

Selection of Archetypical Building Configuration for Special Reinforced Concrete Moment-Resisting Frames

Prakash S Badal¹ and Ravi Sinha¹

*¹Department of Civil Engineering,
Indian Institute of Technology Bombay, Mumbai, India*

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Indian Institute of Technology Bombay
Powai, Mumbai-400 076, India

Executive summary

For assessing the seismic behavior of a seismic-force-resisting system, a set of buildings are selected that is capable of capturing a reasonably wide range of design parameters and structural attributes. Such a set of selected buildings is called *archetypical buildings*. Since building codes allow significant liberty in the selection of the building configurations within a lateral load resisting system, the intention behind selecting these buildings is not to include every conceivable building frame in this set, but to offer a systematic characterization of the key design variables. In addition, while selecting the set of archetypical building configurations, due consideration is given to the region-specific construction practices and existing building stock. Archetypical configurations should carefully avoid introduction of overstrength (exceeding minimum design code requirement) in the members arising due to probable convenience in construction. For instance, in practice, equal reinforcements in continuous members can be provided throughout the member for ease in placing of the bars. However, carrying over this feature to the design of archetypical buildings will result in an overestimation that cannot be guaranteed if the relevant design guidelines are followed. Archetypes are used to fill the gap between seismic performance of a specific building and generalized seismic behavior of an entire class of buildings. Selection of archetype buildings is based on the design variables and system attributes that are anticipated to have a measurable effect on the seismic response (FEMA-P695, 2009).

For evaluating several lateral-load resisting systems, Kircher et al. (2010) developed archetypical buildings for reinforced masonry shear wall structures, reinforced concrete shear wall structures, braced frame structures, and steel moment frame structures. Though their report essentially intends to evaluate the methodology proposed by FEMA-P695 (2009) for assessing seismic performance factors, the archetypical building selected in such manner can be used for prediction of other aspects of the performance-based seismic design of the buildings as well.

The present technical report is intended to offer the details of archetypical buildings selected for special reinforced concrete moment-resisting frame buildings satisfying Indian seismic design standard (IS-1893 (Part 1), 2002) and ductile detailing standard (IS-13920, 1993). Based on the architectural and structural drawings of several real buildings in India, we consider archetype configuration as a space frame having 9×3 bays as a baseline. To select the set of archetypical buildings, following key design variables have been considered:

- *Ductility*—Buildings having high-ductility (IS-13920, 1993).
- *Seismic zone*—III, IV, and V (PGA for MCE of 0.16g, 0.24g, and 0.36g) (IS-1893 (Part 1), 2002).
- *Building's fundamental time period*—Buildings between two and twelve-story high.
- *Bay-width*—8200 mm (benchmark) and 6000 mm (to represent smaller commercial buildings and to observe the effect of bay-width).
- *Number of Bays*—3 (benchmark) and 5 (to observe the effect of number of bays).

Several heights of buildings have been selected to represent the variation in the time period of the buildings. These buildings range from two to twelve-stories. The effect of depth of foundation has been incorporated by longer columns on the ground floor (4500 mm) compared to the regular floor height (3900 mm). Six and Ten buildings with heights varying between two and twelve stories have been considered for high seismic regions, i.e., zone-IV and V, respectively. However, for seismic zone-III, only two high-rise buildings were considered to observe measurable seismic response. Generally, the archetypical buildings have a bay-width of 8200 mm. Based on the authors' experience, this bay-width was judged to be representative of a large number of commercial buildings in the region. The number of bays is typically kept as three. A 3-bay frame is the minimum required configuration to have an internal bay. Four buildings having five bays in seismic zone-V have been included in the archetypical buildings to observe the effect of the number of bays. Besides, four buildings with a reduced

bay-width of 6000 mm were selected to observe the impact of bay-width on the seismic performance of the buildings. Finally, four more buildings having reduced bay-width of 6000 mm and five bays have been selected in the set of archetype buildings. Thus, a total of **thirty buildings** have been selected as archetypical buildings.

In what follows, we present the design and detailing of each archetypical building. A 3-dimensional model was used for designing. Accidental torsion equivalent to 5% eccentricity as recommended by seismic design standard IS 1893 (Part 1) (2002) has been considered for the design. Since the selected archetypical buildings are regular, equivalent lateral force method has been used for the design of the buildings. Design and detailing of the archetypical buildings have been carried as per design standard (IS-456, 2000) and Indian ductile-detailing standard (IS-13920, 1993). Design and detailing of the reinforced concrete members have been carefully carried out to have as little margin as possible and yet comply with all provisions of the standards. In this way, we have avoided introducing undesirable overstrength in the members. The frugal design strategy is followed for deciding the cross-section of the columns and beams as well selecting the longitudinal and transverse reinforcements in the member.

One of the prime motivations behind developing the set of archetypical buildings is to assess their performance up to collapse by analytically subjecting them to an increasing level of earthquake time-history records. To this end, for each archetype building, a nonlinear two-dimensional model is created in *OpenSees*, an open-source simulation software. This frame is chosen based on the governing direction of the horizontal load carrying capacity, which is usually the direction with the smaller number of bays. In these cases, the direction with 3 or 5 bays (against the 9 bays along other direction) happens to be the critical direction. Therefore, the configurations and reinforcement details of this 2-dimensional frame are shown.

In this technical report, we present the design details of different members of the governing frame of the buildings. Descriptive design information of each building initiates with

details of general building configuration including assigned building ID, seismic zone, number of stories, number of bays, bay-width, soil strata, live load, and superimposed load. Material details and design base shear calculation as per IS 1893 (Part 1) (2002) is also given. Next, four Figures—**Xa**, **Xb**, **Xc**, and **Xd**—are provided for each building, where **X** is the serial number of the building. The first figure shows the section sizes of the frame, the second figure consists of the longitudinal reinforcement required at the critical locations of each cross-section (at ends of the columns and at ends and mid-span of the beams) normalized by the effective area of the cross-section, the third figure shows the required transverse reinforcement in each member, and finally, the fourth figure shows frame details along with the provided reinforcement and their placement in each member. Information given in the fourth figure along with general building information is sufficient to create the nonlinear analytical model for the considered building.

Finally, we wish to emphasize two points. First, selected archetypical buildings are regular and simple. The buildings having various kinds of irregularities (plan irregularities like torsional or non-parallel systems or vertical irregularities like the presence of a soft story or mass irregularity) is adjudged to be more vulnerable to lateral forces. In other words, predictions of the seismic performance of a class of buildings based on the selected archetypical buildings would constitute an upper limit on the buildings that comply with the design code. Thus, recommendations based on the analysis of selected archetypical buildings can be treated as minimal required improvements based on best observed performance.

Second, different studies would almost always end up selecting different sets of archetypical buildings. However, if carried out wisely, the selection of any set of sufficient numbers of archetypical buildings would result in strikingly similar conclusions regarding the seismic performance of the buildings with respect to the considered key design variables or system attributes.

References

- FEMA-P695. (2009). Quantification of Building Seismic Performance Factors. *Applied Technology Council, Redwood City, California.*
- IS-456. (2000). Plain and Reinforced Concrete-Code of Practice, Bureau of Indian Standards, New Delhi. *Bureau of Indian Standards, New Delhi.*
- IS-1893 (Part 1). (2002). Criteria for earthquake resistant design of structures. *Bureau of Indian Standards, New Delhi.*
- IS-13920. (1993). Ductile detailing of reinforced concrete structures subjected to seismic forces- code of practice. *Bureau of Indian Standards, New Delhi.*
- Kircher, C., Deierlein, G., Hooper, J., Krawinkler, H., Mahin, S., Shing, B., & Wallace, J. (2010). *Evaluation of the FEMA P-695 methodology for quantification of building seismic performance factors* (No. NIST GCR 10-917-8). National Institute of Standards and Technology.

Symbols

In the present report, unless stated otherwise, all dimensions are in m, loads in kilonewton, stresses in MPa. Longitudinal reinforcement shown in the elevation are given as percentage of the effective cross-section area (width $\times$ effective depth). Transverse reinforcement is marked in the units of mm²/m.

For beams, **B350X750** indicates a beam having 350 mm width and 750 mm of total depth. Similarly, for columns, **400X450** indicates a column having cross section of 400 mm by 450 mm. First dimension, i.e., 400 mm in this case, is along the direction perpendicular to the plane shown in the elevation (global Y-axis), whereas the second dimension, i.e., 450 mm in this case, is along the direction observable in the shown elevation (global X-axis).

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1.1. General building configuration and loading inputs

Building Id:	2207
No of stories:	7
No of Bays:	3
Seismic zone (as per IS 1893-1):	III
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	2.63 sec

1.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

1.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.16
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	27.9 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.91 sec
Time period, $T_{a,Y}$:	0.91 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.10
Avrg response accn coeff, $(S_a/g)_y$:	1.10
Design Seis. coeff, $(A_h)_x$:	0.0176
Design Seis. coeff, $(A_h)_y$:	0.0176

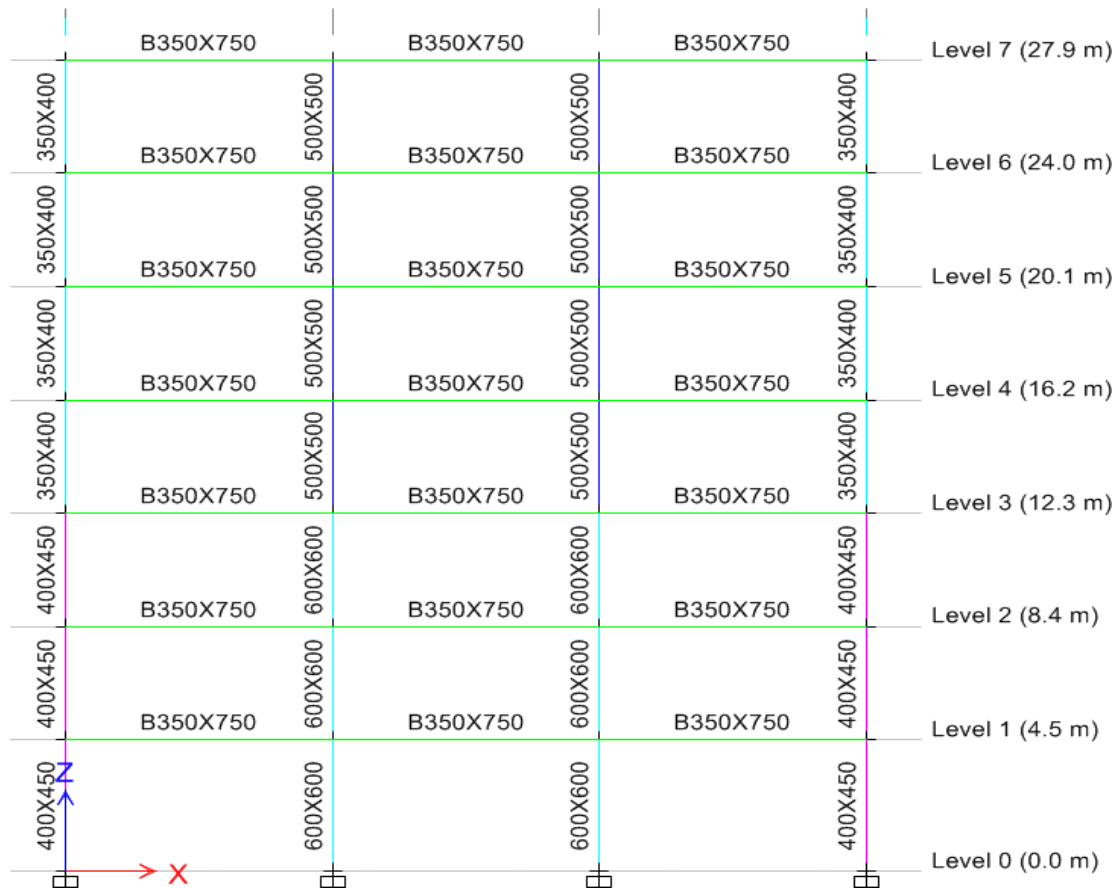


Fig. 1a. Beam column sizes for building ID 2207

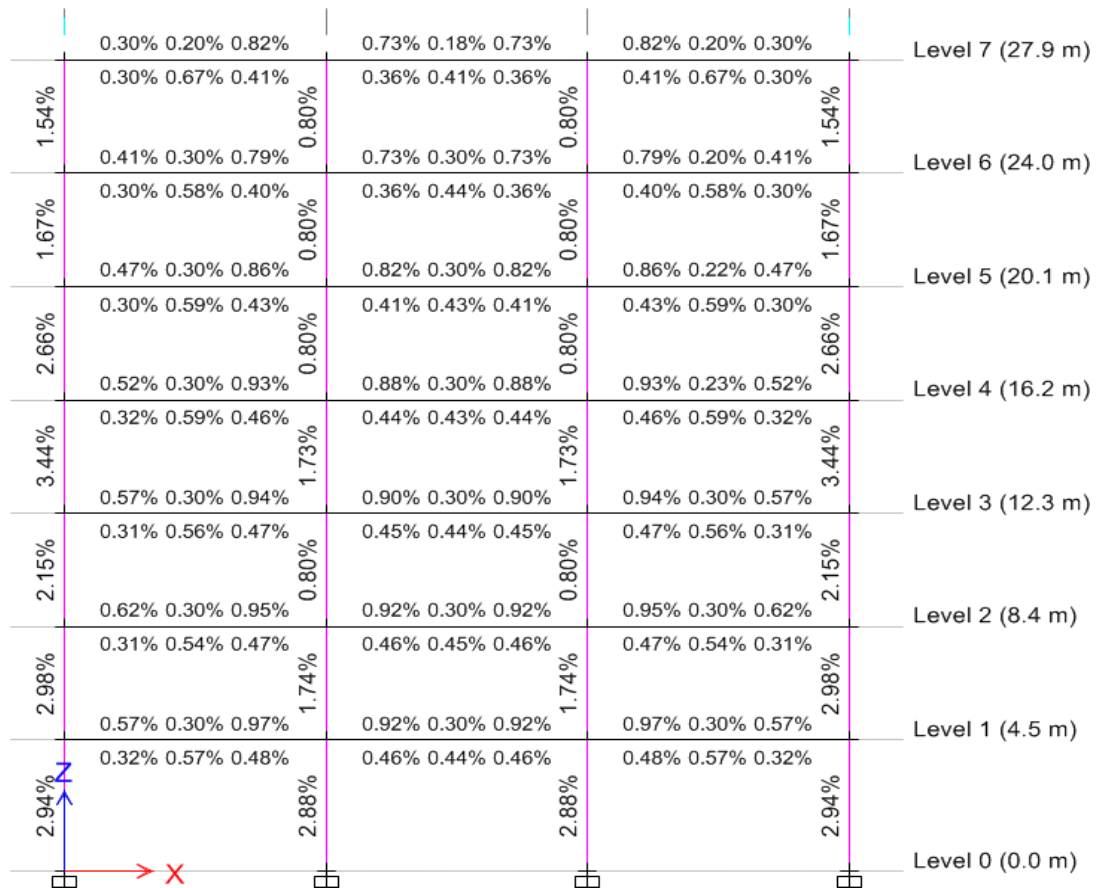


Fig. 1b. Required longitudinal reinforcement for building ID 2207

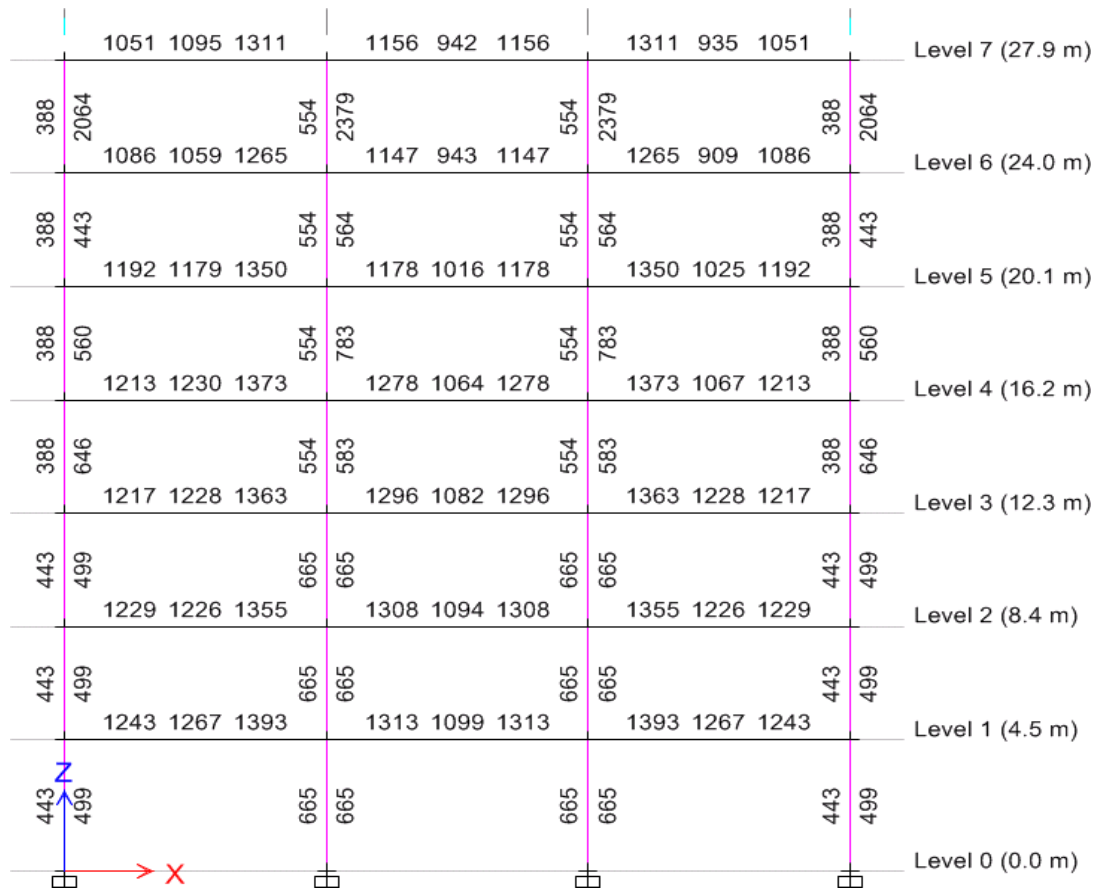


Fig. 1c. Required transverse reinforcement for building ID 2207

2.1. General building configuration and loading inputs

Building Id:	2209
No of stories:	12
No of Bays:	3
Seismic zone (as per IS 1893-1):	III
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	4.12 sec

2.2. Material and modeling details

Column conc grade, f_{ck} :	50 MPa
Column conc expected, $f_{ck,exp}$:	58.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	32048.2 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

2.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.16
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	47.4 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	1.35 sec
Time period, $T_{a,Y}$:	1.35 sec
Avrg response accn coeff, $(S_a/g)_x$:	0.74
Avrg response accn coeff, $(S_a/g)_y$:	0.74
Design Seis. coeff, $(A_h)_x$:	0.0118
Design Seis. coeff, $(A_h)_y$:	0.0118

	B350X750	B350X750	B350X750	Level 12 (47.4 m)
350X450	B350X750	B350X750	B350X750	Level 11 (43.5 m)
350X450	B350X750	B350X750	B350X750	Level 10 (39.6 m)
350X450	B350X750	B350X750	B350X750	Level 9 (35.7 m)
350X450	B350X750	B350X750	B350X750	Level 8 (31.8 m)
400X500	B350X750	B350X750	B350X750	Level 7 (27.9 m)
400X500	B350X750	B350X750	B350X750	Level 6 (24.0 m)
400X500	B350X750	B350X750	B350X750	Level 5 (20.1 m)
400X500	B350X750	B350X750	B350X750	Level 4 (16.2 m)
450X550	B350X750	B350X750	B350X750	Level 3 (12.3 m)
450X550	B350X750	B350X750	B350X750	Level 2 (8.4 m)
450X550	B350X750	B350X750	B350X750	Level 1 (4.5 m)
450X550	700X700	700X700	450X550	Level 0 (0.0 m)

Fig. 2a. Beam column sizes for building ID 2209

		0.30% 0.18% 0.73%	0.71% 0.18% 0.71%	0.73% 0.18% 0.30%	Level 12 (47.4 m)
	1.42%	0.30% 0.64% 0.36%	0.36% 0.43% 0.36%	0.36% 0.64% 0.30%	
		0.50% 0.17% 0.68%	0.68% 0.17% 0.68%	0.68% 0.17% 0.50%	Level 11 (43.5 m)
	0.80%	0.30% 0.56% 0.34%	0.34% 0.46% 0.34%	0.34% 0.56% 0.30%	
		0.55% 0.18% 0.72%	0.74% 0.30% 0.74%	0.72% 0.18% 0.55%	Level 10 (39.6 m)
	0.87%	0.30% 0.57% 0.36%	0.37% 0.45% 0.37%	0.36% 0.57% 0.30%	
		0.60% 0.30% 0.80%	0.80% 0.30% 0.80%	0.80% 0.30% 0.60%	Level 9 (35.7 m)
	1.46%	0.30% 0.57% 0.40%	0.40% 0.44% 0.40%	0.40% 0.57% 0.30%	
		0.63% 0.30% 0.83%	0.84% 0.30% 0.84%	0.83% 0.21% 0.63%	Level 8 (31.8 m)
	0.80%	0.32% 0.55% 0.42%	0.42% 0.44% 0.42%	0.42% 0.55% 0.32%	
		0.67% 0.30% 0.87%	0.91% 0.30% 0.91%	0.87% 0.22% 0.67%	Level 7 (27.9 m)
	0.93%	0.33% 0.53% 0.44%	0.45% 0.45% 0.45%	0.44% 0.53% 0.33%	
		0.70% 0.30% 0.92%	0.94% 0.30% 0.94%	0.92% 0.30% 0.70%	Level 6 (24.0 m)
	1.58%	0.35% 0.54% 0.46%	0.47% 0.45% 0.47%	0.46% 0.54% 0.35%	
		0.71% 0.30% 0.95%	0.97% 0.30% 0.97%	0.95% 0.30% 0.71%	Level 5 (20.1 m)
	2.16%	0.36% 0.54% 0.48%	0.48% 0.45% 0.48%	0.48% 0.54% 0.36%	
		0.74% 0.30% 0.95%	0.95% 0.30% 0.95%	0.95% 0.30% 0.74%	Level 4 (16.2 m)
	1.36%	0.37% 0.52% 0.47%	0.48% 0.44% 0.48%	0.47% 0.52% 0.37%	
		0.76% 0.30% 0.95%	0.96% 0.30% 0.96%	0.95% 0.30% 0.76%	Level 3 (12.3 m)
	1.90%	0.38% 0.51% 0.48%	0.48% 0.44% 0.48%	0.48% 0.51% 0.38%	
		0.77% 0.30% 0.95%	0.95% 0.30% 0.95%	0.95% 0.30% 0.77%	Level 2 (8.4 m)
	2.59%	0.38% 0.51% 0.48%	0.47% 0.44% 0.47%	0.48% 0.51% 0.38%	
		0.69% 0.30% 0.93%	0.91% 0.30% 0.91%	0.93% 0.30% 0.69%	Level 1 (4.5 m)
	2.97%	0.35% 0.52% 0.47%	0.45% 0.44% 0.45%	0.47% 0.52% 0.35%	
					Level 0 (0.0 m)

Fig. 2b. Required longitudinal reinforcement for building ID 2209

1039 974 1186				1138 925 1138				1186 974 1039				Level 12 (47.4 m)
388	1631		499	2481		499	2481		388	1631		Level 11 (43.5 m)
	1097 932 1145			1116 903 1116			1145 932 1097					
388	499		499	626		499	626		388	499		Level 10 (39.6 m)
	1106 997 1210			1149 953 1149			1210 997 1106					
388	499		499	755		499	755		388	499		Level 9 (35.7 m)
	1144 1079 1268			1167 994 1167			1268 1079 1144					
388	798		499	579		499	579		388	798		Level 8 (31.8 m)
	1191 1131 1301			1247 1033 1247			1301 973 1191					
443	554		665	665		665	665		443	554		Level 7 (27.9 m)
	1254 1175 1325			1298 1085 1298			1325 1029 1254					
443	554		665	665		665	665		443	554		Level 6 (24.0 m)
	1276 1215 1349			1323 1110 1323			1349 1046 1276					
443	570		665	665		665	665		443	570		Level 5 (20.1 m)
	1286 1246 1370			1343 1129 1343			1370 1075 1286					
443	554		665	665		665	665		443	554		Level 4 (16.2 m)
	1286 1235 1362			1402 1087 1402			1362 1235 1286					
499	610		776	776		776	776		499	610		Level 3 (12.3 m)
	1288 1228 1354			1406 1091 1406			1354 1228 1288					
499	610		776	776		776	776		499	610		Level 2 (8.4 m)
	1283 1224 1350			1399 1084 1399			1350 1224 1283					
499	610		776	776		776	776		499	610		Level 1 (4.5 m)
	1257 1209 1340			1289 1049 1289			1340 1209 1257					
499	610		776	776		776	776		499	610		Level 0 (0.0 m)

Fig. 2c. Required transverse reinforcement for building ID 2209

Grade beam depth (mm)

3.1. General building configuration and loading inputs

Building Id:	2211
No of stories:	2
No of Bays:	3
Seismic zone (as per IS 1893-1):	IV
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	1.06 sec

3.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

3.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.24
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	8.4 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.37 sec
Time period, $T_{a,Y}$:	0.37 sec
Avrg response accn coeff, $(S_a/g)_x$:	2.50
Avrg response accn coeff, $(S_a/g)_y$:	2.50
Design Seis. coeff, $(A_h)_x$:	0.0600
Design Seis. coeff, $(A_h)_y$:	0.0600

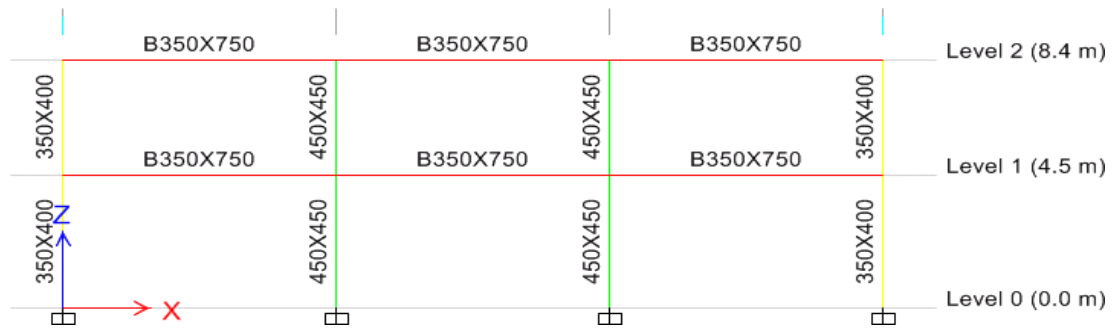


Fig. 3a. Beam column sizes for building ID 2211

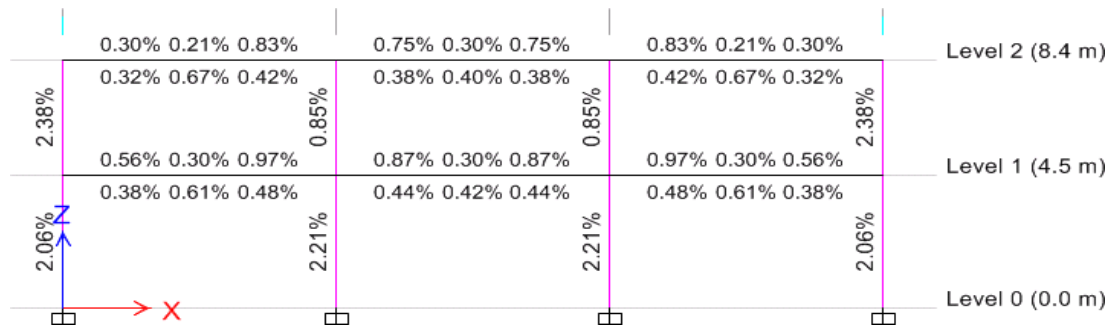


Fig. 3b. Required longitudinal reinforcement for building ID 2211

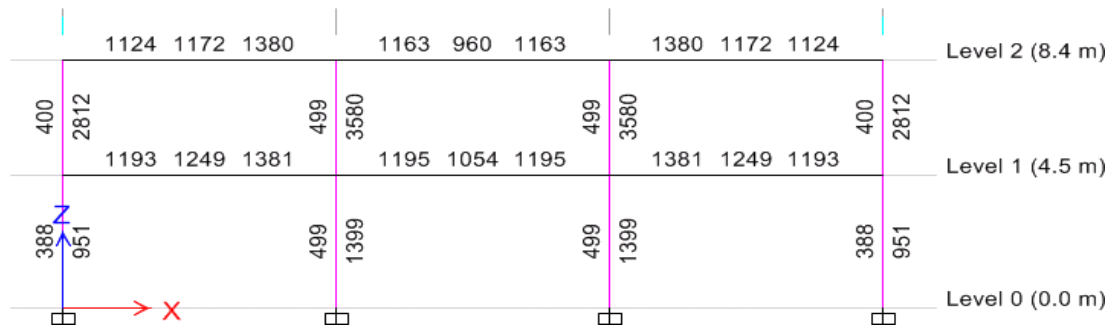


Fig. 3c. Required transverse reinforcement for building ID 2211

Bldg ID- 2211

Seismic code IS 1893-1 (2002)

Detailing Special 13920 (1993)

