10.11	kNm
Muy	=	-42.42	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	2.79	
Reinforcement Provided	=	4-T25 + 6-T20	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	76.6	deg
MRes	=	43.61	kNm
MCap	=	50.65	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.86 <= 1	

Shear Calculation	Along D	Along B
Critical Load	[1] : 1.5 (Dead) +1.5	[1] : 1.5 (Dead) +1.5

Combination	(SIDL) +1.5 (Live)	(SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-12.956	-10.763
Pu (kN)	2135.35	2107.84
Deff , Beff (mm)	547.5	177.5
Aeff (sqmm)	125925	106500
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1029	0.1011
Pt (%)	1.394	1.394
Design shear strength, Tc (N/sqmm)	0.6989	0.6989
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	3.5436	3.9688
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)	1.0483	1.0483
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	
	=	6.25	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	320	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C23	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C19	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1606.09	kN
Mux	=	-44.15	kNm
Muy	=	-30.47	kNm
Vux	=	-18.31	kN
Vuy	=	-23.61	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	32.12	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-44.15	---	-44.15	0	-44.15
Minor Axis - Muy	-30.47	32.12	-32.12	0	-32.12

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1606.09	kN
Mux	=	-44.15	kNm
Muy	=	-32.12	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.33	
Reinforcement Provided	=	8-T16 + 2-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	36.04	deg
MRes	=	54.6	kNm
MCap	=	60.53	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.9 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-23.6116	-18.3079

Pu (kN)	1592.9	1592.9
Deff , Beff (mm)	552	182
Aeff (sqmm)	126960	109200
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.186	0.1677
Pt (%)	0.665	0.665
Design shear strength, Tc (N/sqmm)	0.5349	0.5349
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.882	3.1881
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)	0.8023	0.8023
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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C23
Level	:	GROUND To FIRST

Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C19	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1160.64	kN
Mux	=	-23.14	kNm
Muy	=	-19.88	kNm
Vux	=	-13.67	kN
Vuy	=	-15.69	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	23.21	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-23.14	---	-23.14	0	-23.14
Minor Axis - Muy	-19.88	23.21	-23.21	0	-23.21

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1160.64	kN
Mux	=	-23.14	kNm
Muy	=	-23.21	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	45.09	deg
MRes	=	32.78	kNm
MCap	=	62.71	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.52 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-15.6942	-13.6734
Pu (kN)	1147.45	1147.45
Deff , Beff (mm)	554	184

Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1232	0.1239
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.3508	2.559
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C23
Level	:	FIRST To SECOND
Frame Type	=	Non-Ductile
Response Reduction Factor	=	3

Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C19	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	715.91	kN
Mux	=	-28.38	kNm
Muy	=	-21.1	kNm
Vux	=	-13.67	kN
Vuy	=	-18.11	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	17.97	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	

Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-28.38	17.97	-28.38	0	-28.38
Minor Axis - Muy	-21.1	---	-21.1	0	-21.1

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	715.91	kN
Mux	=	-28.38	kNm
Muy	=	-21.1	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	36.63	deg
MRes	=	35.36	kNm
MCap	=	107.43	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.33 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-18.1123	-13.6692
Pu (kN)	702.72	702.72
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400

Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1421	0.1238
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.8273	1.9548
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C23
Level	:	SECOND To THIRD
Frame Type	=	Non-Ductile
Response Reduction Factor	=	3
Design Code	=	IS 456 : 2000 + IS 13920 : 2016

Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C19	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	271.92	kN
Mux	=	-29.86	kNm
Muy	=	-22.92	kNm
Vux	=	-16.63	kN
Vuy	=	-21.32	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	6.83	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D

	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-29.86	6.83	-29.86	0	-29.86
Minor Axis - Muy	-22.92	---	-22.92	0	-22.92

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	271.92	kN
Mux	=	-29.86	kNm
Muy	=	-22.92	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	37.51	deg
MRes	=	37.65	kNm
MCap	=	102.82	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.37 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-21.3223	-16.6344
Pu (kN)	258.73	258.73
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)

Tv (N/sqmm)	0.1673	0.1507
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3046	1.3515
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3046	1.3515
Enhanced shear strength, Tc-e (N/sqmm)	0.5254	0.5443
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C24	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm

Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3000	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C32	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	522.34	kN
Mux	=	2.7	kNm
Muy	=	3.33	kNm
Vux	=	4.21	kN
Vuy	=	0.11	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	13.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	10.45	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	13.04	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	13.04, Column Slender Along B	
Slenderness moment along B	=	(Pu B/ 2000) (Ley/B)^2	
	=	10.22	kNm
Design slenderness moment along B			
Puz	=	1573.16	kN
Pb	=	507.91	kN
Reduction factor 'k' for slenderness moment	=	(Puz - Pu) / (Puz - Pb) < = 1	
	=	0.99 < = 1, Hence k=0.99	
MsIndy	=	k x 10.22	
	=	10.08	kNm

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	MsIndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	2.7	---	2.7	0	2.7
Minor Axis - Muy	3.33	10.45	10.45	10.08	20.53

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	522.34	kN
Mux	=	2.7	kNm
Muy	=	20.53	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	82.51	deg
MRes	=	20.7	kNm
MCap	=	53.32	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.39 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	11.4461	4.2146
Pu (kN)	535.19	509.15
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0898	0.0382
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.63	1.6918
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C24	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3000	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C32	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	424.57	kN
Mux	=	1.82	kNm
Muy	=	13.78	kNm
Vux	=	7.75	kN
Vuy	=	1.41	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	13.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	8.49	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	13.04	
	<	60	(Hence Ok)
Column Is Unbraced Along D			
Slenderness Check Along D:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	
Column Is Unbraced Along B			
Slenderness Check Along B:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	13.04, Column Slender Along B	
Slenderness moment along B	=	(Pu B/ 2000) (Ley/B)^2	
	=	8.31	kNm
Design slenderness moment along B			
Puz	=	1573.16	kN
Pb	=	507.91	kN
Reduction factor 'k' for slenderness moment	=	(Puz - Pu) / (Puz - Pb) < = 1	
	=	1.08 > = 1, Hence k=1	
Mslndy	=	k x 8.31	
	=	8.31	kNm