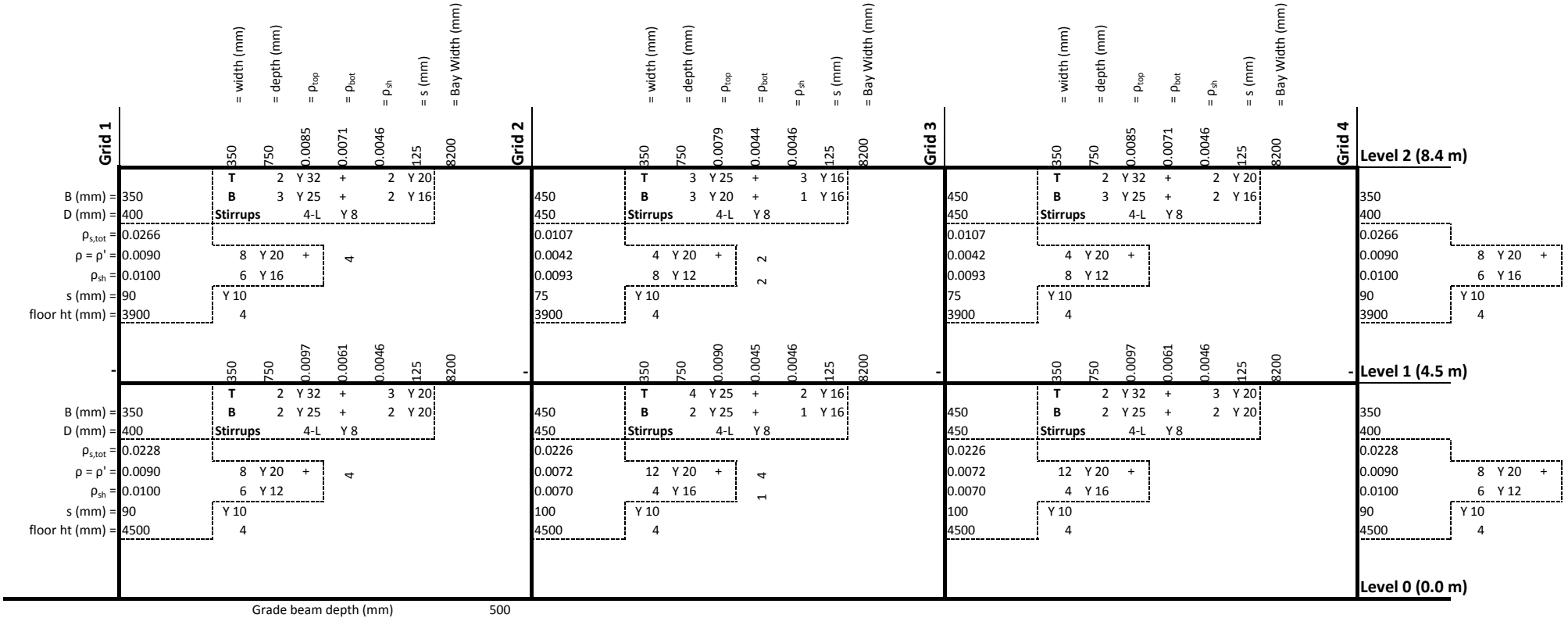


Fig. 3d. Provided reinforcement and modeling details for building ID 2211

4.1. General building configuration and loading inputs

Building Id:	2213
No of stories:	4
No of Bays:	3
Seismic zone (as per IS 1893-1):	IV
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	1.72 sec

4.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

4.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.24
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	16.2 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.61 sec
Time period, $T_{a,Y}$:	0.61 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.65
Avrg response accn coeff, $(S_a/g)_y$:	1.65
Design Seis. coeff, $(A_h)_x$:	0.0396
Design Seis. coeff, $(A_h)_y$:	0.0396



Fig. 4a. Beam column sizes for building ID 2213

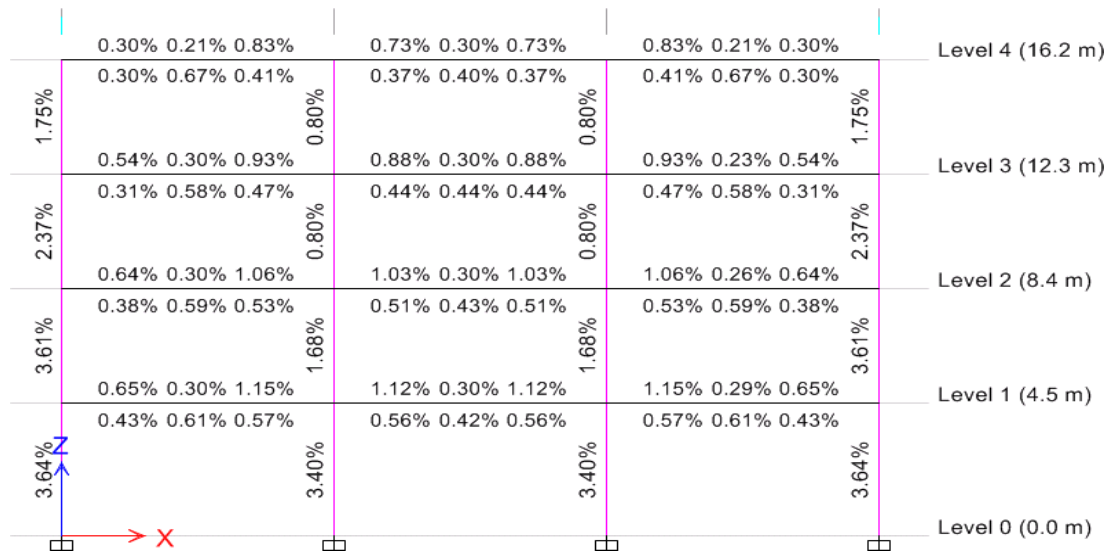


Fig. 4b. Required longitudinal reinforcement for building ID 2213

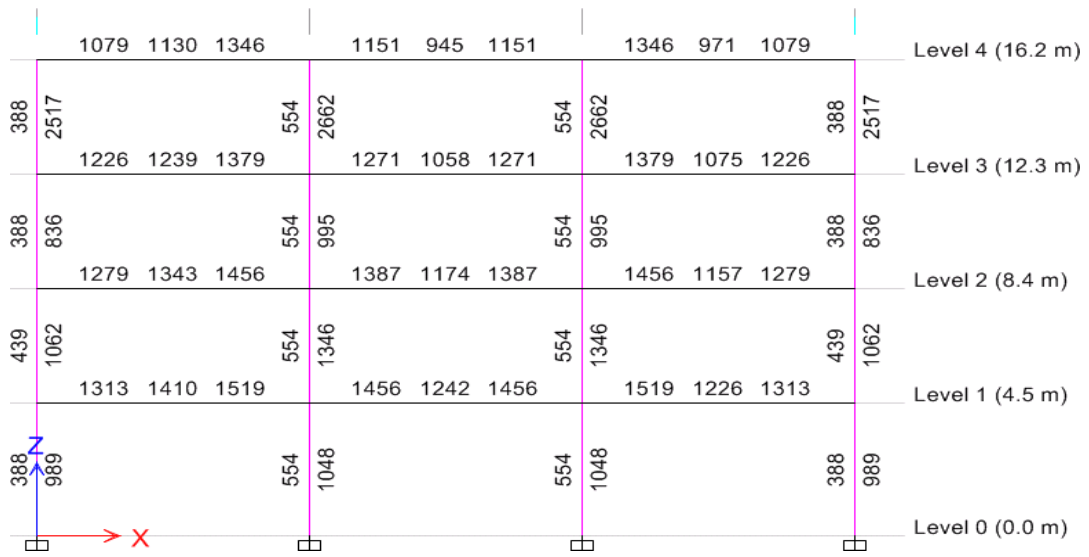


Fig. 4c. Required transverse reinforcement for building ID 2213

Bldg ID- 2213

Seismic code IS 1893-1 (2002)

Detailing Special 13920 (1993)

Grid 1		Grid 2		Grid 3		Grid 4	
= width (mm)		= width (mm)		= width (mm)		= width (mm)	
= depth (mm)		= depth (mm)		= depth (mm)		= depth (mm)	
= ρ_{top}		= ρ_{top}		= ρ_{top}		= ρ_{top}	
= ρ_{bot}		= ρ_{bot}		= ρ_{bot}		= ρ_{bot}	
= ρ_{sh}		= ρ_{sh}		= ρ_{sh}		= ρ_{sh}	
= s (mm)		= s (mm)		= s (mm)		= s (mm)	
= Bay Width (mm)		= Bay Width (mm)		= Bay Width (mm)		= Bay Width (mm)	
Level 4 (16.2 m)		Level 3 (12.3 m)		Level 2 (8.4 m)		Level 1 (4.5 m)	
B (mm) = 350		B (mm) = 350		B (mm) = 350		B (mm) = 350	
D (mm) = 400		D (mm) = 400		D (mm) = 400		D (mm) = 400	
$\rho_{s,tot} = 0.0176$		$\rho_{s,tot} = 0.0082$		$\rho_{s,tot} = 0.0082$		$\rho_{s,tot} = 0.0082$	
$\rho = \rho' = 0.0057$		$\rho = \rho' = 0.0029$		$\rho = \rho' = 0.0029$		$\rho = \rho' = 0.0029$	
$\rho_{sh} = 0.0100$		$\rho_{sh} = 0.0084$		$\rho_{sh} = 0.0084$		$\rho_{sh} = 0.0084$	
s (mm) = 90		s (mm) = 75		s (mm) = 75		s (mm) = 75	
floor ht (mm) = 3900		floor ht (mm) = 3900		floor ht (mm) = 3900		floor ht (mm) = 3900	
Level 0 (0.0 m)		Level 0 (0.0 m)		Level 0 (0.0 m)		Level 0 (0.0 m)	
Grade beam depth (mm)		Grade beam depth (mm)		Grade beam depth (mm)		Grade beam depth (mm)	
500		500		500		500	

Fig. 4d. Provided reinforcement and modeling details for building ID 2213

5.1. General building configuration and loading inputs

Building Id:	2451
No of stories:	5
No of Bays:	3
Seismic zone (as per IS 1893-1):	IV
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	2.05 sec

5.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

5.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.24
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	20.1 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.71 sec
Time period, $T_{a,Y}$:	0.71 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.40
Avrg response accn coeff, $(S_a/g)_y$:	1.40
Design Seis. coeff, $(A_h)_x$:	0.0337
Design Seis. coeff, $(A_h)_y$:	0.0337



Fig. 5a. Beam column sizes for building ID 2451

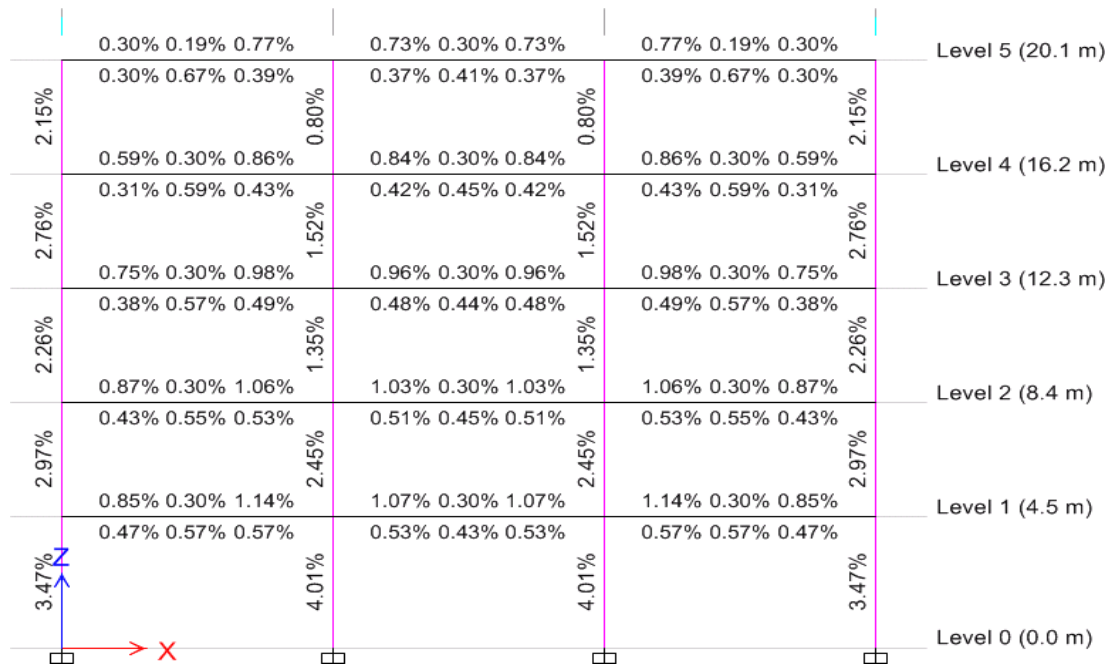


Fig. 5b. Required longitudinal reinforcement for building ID 2451

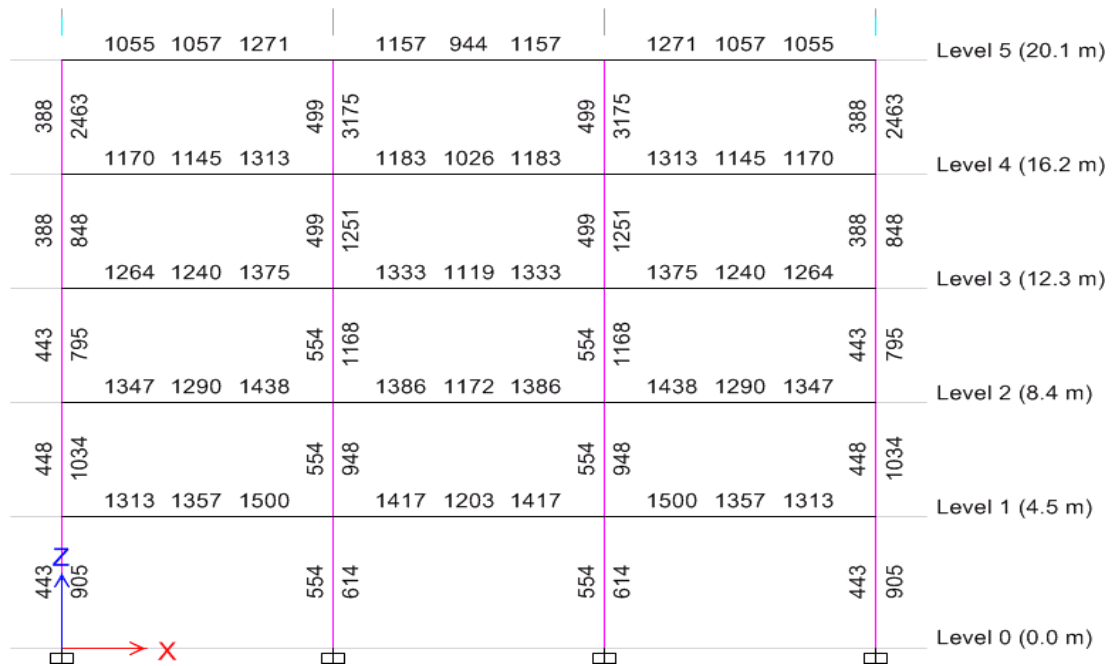


Fig. 5c. Required transverse reinforcement for building ID 2451

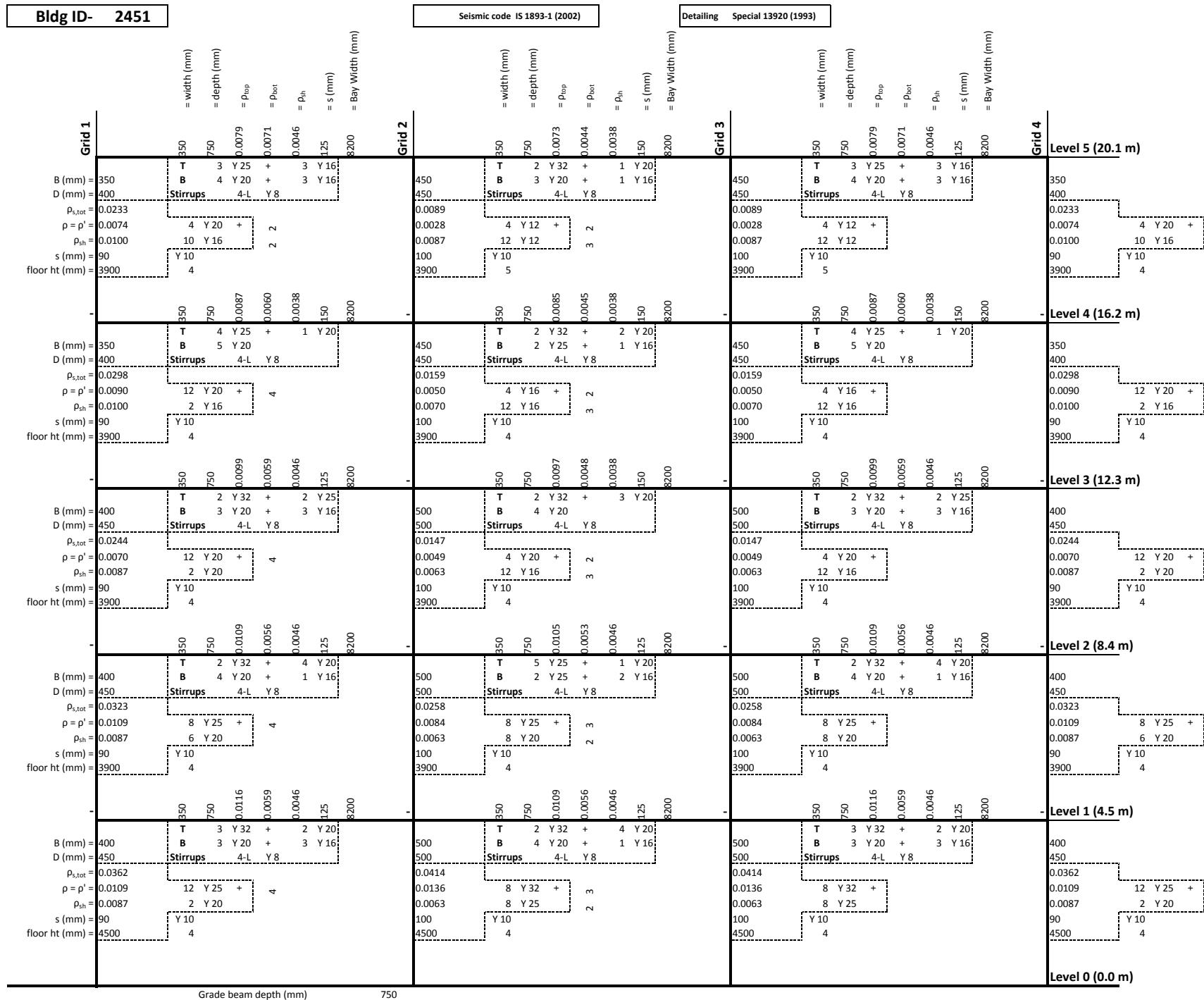


Fig. 5d. Provided reinforcement and modeling details for building ID 2451

6.1. General building configuration and loading inputs

Building Id:	2453
No of stories:	6
No of Bays:	3
Seismic zone (as per IS 1893-1):	IV
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	2.32 sec

6.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

6.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.24
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	24 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.81 sec
Time period, $T_{a,Y}$:	0.81 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.23
Avrg response accn coeff, $(S_a/g)_y$:	1.23
Design Seis. coeff, $(A_h)_x$:	0.0295
Design Seis. coeff, $(A_h)_y$:	0.0295

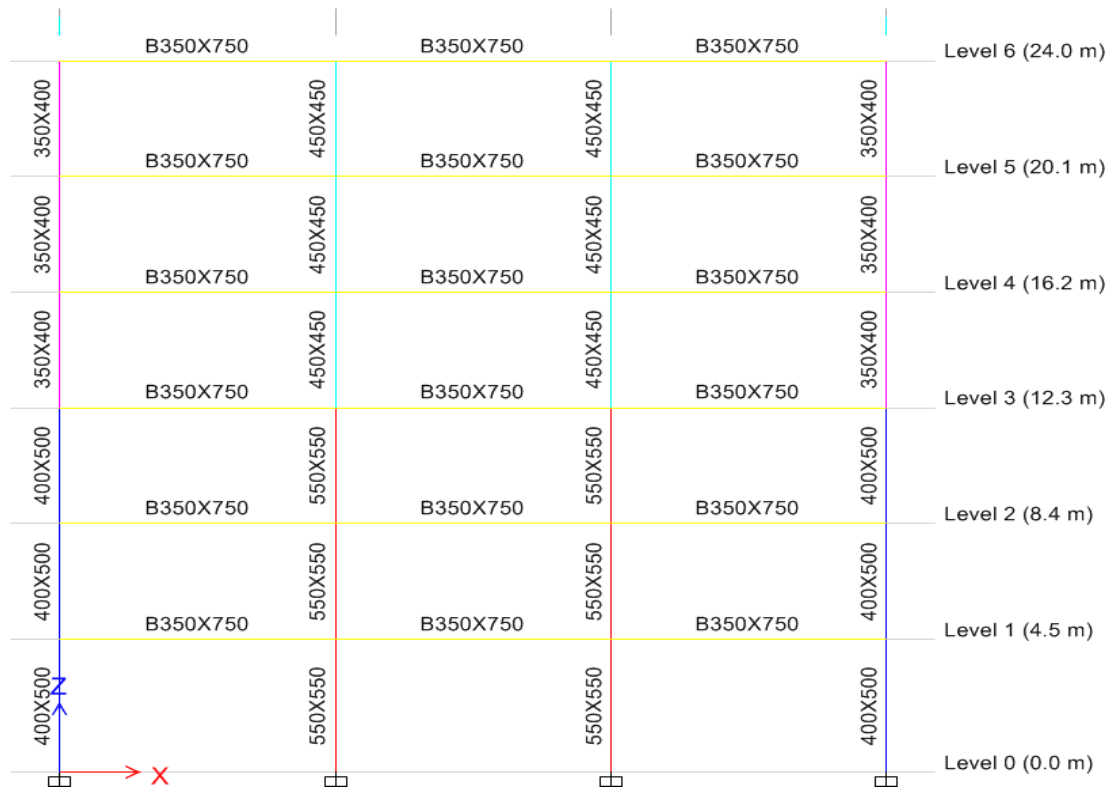


Fig. 6a. Beam column sizes for building ID 2453

	0.30% 0.19% 0.77%	0.73% 0.30% 0.73%	0.77% 0.19% 0.30%	Level 6 (24.0 m)
2.01%	0.30% 0.68% 0.38%	0.37% 0.42% 0.37%	0.38% 0.68% 0.30%	
	0.58% 0.30% 0.83%	0.82% 0.30% 0.82%	0.83% 0.30% 0.58%	Level 5 (20.1 m)
2.79%	0.30% 0.59% 0.41%	0.41% 0.45% 0.41%	0.41% 0.59% 0.30%	
	0.70% 0.30% 0.98%	0.96% 0.30% 0.96%	0.98% 0.30% 0.70%	Level 4 (16.2 m)
3.88%	0.40% 0.60% 0.49%	0.48% 0.44% 0.48%	0.49% 0.60% 0.40%	
	0.83% 0.30% 1.04%	1.03% 0.30% 1.03%	1.04% 0.30% 0.83%	Level 3 (12.3 m)
2.03%	0.42% 0.56% 0.52%	0.52% 0.45% 0.52%	0.52% 0.56% 0.42%	
	0.93% 0.30% 1.09%	1.08% 0.30% 1.08%	1.09% 0.30% 0.93%	Level 2 (8.4 m)
2.71%	0.47% 0.53% 0.55%	0.54% 0.45% 0.54%	0.55% 0.53% 0.47%	
	0.88% 0.30% 1.14%	1.09% 0.30% 1.09%	1.14% 0.30% 0.88%	Level 1 (4.5 m)
3.19%	0.44% 0.55% 0.57%	0.54% 0.44% 0.54%	0.57% 0.55% 0.44%	
				Level 0 (0.0 m)

Fig. 6b. Required longitudinal reinforcement for building ID 2453

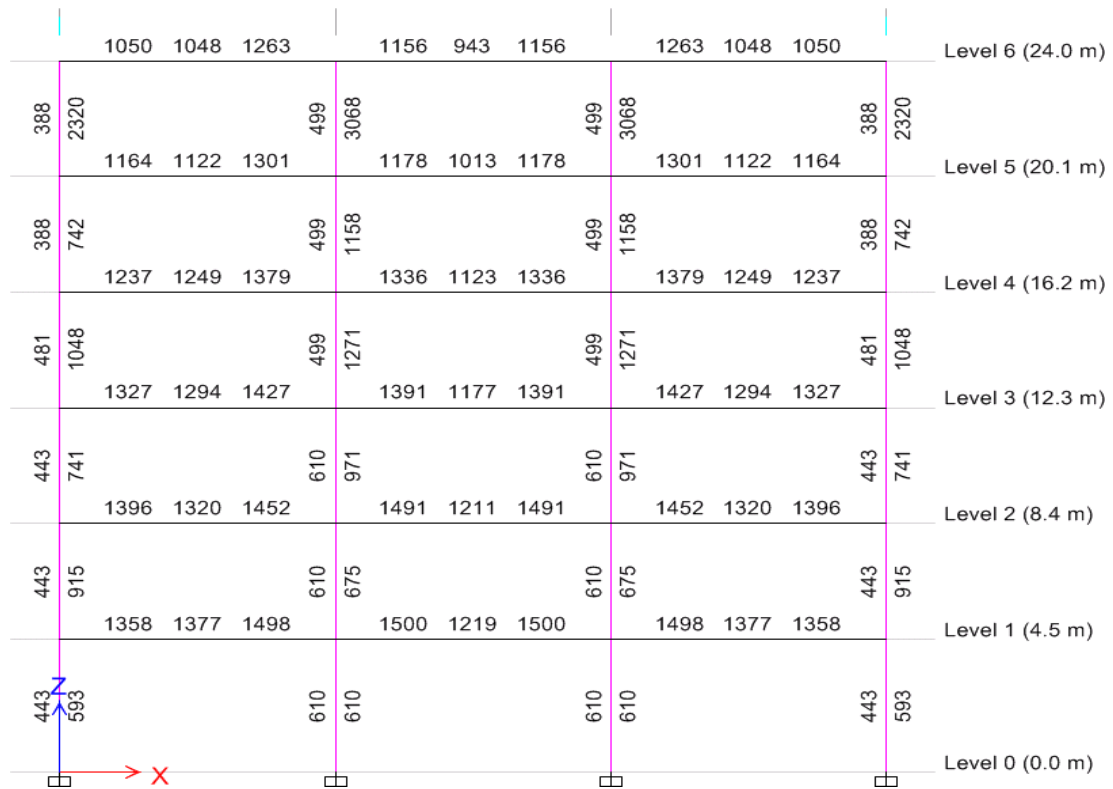


Fig. 6c. Required transverse reinforcement for building ID 2453

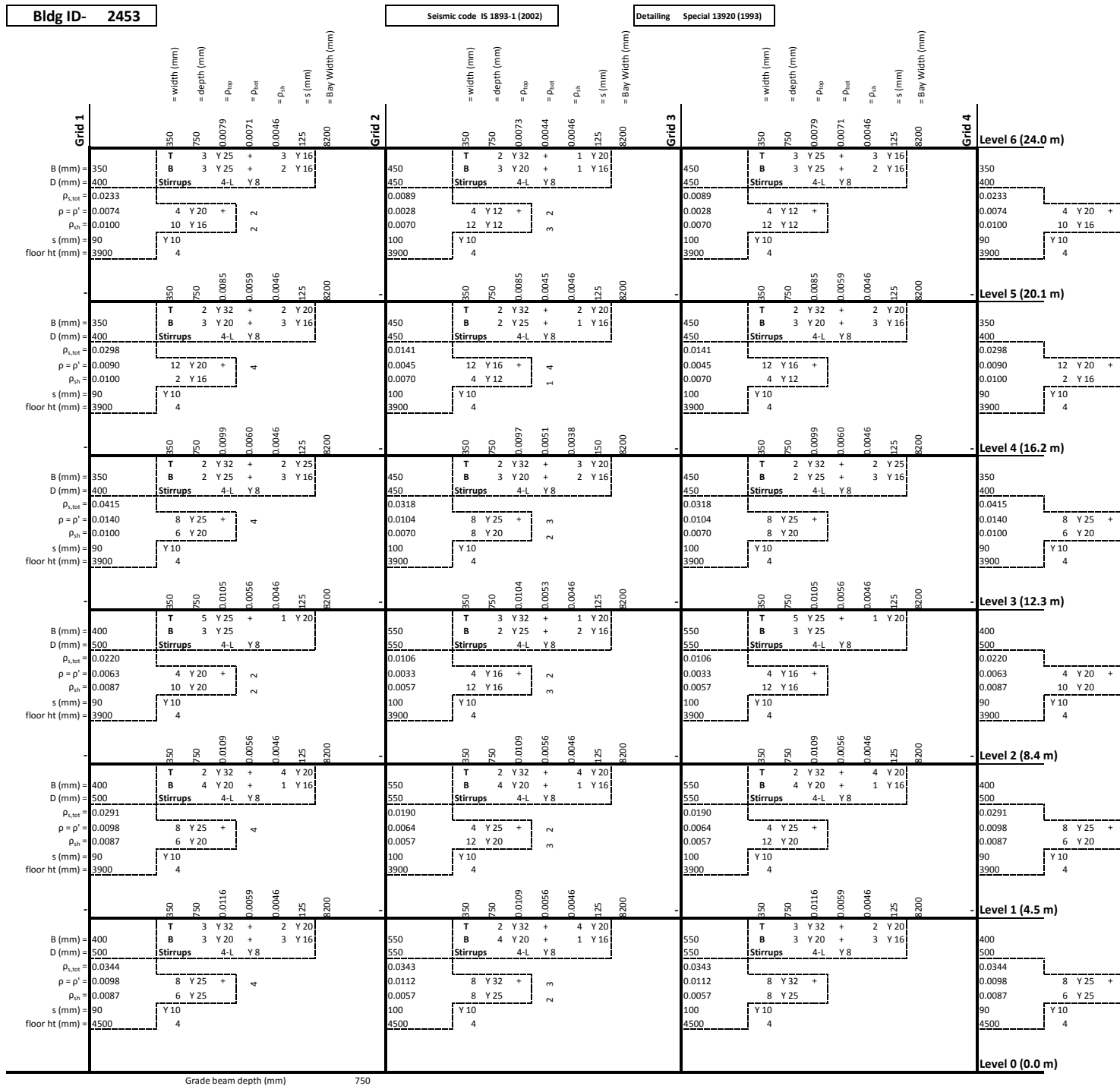


Fig. 6d. Provided reinforcement and modeling details for building ID 2453

7.1. General building configuration and loading inputs

Building Id:	2215
No of stories:	7
No of Bays:	3
Seismic zone (as per IS 1893-1):	IV
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	2.55 sec

7.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

7.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.24
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	27.9 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.91 sec
Time period, $T_{a,Y}$:	0.91 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.10
Avrg response accn coeff, $(S_a/g)_y$:	1.10
Design Seis. coeff, $(A_h)_x$:	0.0264
Design Seis. coeff, $(A_h)_y$:	0.0264



Fig. 7a. Beam column sizes for building ID 2215

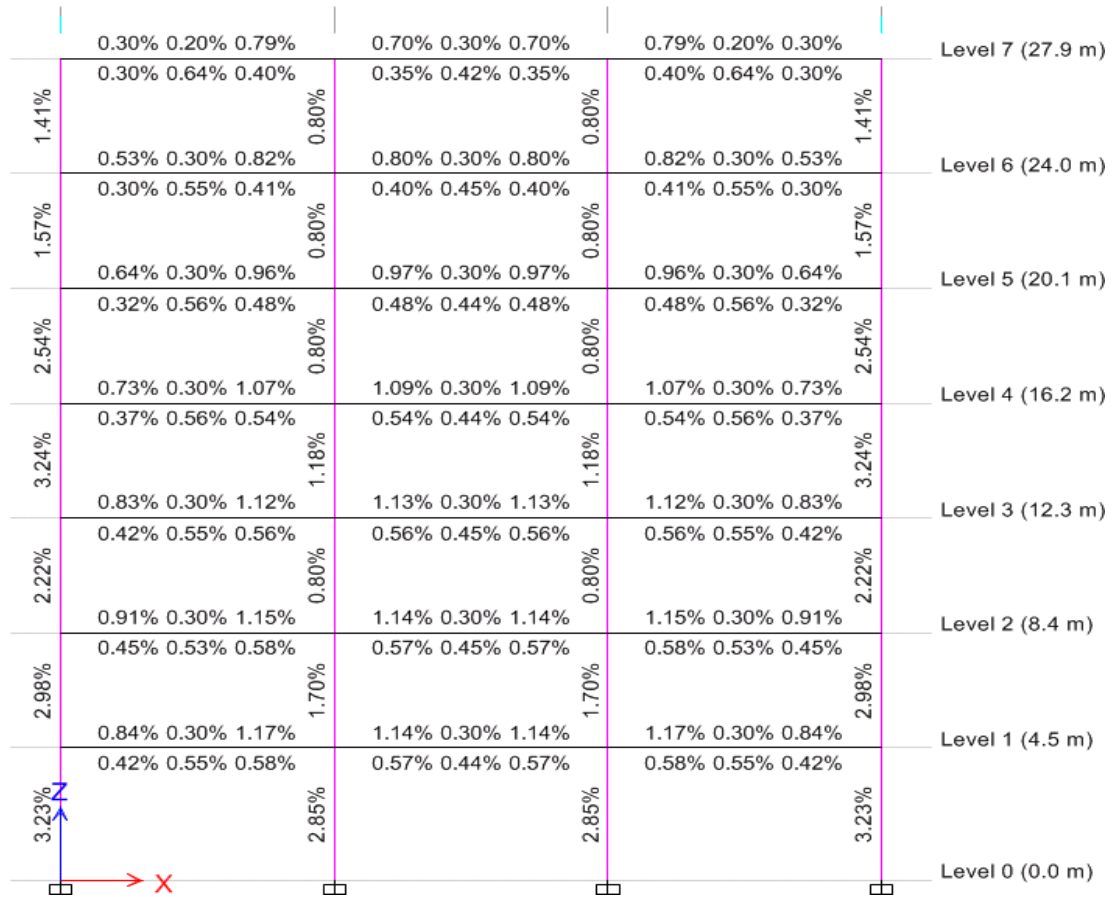


Fig. 7b. Required longitudinal reinforcement for building ID 2215

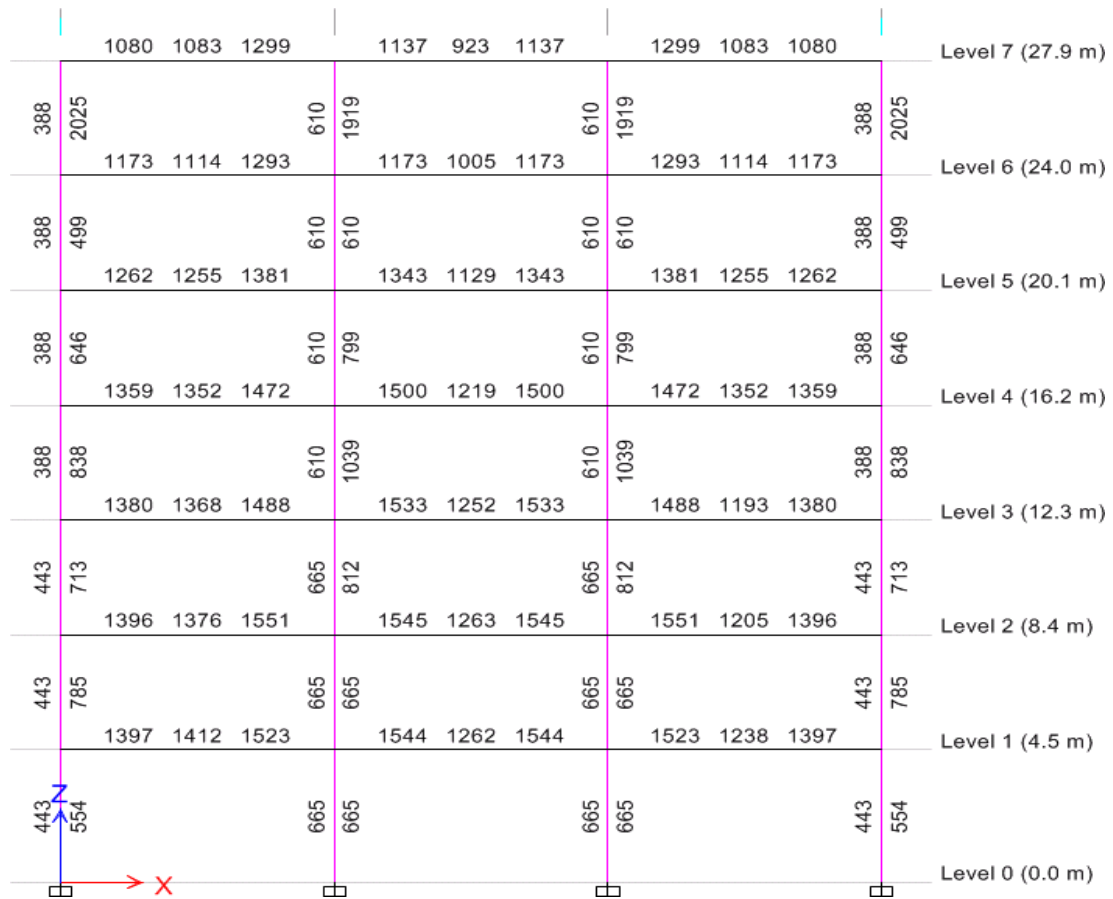


Fig. 7c. Required transverse reinforcement for building ID 2215

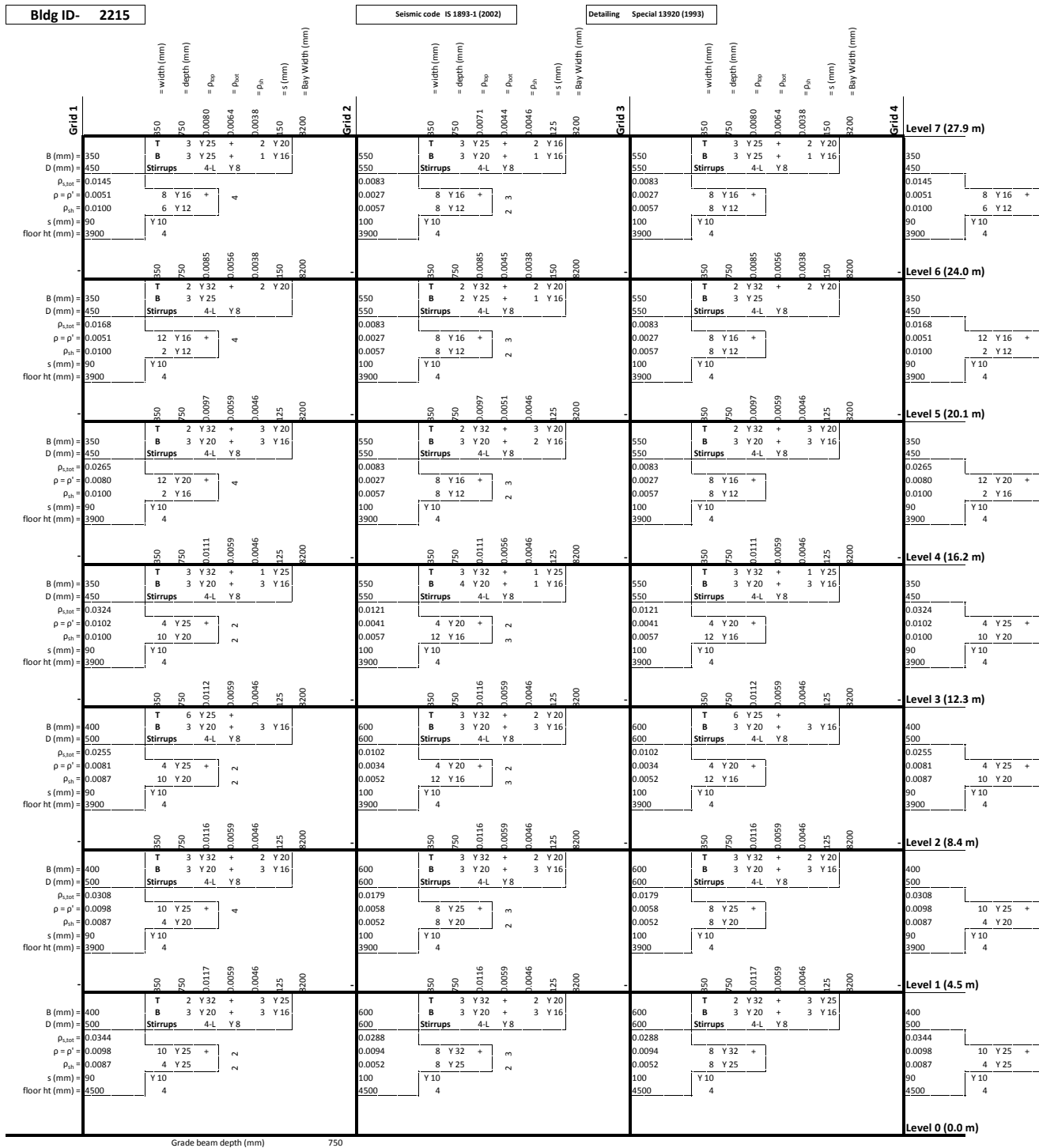


Fig. 7d. Provided reinforcement and modeling details for building ID 2215

8.1. General building configuration and loading inputs

Building Id:	2217
No of stories:	12
No of Bays:	3
Seismic zone (as per IS 1893-1):	IV
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	3.90 sec

8.2. Material and modeling details

Column conc grade, f_{ck} :	50 MPa
Column conc expected, $f_{ck,exp}$:	58.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	32048.2 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

8.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.24
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	47.4 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	1.35 sec
Time period, $T_{a,Y}$:	1.35 sec
Avrg response accn coeff, $(S_a/g)_x$:	0.74
Avrg response accn coeff, $(S_a/g)_y$:	0.74
Design Seis. coeff, $(A_h)_x$:	0.0177
Design Seis. coeff, $(A_h)_y$:	0.0177

	B400X750	B400X750	B400X750	Level 12 (47.4 m)
400X450	B400X750	B400X750	B400X750	Level 11 (43.5 m)
400X450	B400X750	B400X750	B400X750	Level 10 (39.6 m)
400X450	B400X750	B400X750	B400X750	Level 9 (35.7 m)
400X450	B400X750	B400X750	B400X750	Level 8 (31.8 m)
450X500	B400X750	B400X750	B400X750	Level 7 (27.9 m)
450X500	B400X750	B400X750	B400X750	Level 6 (24.0 m)
450X500	B400X750	B400X750	B400X750	Level 5 (20.1 m)
450X500	B400X750	B400X750	B400X750	Level 4 (16.2 m)
450X600	B400X750	B400X750	B400X750	Level 3 (12.3 m)
450X600	B400X750	B400X750	B400X750	Level 2 (8.4 m)
450X600	B400X750	B400X750	B400X750	Level 1 (4.5 m)
450X600				Level 0 (0.0 m)

Fig. 8a. Beam column sizes for building ID 2217

	0.30% 0.15% 0.59%	0.60% 0.15% 0.60%	0.59% 0.15% 0.30%	Level 12 (47.4 m)
1.31%	0.30% 0.56% 0.30% 0.51% 0.14% 0.55%	0.30% 0.39% 0.30% 0.64% 0.30% 0.64%	0.30% 0.56% 0.30% 0.55% 0.14% 0.51%	Level 11 (43.5 m)
0.85%	0.30% 0.49% 0.30% 0.58% 0.30% 0.66%	0.32% 0.41% 0.32% 0.75% 0.30% 0.75%	0.30% 0.49% 0.30% 0.66% 0.30% 0.58%	Level 10 (39.6 m)
0.99%	0.30% 0.50% 0.33% 0.67% 0.30% 0.77%	0.37% 0.40% 0.37% 0.84% 0.30% 0.84%	0.33% 0.50% 0.30% 0.77% 0.30% 0.67%	Level 9 (35.7 m)
1.55%	0.34% 0.50% 0.38% 0.74% 0.30% 0.83%	0.42% 0.40% 0.42% 0.92% 0.30% 0.92%	0.38% 0.50% 0.34% 0.83% 0.30% 0.74%	Level 8 (31.8 m)
0.80%	0.37% 0.48% 0.42% 0.81% 0.30% 0.89%	0.46% 0.40% 0.46% 1.00% 0.30% 1.00%	0.42% 0.48% 0.37% 0.89% 0.30% 0.81%	Level 7 (27.9 m)
1.20%	0.40% 0.47% 0.45% 0.84% 0.30% 0.96%	0.50% 0.40% 0.50% 1.05% 0.30% 1.05%	0.45% 0.47% 0.40% 0.96% 0.30% 0.84%	Level 6 (24.0 m)
1.77%	0.42% 0.47% 0.48% 0.86% 0.30% 1.01%	0.52% 0.40% 0.52% 1.08% 0.30% 1.08%	0.48% 0.47% 0.42% 1.01% 0.30% 0.86%	Level 5 (20.1 m)
2.28%	0.43% 0.47% 0.51% 0.89% 0.30% 1.02%	0.54% 0.39% 0.54% 1.07% 0.30% 1.07%	0.51% 0.47% 0.43% 1.02% 0.30% 0.89%	Level 4 (16.2 m)
1.40%	0.44% 0.45% 0.51% 0.92% 0.30% 1.03%	0.54% 0.39% 0.54% 1.08% 0.30% 1.08%	0.51% 0.45% 0.44% 1.03% 0.30% 0.92%	Level 3 (12.3 m)
1.89%	0.46% 0.44% 0.52% 0.92% 0.30% 1.04%	0.54% 0.39% 0.54% 1.07% 0.30% 1.07%	0.52% 0.44% 0.46% 1.04% 0.30% 0.92%	Level 2 (8.4 m)
2.65%	0.46% 0.44% 0.52% 0.83% 0.30% 1.02%	0.53% 0.39% 0.53% 1.01% 0.30% 1.01%	0.52% 0.44% 0.46% 1.02% 0.30% 0.83%	Level 1 (4.5 m)
3.14%	0.42% 0.45% 0.51% 2.91%	0.50% 0.39% 0.50% 2.91%	0.51% 0.45% 0.42% 3.14%	Level 0 (0.0 m)

Fig. 8b. Required longitudinal reinforcement for building ID 2217

	982	875	1121		1082	854	1082		1121	875	982		Level 12 (47.4 m)
443	1498			554	1916			554	1916			443	1498
	1079	867	1110		1117	902	1117		1110	867	1079		Level 11 (43.5 m)
443	755			554	554			554	554			443	755
	1124	988	1205		1209	993	1209		1205	988	1124		Level 10 (39.6 m)
443	768			554	816			554	816			443	768
	1214	1106	1285		1292	1077	1292		1285	1106	1214		Level 9 (35.7 m)
443	854			554	952			554	952			443	854
	1294	1183	1380		1437	1152	1437		1380	1072	1294		Level 8 (31.8 m)
499	613			665	665			665	665			499	613
	1363	1232	1430		1503	1219	1503		1430	1154	1363		Level 7 (27.9 m)
499	687			665	665			665	665			499	687
	1395	1288	1487		1544	1260	1544		1487	1176	1395		Level 6 (24.0 m)
499	738			665	665			665	665			499	738
	1413	1337	1535		1575	1291	1575		1535	1185	1413		Level 5 (20.1 m)
499	778			665	665			665	665			499	778
	1439	1357	1544		1573	1253	1573		1544	1229	1439		Level 4 (16.2 m)
499	665			776	776			776	776			499	665
	1465	1373	1551		1578	1259	1578		1551	1272	1465		Level 3 (12.3 m)
499	665			776	776			776	776			499	665
	1457	1379	1556		1569	1250	1569		1556	1262	1457		Level 2 (8.4 m)
499	665			776	776			776	776			499	665
	1400	1379	1528		1518	1198	1518		1528	1213	1400		Level 1 (4.5 m)
499	665			776	776			776	776			499	665
													Level 0 (0.0 m)

Fig. 8c. Required transverse reinforcement for building ID 2217

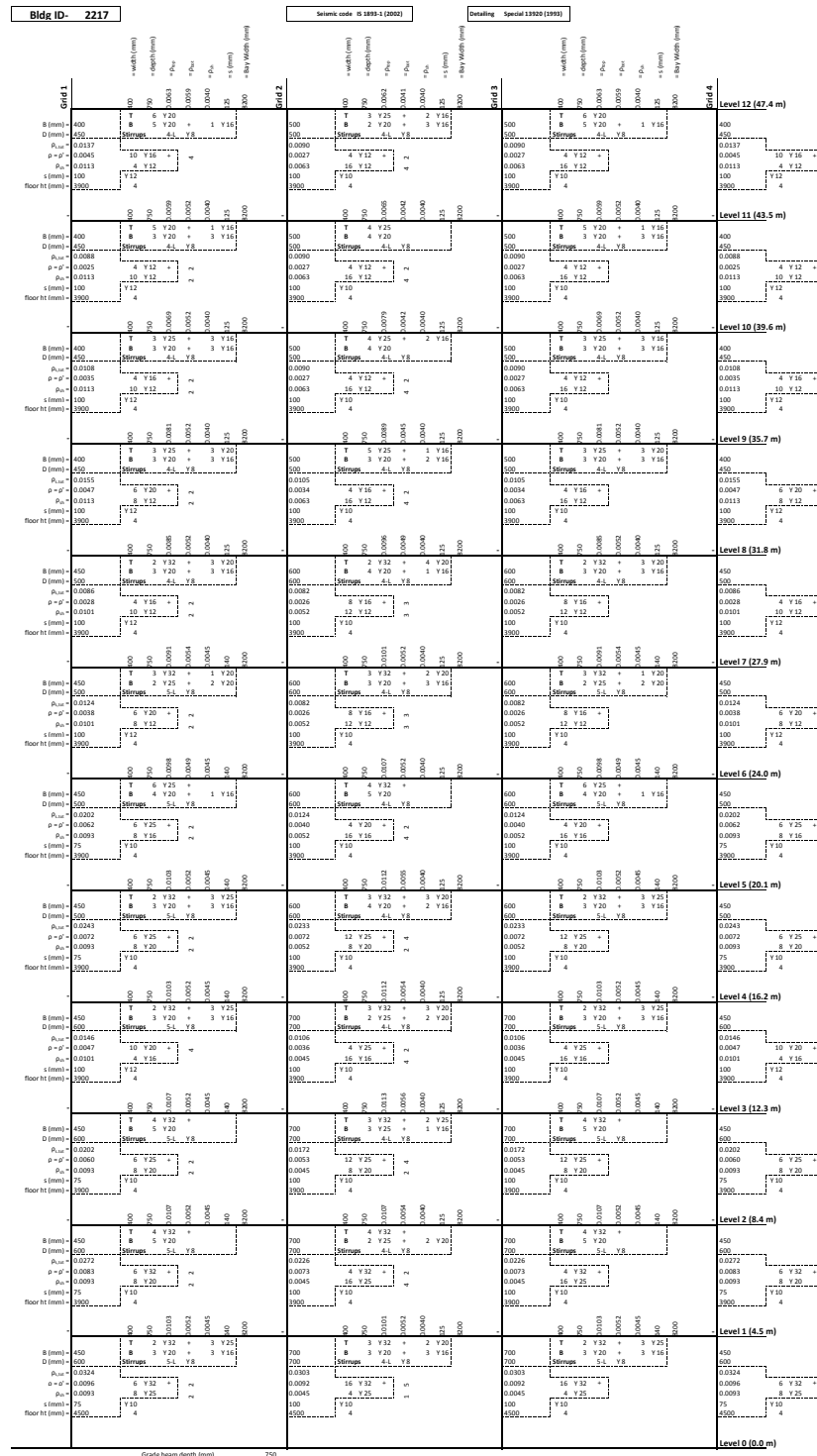


Fig. 8d. Provided reinforcement and modeling details for building ID 2217

9.1. General building configuration and loading inputs

Building Id:	2219
No of stories:	2
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	0.96 sec

9.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

9.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	8.4 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.37 sec
Time period, $T_{a,Y}$:	0.37 sec
Avrg response accn coeff, $(S_a/g)_x$:	2.50
Avrg response accn coeff, $(S_a/g)_y$:	2.50
Design Seis. coeff, $(A_h)_x$:	0.0900
Design Seis. coeff, $(A_h)_y$:	0.0900

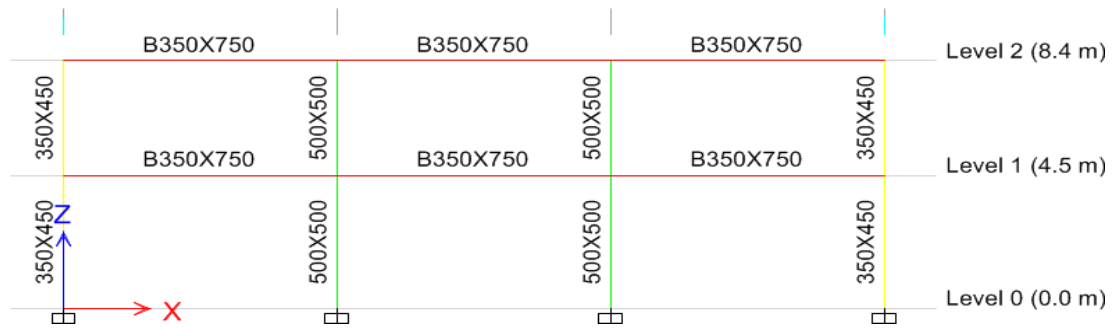


Fig. 9a. Beam column sizes for building ID 2219

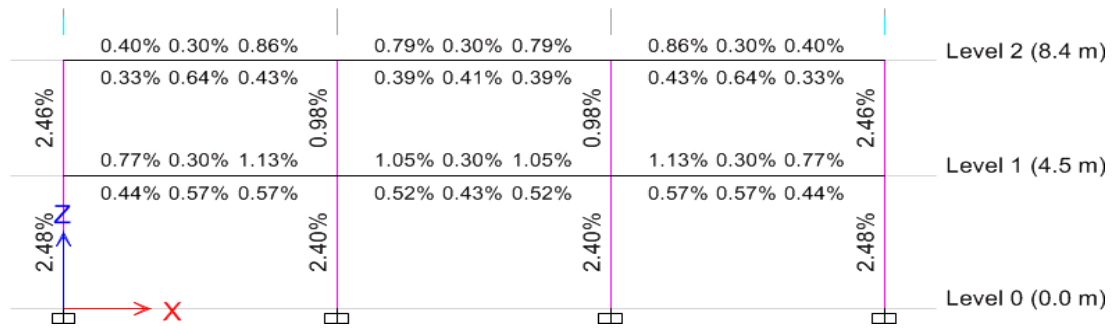


Fig. 9b. Required longitudinal reinforcement for building ID 2219

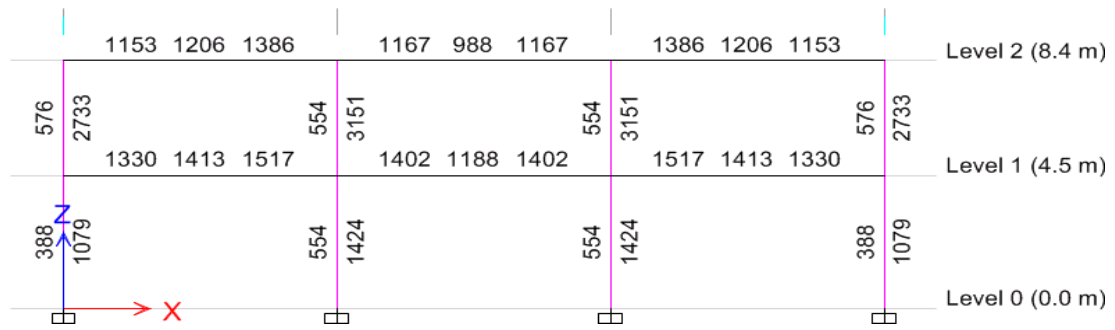


Fig. 9c. Required transverse reinforcement for building ID 2219

Bldg ID- 2219

Seismic code IS 1893-1 (2002)

Detailing Special 13920 (1993)

Grid 1	= width (mm)							= depth (mm)							= ρ_{top}							= ρ_{bot}							= ρ_{sh}							= s (mm)							= Bay Width (mm)													
	350							750							0.0087							0.0064							0.0046							125							8200													
B (mm) =	350							4 Y 25							+							1 Y 20																																		
D (mm) =	450							Stirrups							4-L Y 8																																									
$\rho_{s,tot}$ =	0.0251																																																							
$\rho = \rho'$ =	0.0080							10 Y 20							+																																									
ρ_{sh} =	0.0100							4 Y 16																																																
s (mm) =	90							Y 10																																																
floor ht (mm) =	3900							4																																																
Grid 2	= width (mm)							= depth (mm)							= ρ_{top}							= ρ_{bot}							= ρ_{sh}							= s (mm)							= Bay Width (mm)													
	350							750							0.0079							0.0045							0.0046							125							8200													
B (mm) =	500							3 Y 25							+							3 Y 16																																		
D (mm) =	500							Stirrups							4-L Y 8																																									
$\rho_{s,tot}$ =	0.0105																																																							
$\rho = \rho'$ =	0.0034							4 Y 16							+																																									
ρ_{sh} =	0.0079							16 Y 12														4 2																																		
s (mm) =	100							Y 10																																																
floor ht (mm) =	3900							5																																																
Grid 3	= width (mm)							= depth (mm)							= ρ_{top}							= ρ_{bot}							= ρ_{sh}							= s (mm)							= Bay Width (mm)													
	350							750							0.0087							0.0064							0.0046							125							8200													
B (mm) =	500							4 Y 25							+							1 Y 20																																		
D (mm) =	500							Stirrups							4-L Y 8																																									
$\rho_{s,tot}$ =	0.0105																																																							
$\rho = \rho'$ =	0.0034							4 Y 16							+																																									
ρ_{sh} =	0.0079							16 Y 12																																																
s (mm) =	100							Y 10																																																
floor ht (mm) =	3900							5																																																
Grid 4	= width (mm)							= depth (mm)							= ρ_{top}							= ρ_{bot}							= ρ_{sh}							= s (mm)							= Bay Width (mm)													
	350							750							0.0087							0.0064							0.0046							125							8200													
B (mm) =	500							4 Y 25							+							1 Y 20																																		
D (mm) =	500							Stirrups							4-L Y 8																																									
$\rho_{s,tot}$ =	0.0105																																																							
$\rho = \rho'$ =	0.0034							4 Y 16							+																																									
ρ_{sh} =	0.0079							16 Y 12																																																
s (mm) =	100							Y 10																																																
floor ht (mm) =	3900							5																																																
Level 2 (8.4 m)																																																								
B (mm) =	350							4 Y 25							+							1 Y 20																																		
D (mm) =	450							Stirrups							4-L Y 8																																									
$\rho_{s,tot}$ =	0.0251																																																							
$\rho = \rho'$ =	0.0080							10 Y 20							+																																									
ρ_{sh} =	0.0100							4 Y 16																																																
s (mm) =	90							Y 10																																																
floor ht (mm) =	3900							4																																																
Level 1 (4.5 m)																																																								
B (mm) =	350							3 Y 32							+							2 Y 20																																		
D (mm) =	450							Stirrups							4-L Y 8																																									
$\rho_{s,tot}$ =	0.0251																																																							
$\rho = \rho'$ =	0.0080							10 Y 20							+																																									
ρ_{sh} =	0.0100							4 Y 16																																																
s (mm) =	90							Y 10																																																
floor ht (mm) =	4500							4																																																
Level 0 (0.0 m)																																																								
Grade beam depth (mm)																																																								
500																																																								

Fig. 9d. Provided reinforcement and modeling details for building ID 2219

10.1. General building configuration and loading inputs

Building Id:	2221
No of stories:	4
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	1.55 sec

10.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

10.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	16.2 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.61 sec
Time period, $T_{a,Y}$:	0.61 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.65
Avrg response accn coeff, $(S_a/g)_y$:	1.65
Design Seis. coeff, $(A_h)_x$:	0.0594
Design Seis. coeff, $(A_h)_y$:	0.0594