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	1.82	---	1.82	0	1.82
Minor Axis - Muy	13.78	8.49	13.78	8.31	22.09

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	424.57	kN
Mux	=	1.82	kNm
Muy	=	22.09	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66

Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	85.28	deg
MRes	=	22.16	kNm
MCap	=	53.68	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.41 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	1.4069	7.7519
Pu (kN)	411.38	411.38
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.011	0.0702
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.4843	1.5589
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.4843	1.5
Enhanced shear strength, Tc-e (N/sqmm)	0.5978	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C24	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3000	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C32	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	317.25	kN
Mux	=	1.9	kNm
Muy	=	7.06	kNm
Vux	=	4.74	kN
Vuy	=	1.11	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	13.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	6.34	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	13.04	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	13.04, Column Slender Along B	
Slenderness moment along B	=	(Pu B/ 2000) (Ley/B)^2	
	=	6.21	kNm

Design slenderness moment along B

Puz	=	1573.16	kN
Pb	=	507.91	kN
Reduction factor 'k' for slenderness moment	=	(Puz - Pu) / (Puz - Pb) < = 1	
	=	1.18 > = 1, Hence k=1	
MsIndy	=	k x 6.21	
	=	6.21	kNm

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	MsIndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	1.9	---	1.9	0	1.9
Minor Axis - Muy	7.06	6.34	7.06	6.21	13.27

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	317.25	kN
Mux	=	1.9	kNm
Muy	=	13.27	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	81.86	deg
MRes	=	13.41	kNm
MCap	=	51.36	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.26 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	1.1123	4.7423
Pu (kN)	304.05	304.05
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0087	0.043
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3579	1.4131
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3579	1.4131
Enhanced shear strength, Tc-e (N/sqmm)	0.5469	0.5692
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C24	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3000	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C32	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	204.44	kN

Mux	=	2.62	kNm
Muy	=	6.13	kNm
Vux	=	3.45	kN
Vuy	=	2.34	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	13.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	4.09	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	13.04	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	13.04, Column Slender Along B	
Slenderness moment along B	=	(Pu B/ 2000) (Ley/B)^2	
	=	4	kNm

Design slenderness moment along B

Puz	=	1573.16	kN
Pb	=	507.91	kN
Reduction factor 'k' for slenderness moment	=	(Puz - Pu) / (Puz - Pb) < = 1	
	=	1.28 > = 1, Hence k=1	
Mslndy	=	k x 4	
	=	4	kNm

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	2.62	---	2.62	0	2.62
Minor Axis - Muy	6.13	4.09	6.13	4	10.13

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	204.44	kN
Mux	=	2.62	kNm
Muy	=	10.13	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	75.51	deg
MRes	=	10.46	kNm
MCap	=	50.04	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.21 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	2.3447	3.4505
Pu (kN)	191.25	191.25
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0184	0.0313
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.2251	1.2599
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.2251	1.2599
Enhanced shear strength, Tc-e (N/sqmm)	0.4934	0.5074

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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C24	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3000	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C32	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	89.98	kN
Mux	=	-1.61	kNm
Muy	=	8.58	kNm
Vux	=	7.45	kN
Vuy	=	-2.75	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	13.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	1.8	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	13.04	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	13.04, Column Slender Along B	
Slenderness moment along B	=	(Pu B/ 2000) (Ley/B)^2	
	=	1.76	kNm

Design slenderness moment along B

Puz	=	1573.16	kN
Pb	=	507.91	kN
Reduction factor 'k' for slenderness moment	=	(Puz - Pu) / (Puz - Pb) < = 1	
	=	1.39 > = 1, Hence k=1	
MsIndy	=	k x 1.76	
	=	1.76	kNm

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-1.61	---	-1.61	0	-1.61
Minor Axis - Muy	8.58	1.8	8.58	1.76	10.34

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	89.98	kN
Mux	=	-1.61	kNm
Muy	=	10.34	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	81.17	deg
MRes	=	10.47	kNm
MCap	=	41.87	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.25 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-2.7503	7.451
Pu (kN)	76.79	76.79
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0216	0.0675
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.0904	1.1043
Shear Strength Enhancement Factor	-	-

(Tensile Force)		
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.0904	1.1043
Enhanced shear strength, Tc-e (N/sqmm)	0.4392	0.4448
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C25	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm

Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C21	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1180.77	kN
Mux	=	52.75	kNm
Muy	=	-2.1	kNm
Vux	=	1.36	kN
Vuy	=	-30.89	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	23.62	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

				Mslndx	**Mdesign-**

Direction	Manalysis	Mmin (Abs)	Mdesign	(Abs)	final
	A	B	C	E	F
Major Axis - Mux	52.75	---	52.75	0	52.75
Minor Axis - Muy	-2.1	23.62	-23.62	0	-23.62

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1180.77	kN
Mux	=	52.75	kNm
Muy	=	-23.62	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	24.12	deg
MRes	=	57.8	kNm
MCap	=	76.39	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.76 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-30.8943	1.3626
Pu (kN)	1180.77	1180.77
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2425	0.0123
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.39	2.6043
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength	1.5	1.5

Enhancement Factor (max)		
Shear Strength Enhancement Factor	1.5	1.5
Enhanced shear strength, Tc-e (N/sqmm)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C25	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm

No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C21	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	946.32	kN
Mux	=	-102	kNm
Muy	=	3.4	kNm
Vux	=	2.17	kN
Vuy	=	-63.08	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	18.93	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F