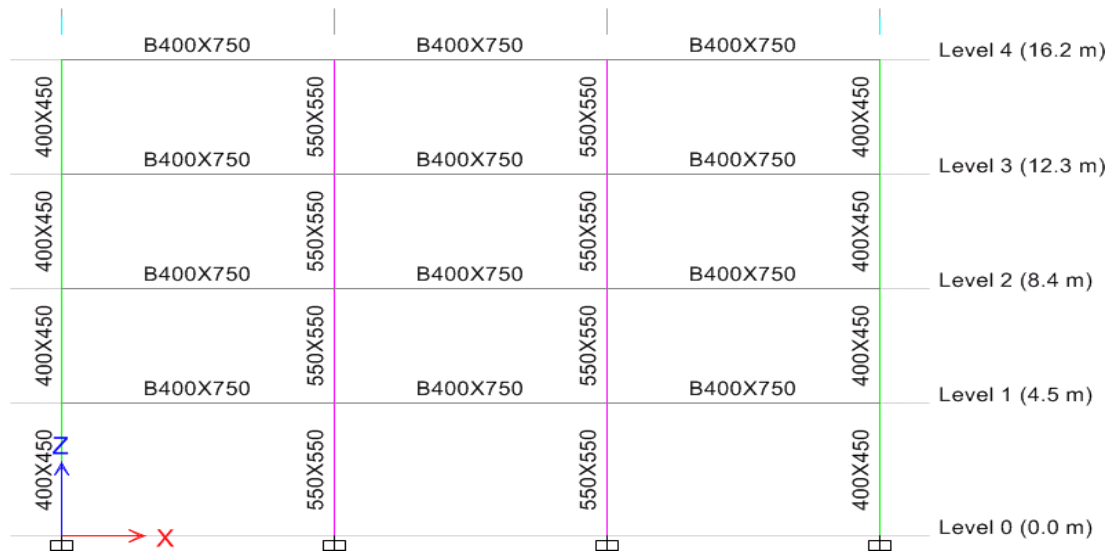


Fig. 10a. Beam column sizes for building ID 2221

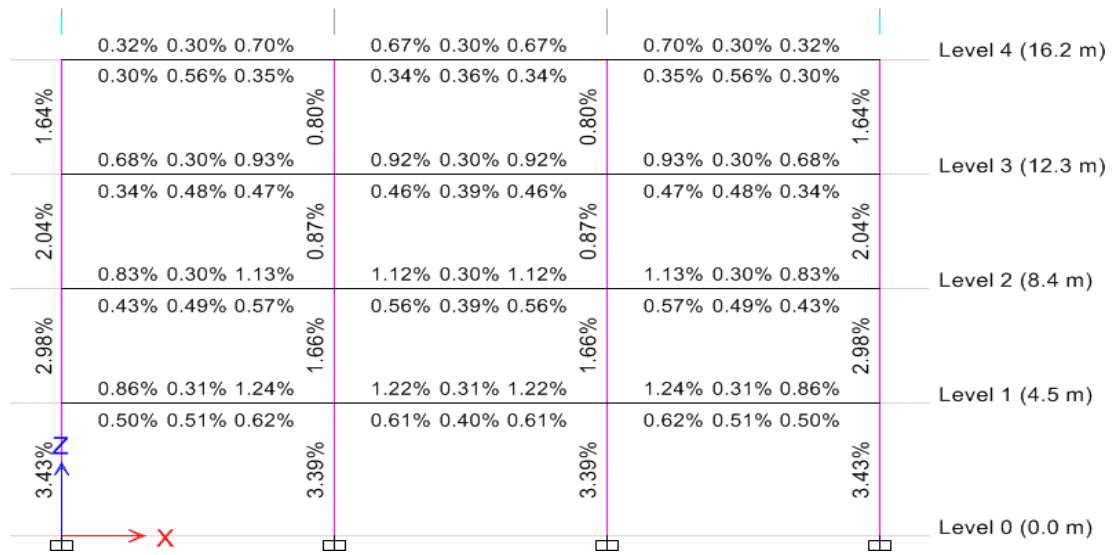


Fig. 10b. Required longitudinal reinforcement for building ID 2221



Fig. 10c. Required transverse reinforcement for building ID 2221

Grid 1	= width (mm) = depth (mm) = ρ_{top} = ρ_{bot} = ρ_{sh} = s (mm) = Bay Width (mm)							Grid 2	= width (mm) = depth (mm) = ρ_{top} = ρ_{bot} = ρ_{sh} = s (mm) = Bay Width (mm)							Grid 3	= width (mm) = depth (mm) = ρ_{top} = ρ_{bot} = ρ_{sh} = s (mm) = Bay Width (mm)							Grid 4											
	400 750 0.0072 0.0056 0.0040 125 8200								400 750 0.0069 0.0039 0.0040 125 8200								400 750 0.0072 0.0056 0.0040 125 8200																		
B (mm) = 400 D (mm) = 450 $\rho_{s,tot}$ = 0.0165 $\rho = \rho'$ = 0.0070 ρ_{sh} = 0.0105 s (mm) = 75 floor ht (mm) = 3900	T 4 Y 25 + 1 Y 16 B 3 Y 25 + 1 Y 16 Stirrups 4-L Y 8							550 550 0.0083 0.0027 0.0057 100 3900	T 3 Y 25 + 3 Y 16 B 2 Y 25 + 1 Y 16 Stirrups 4-L Y 8							550 550 0.0083 0.0027 0.0057 100 3900	T 4 Y 25 + 1 Y 16 B 3 Y 25 + 1 Y 16 Stirrups 4-L Y 8							400 450 0.0165 0.0070 0.0105 75 3900	8 Y 20 + 4 Y 12 Y 10										
B (mm) = 400 D (mm) = 450 $\rho_{s,tot}$ = 0.0209 $\rho = \rho'$ = 0.0070 ρ_{sh} = 0.0105 s (mm) = 75 floor ht (mm) = 3900	T 5 Y 25 + 2 Y 16 B 4 Y 20 + 1 Y 16 Stirrups 4-L Y 8							550 550 0.0098 0.0035 0.0076 75 3900	T 5 Y 25 + 1 Y 20 B 2 Y 25 + 2 Y 16 Stirrups 4-L Y 8							550 550 0.0098 0.0035 0.0076 75 3900	T 5 Y 25 + 2 Y 16 B 4 Y 20 + 1 Y 16 Stirrups 4-L Y 8							400 450 0.0209 0.0070 0.0105 75 3900	4 Y 20 + 8 Y 20 Y 10										
B (mm) = 400 D (mm) = 450 $\rho_{s,tot}$ = 0.0303 $\rho = \rho'$ = 0.0089 ρ_{sh} = 0.0105 s (mm) = 75 floor ht (mm) = 3900	T 3 Y 32 + 2 Y 25 B 5 Y 20 + 1 Y 16 Stirrups 4-L Y 10							550 550 0.0189 0.0074 0.0076 75 3900	T 3 Y 32 + 2 Y 25 B 5 Y 20 + 1 Y 16 Stirrups 4-L Y 8							550 550 0.0189 0.0074 0.0076 75 3900	T 3 Y 32 + 2 Y 25 B 5 Y 20 + 1 Y 16 Stirrups 4-L Y 10							400 450 0.0303 0.0089 0.0105 75 3900	6 Y 25 + 8 Y 20 Y 10										
B (mm) = 400 D (mm) = 450 $\rho_{s,tot}$ = 0.0353 $\rho = \rho'$ = 0.0124 ρ_{sh} = 0.0105 s (mm) = 75 floor ht (mm) = 4500	T 4 Y 32 + 2 Y 20 B 3 Y 25 + 2 Y 16 Stirrups 4-L Y 10							550 550 0.0343 0.0112 0.0057 100 4500	T 4 Y 32 + 1 Y 25 B 3 Y 25 + 2 Y 16 Stirrups 4-L Y 10							550 550 0.0343 0.0112 0.0057 100 4500	T 4 Y 32 + 2 Y 20 B 3 Y 25 + 2 Y 16 Stirrups 4-L Y 10							400 450 0.0353 0.0124 0.0105 75 4500	4 Y 32 + 10 Y 20 Y 10										
Grade beam depth (mm) 500																																			
Level 0 (0.0 m)																																			

Fig. 10d. Provided reinforcement and modeling details for building ID 2221

11.1. General building configuration and loading inputs

Building Id:	2433
No of stories:	5
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	1.84 sec

11.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

11.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	20.1 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.71 sec
Time period, $T_{a,Y}$:	0.71 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.40
Avrg response accn coeff, $(S_a/g)_y$:	1.40
Design Seis. coeff, $(A_h)_x$:	0.0506
Design Seis. coeff, $(A_h)_y$:	0.0506

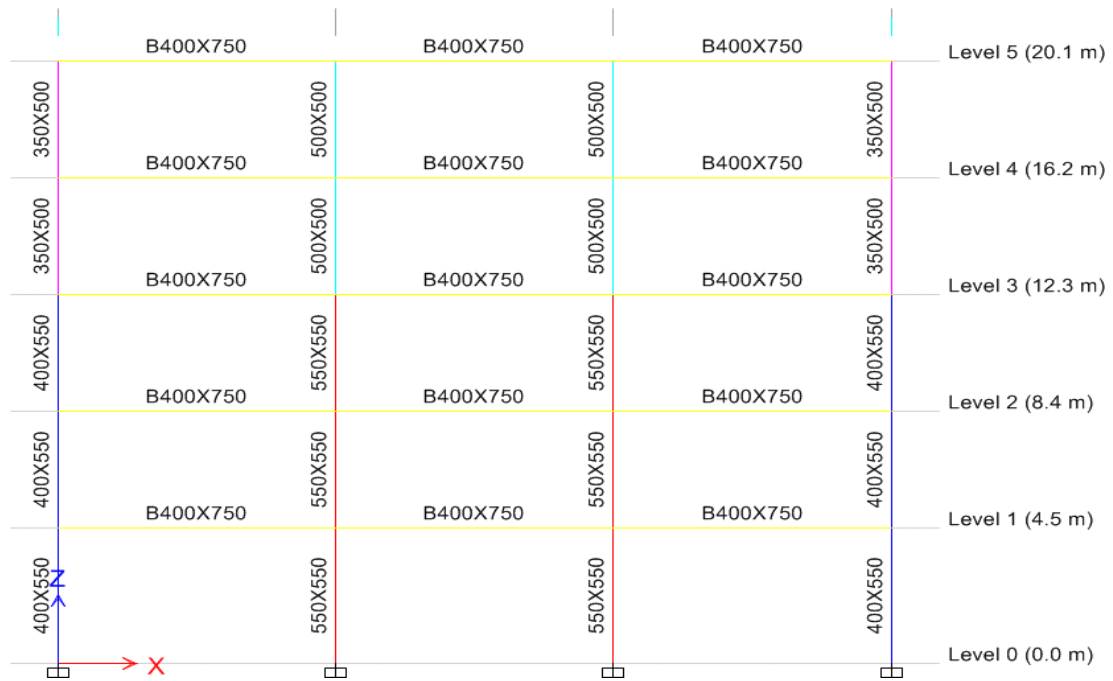


Fig. 11a. Beam column sizes for building ID 2433

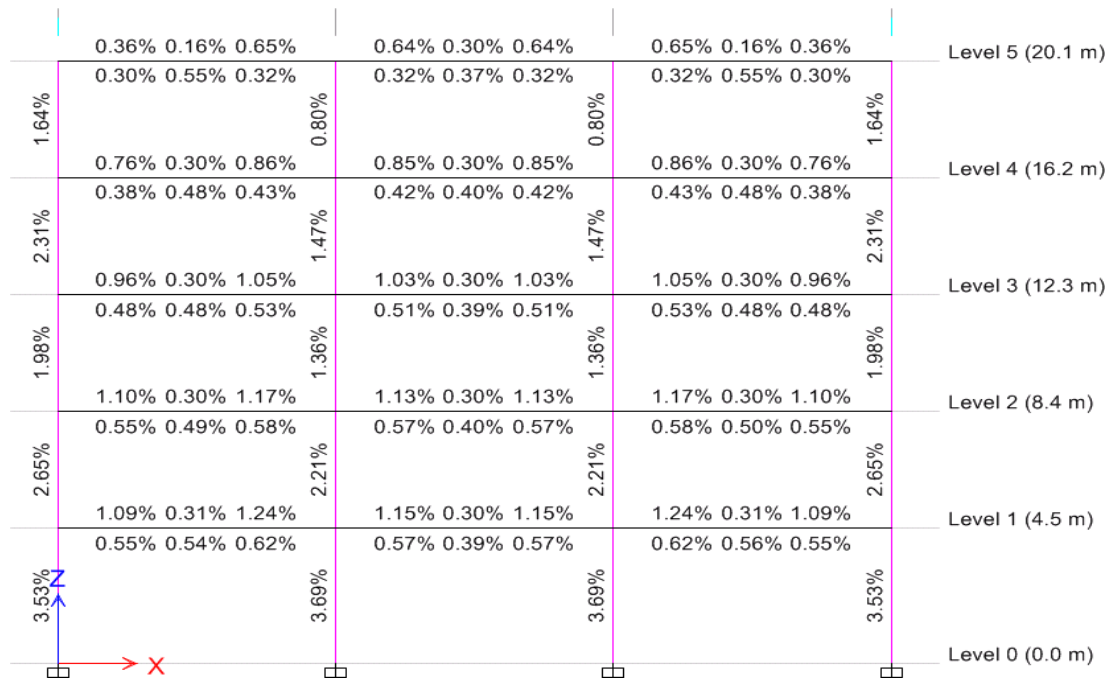


Fig. 11b. Required longitudinal reinforcement for building ID 2433

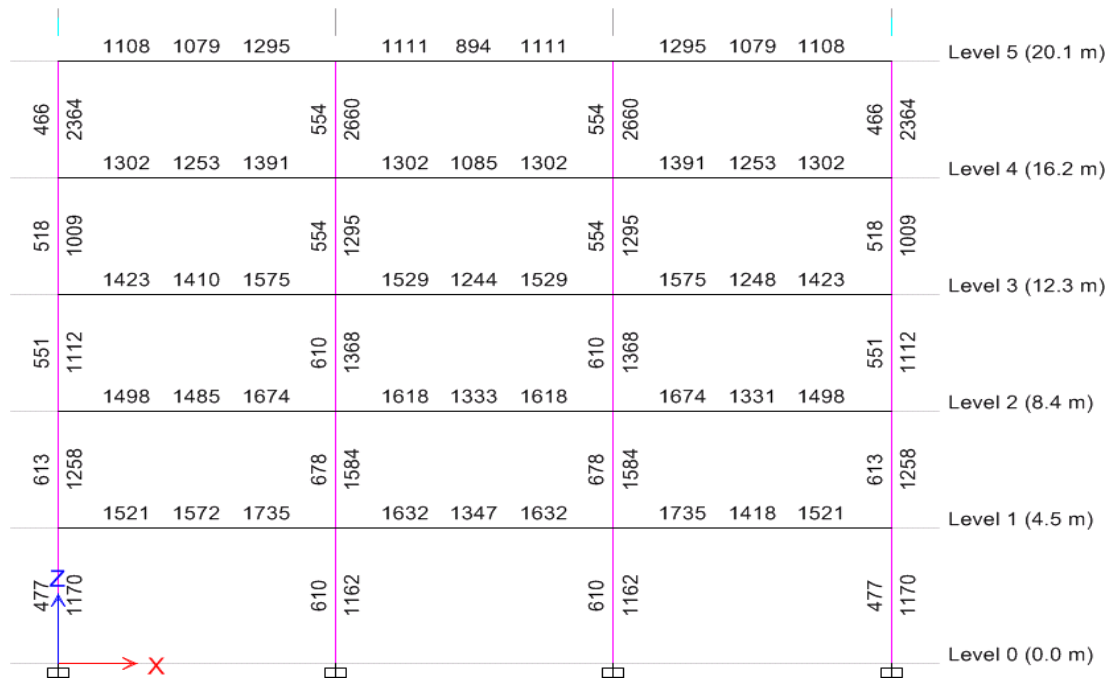


Fig. 11c. Required transverse reinforcement for building ID 2433

Fig. 11d. Provided reinforcement and modeling details for building ID 2433

12.1. General building configuration and loading inputs

Building Id:	2435
No of stories:	6
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	2.10 sec

12.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

12.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	24 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.81 sec
Time period, $T_{a,Y}$:	0.81 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.23
Avrg response accn coeff, $(S_a/g)_y$:	1.23
Design Seis. coeff, $(A_h)_x$:	0.0443
Design Seis. coeff, $(A_h)_y$:	0.0443

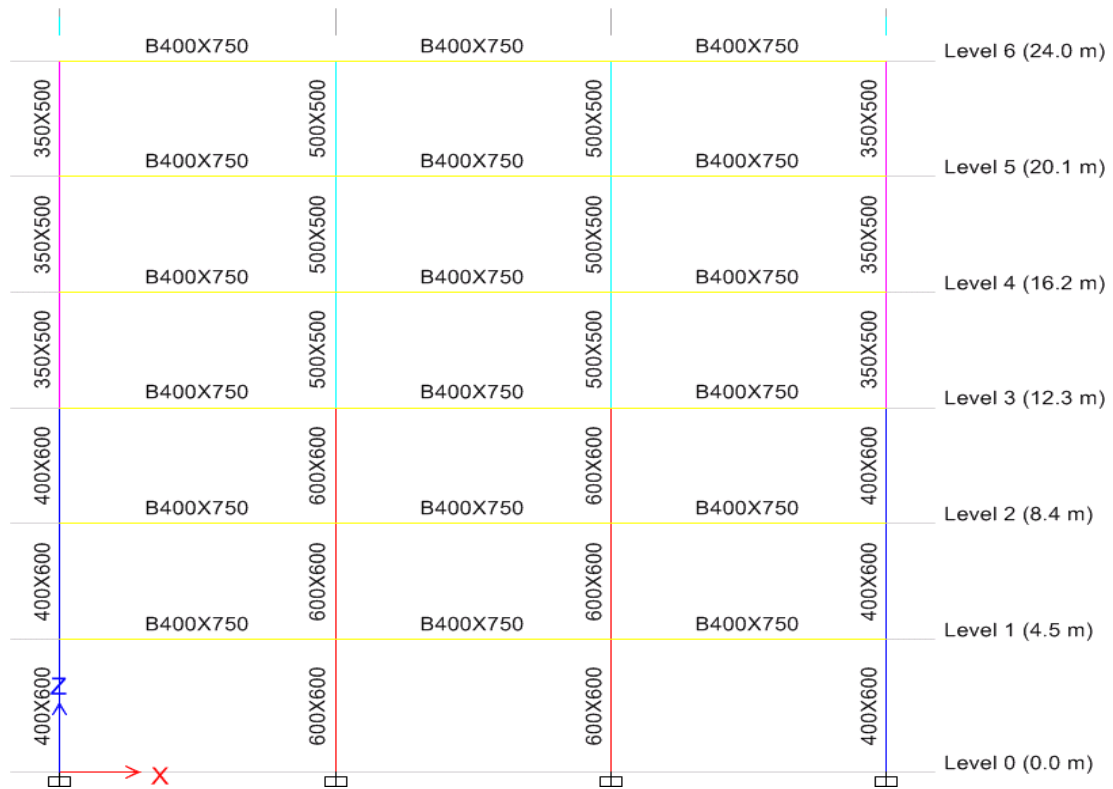


Fig. 12a. Beam column sizes for building ID 2435

		0.34% 0.16% 0.64%	0.63% 0.30% 0.63%	0.64% 0.16% 0.34%	Level 6 (24.0 m)
1.55%		0.30% 0.55% 0.32%	0.31% 0.37% 0.31%	0.32% 0.55% 0.30%	
		0.73% 0.30% 0.82%	0.83% 0.30% 0.83%	0.82% 0.30% 0.73%	Level 5 (20.1 m)
2.30%		0.36% 0.48% 0.41%	0.41% 0.40% 0.41%	0.41% 0.48% 0.36%	
		0.92% 0.30% 1.04%	1.02% 0.30% 1.02%	1.04% 0.30% 0.92%	Level 4 (16.2 m)
3.05%		0.46% 0.49% 0.52%	0.51% 0.39% 0.51%	0.52% 0.49% 0.46%	
		1.06% 0.30% 1.15%	1.14% 0.30% 1.14%	1.15% 0.30% 1.06%	Level 3 (12.3 m)
1.77%		0.53% 0.50% 0.58%	0.57% 0.39% 0.57%	0.58% 0.50% 0.53%	
		1.15% 0.31% 1.22%	1.21% 0.30% 1.21%	1.22% 0.31% 1.15%	Level 2 (8.4 m)
2.37%		0.57% 0.49% 0.61%	0.61% 0.42% 0.61%	0.61% 0.50% 0.57%	
		1.10% 0.31% 1.25%	1.19% 0.30% 1.19%	1.25% 0.31% 1.10%	Level 1 (4.5 m)
		0.55% 0.52% 0.63%	0.59% 0.40% 0.59%	0.63% 0.54% 0.55%	
3.36%					Level 0 (0.0 m)

Fig. 12b. Required longitudinal reinforcement for building ID 2435

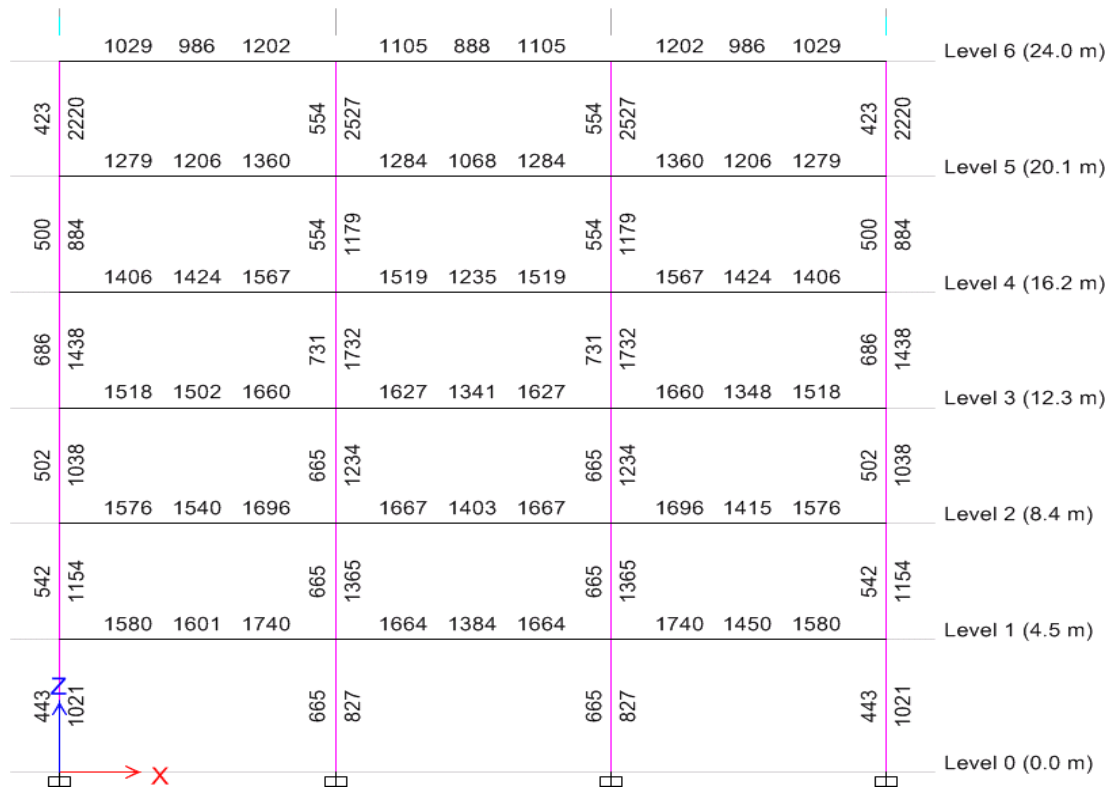


Fig. 12c. Required transverse reinforcement for building ID 2435

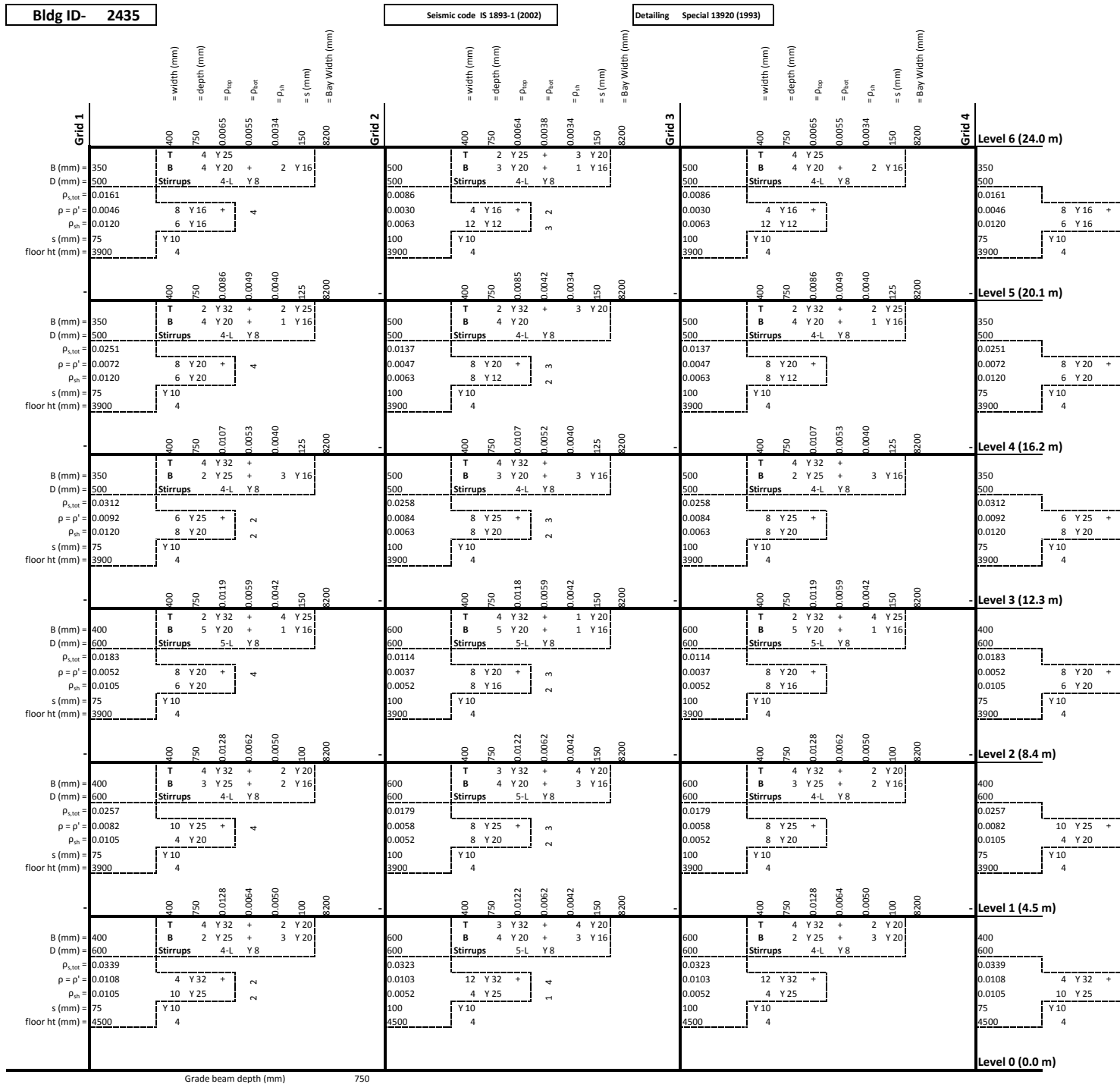


Fig. 12d. Provided reinforcement and modeling details for building ID 2435

13.1. General building configuration and loading inputs

Building Id:	2223
No of stories:	7
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	2.39 sec

13.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

13.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	27.9 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.91 sec
Time period, $T_{a,Y}$:	0.91 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.10
Avrg response accn coeff, $(S_a/g)_y$:	1.10
Design Seis. coeff, $(A_h)_x$:	0.0395
Design Seis. coeff, $(A_h)_y$:	0.0395



Fig. 13a. Beam column sizes for building ID 2223

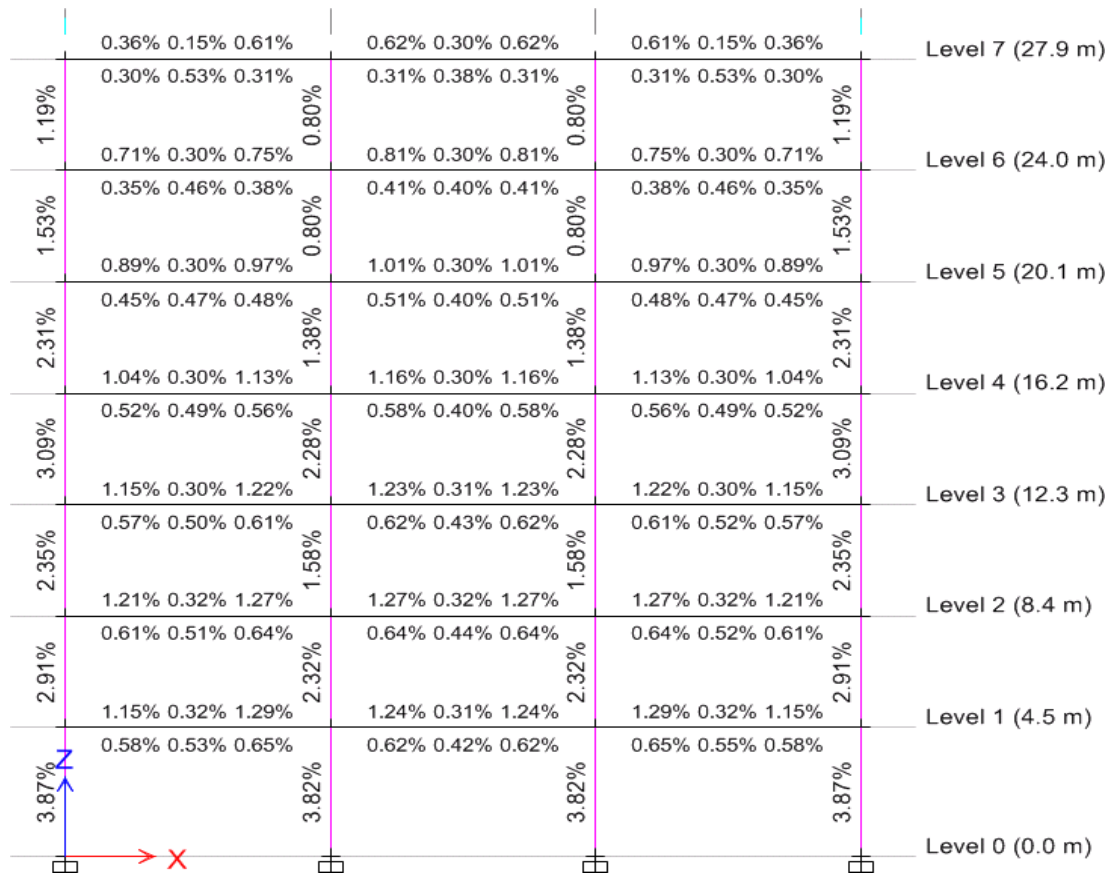


Fig. 13b. Required longitudinal reinforcement for building ID 2223

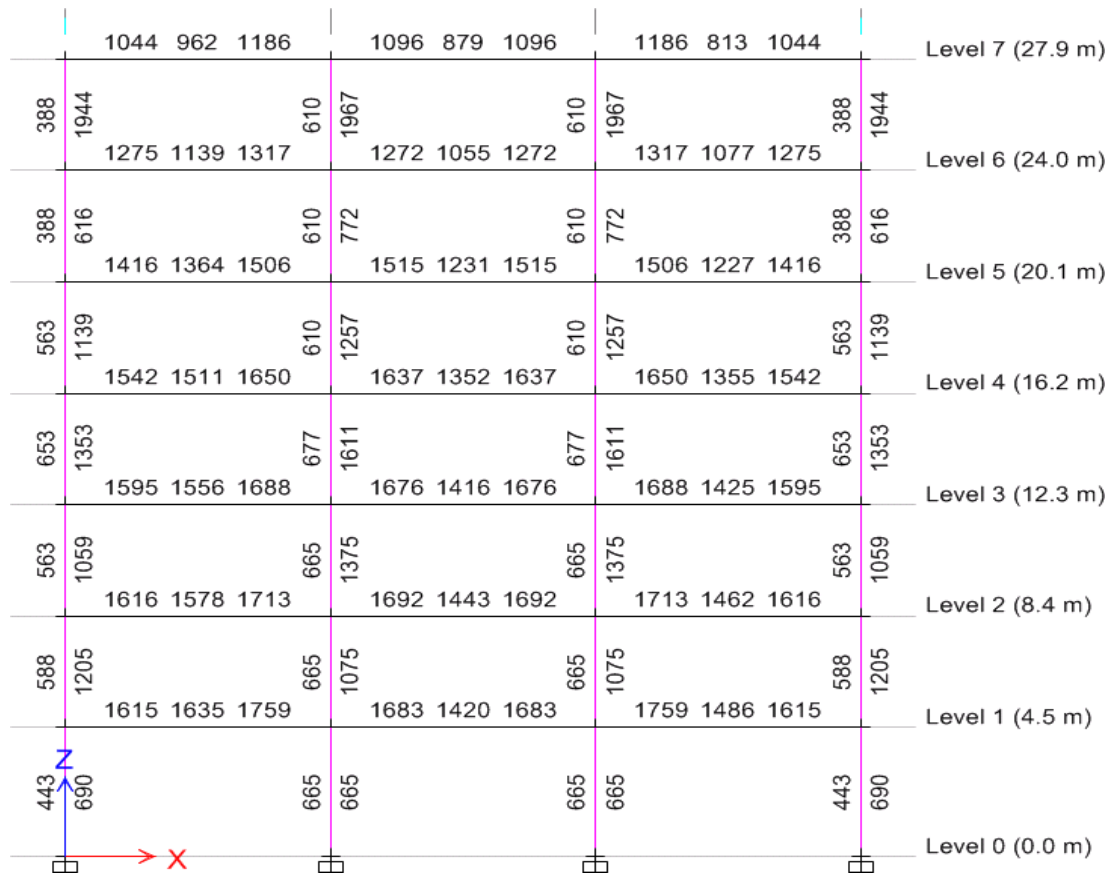


Fig. 13c. Required transverse reinforcement for building ID 2223

Bldg ID- 2223

Seismic code IS 1893-1 (2002)