Major Axis - Mux	-102	---	-102	0	-102
Minor Axis - Muy	3.4	18.93	18.93	0	18.93

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	946.32	kN
Mux	=	-102	kNm
Muy	=	18.93	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	$Tan^{-1}(Muy/Mux)$	
	=	10.51	deg
MRes	=	103.74	kNm
MCap	=	114.65	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.9 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-63.0792	2.1749
Pu (kN)	933.12	933.12
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.495	0.0197
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.0985	2.2678
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength	1.5	1.5

Enhancement Factor		
Enhanced shear strength, Tc-e (N/sqmm)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C25	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	

Column Type	:	UnBraced
Minimum eccentricity check	:	One Axis at a Time
Code defined D/B ratio	:	4
D/B Ratio	:	2.61 <= 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C21	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	697.44	kN
Mux	=	-86.83	kNm
Muy	=	2.98	kNm
Vux	=	2.01	kN
Vuy	=	-57.89	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	13.95	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-86.83	---	-86.83	0	-86.83
Minor Axis - Muy	2.98	13.95	13.95	0	13.95

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	697.44	kN
Mux	=	-86.83	kNm
Muy	=	13.95	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	9.13	deg
MRes	=	87.95	kNm
MCap	=	135.02	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.65 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-57.8894	2.0069
Pu (kN)	684.25	684.25
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.4543	0.0182
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.8055	1.9297
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	0.6041	0.6041

strength, Tc-e (N/sqmm)		
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C25	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	

Code defined D/B ratio	:	4
D/B Ratio	:	2.61 <= 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C21	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	448.01	kN
Mux	=	-88.97	kNm
Muy	=	2.98	kNm
Vux	=	1.9	kN
Vuy	=	-57.81	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	8.96	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-88.97	---	-88.97	0	-88.97
Minor Axis - Muy	2.98	8.96	8.96	0	8.96

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	448.01	kN
Mux	=	-88.97	kNm
Muy	=	8.96	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	5.75	deg
MRes	=	89.42	kNm
MCap	=	140.06	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.64 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-57.8143	1.8973
Pu (kN)	434.82	434.82
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.4537	0.0172
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5119	1.5908
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)	0.6041	0.6041

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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C25	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C21	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	198.61	kN
Mux	=	-93.04	kNm
Muy	=	3.95	kNm
Vux	=	3.25	kN
Vuy	=	-66.52	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	4.99	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-93.04	4.99	-93.04	0	-93.04
Minor Axis - Muy	3.95	---	3.95	0	3.95

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	198.61	kN
Mux	=	-93.04	kNm
Muy	=	3.95	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	2.44	deg
MRes	=	93.12	kNm
MCap	=	124.65	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.75 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-66.5178	3.2548
Pu (kN)	185.41	185.41
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.522	0.0295
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.2183	1.2519
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.2183	1.2519
Enhanced shear strength, Tc-e (N/sqmm)	0.4907	0.5042
Design shear check	Tv > Tc x Enhancement factor	Tv < Tc x Enhancement factor

Shear Links Design	Shear Links Required	Shear Links Not Required
Pt %	0.328	-
Shear resisted by concrete Vc (kN)	(Tc-e) x (B x Deff)	-
	61.66	-
Shear to be resisted by shear reinforcement = Vus (kN)	Vu - Vc	
	4.86	-
Area of shear reinforcement required, Asv (sqmm)	(Vus x 1000) / (Deff x 0.87 x Fy)	(Vus x 1000) / (Beff x 0.87 x Fy)
	24.27	-
Master Link Rebar (mm)	8	-
Number of legs provided	2	-
Spacing of links reqd (mm)	4141	-
Spacing of links prvd, Sv (mm)	175	-
Asv Provided (sqmm)	574.46	-

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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C26
Level	:	Base To STILT
Frame Type	=	Non-Ductile
Response Reduction Factor	=	3
Design Code	=	IS 456 : 2000 + IS 13920 : 2016

Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C22	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	2054.01	kN
Mux	=	-7.2	kNm
Muy	=	0.72	kNm
Vux	=	-5.56	kN
Vuy	=	-3.18	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	41.08	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	0, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-7.2	---	-7.2	0	-7.2
Minor Axis - Muy	0.72	41.08	41.08	0	41.08

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	2054.01	kN
Mux	=	-7.2	kNm
Muy	=	41.08	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	2.79	
Reinforcement Provided	=	4-T25 + 6-T20	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	80.05	deg
MRes	=	41.71	kNm
MCap	=	52.05	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.8 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-6.1779	7.1204
Pu (kN)	2018.78	2018.78
Deff , Beff (mm)	547.5	177.5
Aeff (sqmm)	125925	106500
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0491	0.0669

Pt (%)	1.394	1.394
Design shear strength, Tc (N/sqmm)	0.6989	0.6989
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	3.4047	3.8434
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)	1.0483	1.0483
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	
	=	6.25	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	320	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C26	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm

Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C22	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1572.89	kN
Mux	=	12.02	kNm
Muy	=	-12.97	kNm
Vux	=	13.38	kN
Vuy	=	-13.98	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	31.46	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	12.02	---	12.02	0	12.02
Minor Axis - Muy	-12.97	31.46	-31.46	0	-31.46

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1572.89	kN
Mux	=	12.02	kNm
Muy	=	-31.46	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.33	
Reinforcement Provided	=	8-T16 + 2-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	69.08	deg
MRes	=	33.68	kNm
MCap	=	38.35	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.88 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-13.9789	13.3756
Pu (kN)	1572.89	1572.89
Deff , Beff (mm)	552	182
Aeff (sqmm)	126960	109200
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1101	0.1225
Pt (%)	0.665	0.665
Design shear strength,	0.5349	0.5349

Tc (N/sqmm)		
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.8583	3.1606
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)	0.8023	0.8023
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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C26	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm

Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C22	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1131.98	kN
Mux	=	13.97	kNm
Muy	=	-12.24	kNm
Vux	=	11.51	kN
Vuy	=	-14.64	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	22.64	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	

Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	13.97	---	13.97	0	13.97
Minor Axis - Muy	-12.24	22.64	-22.64	0	-22.64

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1131.98	kN
Mux	=	13.97	kNm
Muy	=	-22.64	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	58.33	deg
MRes	=	26.6	kNm
MCap	=	52.63	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.51 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-14.6374	11.514
Pu (kN)	1131.98	1131.98
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1149	0.1043
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength	1 + 3 x Pu / (B x D x Fck)	

Enhancement Factor (Compressive Force)		
	2.3326	2.538
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C26	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm

Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C22	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	705.18	kN
Mux	=	-24.25	kNm
Muy	=	17.4	kNm
Vux	=	11.45	kN
Vuy	=	-16.21	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	17.7	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	

= 11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-24.25	17.7	-24.25	0	-24.25
Minor Axis - Muy	17.4	---	17.4	0	17.4

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	705.18	kN
Mux	=	-24.25	kNm
Muy	=	17.4	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	35.66	deg
MRes	=	29.85	kNm
MCap	=	109.18	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.27 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-16.208	11.4495
Pu (kN)	691.99	691.99
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1272	0.1037
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	

	1.8146	1.9402
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C26	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm

Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C22	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	265.81	kN
Mux	=	-22.67	kNm
Muy	=	17.29	kNm
Vux	=	11.91	kN
Vuy	=	-13.83	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	6.67	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-22.67	6.67	-22.67	0	-22.67
Minor Axis - Muy	17.29	---	17.29	0	17.29

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	265.81	kN
Mux	=	-22.67	kNm
Muy	=	17.29	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	37.33	deg
MRes	=	28.51	kNm
MCap	=	102.68	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.28 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-13.835	11.9113
Pu (kN)	252.62	252.62
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1086	0.1079
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.2974	1.3432

Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.2974	1.3432
Enhanced shear strength, Tc-e (N/sqmm)	0.5225	0.541
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C27	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm

Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C27	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1832.91	kN
Mux	=	-5.04	kNm
Muy	=	-17.66	kNm
Vux	=	-19.6	kN
Vuy	=	-10.63	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	36.66	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-5.04	---	-5.04	0	-5.04
Minor Axis - Muy	-17.66	36.66	-36.66	0	-36.66

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1832.91	kN
Mux	=	-5.04	kNm
Muy	=	-36.66	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	2.11	
Reinforcement Provided	=	8-T20 + 2-T16	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	82.17	deg
MRes	=	37	kNm
MCap	=	41.49	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.89 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-10.6325	20.3971
Pu (kN)	1819.71	1854.65
Deff , Beff (mm)	550	180
Aeff (sqmm)	126500	108000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0841	0.1889
Pt (%)	1.056	1.056
Design shear strength, Tc (N/sqmm)	0.6349	0.6349
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	3.1578	3.5759
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)	0.9523	0.9523
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	
	=	5	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	256	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C27	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm

Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C27	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1426.06	kN
Mux	=	-34.05	kNm
Muy	=	-61.36	kNm
Vux	=	-40.54	kN
Vuy	=	-20.26	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	28.52	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

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

	A	B	C	E	F
Major Axis - Mux	-34.05	---	-34.05	0	-34.05
Minor Axis - Muy	-61.36	28.52	-61.36	0	-61.36

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1426.06	kN
Mux	=	-34.05	kNm
Muy	=	-61.36	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.78	
Reinforcement Provided	=	4-T20 + 6-T16	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	60.97	deg
MRes	=	70.18	kNm
MCap	=	80.12	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.88 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-20.2604	-40.5357
Pu (kN)	1412.87	1412.87
Deff , Beff (mm)	550	180
Aeff (sqmm)	126500	108000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1602	0.3753
Pt (%)	0.892	0.892
Design shear strength, Tc (N/sqmm)	0.5974	0.5974
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.6753	2.9623
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)	0.896	0.896
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	
	=	5	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	256	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	200	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	200	---	---	200	---

General Data

Column No.	:	C27	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	

Column Type	:	UnBraced
Minimum eccentricity check	:	One Axis at a Time
Code defined D/B ratio	:	4
D/B Ratio	:	2.61 <= 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C27	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1030.76	kN
Mux	=	-21.57	kNm
Muy	=	-57.97	kNm
Vux	=	-38.89	kN
Vuy	=	-14.41	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	20.62	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-21.57	---	-21.57	0	-21.57
Minor Axis - Muy	-57.97	20.62	-57.97	0	-57.97

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1030.76	kN
Mux	=	-21.57	kNm
Muy	=	-57.97	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.07	
Reinforcement Provided	=	4-T16 + 6-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	69.59	deg
MRes	=	61.85	kNm
MCap	=	62.57	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.99 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-14.4078	-38.8875
Pu (kN)	1017.57	1017.57
Deff , Beff (mm)	552	182
Aeff (sqmm)	126960	109200
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1135	0.3561
Pt (%)	0.537	0.537
Design shear strength, Tc (N/sqmm)	0.4923	0.4923
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.2022	2.3978
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	0.7385	0.7385

strength, Tc-e (N/sqmm)		
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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C27	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	

Code defined D/B ratio	:	4
D/B Ratio	:	2.61 <= 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C27	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	637.17	kN
Mux	=	-27.47	kNm
Muy	=	-59.39	kNm
Vux	=	-39.91	kN
Vuy	=	-20.89	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	15.99	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-27.47	15.99	-27.47	0	-27.47
Minor Axis - Muy	-59.39	---	-59.39	0	-59.39

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	637.17	kN
Mux	=	-27.47	kNm
Muy	=	-59.39	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.82	
Reinforcement Provided	=	10-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	65.18	deg
MRes	=	65.44	kNm
MCap	=	69.71	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.94 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-20.8901	-39.9074
Pu (kN)	623.98	623.98
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1639	0.3615
Pt (%)	0.41	0.41
Design shear strength, Tc (N/sqmm)	0.4416	0.4416
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.7346	1.8478
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	0.6624	0.6624