Detailing Special 13920 (1993)

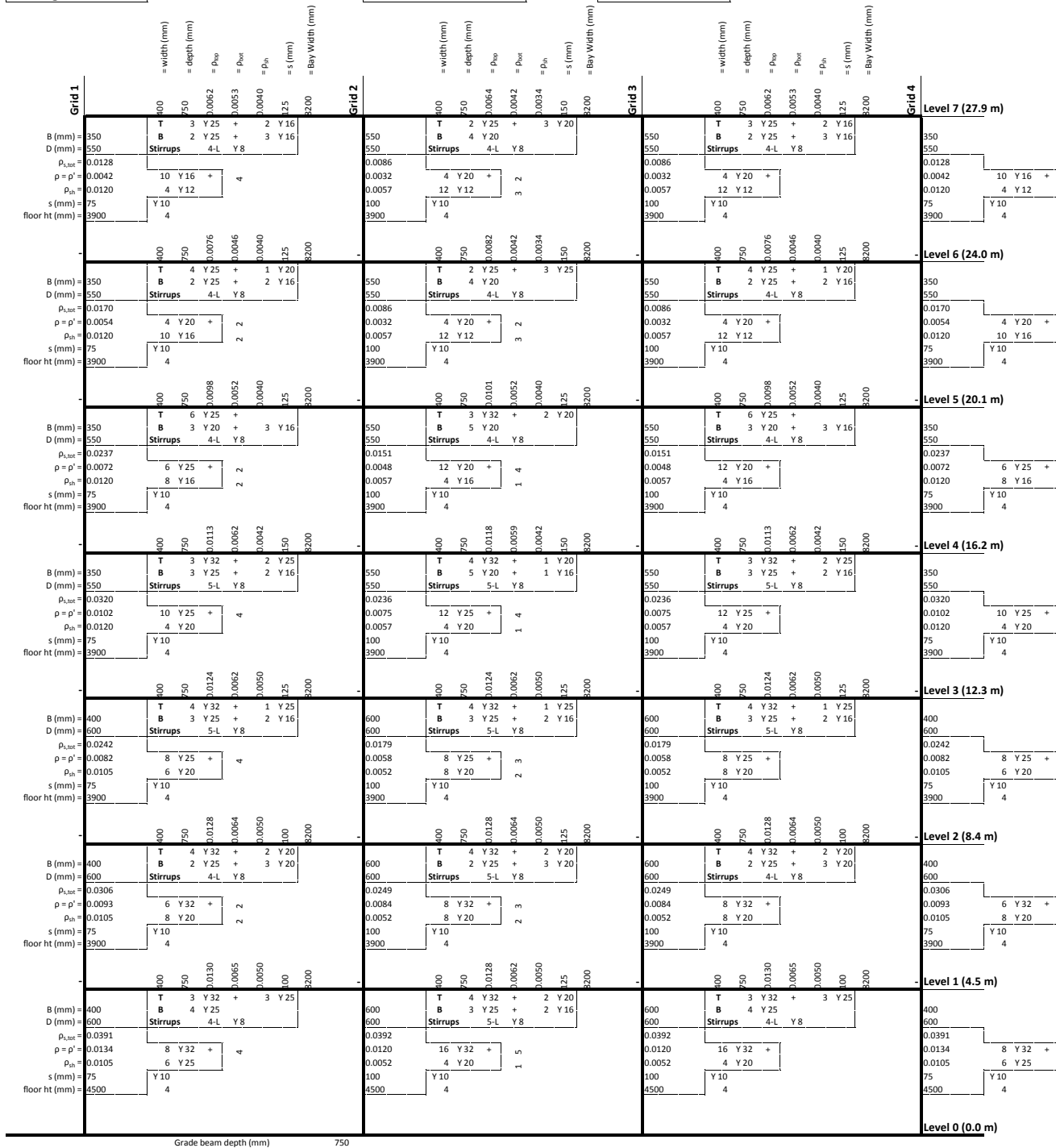


Fig. 13d. Provided reinforcement and modeling details for building ID 2223

14.1. General building configuration and loading inputs

Building Id:	2457
No of stories:	8
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	2.66 sec

14.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

14.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	31.8 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	1.00 sec
Time period, $T_{a,Y}$:	1.00 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.00
Avrg response accn coeff, $(S_a/g)_y$:	1.00
Design Seis. coeff, $(A_h)_x$:	0.0358
Design Seis. coeff, $(A_h)_y$:	0.0358



Fig. 14a. Beam column sizes for building ID 2457

	0.39% 0.15% 0.58%	0.61% 0.30% 0.61%	0.58% 0.15% 0.39%	LEVEL 8 (31.8 m)
0.89%	0.30% 0.52% 0.30%	0.30% 0.39% 0.30%	0.30% 0.52% 0.30%	
	0.72% 0.30% 0.70%	0.78% 0.30% 0.78%	0.70% 0.30% 0.72%	LEVEL 7 (27.9 m)
1.21%	0.36% 0.45% 0.35%	0.39% 0.41% 0.39%	0.35% 0.45% 0.36%	
	0.91% 0.30% 0.90%	0.97% 0.30% 0.97%	0.90% 0.30% 0.91%	LEVEL 6 (24.0 m)
1.73%	0.46% 0.46% 0.45%	0.49% 0.40% 0.49%	0.45% 0.46% 0.46%	
	1.07% 0.30% 1.07%	1.12% 0.30% 1.12%	1.07% 0.30% 1.07%	LEVEL 5 (20.1 m)
2.37%	0.53% 0.47% 0.54%	0.56% 0.40% 0.56%	0.54% 0.47% 0.53%	
	1.18% 0.30% 1.21%	1.22% 0.30% 1.22%	1.21% 0.30% 1.18%	LEVEL 4 (16.2 m)
2.82%	0.59% 0.52% 0.60%	0.61% 0.42% 0.61%	0.60% 0.53% 0.59%	
	1.21% 0.32% 1.27%	1.29% 0.32% 1.29%	1.27% 0.32% 1.21%	LEVEL 3 (12.3 m)
1.75%	0.60% 0.53% 0.63%	0.64% 0.45% 0.64%	0.63% 0.53% 0.60%	
	1.22% 0.33% 1.31%	1.34% 0.33% 1.34%	1.31% 0.33% 1.22%	LEVEL 2 (8.4 m)
2.50%	0.61% 0.51% 0.65%	0.67% 0.47% 0.67%	0.65% 0.51% 0.61%	
	1.14% 0.32% 1.29%	1.27% 0.32% 1.27%	1.29% 0.32% 1.14%	LEVEL 1 (4.5 m)
3.37%	0.57% 0.53% 0.65%	0.64% 0.44% 0.64%	0.65% 0.53% 0.57%	LEVEL 0 (0.0 m)

Fig. 14b. Required longitudinal reinforcement for building ID 2457

	1027	903	1147		1084	867	1084		1147	754	1027		LEVEL 8 (31.8 m)
443	1462			610	1826			610	1826			443	1462
	1227	1041	1243		1247	1031	1247		1243	1041	1227		LEVEL 7 (27.9 m)
443	779			610	651			610	651			443	779
	1401	1250	1435		1483	1198	1483		1435	1172	1401		LEVEL 6 (24.0 m)
479	897			610	1044			610	1044			479	897
	1493	1392	1583		1609	1324	1609		1583	1289	1493		LEVEL 5 (20.1 m)
600	1028			630	1378			630	1378			600	1028
	1533	1505	1688		1673	1403	1673		1688	1366	1533		LEVEL 4 (16.2 m)
694	1200			610	1316			610	1316			694	1200
	1582	1539	1703		1699	1459	1699		1703	1539	1582		LEVEL 3 (12.3 m)
499	912			720	1053			720	1053			499	912
	1610	1554	1713		1718	1491	1718		1713	1554	1610		LEVEL 2 (8.4 m)
515	1009			720	756			720	756			515	1009
	1590	1587	1744		1694	1447	1694		1744	1587	1590		LEVEL 1 (4.5 m)
499	665			720	720			720	720			499	665
													LEVEL 0 (0.0 m)

Fig. 14c. Required transverse reinforcement for building ID 2457

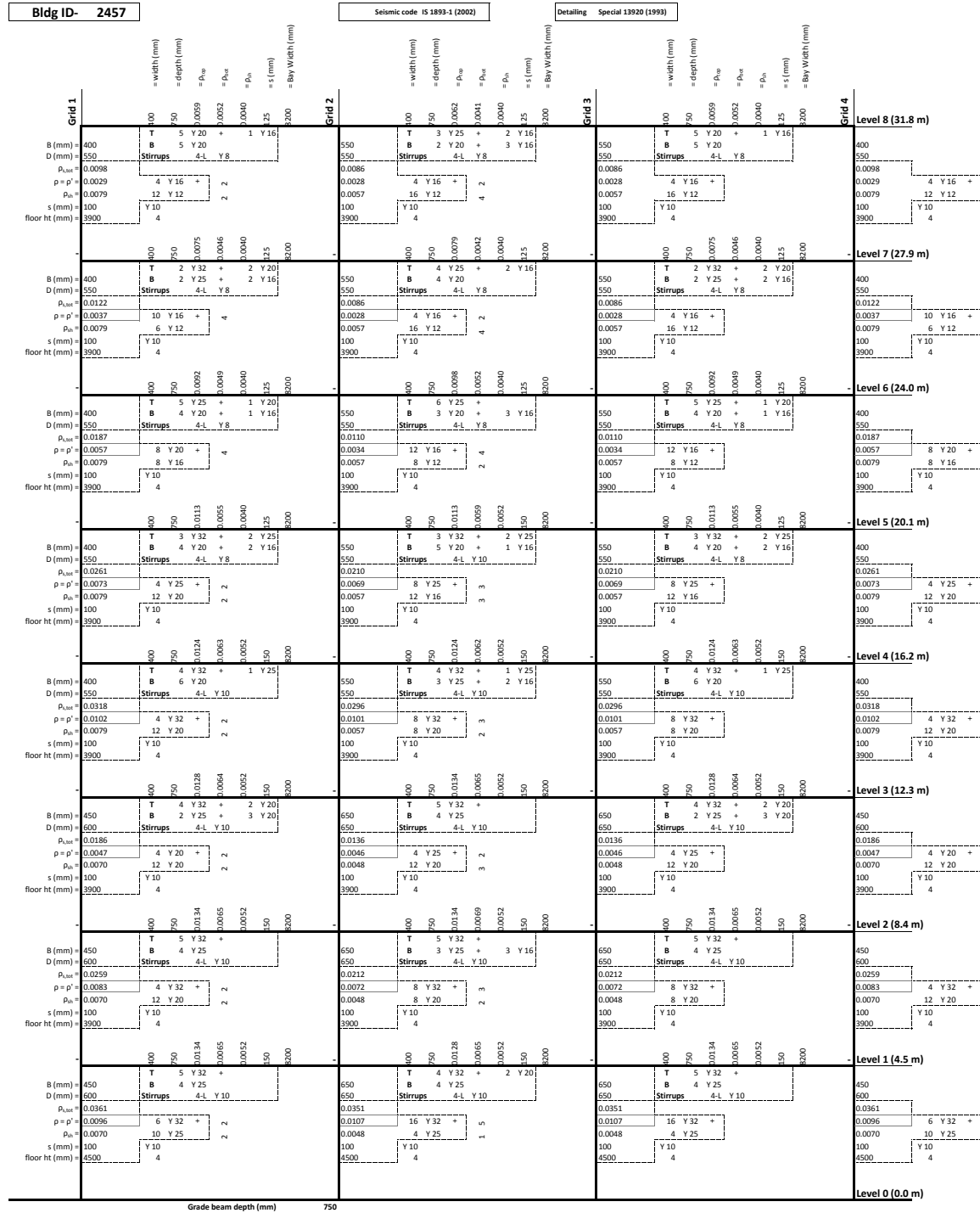


Fig. 14d. Provided reinforcement and modeling details for building ID 2457

15.1. General building configuration and loading inputs

Building Id:	2459
No of stories:	9
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	2.94 sec

15.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

15.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	35.7 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	1.10 sec
Time period, $T_{a,Y}$:	1.10 sec
Avrg response accn coeff, $(S_a/g)_x$:	0.91
Avrg response accn coeff, $(S_a/g)_y$:	0.91
Design Seis. coeff, $(A_h)_x$:	0.0329
Design Seis. coeff, $(A_h)_y$:	0.0329

	B400X750		B400X750		B400X750		LEVEL 9 (35.7 m)
400X500	B400X750	500X500	B400X750	500X500	B400X750	400X500	LEVEL 8 (31.8 m)
400X500	B400X750	500X500	B400X750	500X500	B400X750	400X500	LEVEL 7 (27.9 m)
400X500	B400X750	500X500	B400X750	500X500	B400X750	400X500	LEVEL 6 (24.0 m)
400X600	B400X750	600X600	B400X750	600X600	B400X750	400X600	LEVEL 5 (20.1 m)
400X600	B400X750	600X600	B400X750	600X600	B400X750	400X600	LEVEL 4 (16.2 m)
400X600	B400X750	600X600	B400X750	600X600	B400X750	400X600	LEVEL 3 (12.3 m)
450X650	B400X750	650X650	B400X750	650X650	B400X750	450X650	LEVEL 2 (8.4 m)
450X650	B400X750	650X650	B400X750	650X650	B400X750	450X650	LEVEL 1 (4.5 m)
450X650		650X650		650X650		450X650	LEVEL 0 (0.0 m)

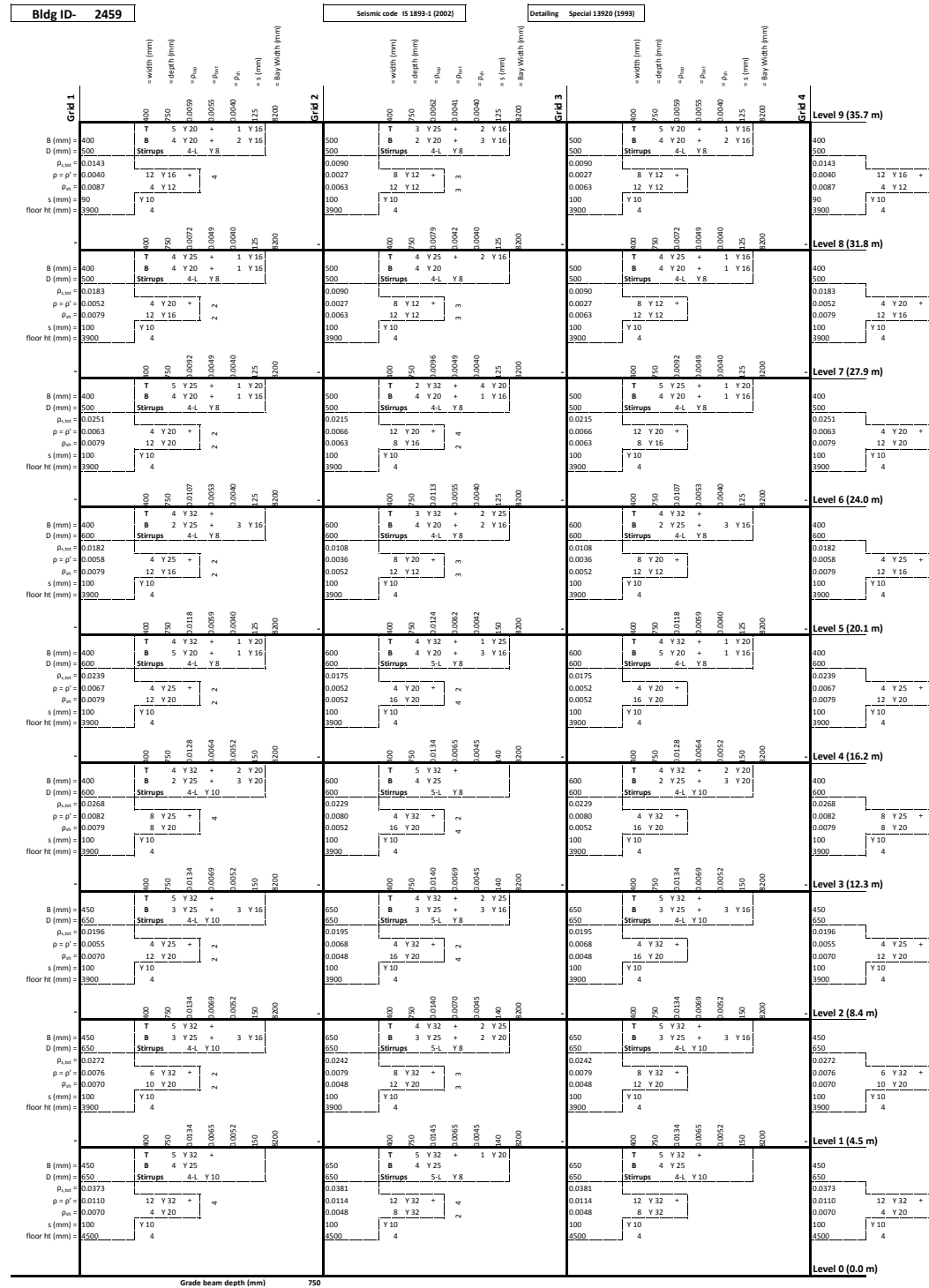
Fig. 15a. Beam column sizes for building ID 2459

	0.36% 0.14% 0.58%	0.60% 0.30% 0.60%	0.58% 0.14% 0.36%	LEVEL 9 (35.7 m)
1.31%	0.30% 0.54% 0.30%	0.30% 0.40% 0.30%	0.30% 0.54% 0.30%	
	0.71% 0.30% 0.67%	0.76% 0.30% 0.76%	0.67% 0.30% 0.71%	LEVEL 8 (31.8 m)
1.64%	0.36% 0.47% 0.33%	0.38% 0.41% 0.38%	0.33% 0.47% 0.36%	
	0.90% 0.30% 0.87%	0.94% 0.30% 0.94%	0.87% 0.30% 0.90%	LEVEL 7 (27.9 m)
2.36%	0.45% 0.48% 0.44%	0.47% 0.41% 0.47%	0.44% 0.48% 0.45%	
	1.05% 0.30% 1.01%	1.10% 0.30% 1.10%	1.01% 0.30% 1.05%	LEVEL 6 (24.0 m)
1.72%	0.53% 0.46% 0.51%	0.55% 0.40% 0.55%	0.51% 0.46% 0.53%	
	1.17% 0.30% 1.12%	1.23% 0.31% 1.23%	1.12% 0.30% 1.17%	LEVEL 5 (20.1 m)
2.22%	0.59% 0.46% 0.56%	0.62% 0.44% 0.62%	0.56% 0.47% 0.59%	
	1.25% 0.31% 1.23%	1.30% 0.33% 1.30%	1.23% 0.31% 1.25%	LEVEL 4 (16.2 m)
2.53%	0.62% 0.50% 0.61%	0.65% 0.46% 0.65%	0.61% 0.52% 0.62%	
	1.30% 0.32% 1.28%	1.33% 0.33% 1.33%	1.28% 0.32% 1.30%	LEVEL 3 (12.3 m)
1.76%	0.65% 0.51% 0.64%	0.67% 0.48% 0.67%	0.64% 0.53% 0.65%	
	1.32% 0.33% 1.31%	1.34% 0.34% 1.34%	1.31% 0.33% 1.32%	LEVEL 2 (8.4 m)
2.43%	0.66% 0.51% 0.66%	0.67% 0.48% 0.67%	0.66% 0.53% 0.66%	
	1.21% 0.32% 1.29%	1.26% 0.31% 1.26%	1.29% 0.32% 1.21%	LEVEL 1 (4.5 m)
3.54%	0.60% 0.52% 0.65%	0.63% 0.44% 0.63%	0.65% 0.54% 0.60%	LEVEL 0 (0.0 m)

Fig. 15b. Required longitudinal reinforcement for building ID 2459

	1005	888	1139	1078	862	1078	1139	888	1005	LEVEL 9 (35.7 m)
443	1522		554	2197		554	2197		443	
	1201	1010	1227	1227	1011	1227	1227	1010	1201	LEVEL 8 (31.8 m)
443	847		554	795		554	795		443	
	1381	1217	1419	1448	1165	1448	1419	1217	1381	LEVEL 7 (27.9 m)
584	981		554	1260		554	1260		584	
	1505	1342	1538	1594	1308	1594	1538	1287	1505	LEVEL 6 (24.0 m)
485	902		665	955		665	955		485	
	1592	1445	1600	1671	1417	1671	1600	1437	1592	LEVEL 5 (20.1 m)
566	977		665	1223		665	1223		566	
	1624	1528	1662	1704	1465	1704	1662	1482	1624	LEVEL 4 (16.2 m)
596	1078		665	1075		665	1075		596	
	1643	1546	1678	1714	1489	1714	1678	1503	1643	LEVEL 3 (12.3 m)
499	852		720	791		720	791		499	
	1644	1550	1701	1719	1495	1719	1701	1503	1644	LEVEL 2 (8.4 m)
499	999		720	720		720	720		499	
	1601	1579	1733	1687	1439	1687	1733	1438	1601	LEVEL 1 (4.5 m)
499	720		720	720		720	720		499	
										LEVEL 0 (0.0 m)

Fig. 15c. Required transverse reinforcement for building ID 2459



16.1. General building configuration and loading inputs

Building Id:	2461
No of stories:	10
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	3.25 sec

16.2. Material and modeling details

Column conc grade, f_{ck} :	50 MPa
Column conc expected, $f_{ck,exp}$:	58.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	32048.2 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

16.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	39.6 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	1.18 sec
Time period, $T_{a,Y}$:	1.18 sec
Avrg response accn coeff, $(S_a/g)_x$:	0.84
Avrg response accn coeff, $(S_a/g)_y$:	0.84
Design Seis. coeff, $(A_h)_x$:	0.0304
Design Seis. coeff, $(A_h)_y$:	0.0304

	B400X750	B400X750	B400X750	LEVEL 10 (39.6 m)
400X500	B400X750	B400X750	B400X750	LEVEL 9 (35.7 m)
400X500	B400X750	B400X750	B400X750	LEVEL 8 (31.8 m)
400X500	B400X750	B400X750	B400X750	LEVEL 7 (27.9 m)
400X600	B400X750	B400X750	B400X750	LEVEL 6 (24.0 m)
400X600	B400X750	B400X750	B400X750	LEVEL 5 (20.1 m)
400X600	B400X750	B400X750	B400X750	LEVEL 4 (16.2 m)
400X600	B400X750	B400X750	B400X750	LEVEL 3 (12.3 m)
450X650	B400X750	B400X750	B400X750	LEVEL 2 (8.4 m)
450X650	B400X750	B400X750	B400X750	LEVEL 1 (4.5 m)
450X650	B400X750	B400X750	B400X750	LEVEL 0 (0.0 m)

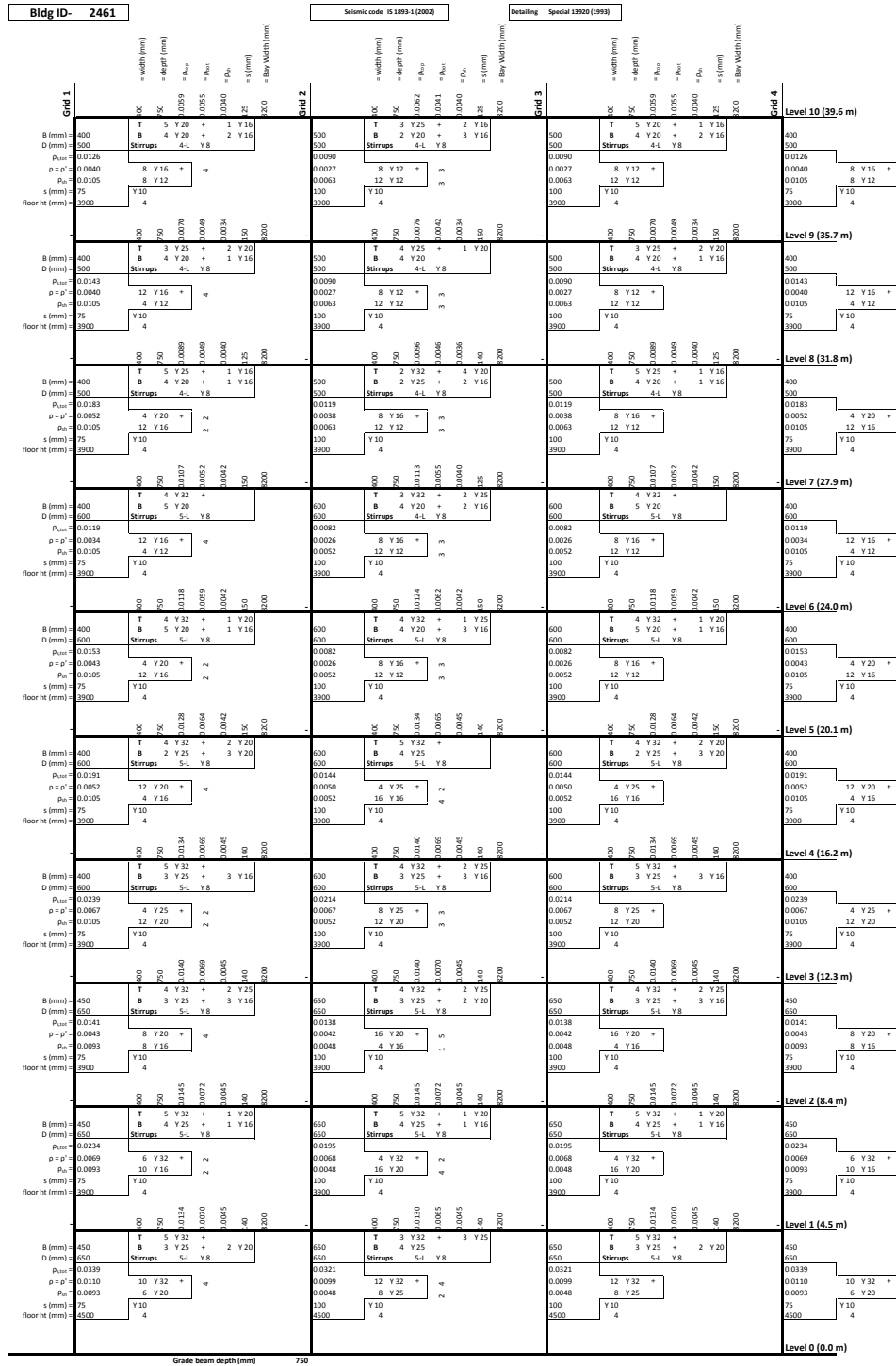
Fig. 16a. Beam column sizes for building ID 2461

	0.36% 0.14% 0.56%	0.59% 0.30% 0.59%	0.56% 0.14% 0.36%	LEVEL 10 (39.6 m)
1.22%	0.30% 0.54% 0.30%	0.30% 0.40% 0.30%	0.30% 0.54% 0.30%	
	0.70% 0.30% 0.62%	0.75% 0.30% 0.75%	0.62% 0.30% 0.70%	LEVEL 9 (35.7 m)
1.31%	0.35% 0.47% 0.31%	0.37% 0.42% 0.37%	0.31% 0.47% 0.35%	
	0.88% 0.30% 0.82%	0.92% 0.30% 0.92%	0.82% 0.30% 0.88%	LEVEL 8 (31.8 m)
1.74%	0.44% 0.48% 0.41%	0.46% 0.41% 0.46%	0.41% 0.48% 0.44%	
	1.04% 0.30% 0.95%	1.08% 0.30% 1.08%	0.95% 0.30% 1.04%	LEVEL 7 (27.9 m)
1.17%	0.52% 0.46% 0.48%	0.54% 0.41% 0.54%	0.48% 0.46% 0.52%	
	1.17% 0.30% 1.07%	1.22% 0.31% 1.22%	1.07% 0.30% 1.17%	LEVEL 6 (24.0 m)
1.51%	0.58% 0.45% 0.53%	0.61% 0.44% 0.61%	0.53% 0.45% 0.58%	
	1.26% 0.31% 1.18%	1.31% 0.33% 1.31%	1.18% 0.31% 1.26%	LEVEL 5 (20.1 m)
1.83%	0.63% 0.49% 0.59%	0.65% 0.46% 0.65%	0.59% 0.50% 0.63%	
	1.31% 0.33% 1.27%	1.36% 0.34% 1.36%	1.27% 0.33% 1.31%	LEVEL 4 (16.2 m)
2.24%	0.66% 0.52% 0.63%	0.68% 0.48% 0.68%	0.63% 0.53% 0.66%	
	1.34% 0.34% 1.31%	1.38% 0.34% 1.38%	1.31% 0.34% 1.34%	LEVEL 3 (12.3 m)
1.38%	0.67% 0.52% 0.65%	0.69% 0.49% 0.69%	0.65% 0.54% 0.67%	
	1.36% 0.34% 1.34%	1.38% 0.35% 1.38%	1.34% 0.34% 1.36%	LEVEL 2 (8.4 m)
1.98%	0.68% 0.52% 0.67%	0.69% 0.49% 0.69%	0.67% 0.54% 0.68%	
	1.24% 0.33% 1.32%	1.29% 0.32% 1.29%	1.32% 0.33% 1.24%	LEVEL 1 (4.5 m)
3.12%	0.62% 0.53% 0.66%	0.64% 0.45% 0.64%	0.66% 0.55% 0.62%	
				LEVEL 0 (0.0 m)