(N/sqmm)		
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C27	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	

D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C27	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	243.15	kN
Mux	=	-9.88	kNm
Muy	=	-53.78	kNm
Vux	=	-33.43	kN
Vuy	=	6.82	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	6.1	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-9.88	6.1	-9.88	0	-9.88
Minor Axis - Muy	-53.78	---	-53.78	0	-53.78

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	243.15	kN
Mux	=	-9.88	kNm
Muy	=	-53.78	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.91	
Reinforcement Provided	=	4-T16 + 4-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	79.59	deg
MRes	=	54.68	kNm
MCap	=	58.19	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.94 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	6.8221	-33.433
Pu (kN)	229.96	229.96
Deff , Beff (mm)	552	182
Aeff (sqmm)	126960	109200
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0537	0.3062
Pt (%)	0.455	0.455
Design shear strength, Tc (N/sqmm)	0.4609	0.4609
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.2717	1.3159
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.2717	1.3159
Enhanced shear strength, Tc-e (N/sqmm)	0.5861	0.6064

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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C28	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3000	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C28	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	938.53	kN
Mux	=	16.13	kNm
Muy	=	3.54	kNm
Vux	=	4.2	kN
Vuy	=	17.07	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	13.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	18.77	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	13.04	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	13.04, Column Slender Along B	
Slenderness moment along B	=	(Pu B/ 2000) (Ley/B)^2	
	=	18.36	kNm

Design slenderness moment along B

Puz	=	1573.16	kN
Pb	=	507.91	kN
Reduction factor 'k' for slenderness moment	=	(Puz - Pu) / (Puz - Pb) < = 1	
	=	0.6 < = 1, Hence k=0.6	
MslIndy	=	k x 18.36	
	=	10.94	kNm

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	16.13	---	16.13	0	16.13
Minor Axis - Muy	3.54	18.77	18.77	10.94	29.71

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	938.53	kN
Mux	=	16.13	kNm
Muy	=	29.71	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	61.5	deg
MRes	=	33.81	kNm
MCap	=	61.52	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.55 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	17.0694	-19.0627
Pu (kN)	925.33	959.33
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.134	0.1727
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.0893	2.3034
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C28	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm

Clear Floor Height @ B	=	3000	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C28	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	736.21	kN
Mux	=	56.12	kNm
Muy	=	13.76	kNm
Vux	=	8.26	kN
Vuy	=	35.72	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	13.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	14.72	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	13.04	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	13.04, Column Slender Along B	
Slenderness moment along B	=	(Pu B/ 2000) (Ley/B)^2	
	=	14.4	kNm

Design slenderness moment along B

Puz	=	1573.16	kN
Pb	=	507.91	kN
Reduction factor 'k' for slenderness moment	=	(Puz - Pu) / (Puz - Pb) < = 1	
	=	0.79 < = 1, Hence k=0.79	
MsIndy	=	k x 14.4	
	=	11.32	kNm

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	56.12	---	56.12	0	56.12
Minor Axis - Muy	13.76	14.72	14.72	11.32	26.04

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	736.21	kN
Mux	=	56.12	kNm
Muy	=	26.04	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	24.89	deg
MRes	=	61.87	kNm
MCap	=	120.33	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.51 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	35.7247	8.2632
Pu (kN)	723.02	723.02
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400

Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2804	0.0748
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.8511	1.9824
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C28
Level	:	GROUND To FIRST
Frame Type	=	Non-Ductile
Response Reduction Factor	=	3
Design Code	=	IS 456 : 2000 + IS 13920 : 2016

Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3000	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C28	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	535.14	kN
Mux	=	47.79	kNm
Muy	=	10.12	kNm
Vux	=	6.71	kN
Vuy	=	32.58	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	13.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	10.7	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	13.04	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	13.04, Column Slender Along B	
Slenderness moment along B	=	(Pu B/ 2000) (Ley/B)^2	
	=	10.47	kNm
Design slenderness moment along B			
Puz	=	1573.16	kN
Pb	=	507.91	kN
Reduction factor 'k' for slenderness moment	=	(Puz - Pu) / (Puz - Pb) < = 1	
	=	0.97 < = 1, Hence k=0.97	
MsIndy	=	k x 10.47	
	=	10.2	kNm

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	MsIndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	47.79	---	47.79	0	47.79
Minor Axis - Muy	10.12	10.7	10.7	10.2	20.91

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	535.14	kN
Mux	=	47.79	kNm
Muy	=	20.91	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	23.63	deg
MRes	=	52.16	kNm
MCap	=	128.02	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.41 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	32.5753	6.7085
Pu (kN)	521.95	521.95
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2557	0.0608
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.6144	1.7092
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C28	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3000	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C28	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	336.19	kN
Mux	=	51.35	kNm
Muy	=	11.04	kNm
Vux	=	7.44	kN
Vuy	=	33.99	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	8.44	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	13.04	
	<	60	(Hence Ok)
Column Is Unbraced Along D			
Slenderness Check Along D:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	
Column Is Unbraced Along B			
Slenderness Check Along B:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	13.04, Column Slender Along B	
Slenderness moment along B	=	(Pu B/ 2000) (Ley/B)^2	
	=	6.58	kNm
Design slenderness moment along B			
Puz	=	1573.16	kN
Pb	=	507.91	kN
Reduction factor 'k' for slenderness moment	=	(Puz - Pu) / (Puz - Pb) < = 1	
	=	1.16 > = 1, Hence k=1	
MsIndy	=	k x 6.58	
	=	6.58	kNm

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	MsIndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	51.35	8.44	51.35	0	51.35
Minor Axis - Muy	11.04	---	11.04	6.58	17.62

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	336.19	kN
Mux	=	51.35	kNm
Muy	=	17.62	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	18.93	deg
MRes	=	54.29	kNm
MCap	=	127.87	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.42 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	33.9882	7.4426
Pu (kN)	322.99	322.99
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2667	0.0674
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3802	1.4389
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3802	1.4389
Enhanced shear strength, Tc-e (N/sqmm)	0.5559	0.5795
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C28	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3000	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C28	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	138.62	kN
Mux	=	51.82	kNm
Muy	=	11.12	kNm
Vux	=	7.12	kN
Vuy	=	36.47	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	3.48	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	13.04	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	13.04, Column Slender Along B	
Slenderness moment along B	=	(Pu B/ 2000) (Ley/B)^2	
	=	2.71	kNm

Design slenderness moment along B

Puz	=	1573.16	kN
Pb	=	507.91	kN
Reduction factor 'k' for slenderness moment	=	(Puz - Pu) / (Puz - Pb) < = 1	
	=	1.35 > = 1, Hence k=1	
MslndY	=	k x 2.71	
	=	2.71	kNm

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	51.82	3.48	51.82	0	51.82
Minor Axis - Muy	11.12	---	11.12	2.71	13.83

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	138.62	kN
Mux	=	51.82	kNm
Muy	=	13.83	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	14.94	deg
MRes	=	53.63	kNm
MCap	=	112.54	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.48 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	36.4746	7.1171
Pu (kN)	125.43	125.43
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2863	0.0645
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1477	1.1704
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1477	1.1704
Enhanced shear strength, Tc-e (N/sqmm)	0.4622	0.4714
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C29	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C23
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Critical Location	=	Bottom Joint

Pu	=	782.95	kN
Mux	=	-0.96	kNm
Muy	=	-5.81	kNm
Vux	=	-8.26	kN
Vuy	=	-1.02	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	15.66	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-0.96	---	-0.96	0	-0.96
Minor Axis - Muy	-5.81	15.66	-15.66	0	-15.66

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	782.95	kN
Mux	=	-0.96	kNm
Muy	=	-15.66	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	86.51	deg
MRes	=	15.69	kNm
MCap	=	49.4	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.32 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-4.7791	-8.2626
Pu (kN)	799.75	769.76
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0375	0.0748
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.9415	2.0459
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)	0.6041	0.6041
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	

	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C29	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C23	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	625.24	kN
Mux	=	-8.08	kNm

Muy	=	-30.25	kNm
Vux	=	-19.37	kN
Vuy	=	-4.18	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	12.5	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-8.08	---	-8.08	0	-8.08
Minor Axis - Muy	-30.25	12.5	-30.25	0	-30.25

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	625.24	kN
Mux	=	-8.08	kNm

Muy	=	-30.25	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	75.05	deg
MRes	=	31.31	kNm
MCap	=	55.14	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.57 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-4.1835	-19.3714
Pu (kN)	612.05	612.05
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0328	0.1755
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.7205	1.8316
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)	0.6041	0.6041
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	
	=	3	mm

Criterion for spacing of normal

links

Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C29	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C23	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	462.86	kN
Mux	=	-10.83	kNm
Muy	=	-26.2	kNm
Vux	=	-17.7	kN

Vuy	=	-5.93	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	9.26	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-10.83	---	-10.83	0	-10.83
Minor Axis - Muy	-26.2	9.26	-26.2	0	-26.2

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	462.86	kN
Mux	=	-10.83	kNm
Muy	=	-26.2	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	67.55	deg
MRes	=	28.35	kNm
MCap	=	62.87	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.45 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-5.9273	-17.6981
Pu (kN)	449.66	449.66
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0465	0.1603
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5293	1.611
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm

Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C29	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C23	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	298.6	kN
Mux	=	-11.58	kNm
Muy	=	-27.08	kNm
Vux	=	-17.93	kN
Vuy	=	-8.51	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	7.49	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-11.58	7.49	-11.58	0	-11.58
Minor Axis - Muy	-27.08	---	-27.08	0	-27.08

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	298.6	kN
Mux	=	-11.58	kNm
Muy	=	-27.08	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	66.85	deg
MRes	=	29.45	kNm
MCap	=	61.06	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.48 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-8.5122	-17.9325
Pu (kN)	285.41	285.41
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0668	0.1624
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.336	1.3878
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.336	1.3878
Enhanced shear strength, Tc-e (N/sqmm)	0.5381	0.5589
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm

Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C29	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C23	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	133.16	kN
Mux	=	-5.4	kNm
Muy	=	-28.28	kNm
Vux	=	-19.4	kN
Vuy	=	1.09	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	3.34	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-5.4	3.34	-5.4	0	-5.4
Minor Axis - Muy	-28.28	---	-28.28	0	-28.28

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	133.16	kN
Mux	=	-5.4	kNm
Muy	=	-28.28	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	79.19	deg
MRes	=	28.79	kNm
MCap	=	45.05	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.64 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	1.088	-19.4039
Pu (kN)	119.96	119.96
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0085	0.1758
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1412	1.163
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1412	1.163
Enhanced shear strength, Tc-e (N/sqmm)	0.4596	0.4684
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C30	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C24	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1298.23	kN
Mux	=	-10.23	kNm
Muy	=	-1.39	kNm
Vux	=	4.15	kN
Vuy	=	-3.37	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	25.96	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	0, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	0, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-10.23	---	-10.23	0	-10.23
Minor Axis - Muy	-1.39	25.96	-25.96	0	-25.96

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1298.23	kN
Mux	=	-10.23	kNm
Muy	=	-25.96	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66
Reinforcement Provided	=	8-T12

Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	68.5	deg
MRes	=	27.91	kNm
MCap	=	30.56	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.91 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-16.9301	-8.4423
Pu (kN)	1264.6	1264.6
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.1329	0.0765
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.4887	2.7182
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C30	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C24	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1001.44	kN
Mux	=	-55.66	kNm
Muy	=	-25.71	kNm
Vux	=	-16.5	kN
Vuy	=	-34.4	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	25.14	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-55.66	25.14	-55.66	0	-55.66
Minor Axis - Muy	-25.71	---	-25.71	0	-25.71