Fig. 16b. Required longitudinal reinforcement for building ID 2461

999 863 1122				1069 854 1069			1122 863 999			LEVEL 10 (39.6 m)	
443	1521		554	2113		554	2113		443	1521	LEVEL 9 (35.7 m)
	1192	997	1183		1212	997	1212		1183	997	1192
443	863		554	732		554	732		443	863	LEVEL 8 (31.8 m)
	1364	1172	1374		1428	1146	1428		1374	1172	1364
558	1010		554	1153		554	1153		558	1010	LEVEL 7 (27.9 m)
	1516	1297	1494		1576	1291	1576		1494	1288	1516
476	922		665	865		665	865		476	922	LEVEL 6 (24.0 m)
	1612	1405	1563		1659	1408	1659		1563	1445	1612
559	951		665	1139		665	1139		559	951	LEVEL 5 (20.1 m)
	1633	1493	1634		1696	1464	1696		1634	1500	1633
625	1045		668	1336		668	1336		625	1045	LEVEL 4 (16.2 m)
	1674	1565	1695		1722	1502	1722		1695	1535	1674
639	1126		665	1268		665	1268		639	1126	LEVEL 3 (12.3 m)
	1677	1573	1698		1728	1516	1728		1698	1542	1677
499	889		720	1054		720	1054		499	889	LEVEL 2 (8.4 m)
	1663	1571	1705		1729	1517	1729		1705	1533	1663
499	1042		720	720		720	720		499	1042	LEVEL 1 (4.5 m)
	1617	1594	1735		1694	1456	1694		1735	1460	1617
499	720		720	720		720	720		499	720	LEVEL 0 (0.0 m)

Fig. 16c. Required transverse reinforcement for building ID 2461



17.1. General building configuration and loading inputs

Building Id:	2463
No of stories:	11
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	3.55 sec

17.2. Material and modeling details

Column conc grade, f_{ck} :	50 MPa
Column conc expected, $f_{ck,exp}$:	58.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	32048.2 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

17.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	43.5 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	1.27 sec
Time period, $T_{a,Y}$:	1.27 sec
Avrg response accn coeff, $(S_a/g)_x$:	0.79
Avrg response accn coeff, $(S_a/g)_y$:	0.79
Design Seis. coeff, $(A_h)_x$:	0.0283
Design Seis. coeff, $(A_h)_y$:	0.0283

	B400X750		B400X750		B400X750		LEVEL 11 (43.5 m)
400X500		500X500		500X500		400X500	
	B400X750		B400X750		B400X750		LEVEL 10 (39.6 m)
400X500		500X500		500X500		400X500	
	B400X750		B400X750		B400X750		LEVEL 9 (35.7 m)
400X500		500X500		500X500		400X500	
	B400X750		B400X750		B400X750		LEVEL 8 (31.8 m)
400X600		600X600		600X600		400X600	
	B400X750		B400X750		B400X750		LEVEL 7 (27.9 m)
400X600		600X600		600X600		400X600	
	B400X750		B400X750		B400X750		LEVEL 6 (24.0 m)
400X600		600X600		600X600		400X600	
	B400X750		B400X750		B400X750		LEVEL 5 (20.1 m)
400X600		600X600		600X600		400X600	
	B400X750		B400X750		B400X750		LEVEL 4 (16.2 m)
450X650		650X650		650X650		450X650	
	B400X750		B400X750		B400X750		LEVEL 3 (12.3 m)
450X650		650X650		650X650		450X650	
	B400X750		B400X750		B400X750		LEVEL 2 (8.4 m)
450X650		650X650		650X650		450X650	
	B400X750		B400X750		B400X750		LEVEL 1 (4.5 m)
450X650		650X650		650X650		450X650	
							LEVEL 0 (0.0 m)

Fig. 17a. Beam column sizes for building ID 2463

	0.37% 0.13% 0.54%	0.59% 0.30% 0.59%	0.54% 0.13% 0.37%	LEVEL 11 (43.5 m)
1.25%	0.30% 0.54% 0.30%	0.30% 0.41% 0.30%	0.30% 0.54% 0.30%	
	0.70% 0.30% 0.58%	0.74% 0.30% 0.74%	0.58% 0.30% 0.70%	LEVEL 10 (39.6 m)
1.30%	0.35% 0.47% 0.30%	0.37% 0.42% 0.37%	0.30% 0.47% 0.35%	
	0.87% 0.30% 0.78%	0.90% 0.30% 0.90%	0.78% 0.30% 0.87%	LEVEL 9 (35.7 m)
1.71%	0.43% 0.48% 0.39%	0.45% 0.41% 0.45%	0.39% 0.48% 0.43%	
	1.03% 0.30% 0.90%	1.07% 0.30% 1.07%	0.90% 0.30% 1.03%	LEVEL 8 (31.8 m)
1.18%	0.51% 0.46% 0.45%	0.53% 0.41% 0.53%	0.45% 0.46% 0.51%	
	1.16% 0.30% 1.02%	1.21% 0.30% 1.21%	1.02% 0.30% 1.16%	LEVEL 7 (27.9 m)
1.53%	0.58% 0.45% 0.51%	0.61% 0.43% 0.61%	0.51% 0.45% 0.58%	
	1.26% 0.31% 1.13%	1.30% 0.33% 1.30%	1.13% 0.31% 1.26%	LEVEL 6 (24.0 m)
1.91%	0.63% 0.48% 0.57%	0.65% 0.47% 0.65%	0.57% 0.48% 0.63%	
	1.33% 0.33% 1.23%	1.37% 0.34% 1.37%	1.23% 0.33% 1.33%	LEVEL 5 (20.1 m)
2.23%	0.66% 0.51% 0.61%	0.69% 0.49% 0.69%	0.61% 0.52% 0.66%	
	1.37% 0.34% 1.27%	1.40% 0.35% 1.40%	1.27% 0.34% 1.37%	LEVEL 4 (16.2 m)
1.38%	0.69% 0.51% 0.64%	0.70% 0.51% 0.70%	0.64% 0.53% 0.69%	
	1.40% 0.35% 1.33%	1.41% 0.35% 1.41%	1.33% 0.35% 1.40%	LEVEL 3 (12.3 m)
1.84%	0.70% 0.52% 0.66%	0.71% 0.51% 0.71%	0.66% 0.54% 0.70%	
	1.39% 0.35% 1.37%	1.41% 0.35% 1.41%	1.37% 0.35% 1.39%	LEVEL 2 (8.4 m)
2.56%	0.70% 0.53% 0.68%	0.70% 0.51% 0.70%	0.68% 0.55% 0.70%	
	1.27% 0.34% 1.34%	1.32% 0.33% 1.32%	1.34% 0.34% 1.27%	LEVEL 1 (4.5 m)
3.74%	0.64% 0.54% 0.67%	0.66% 0.46% 0.66%	0.67% 0.56% 0.64%	LEVEL 0 (0.0 m)

Fig. 17b. Required longitudinal reinforcement for building ID 2463

	998	844	1112		1066	850	1066		1112	844	998		LEVEL 11 (43.5 m)
443	1504			554	2017			554	2017			443	1504
	1193	995	1152		1204	988	1204		1152	995	1193		LEVEL 10 (39.6 m)
443	841			554	847			554	847			443	841
	1356	1134	1338		1416	1133	1416		1338	1134	1356		LEVEL 9 (35.7 m)
537	980			554	1078			554	1078			537	980
	1514	1260	1459		1563	1279	1563		1459	1294	1514		LEVEL 8 (31.8 m)
470	894			665	790			665	790			470	894
	1638	1370	1534		1652	1401	1652		1534	1457	1638		LEVEL 7 (27.9 m)
557	931			665	1066			665	1066			557	931
	1652	1463	1617		1693	1462	1693		1617	1515	1652		LEVEL 6 (24.0 m)
631	1032			676	1274			676	1274			631	1032
	1688	1542	1680		1724	1508	1724		1680	1559	1688		LEVEL 5 (20.1 m)
653	1099			665	1276			665	1276			653	1099
	1703	1558	1691		1736	1529	1736		1691	1579	1703		LEVEL 4 (16.2 m)
519	850			720	1087			720	1087			519	850
	1705	1568	1693		1743	1539	1743		1693	1577	1705		LEVEL 3 (12.3 m)
499	1002			720	720			720	720			499	1002
	1690	1597	1720		1742	1536	1742		1720	1561	1690		LEVEL 2 (8.4 m)
499	935			720	720			720	720			499	935
	1639	1614	1744		1707	1476	1707		1744	1486	1639		LEVEL 1 (4.5 m)
499	720			720	720			720	720			499	720
													LEVEL 0 (0.0 m)

Fig. 17c. Required transverse reinforcement for building ID 2463

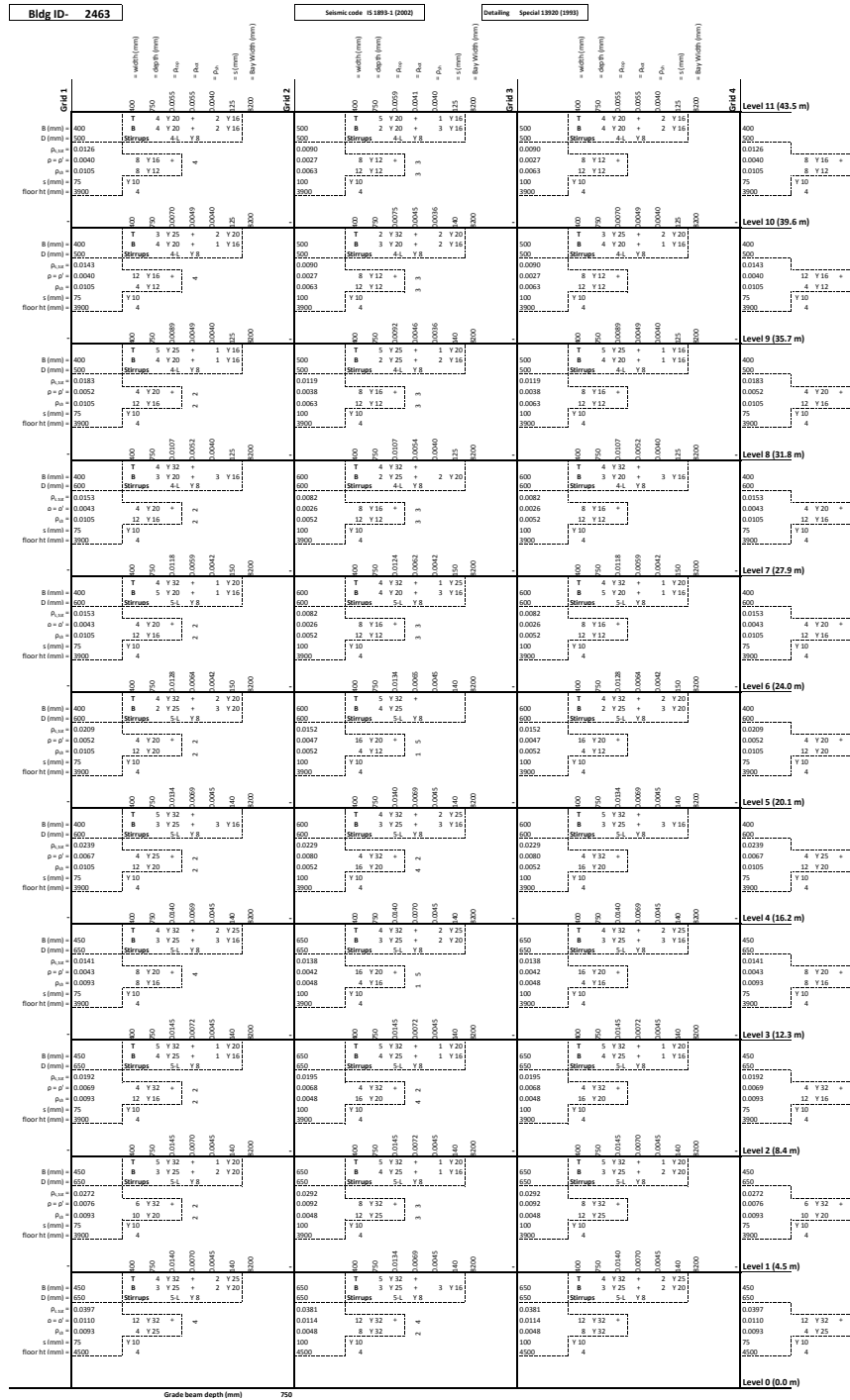


Fig. 17d. Provided reinforcement and modeling details for building ID 2463

18.1. General building configuration and loading inputs

Building Id:	2225
No of stories:	12
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	3.77 sec

18.2. Material and modeling details

Column conc grade, f_{ck} :	50 MPa
Column conc expected, $f_{ck,exp}$:	58.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	32048.2 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

18.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	47.4 m
Dimension along X, b_1 (col-to-col):	24.6 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	1.35 sec
Time period, $T_{a,Y}$:	1.35 sec
Avrg response accn coeff, $(S_a/g)_x$:	0.74
Avrg response accn coeff, $(S_a/g)_y$:	0.74
Design Seis. coeff, $(A_h)_x$:	0.0266
Design Seis. coeff, $(A_h)_y$:	0.0266

	B400X750	B400X750	B400X750	Level 12 (47.4 m)
400X550	B400X750	B400X750	B400X750	Level 11 (43.5 m)
400X550	B400X750	B400X750	B400X750	Level 10 (39.6 m)
400X550	B400X750	B400X750	B400X750	Level 9 (35.7 m)
400X550	B400X750	B400X750	B400X750	Level 8 (31.8 m)
450X650	B400X750	B400X750	B400X750	Level 7 (27.9 m)
450X650	B400X750	B400X750	B400X750	Level 6 (24.0 m)
450X650	B400X750	B400X750	B400X750	Level 5 (20.1 m)
450X650	B400X750	B400X750	B400X750	Level 4 (16.2 m)
500X650	B400X750	B400X750	B400X750	Level 3 (12.3 m)
500X650	B400X750	B400X750	B400X750	Level 2 (8.4 m)
500X650	B400X750	B400X750	B400X750	Level 1 (4.5 m)
500X650	700X700	700X700	500X650	Level 0 (0.0 m)

Fig. 18a. Beam column sizes for building ID 2225

		0.39% 0.13% 0.52%	0.59% 0.30% 0.59%	0.52% 0.13% 0.39%	Level 12 (47.4 m)
	0.95%	0.30% 0.52% 0.30%	0.30% 0.41% 0.30%	0.30% 0.52% 0.30%	
		0.70% 0.18% 0.55%	0.73% 0.30% 0.73%	0.55% 0.30% 0.70%	Level 11 (43.5 m)
	0.85%	0.35% 0.45% 0.30%	0.37% 0.42% 0.37%	0.30% 0.45% 0.35%	
		0.85% 0.30% 0.73%	0.90% 0.30% 0.90%	0.73% 0.30% 0.85%	Level 10 (39.6 m)
	1.22%	0.42% 0.47% 0.36%	0.45% 0.41% 0.45%	0.36% 0.47% 0.42%	
		1.01% 0.30% 0.89%	1.05% 0.30% 1.05%	0.89% 0.30% 1.01%	Level 9 (35.7 m)
	1.45%	0.50% 0.47% 0.45%	0.53% 0.41% 0.53%	0.45% 0.47% 0.50%	
		1.15% 0.30% 0.99%	1.17% 0.30% 1.17%	0.99% 0.30% 1.15%	Level 8 (31.8 m)
	0.80%	0.57% 0.45% 0.49%	0.59% 0.43% 0.59%	0.49% 0.45% 0.57%	
		1.26% 0.32% 1.08%	1.29% 0.32% 1.29%	1.08% 0.32% 1.26%	Level 7 (27.9 m)
	0.85%	0.63% 0.46% 0.54%	0.64% 0.47% 0.64%	0.54% 0.45% 0.63%	
		1.33% 0.33% 1.18%	1.36% 0.34% 1.36%	1.18% 0.33% 1.33%	Level 6 (24.0 m)
	1.12%	0.67% 0.49% 0.59%	0.68% 0.49% 0.68%	0.59% 0.49% 0.67%	
		1.39% 0.35% 1.26%	1.41% 0.35% 1.41%	1.26% 0.35% 1.39%	Level 5 (20.1 m)
	1.41%	0.69% 0.50% 0.63%	0.70% 0.51% 0.70%	0.63% 0.52% 0.69%	
		1.40% 0.35% 1.32%	1.43% 0.36% 1.43%	1.32% 0.35% 1.40%	Level 4 (16.2 m)
	1.18%	0.70% 0.53% 0.66%	0.71% 0.52% 0.71%	0.66% 0.53% 0.70%	
		1.40% 0.35% 1.36%	1.45% 0.36% 1.45%	1.36% 0.35% 1.40%	Level 3 (12.3 m)
	1.67%	0.70% 0.54% 0.68%	0.72% 0.53% 0.72%	0.68% 0.54% 0.70%	
		1.39% 0.35% 1.39%	1.43% 0.36% 1.43%	1.39% 0.35% 1.39%	Level 2 (8.4 m)
	2.35%	0.69% 0.55% 0.69%	0.72% 0.52% 0.72%	0.69% 0.55% 0.69%	
		1.24% 0.33% 1.33%	1.33% 0.33% 1.33%	1.33% 0.33% 1.24%	Level 1 (4.5 m)
3.29%		0.62% 0.54% 0.66%	0.66% 0.47% 0.66%	0.66% 0.54% 0.62%	Level 0 (0.0 m)

Fig. 18b. Required longitudinal reinforcement for building ID 2225

	1014	818	1097		1065	846	1065		1097	731	1014		Level 12 (47.4 m)	
443	1420			610	1566			610	1566			443	1420	Level 11 (43.5 m)
	1222	918	1152		1200	984	1200		1152	1022	1222			
443	733			610	643			610	643			443	733	Level 10 (39.6 m)
	1363	1109	1300		1419	1135	1419		1300	1168	1363			
443	848			610	789			610	789			443	848	Level 9 (35.7 m)
	1491	1249	1445		1544	1261	1544		1445	1270	1491			
521	927			610	1060			610	1060			521	927	Level 8 (31.8 m)
	1626	1324	1527		1633	1373	1633		1527	1406	1626			
499	720			720	720			720	720			499	720	Level 7 (27.9 m)
	1710	1387	1565		1683	1455	1683		1565	1508	1710			
499	741			720	831			720	831			499	741	Level 6 (24.0 m)
	1712	1468	1617		1716	1505	1716		1617	1546	1712			
499	844			720	973			720	973			499	844	Level 5 (20.1 m)
	1714	1535	1669		1739	1534	1739		1669	1576	1714			
517	921			720	1031			720	1031			517	921	Level 4 (16.2 m)
	1715	1575	1691		1746	1517	1746		1691	1575	1715			
554	781			776	844			776	844			554	781	Level 3 (12.3 m)
	1710	1562	1710		1754	1529	1754		1710	1562	1710			
554	860			776	776			776	776			554	860	Level 2 (8.4 m)
	1690	1576	1729		1748	1519	1748		1729	1576	1690			
554	774			776	776			776	776			554	774	Level 1 (4.5 m)
	1603	1564	1729		1704	1451	1704		1729	1564	1603			
554	720			776	776			776	776			554	720	Level 0 (0.0 m)

Fig. 18c. Required transverse reinforcement for building ID 2225

Grade beam depth (mm)

Fig. 18d. Provided reinforcement and modeling details for building ID 2225

19.1. General building configuration and loading inputs

Building Id:	2227
No of stories:	4
No of Bays:	5
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	1.53 sec

19.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

19.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	16.2 m
Dimension along X, b_1 (col-to-col):	41 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.61 sec
Time period, $T_{a,Y}$:	0.61 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.65
Avrg response accn coeff, $(S_a/g)_y$:	1.65
Design Seis. coeff, $(A_h)_x$:	0.0594
Design Seis. coeff, $(A_h)_y$:	0.0594

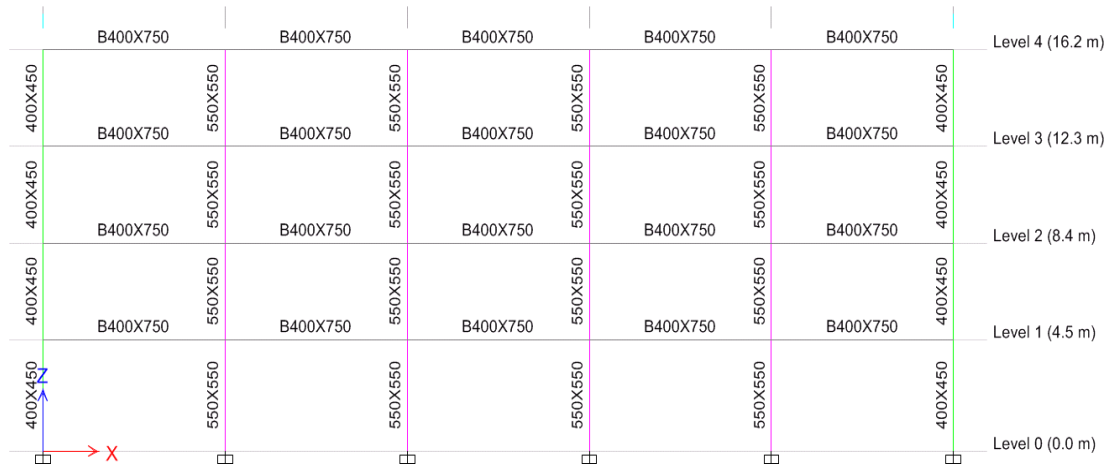


Fig. 19a. Beam column sizes for building ID 2227

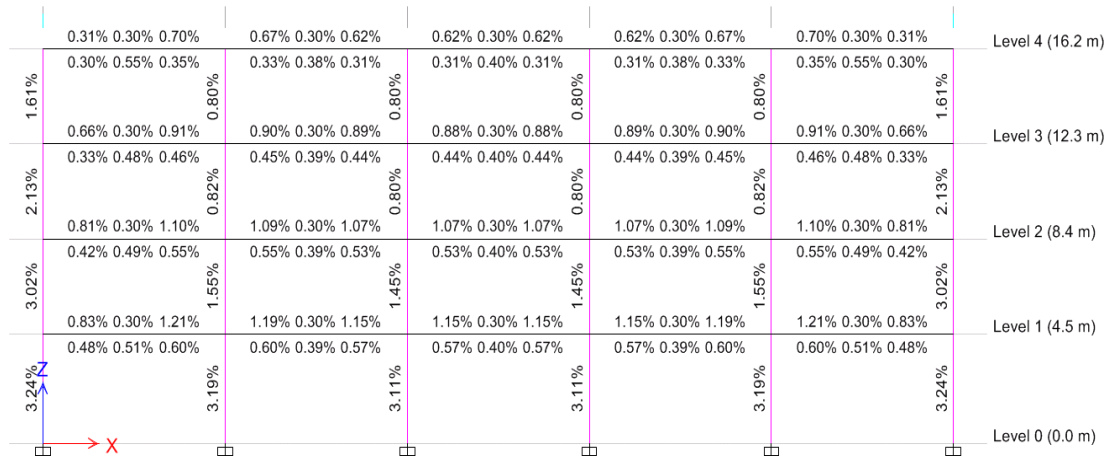


Fig. 19b. Required longitudinal reinforcement for building ID 2227



Fig. 19c. Required transverse reinforcement for building ID 2227

20.1. General building configuration and loading inputs

Building Id:	2437
No of stories:	5
No of Bays:	5
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	1.84 sec

20.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

20.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	20.1 m
Dimension along X, b_1 (col-to-col):	41 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.71 sec
Time period, $T_{a,Y}$:	0.71 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.40
Avrg response accn coeff, $(S_a/g)_y$:	1.40
Design Seis. coeff, $(A_h)_x$:	0.0506
Design Seis. coeff, $(A_h)_y$:	0.0506

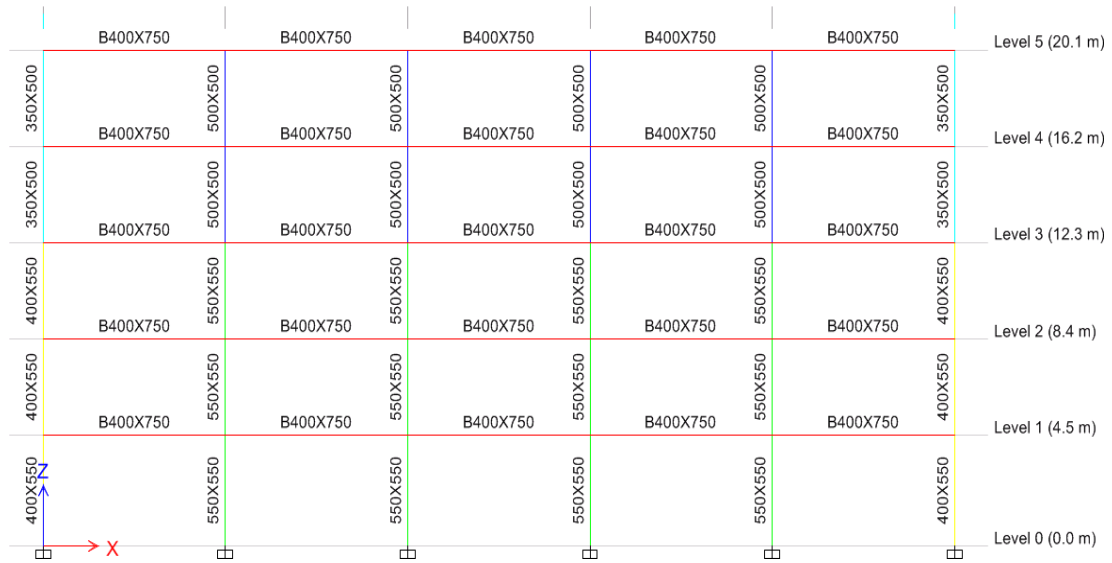


Fig. 20a. Beam column sizes for building ID 2437

	0.36% 0.16% 0.65%	0.64% 0.30% 0.60%	0.60% 0.30% 0.60%	0.60% 0.30% 0.64%	0.65% 0.16% 0.36%	Level 5 (20.1 m)
1.69%	0.30% 0.55% 0.33%	0.32% 0.39% 0.30%	0.30% 0.40% 0.30%	0.30% 0.39% 0.32%	0.33% 0.55% 0.30%	
	0.75% 0.30% 0.85%	0.84% 0.30% 0.84%	0.84% 0.30% 0.84%	0.84% 0.30% 0.84%	0.85% 0.30% 0.75%	Level 4 (16.2 m)
2.33%	0.38% 0.48% 0.43%	0.42% 0.40% 0.42%	0.42% 0.40% 0.42%	0.42% 0.40% 0.42%	0.43% 0.48% 0.38%	
	0.96% 0.30% 1.04%	1.02% 0.30% 1.02%	1.02% 0.30% 1.02%	1.02% 0.30% 1.02%	1.04% 0.30% 0.96%	Level 3 (12.3 m)
2.21%	0.48% 0.47% 0.52%	0.51% 0.40% 0.51%	0.51% 0.40% 0.51%	0.51% 0.40% 0.51%	0.52% 0.47% 0.48%	
	1.09% 0.30% 1.16%	1.12% 0.30% 1.13%	1.13% 0.30% 1.13%	1.13% 0.30% 1.12%	1.16% 0.30% 1.09%	Level 2 (8.4 m)
2.83%	0.54% 0.49% 0.58%	0.56% 0.40% 0.56%	0.56% 0.40% 0.56%	0.56% 0.40% 0.56%	0.58% 0.49% 0.54%	
	1.10% 0.31% 1.24%	1.16% 0.30% 1.15%	1.16% 0.30% 1.16%	1.15% 0.30% 1.16%	1.24% 0.31% 1.10%	Level 1 (4.5 m)
3.58%	0.55% 0.54% 0.62%	0.58% 0.40% 0.57%	0.58% 0.40% 0.58%	0.57% 0.40% 0.58%	0.62% 0.56% 0.55%	Level 0 (0.0 m)