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1001.44	kN
Mux	=	-55.66	kNm
Muy	=	-25.71	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66
Reinforcement Provided	=	8-T12

Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	24.79	deg
MRes	=	61.31	kNm
MCap	=	99.31	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.62 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-34.3974	-16.5018
Pu (kN)	988.24	988.24
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.27	0.1495
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.1634	2.3427
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C30	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C24	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	726.77	kN
Mux	=	-52.27	kNm
Muy	=	-22.76	kNm
Vux	=	-15.43	kN
Vuy	=	-34.46	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	18.24	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-52.27	18.24	-52.27	0	-52.27
Minor Axis - Muy	-22.76	---	-22.76	0	-22.76

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	726.77	kN
Mux	=	-52.27	kNm
Muy	=	-22.76	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66
Reinforcement Provided	=	8-T12

Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	23.53	deg
MRes	=	57.01	kNm
MCap	=	122.26	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.47 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-34.4552	-15.4291
Pu (kN)	713.57	713.57
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2704	0.1398
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.84	1.9695
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C30	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C24	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	452.91	kN
Mux	=	-52.6	kNm
Muy	=	-23.52	kNm
Vux	=	-15.47	kN
Vuy	=	-33.71	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	11.37	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-52.6	11.37	-52.6	0	-52.6
Minor Axis - Muy	-23.52	---	-23.52	0	-23.52

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	452.91	kN
Mux	=	-52.6	kNm
Muy	=	-23.52	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66
Reinforcement Provided	=	8-T12

Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	24.09	deg
MRes	=	57.62	kNm
MCap	=	126.83	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.45 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-33.7121	-15.468
Pu (kN)	439.72	439.72
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.2646	0.1401
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5176	1.5974
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C30	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C24	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	178.85	kN
Mux	=	-58.65	kNm
Muy	=	-25.56	kNm
Vux	=	-18.06	kN
Vuy	=	-43.75	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	4.49	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / D
	=	4.25, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1
Slenderness Ratio	=	Effective Length / B
	=	11.09, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-58.65	4.49	-58.65	0	-58.65
Minor Axis - Muy	-25.56	---	-25.56	0	-25.56

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	178.85	kN
Mux	=	-58.65	kNm
Muy	=	-25.56	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66
Reinforcement Provided	=	8-T12

Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	23.54	deg
MRes	=	63.98	kNm
MCap	=	111.28	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.57 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-43.7489	-18.058
Pu (kN)	165.66	165.66
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.3433	0.1636
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.195	1.2251
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.195	1.2251
Enhanced shear strength, Tc-e (N/sqmm)	0.4813	0.4934
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C31	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C25	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	1452.8	kN
Mux	=	-0.93	kNm
Muy	=	-0.19	kNm
Vux	=	1.75	kN
Vuy	=	-8.26	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	29.06	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	0, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-0.93	---	-0.93	0	-0.93
Minor Axis - Muy	-0.19	29.06	-29.06	0	-29.06

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1452.8	kN
Mux	=	-0.93	kNm
Muy	=	-29.06	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.33
Reinforcement Provided	=	8-T16 + 2-T12
Load Angle	=	Tan^{-1}(Muy/Mux)

	=	88.18	deg
MRes	=	29.07	kNm
MCap	=	37.93	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.77 <= 1	

Shear Calculation	**Along D**	**Along B**
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-8.2606	-5.9074
Pu (kN)	1452.79	1417.91
Deff , Beff (mm)	552	182
Aeff (sqmm)	126960	109200
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0651	0.0541
Pt (%)	0.665	0.665
Design shear strength, Tc (N/sqmm)	0.5349	0.5349
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.7164	2.9477
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)	0.8023	0.8023
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	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C31	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C25	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	1114.3	kN
Mux	=	6.37	kNm
Muy	=	11.9	kNm
Vux	=	-11.47	kN
Vuy	=	-6.06	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	22.29	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	6.37	---	6.37	0	6.37
Minor Axis - Muy	11.9	22.29	22.29	0	22.29

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	1114.3	kN
Mux	=	6.37	kNm
Muy	=	22.29	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	74.05	deg

MRes	=	23.18	kNm
MCap	=	39.85	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.58 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-6.0563	-11.4661
Pu (kN)	1114.3	1114.3
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0475	0.1039
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	2.3118	2.514
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C31	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C25	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Top Joint	
Pu	=	812.21	kN
Mux	=	7.24	kNm
Muy	=	11.14	kNm
Vux	=	-10.38	kN
Vuy	=	-6.85	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30

	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	16.24	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	7.24	---	7.24	0	7.24
Minor Axis - Muy	11.14	16.24	16.24	0	16.24

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	812.21	kN
Mux	=	7.24	kNm
Muy	=	16.24	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	65.97	deg
MRes	=	17.79	kNm
MCap	=	60.47	kNm

Capacity Ratio	=	MRes/ MCap	
	=	0.29 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-6.8461	-10.3766
Pu (kN)	812.21	812.21
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0537	0.094
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.9561	2.1035
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---

Spacing	175	---	---	175	---

General Data

Column No.	:	C31	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C25	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	523.54	kN
Mux	=	-9.7	kNm
Muy	=	-15.51	kNm
Vux	=	-10.41	kN
Vuy	=	-6.5	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	12.77	mm
Mminy	=	Pu x Minimum Eccentricity	

	=	10.47	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-9.7	---	-9.7	0	-9.7
Minor Axis - Muy	-15.51	10.47	-15.51	0	-15.51

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	523.54	kN
Mux	=	-9.7	kNm
Muy	=	-15.51	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	57.99	deg
MRes	=	18.29	kNm
MCap	=	77.12	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.24 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-6.4957	-10.406
Pu (kN)	510.35	510.35
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.051	0.0943
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.6008	1.6934
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C31	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C25	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	223.12	kN
Mux	=	-9.76	kNm
Muy	=	-15.29	kNm
Vux	=	-10.11	kN
Vuy	=	-5.3	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	5.6	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	
	<	60	(Hence Ok)
Column Is Unbraced Along D			
Slenderness Check Along D:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	
Column Is Unbraced Along B			
Slenderness Check Along B:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-9.76	5.6	-9.76	0	-9.76
Minor Axis - Muy	-15.29	---	-15.29	0	-15.29