Fig. 20b. Required longitudinal reinforcement for building ID 2437

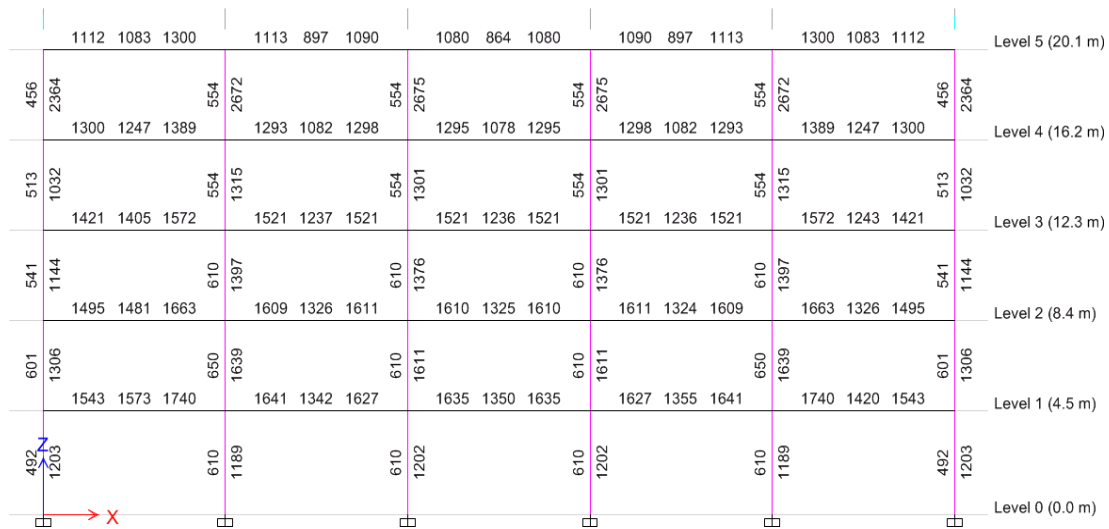


Fig. 20c. Required transverse reinforcement for building ID 2437

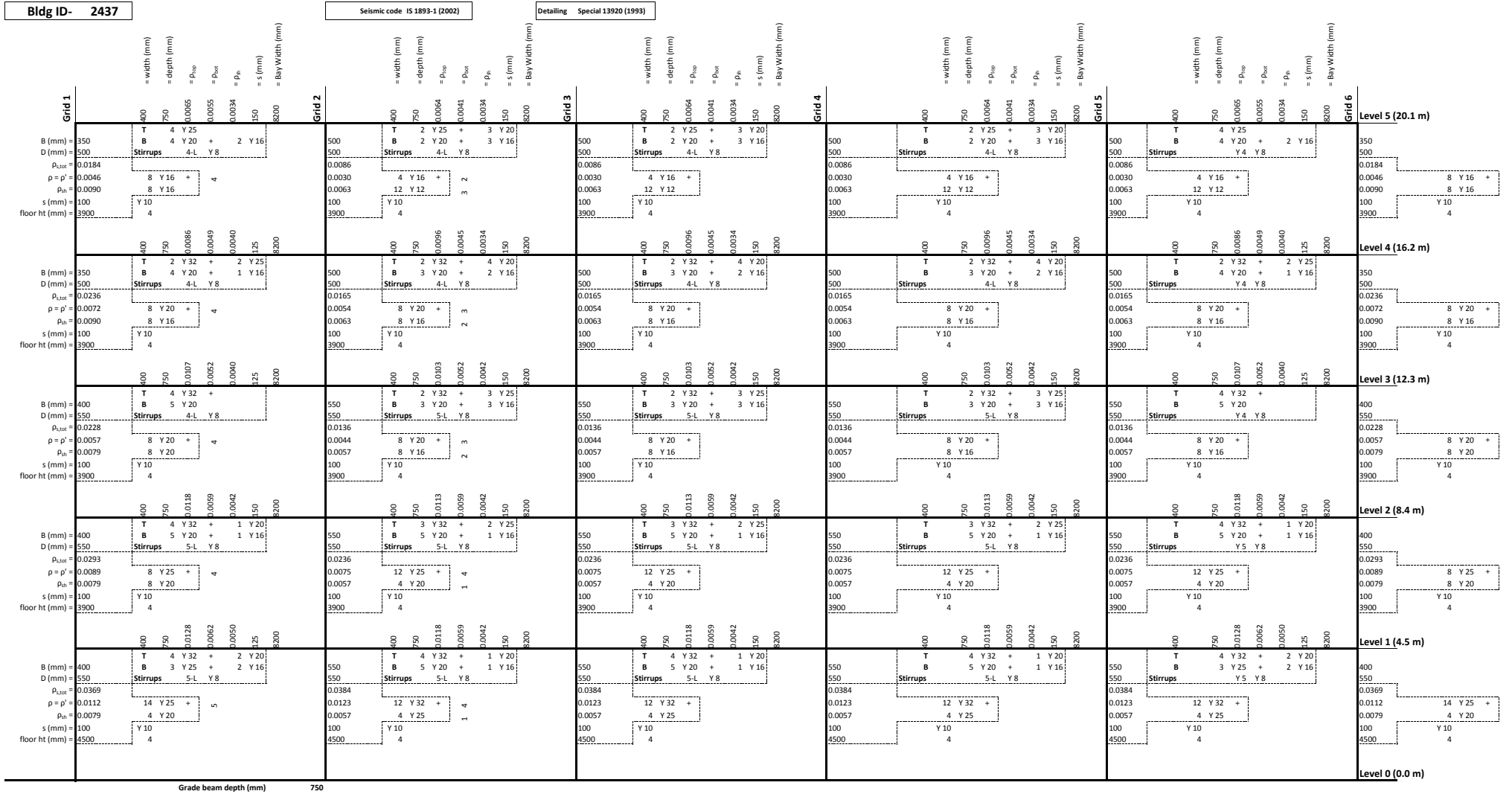


Fig. 20d. Provided reinforcement and modeling details for building ID 2437

21.1. General building configuration and loading inputs

Building Id:	2439
No of stories:	6
No of Bays:	5
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	2.09 sec

21.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

21.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	24 m
Dimension along X, b_1 (col-to-col):	41 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.81 sec
Time period, $T_{a,Y}$:	0.81 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.23
Avrg response accn coeff, $(S_a/g)_y$:	1.23
Design Seis. coeff, $(A_h)_x$:	0.0443
Design Seis. coeff, $(A_h)_y$:	0.0443



Fig. 21a. Beam column sizes for building ID 2439



Fig. 21b. Required longitudinal reinforcement for building ID 2439

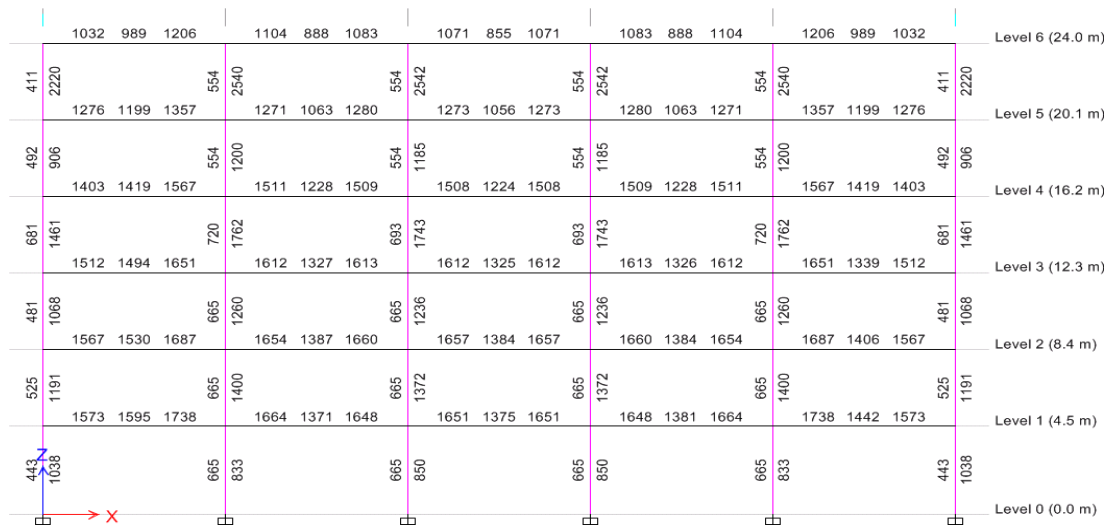


Fig. 21c. Required transverse reinforcement for building ID 2439

Bldg ID- 2439		Seismic code IS 1893-1 (2002)		Detailing Special 13920 (1993)					
Grid 1	= width (mm)		= depth (mm)		= Bay Width (mm)				
	= ρ_{top}		= ρ_{bot}		= ρ_{bot}				
B (mm) = 350	T 4 Y 25		B 4 Y 20 + 2 Y 16		0.0065				
D (mm) = 500	Stirrups		4-L Y 8		0.0055				
$\rho_{\text{top}} = \rho_{\text{bot}}$	0.0164		0.0046		0.0034				
ρ_{bot}	0.0090		0.0090		0.0090				
s (mm) = 100	Y 10		4		150				
floor ht (mm) = 3900	4		4		8200				
Grid 2	= width (mm)		= depth (mm)		= Bay Width (mm)				
	= ρ_{top}		= ρ_{bot}		= ρ_{bot}				
B (mm) = 350	T 5 Y 25		B 4 Y 20 + 1 Y 16		0.0082				
D (mm) = 500	Stirrups		4-L Y 8		0.0049				
$\rho_{\text{top}} = \rho_{\text{bot}}$	0.0236		0.0072		0.0040				
ρ_{bot}	0.0090		0.0090		0.0090				
s (mm) = 100	Y 10		4		125				
floor ht (mm) = 3900	4		4		8200				
Grid 3	= width (mm)		= depth (mm)		= Bay Width (mm)				
	= ρ_{top}		= ρ_{bot}		= ρ_{bot}				
B (mm) = 350	T 4 Y 32		B 5 Y 20		0.0107				
D (mm) = 500	Stirrups		4-L Y 8		0.0052				
$\rho_{\text{top}} = \rho_{\text{bot}}$	0.0328		0.0092		0.0042				
ρ_{bot}	0.0090		0.0090		0.0090				
s (mm) = 100	Y 10		4		125				
floor ht (mm) = 3900	4		4		8200				
Grid 4	= width (mm)		= depth (mm)		= Bay Width (mm)				
	= ρ_{top}		= ρ_{bot}		= ρ_{bot}				
B (mm) = 350	T 4 Y 32		B 5 Y 20		0.0115				
D (mm) = 500	Stirrups		4-L Y 8		0.0059				
$\rho_{\text{top}} = \rho_{\text{bot}}$	0.0328		0.0092		0.0042				
ρ_{bot}	0.0090		0.0090		0.0090				
s (mm) = 100	Y 10		4		125				
floor ht (mm) = 3900	4		4		8200				
Grid 5	= width (mm)		= depth (mm)		= Bay Width (mm)				
	= ρ_{top}		= ρ_{bot}		= ρ_{bot}				
B (mm) = 400	T 7 Y 25		B 5 Y 20 + 1 Y 16		0.0115				
D (mm) = 600	Stirrups		5-L Y 8		0.0059				
$\rho_{\text{top}} = \rho_{\text{bot}}$	0.0209		0.0052		0.0042				
ρ_{bot}	0.0079		0.0079		0.0079				
s (mm) = 100	Y 10		4		150				
floor ht (mm) = 3900	4		4		8200				
Grid 6	= width (mm)		= depth (mm)		= Bay Width (mm)				
	= ρ_{top}		= ρ_{bot}		= ρ_{bot}				
B (mm) = 400	T 4 Y 32		B 3 Y 25 + 2 Y 16		0.0124				
D (mm) = 600	Stirrups		5-L Y 8		0.0062				
$\rho_{\text{top}} = \rho_{\text{bot}}$	0.0268		0.0082		0.0050				
ρ_{bot}	0.0079		0.0079		0.0079				
s (mm) = 100	Y 10		4		125				
floor ht (mm) = 3900	4		4		8200				
Grid 7	= width (mm)		= depth (mm)		= Bay Width (mm)				
	= ρ_{top}		= ρ_{bot}		= ρ_{bot}				
B (mm) = 400	T 4 Y 32		B 3 Y 25 + 2 Y 16		0.0128				
D (mm) = 600	Stirrups		5-L Y 8		0.0062				
$\rho_{\text{top}} = \rho_{\text{bot}}$	0.0332		0.0093		0.0052				
ρ_{bot}	0.0079		0.0079		0.0079				
s (mm) = 100	Y 10		4		125				
floor ht (mm) = 4500	4		4		8200				
Level 6 (24.0 m)									
Level 5 (20.1 m)									
Level 4 (16.2 m)									
Level 3 (12.3 m)									
Level 2 (8.4 m)									
Level 1 (4.5 m)									
Level 0 (0.0 m)									
Grade beam depth (mm)									

Fig. 21d. Provided reinforcement and modeling details for building ID 2439

22.1. General building configuration and loading inputs

Building Id:	2229
No of stories:	7
No of Bays:	5
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	250 mm
Tributary width (trans bay width):	8200 mm
No of transverse bays:	9
Analytical time period:	2.38 sec

22.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

22.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	27.9 m
Dimension along X, b_1 (col-to-col):	41 m
Dimension along Y, b_2 (col-to-col):	73.8 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.91 sec
Time period, $T_{a,Y}$:	0.91 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.10
Avrg response accn coeff, $(S_a/g)_y$:	1.10
Design Seis. coeff, $(A_h)_x$:	0.0395
Design Seis. coeff, $(A_h)_y$:	0.0395



Fig. 22a. Beam column sizes for building ID 2229



Fig. 22b. Required longitudinal reinforcement for building ID 2229



Fig. 22d. Provided reinforcement and modeling details for building ID 2229

23.1. General building configuration and loading inputs

Building Id:	2231
No of stories:	4
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	200 mm
Tributary width (trans bay width):	6000 mm
No of transverse bays:	9
Analytical time period:	1.69 sec

23.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

23.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	16.2 m
Dimension along X, b_1 (col-to-col):	18 m
Dimension along Y, b_2 (col-to-col):	54 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.61 sec
Time period, $T_{a,Y}$:	0.61 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.65
Avrg response accn coeff, $(S_a/g)_y$:	1.65
Design Seis. coeff, $(A_h)_x$:	0.0594
Design Seis. coeff, $(A_h)_y$:	0.0594

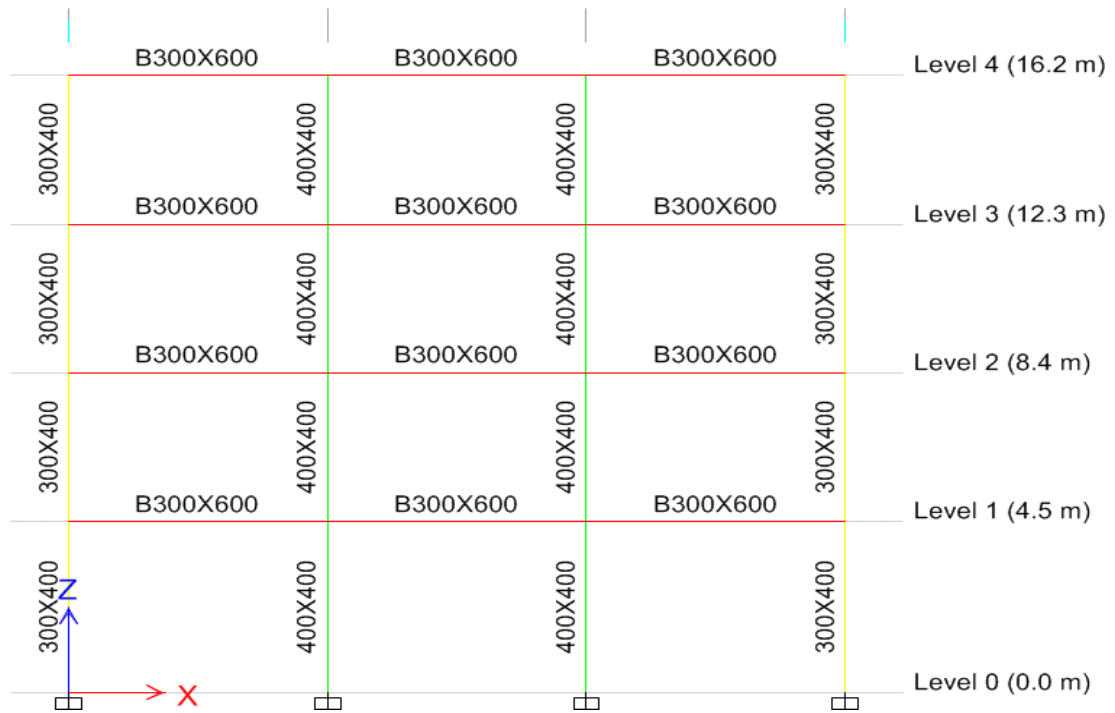


Fig. 23a. Beam column sizes for building ID 2231

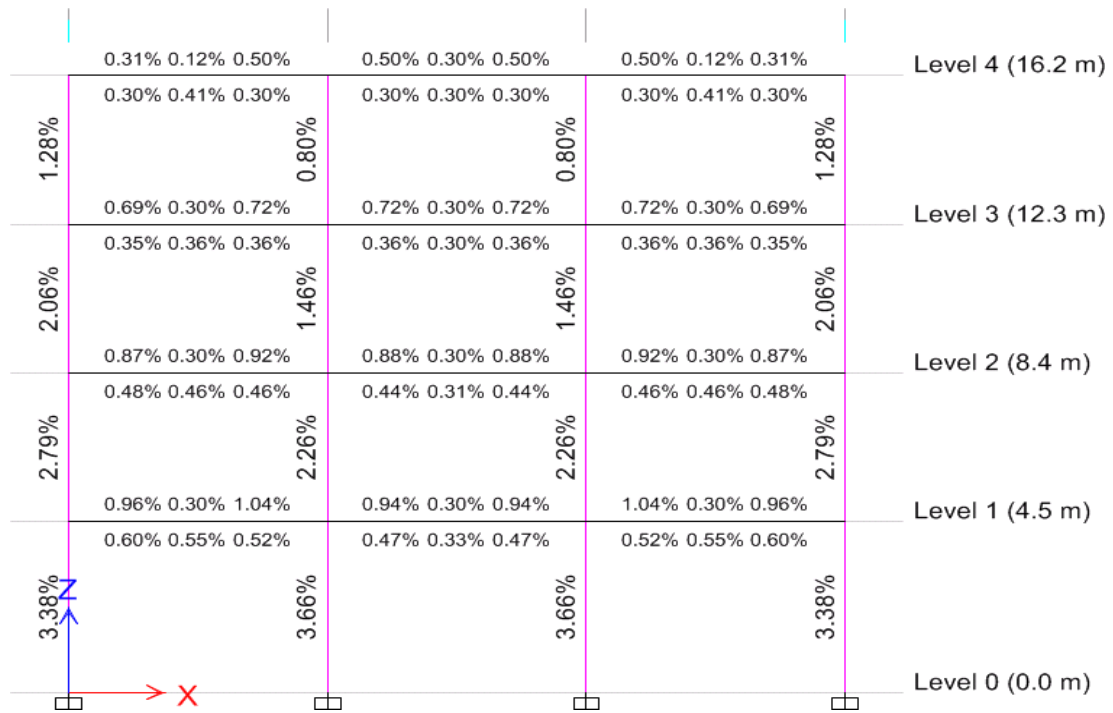


Fig. 23b. Required longitudinal reinforcement for building ID 2231

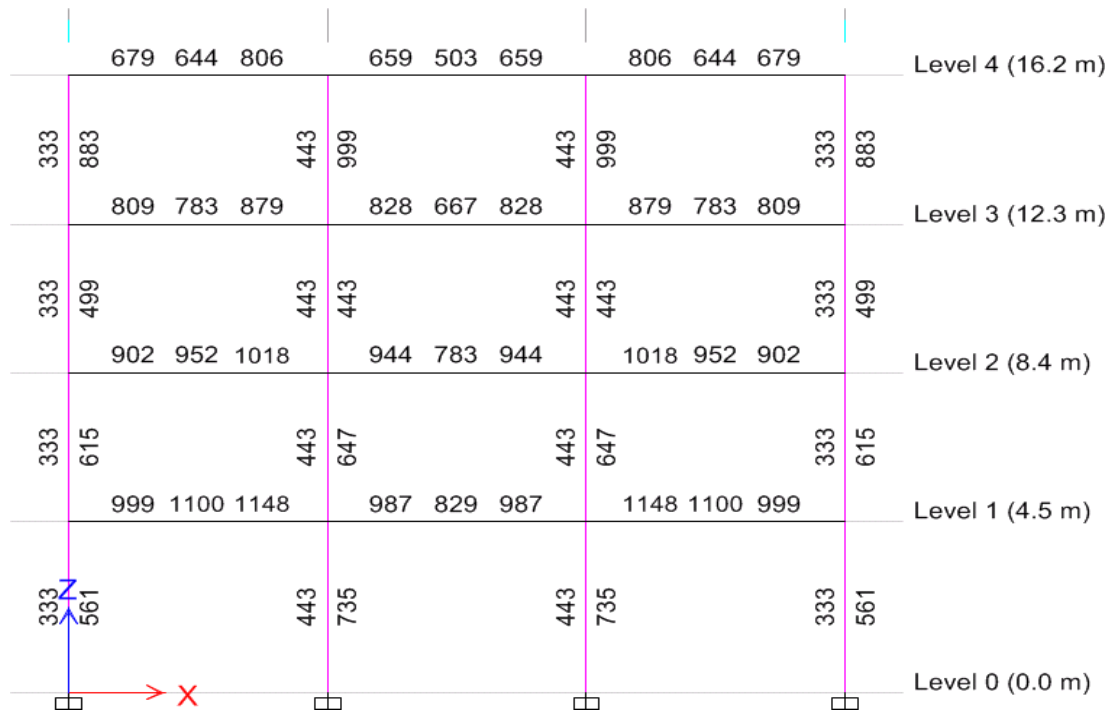


Fig. 23c. Required transverse reinforcement for building ID 2231

Bldg ID- 2231

Seismic code IS 1893-1 (2002)

Detailing Special 13920 (1993)

Grid 1	= width (mm)										= depth (mm)										= ρ_{top}										= ρ_{bot}										= ρ_{sh}										= s (mm)										= Bay Width (mm)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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B (mm) =	300					3 Y 20										+					1 Y 16																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																

24.1. General building configuration and loading inputs

Building Id:	2441
No of stories:	5
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	200 mm
Tributary width (trans bay width):	6000 mm
No of transverse bays:	9
Analytical time period:	1.98 sec

24.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

24.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	20.1 m
Dimension along X, b_1 (col-to-col):	18 m
Dimension along Y, b_2 (col-to-col):	54 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.71 sec
Time period, $T_{a,Y}$:	0.71 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.40
Avrg response accn coeff, $(S_a/g)_y$:	1.40
Design Seis. coeff, $(A_h)_x$:	0.0506
Design Seis. coeff, $(A_h)_y$:	0.0506

	B300X600		B300X600		B300X600		Level 5 (20.1 m)
300X350	B300X600	350X350	B300X600	350X350	B300X600	300X350	Level 4 (16.2 m)
300X350	B300X600	350X350	B300X600	350X350	B300X600	300X350	Level 3 (12.3 m)
300X400	B300X600	450X450	B300X600	450X450	B300X600	300X400	Level 2 (8.4 m)
300X400	B300X600	450X450	B300X600	450X450	B300X600	300X400	Level 1 (4.5 m)
300X400		450X450		450X450		300X400	Level 0 (0.0 m)

Fig. 24a. Beam column sizes for building ID 2441

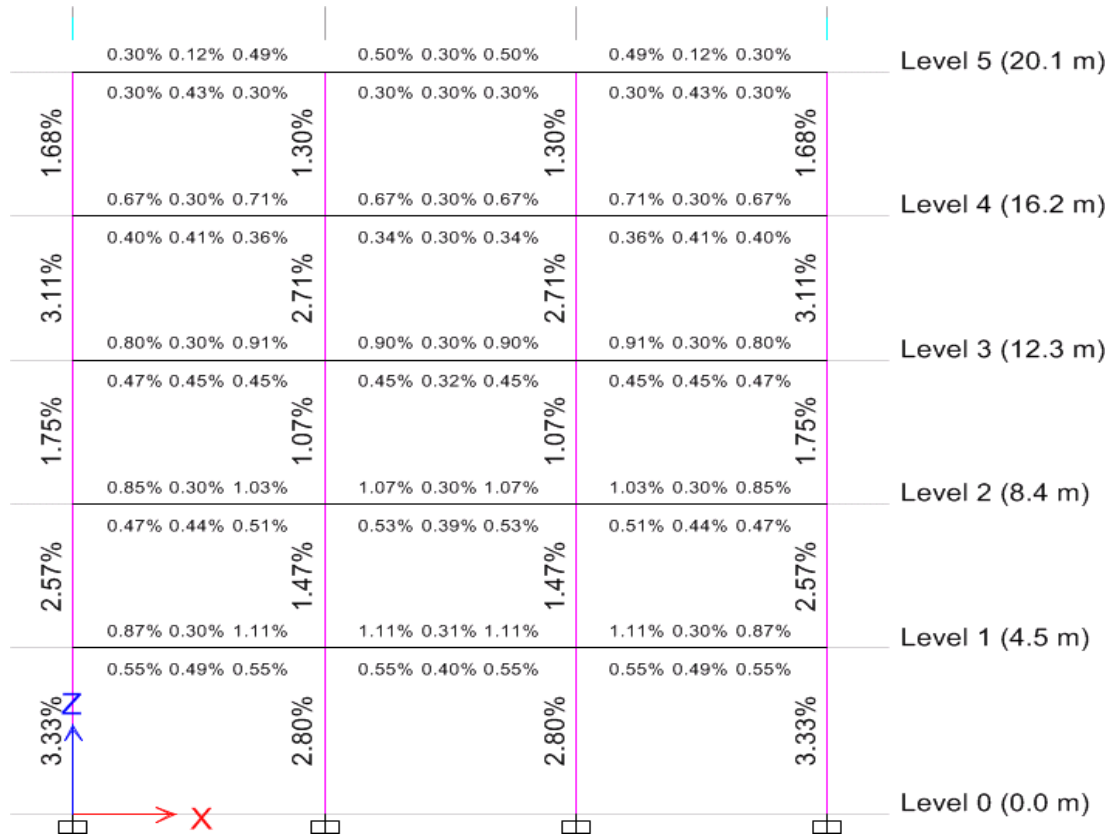


Fig. 24b. Required longitudinal reinforcement for building ID 2441

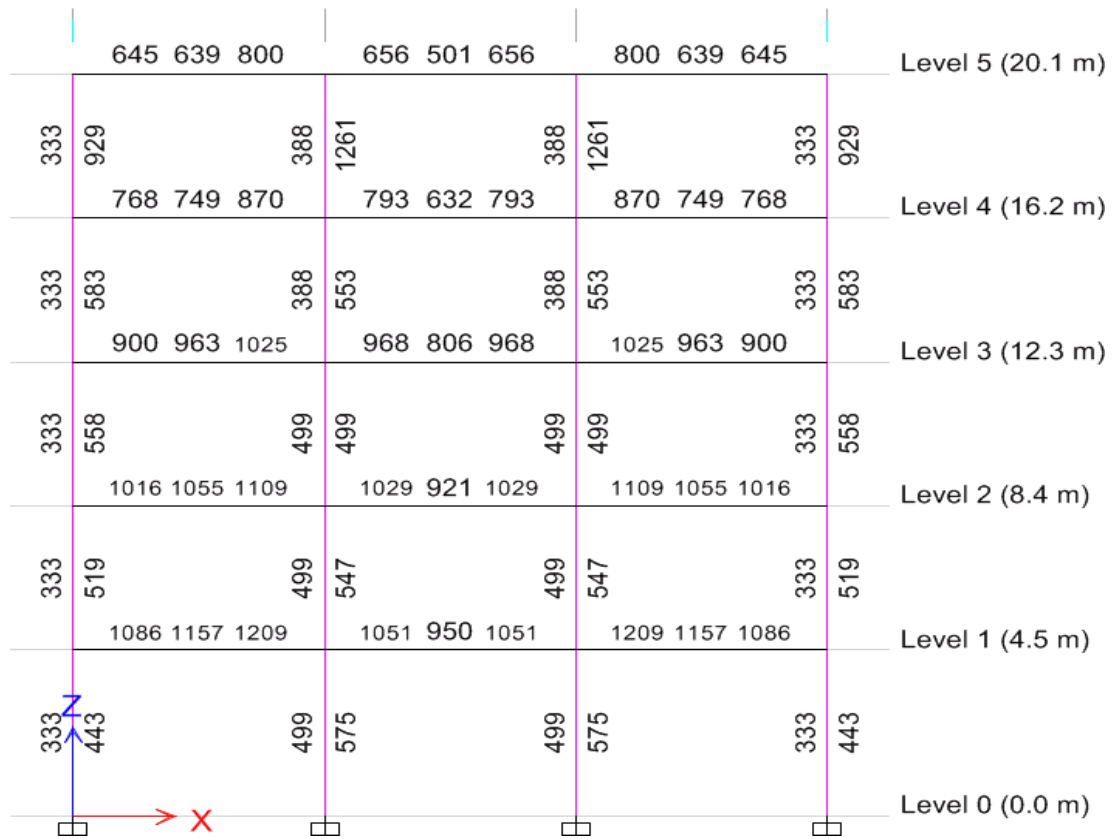


Fig. 24c. Required transverse reinforcement for building ID 2441

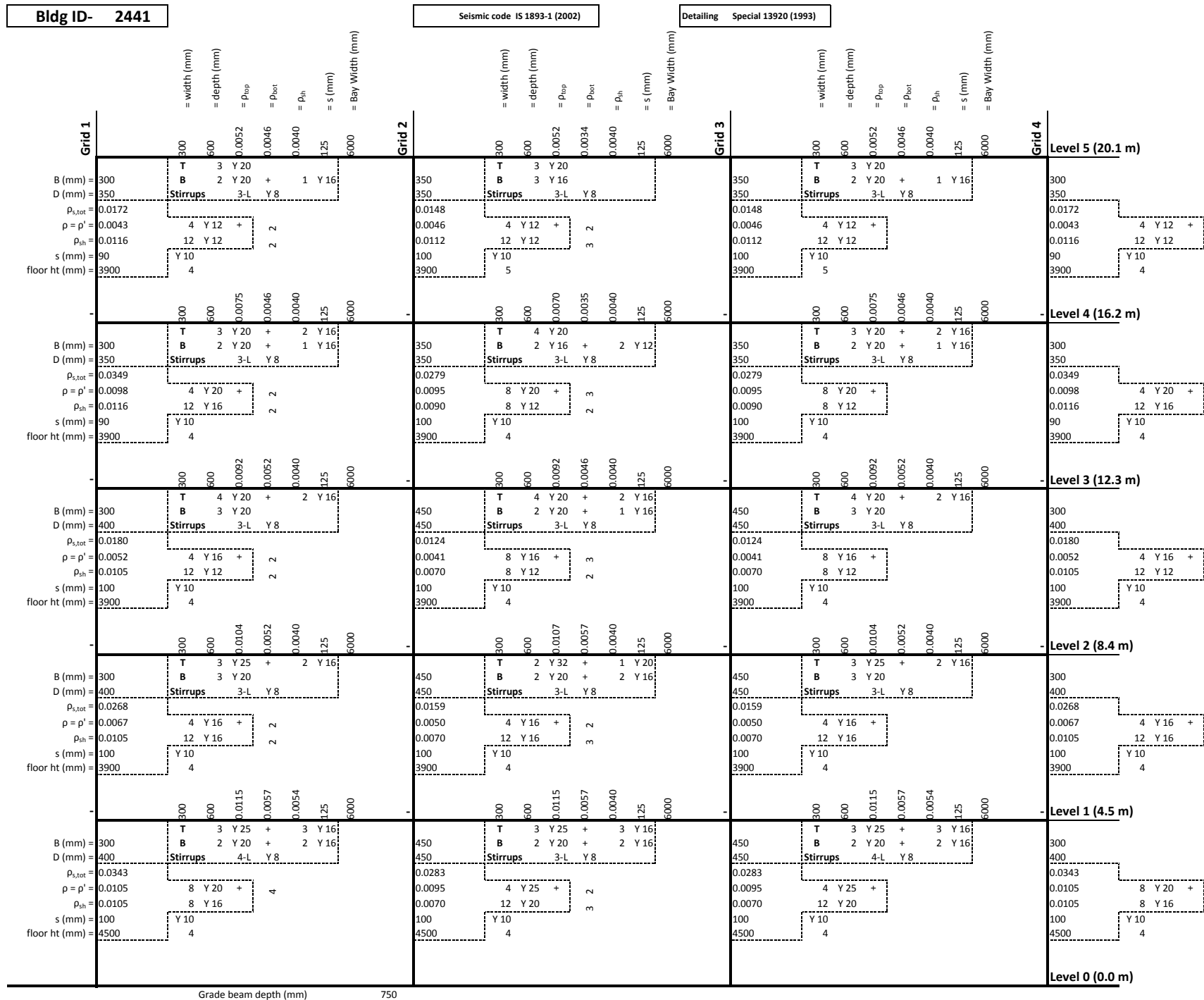


Fig. 24d. Provided reinforcement and modeling details for building ID 2441

25.1. General building configuration and loading inputs

Building Id:	2443
No of stories:	6
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	200 mm
Tributary width (trans bay width):	6000 mm
No of transverse bays:	9
Analytical time period:	2.28 sec