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	223.12	kN
Mux	=	-9.76	kNm
Muy	=	-15.29	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	57.45	deg
MRes	=	18.13	kNm
MCap	=	71.47	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.25 <= 1	

Shear Calculation	Along D	Along B

Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)
Design shear force, Vu (kN)	-5.2954	-10.1144
Pu (kN)	209.92	209.92
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0416	0.0916
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.2471	1.2852
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.2471	1.2852
Enhanced shear strength, Tc-e (N/sqmm)	0.5023	0.5176
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C32	
Level	:	Base To STILT	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	0	mm
Clear Floor Height @ D	=	0	mm
No Of Floors	=	2	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C26	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	798.06	kN
Mux	=	2.91	kNm
Muy	=	-1.04	kNm
Vux	=	-3.08	kN
Vuy	=	2.77	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	7.67	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	15.96	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	0	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	0, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	2.91	---	2.91	0	2.91
Minor Axis - Muy	-1.04	15.96	-15.96	0	-15.96

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	798.06	kN
Mux	=	2.91	kNm
Muy	=	-15.96	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	79.66	deg
MRes	=	16.23	kNm
MCap	=	49.49	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.33 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	-5.6427	-5.2551
Pu (kN)	769.21	769.21
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0443	0.0476
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.9055	2.0451
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C32	
Level	:	STILT To GROUND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C26	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	617.89	kN
Mux	=	-14.91	kNm
Muy	=	-15.44	kNm
Vux	=	-10.3	kN
Vuy	=	-9.72	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	15.51	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-14.91	15.51	-15.51	0	-15.51
Minor Axis - Muy	-15.44	---	-15.44	0	-15.44

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	617.89	kN
Mux	=	-15.51	kNm
Muy	=	-15.44	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	44.87	deg
MRes	=	21.88	kNm
MCap	=	98.26	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.22 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	-9.7156	-10.3003
Pu (kN)	604.7	604.7
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0762	0.0933
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.7119	1.8216
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C32	
Level	:	GROUND To FIRST	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C26	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	451.57	kN
Mux	=	-14.91	kNm
Muy	=	-14.24	kNm
Vux	=	-9.73	kN
Vuy	=	-9.99	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	11.33	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-14.91	11.33	-14.91	0	-14.91
Minor Axis - Muy	-14.24	---	-14.24	0	-14.24

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	451.57	kN
Mux	=	-14.91	kNm
Muy	=	-14.24	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	43.69	deg
MRes	=	20.62	kNm
MCap	=	100.31	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.21 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	-9.9861	-9.7259
Pu (kN)	438.38	438.38
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0784	0.0881
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.5161	1.5956
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)	0.6041	0.6041
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C32	
Level	:	FIRST To SECOND	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C26	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	284.66	kN
Mux	=	-14.83	kNm
Muy	=	-14.82	kNm
Vux	=	-9.95	kN
Vuy	=	-9.93	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	7.14	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-14.83	7.14	-14.83	0	-14.83
Minor Axis - Muy	-14.82	---	-14.82	0	-14.82

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	284.66	kN
Mux	=	-14.83	kNm
Muy	=	-14.82	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	44.98	deg
MRes	=	20.97	kNm
MCap	=	92.91	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.23 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	-9.9315	-9.9486
Pu (kN)	271.47	271.47
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0779	0.0901
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.3196	1.3688
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.3196	1.3688
Enhanced shear strength, Tc-e (N/sqmm)	0.5315	0.5513
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

General Data

Column No.	:	C32	
Level	:	SECOND To THIRD	
Frame Type	=	Non-Ductile	
Response Reduction Factor	=	3	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M20	N/sqmm
Grade Of Steel (Main)	=	Fe500	N/sqmm
Grade Of Steel (Shear)	=	Fe500	N/sqmm
Grade Of Steel - Flexural Design	=	Fe500	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	230	mm
Column D	=	600	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	2550	mm
Clear Floor Height @ D	=	2550	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.61 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	=	C26	
Load Combination	=	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	
Critical Location	=	Bottom Joint	
Pu	=	117.35	kN
Mux	=	-14.95	kNm
Muy	=	-15.5	kNm
Vux	=	-10.58	kN
Vuy	=	-8.74	kN

Minimum Eccentricity Check

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

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	25.1	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	2.95	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.09	

	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	4.25, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.09, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	-14.95	2.95	-14.95	0	-14.95
Minor Axis - Muy	-15.5	---	-15.5	0	-15.5

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	117.35	kN
Mux	=	-14.95	kNm
Muy	=	-15.5	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	0.66	
Reinforcement Provided	=	8-T12	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	46.04	deg
MRes	=	21.53	kNm
MCap	=	80.1	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.27 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)	[1] : 1.5 (Dead) +1.5 (SIDL) +1.5 (Live)

Design shear force, Vu (kN)	-8.7422	-10.575
Pu (kN)	104.16	104.16
Deff , Beff (mm)	554	184
Aeff (sqmm)	127420	110400
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0686	0.0958
Pt (%)	0.328	0.328
Design shear strength, Tc (N/sqmm)	0.4028	0.4028
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1226	1.1415
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5
Shear Strength Enhancement Factor	1.1226	1.1415
Enhanced shear strength, Tc-e (N/sqmm)	0.4521	0.4598
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	
	=	3	mm
Criterion for spacing of normal links			
Min. Longitudinal Bar dia X 16	=	192	mm
Min. dimension of column	=	230	mm
Max. 300 mm	=	300	mm
Provided spacing	=	175	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	175	---	---	175	---

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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