25.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

25.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	24 m
Dimension along X, b_1 (col-to-col):	18 m
Dimension along Y, b_2 (col-to-col):	54 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.81 sec
Time period, $T_{a,Y}$:	0.81 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.23
Avrg response accn coeff, $(S_a/g)_y$:	1.23
Design Seis. coeff, $(A_h)_x$:	0.0443
Design Seis. coeff, $(A_h)_y$:	0.0443

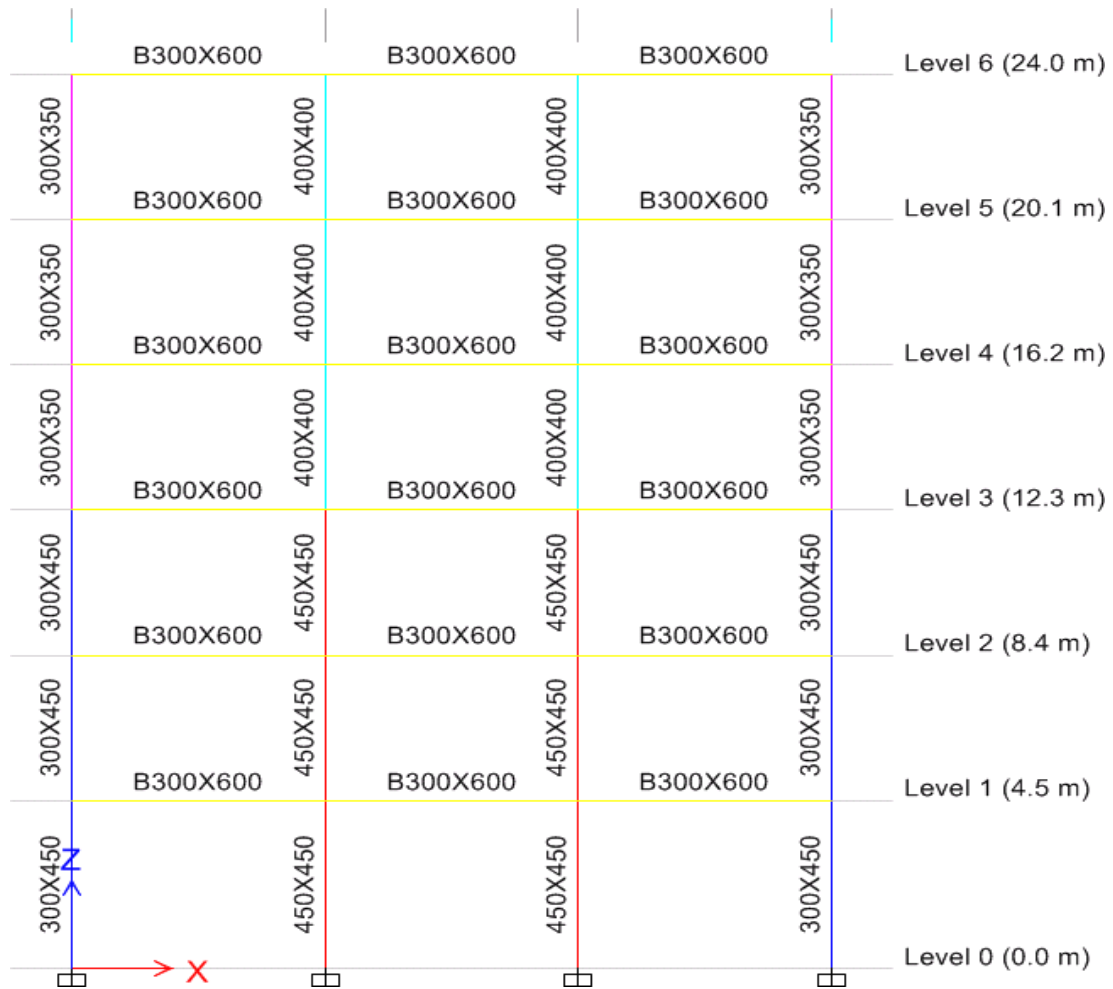


Fig. 25a. Beam column sizes for building ID 2443

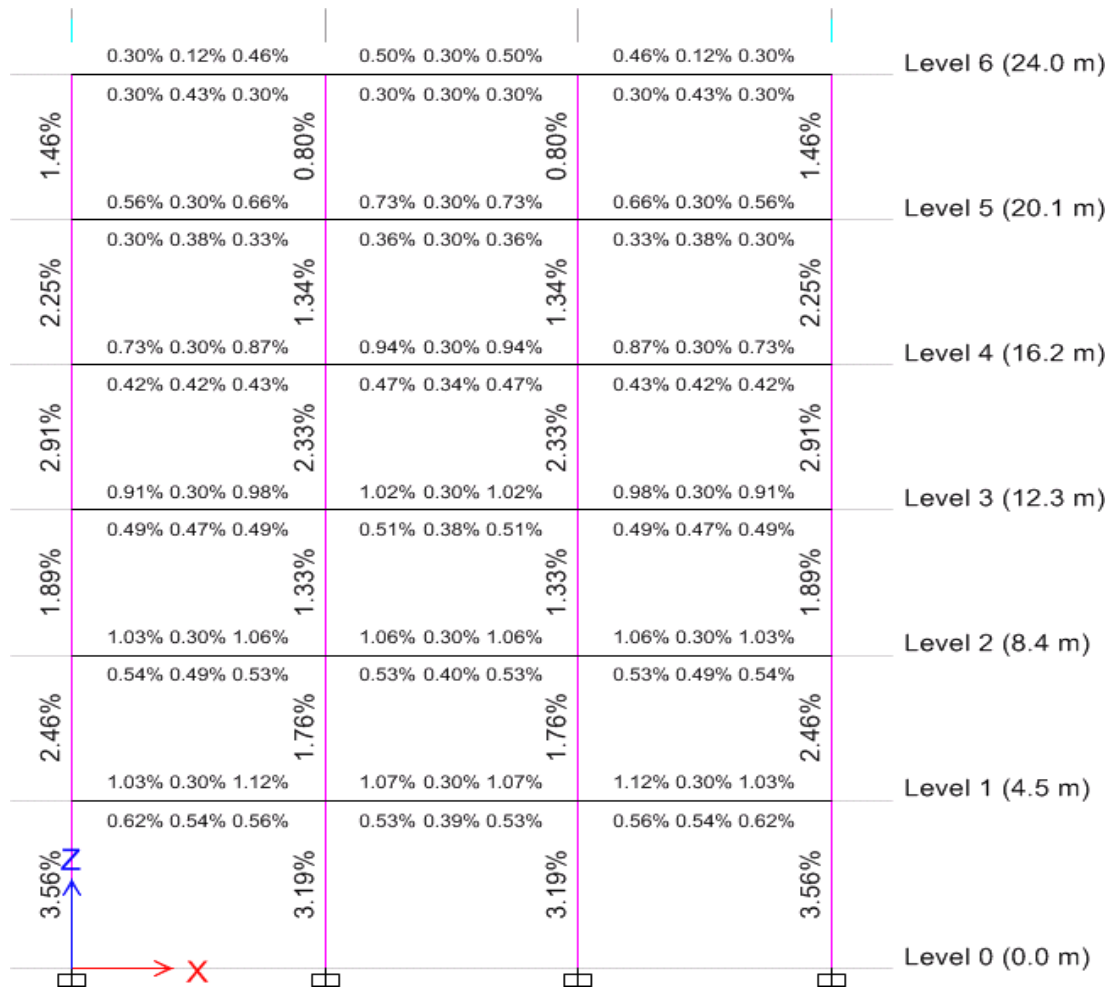


Fig. 25b. Required longitudinal reinforcement for building ID 2443

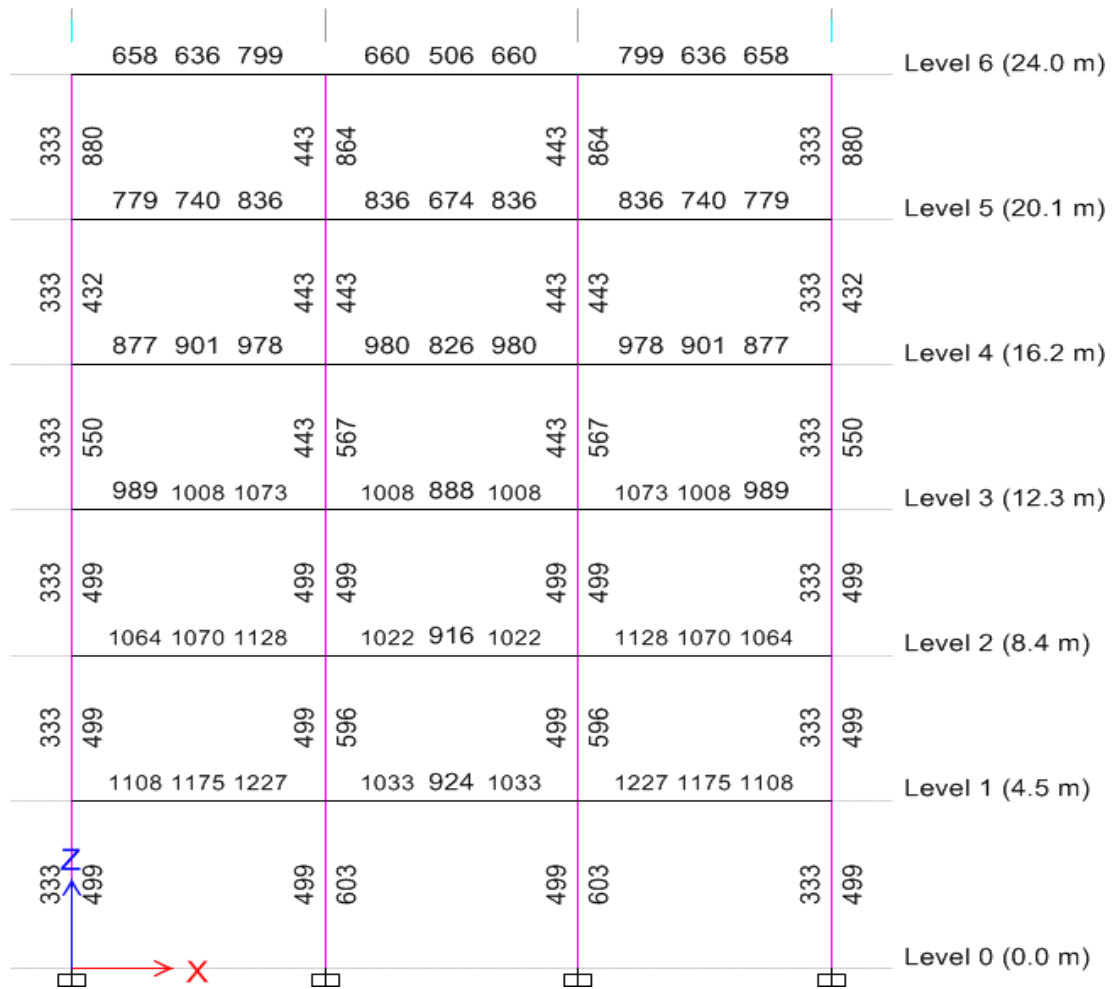


Fig. 25c. Required transverse reinforcement for building ID 2443

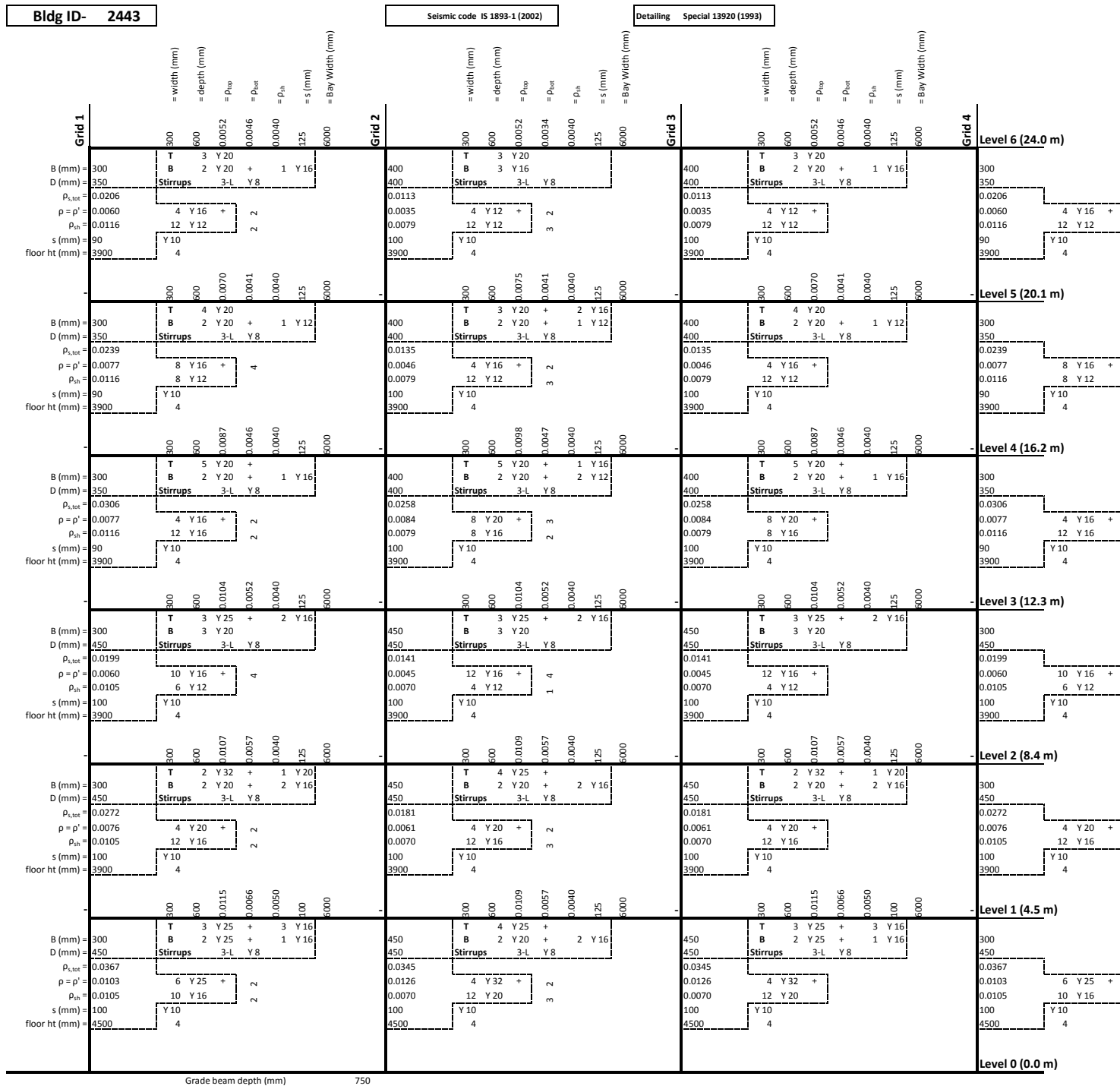


Fig. 25d. Provided reinforcement and modeling details for building ID 2443

26.1. General building configuration and loading inputs

Building Id:	2233
No of stories:	7
No of Bays:	3
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	200 mm
Tributary width (trans bay width):	6000 mm
No of transverse bays:	9
Analytical time period:	2.63 sec

26.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

26.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	27.9 m
Dimension along X, b_1 (col-to-col):	18 m
Dimension along Y, b_2 (col-to-col):	54 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.91 sec
Time period, $T_{a,Y}$:	0.91 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.10
Avrg response accn coeff, $(S_a/g)_y$:	1.10
Design Seis. coeff, $(A_h)_x$:	0.0395
Design Seis. coeff, $(A_h)_y$:	0.0395

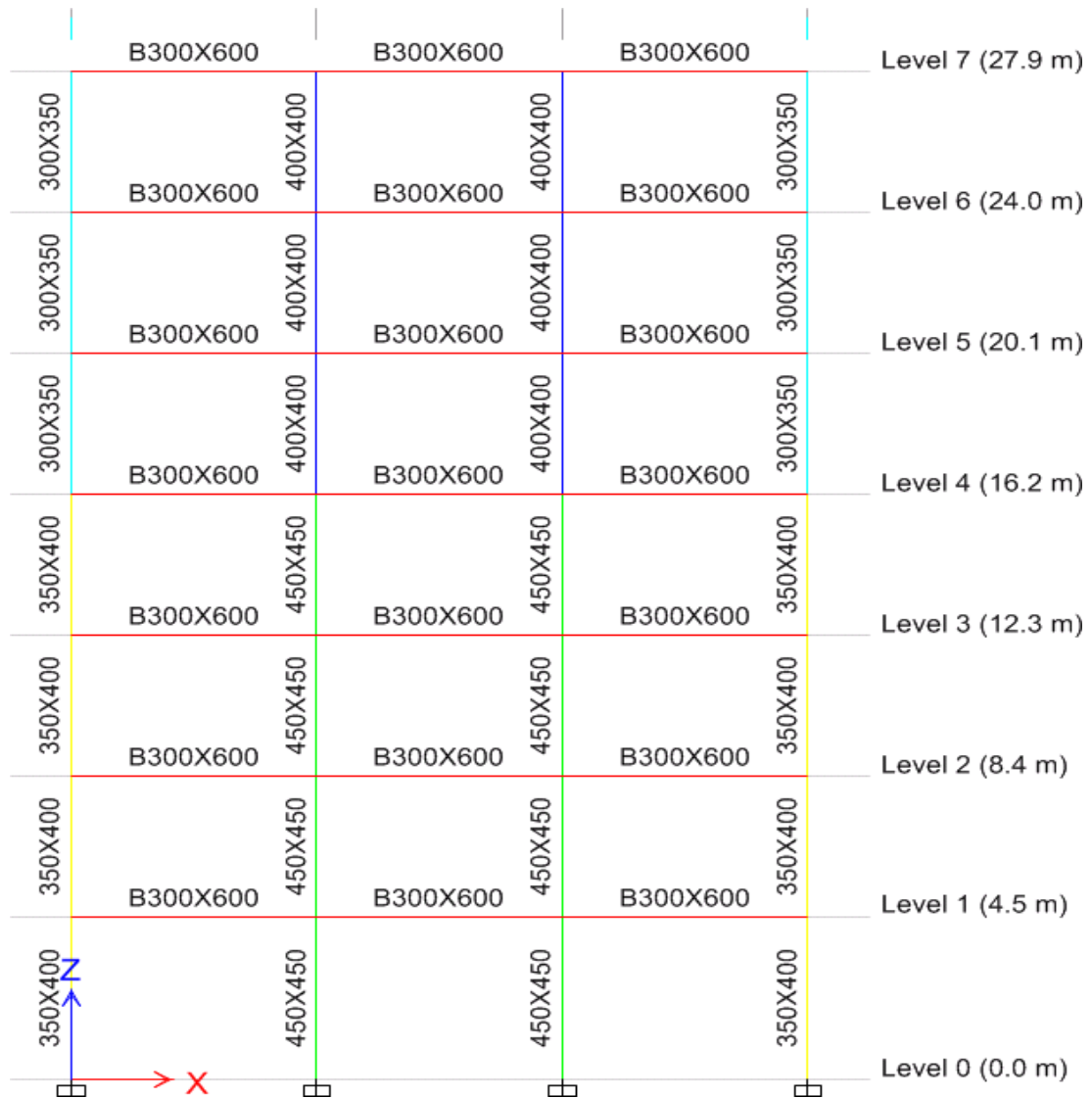


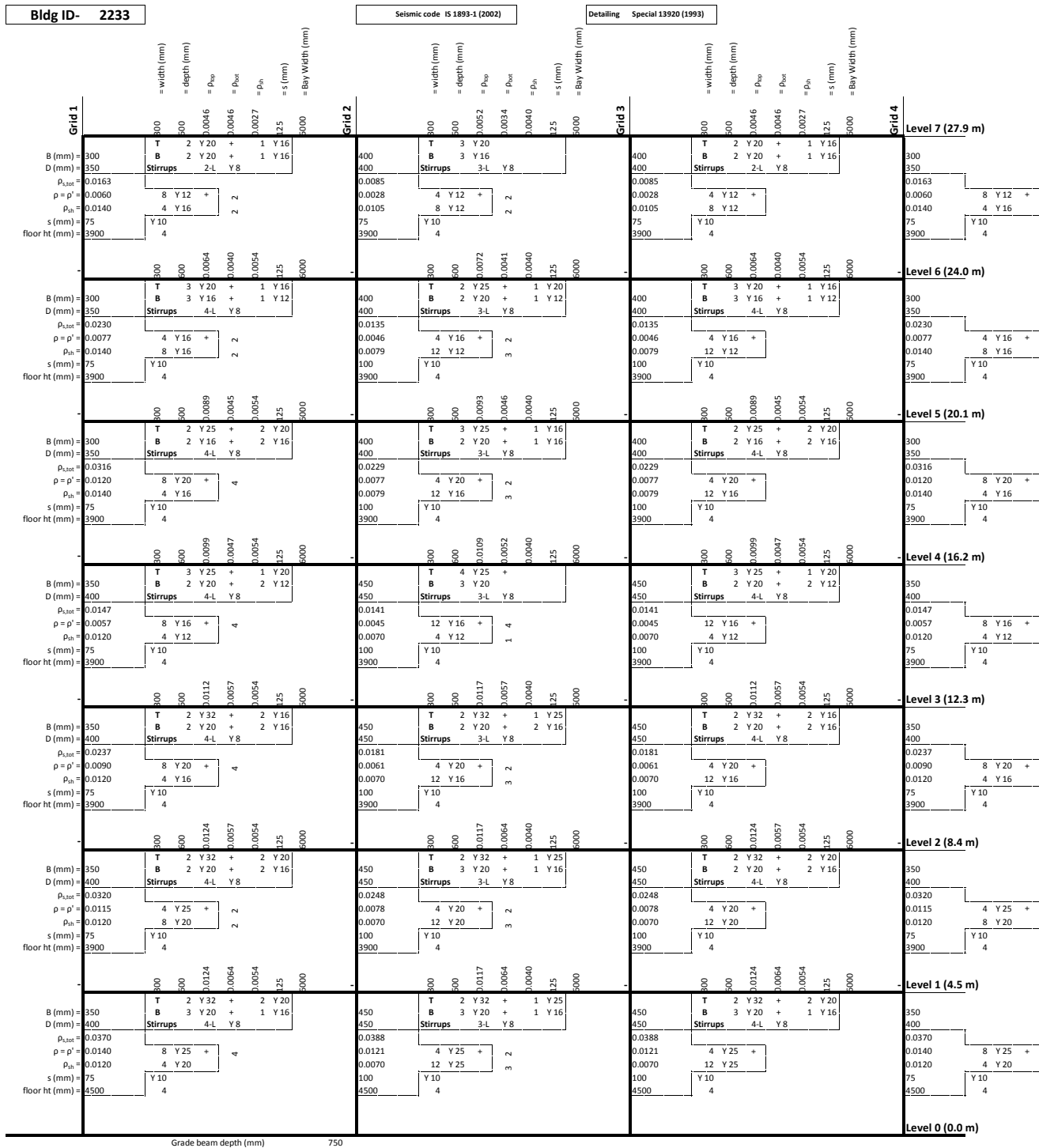
Fig. 26a. Beam column sizes for building ID 2233

	0.30% 0.11% 0.43%	0.49% 0.30% 0.49%	0.43% 0.11% 0.30%	Level 7 (27.9 m)
1.46%	0.30% 0.44% 0.30%	0.30% 0.30% 0.30%	0.30% 0.44% 0.30%	1.46%
	0.54% 0.30% 0.61%	0.70% 0.30% 0.70%	0.61% 0.30% 0.54%	Level 6 (24.0 m)
2.30%	0.30% 0.38% 0.30%	0.35% 0.30% 0.35%	0.30% 0.38% 0.30%	2.30%
	0.72% 0.30% 0.81%	0.91% 0.30% 0.91%	0.81% 0.30% 0.72%	Level 5 (20.1 m)
3.17%	0.39% 0.40% 0.41%	0.45% 0.33% 0.45%	0.41% 0.40% 0.39%	3.17%
	0.89% 0.30% 0.94%	1.03% 0.30% 1.03%	0.94% 0.30% 0.89%	Level 4 (16.2 m)
1.76%	0.46% 0.44% 0.47%	0.51% 0.39% 0.51%	0.47% 0.44% 0.46%	1.76%
	1.01% 0.30% 1.03%	1.11% 0.30% 1.11%	1.03% 0.30% 1.01%	Level 3 (12.3 m)
2.16%	0.51% 0.47% 0.52%	0.55% 0.42% 0.55%	0.52% 0.47% 0.51%	2.16%
	1.05% 0.30% 1.11%	1.15% 0.32% 1.15%	1.11% 0.30% 1.05%	Level 2 (8.4 m)
2.69%	0.56% 0.50% 0.56%	0.58% 0.43% 0.58%	0.56% 0.50% 0.56%	2.69%
	1.03% 0.30% 1.18%	1.17% 0.33% 1.17%	1.18% 0.30% 1.03%	Level 1 (4.5 m)
3.66%	0.64% 0.54% 0.59%	0.58% 0.43% 0.58%	0.59% 0.54% 0.64%	3.66%
				Level 0 (0.0 m)

Fig. 26b. Required longitudinal reinforcement for building ID 2233

	652	609	772	656	497	656	772	609	652	Level 7 (27.9 m)
333	866		443	778		443	778		333	866
	769	693	809	818	657	818	809	693	769	Level 6 (24.0 m)
333	412		443	443		443	443		333	412
	857	848	940	965	806	965	940	848	857	Level 5 (20.1 m)
333	483		443	500		443	500		333	483
	936	919	1006	1008	894	1008	1006	919	936	Level 4 (16.2 m)
388	443		499	499		499	499		388	443
	994	964	1037	1045	949	1045	1037	964	994	Level 3 (12.3 m)
388	443		499	499		499	499		388	443
	1032	1042	1108	1069	974	1069	1108	1042	1032	Level 2 (8.4 m)
388	443		499	545		499	545		388	443
	1083	1142	1199	1075	979	1075	1199	1142	1083	Level 1 (4.5 m)
388	443		499	499		499	499		388	443
										Level 0 (0.0 m)

Fig. 26c. Required transverse reinforcement for building ID 2233



27.1. General building configuration and loading inputs

Building Id:	2235
No of stories:	4
No of Bays:	5
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	200 mm
Tributary width (trans bay width):	6000 mm
No of transverse bays:	9
Analytical time period:	1.70 sec

27.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

27.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	16.2 m
Dimension along X, b_1 (col-to-col):	30 m
Dimension along Y, b_2 (col-to-col):	54 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.61 sec
Time period, $T_{a,Y}$:	0.61 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.65
Avrg response accn coeff, $(S_a/g)_y$:	1.65
Design Seis. coeff, $(A_h)_x$:	0.0594
Design Seis. coeff, $(A_h)_y$:	0.0594



Fig. 27a. Beam column sizes for building ID 2235

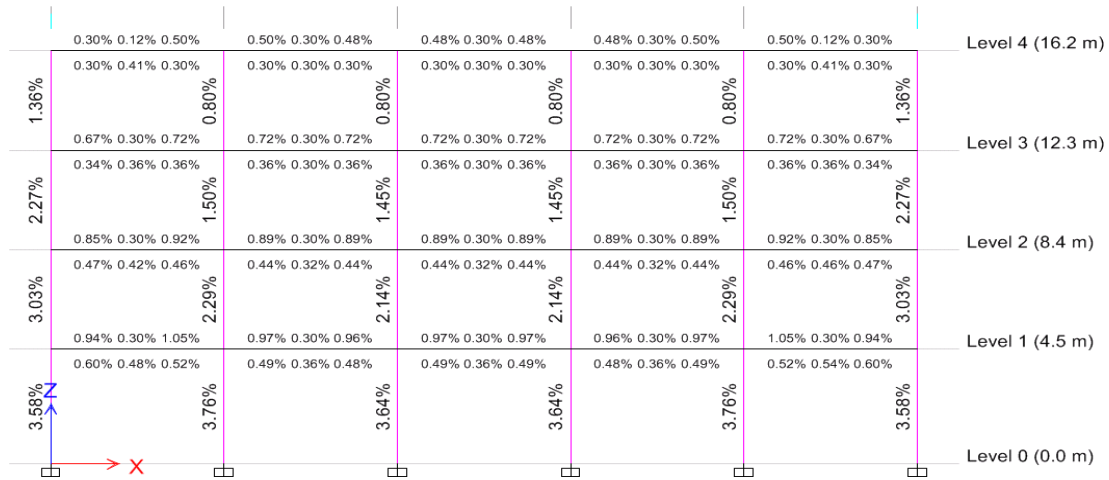


Fig. 27b. Required longitudinal reinforcement for building ID 2235

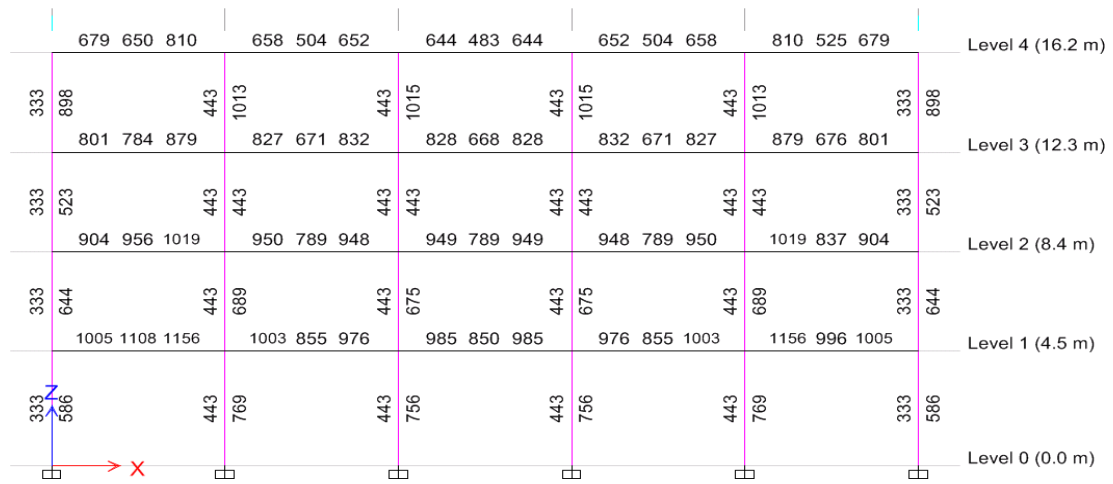


Fig. 27c. Required transverse reinforcement for building ID 2235

28.1. General building configuration and loading inputs

Building Id:	2445
No of stories:	5
No of Bays:	5
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	200 mm
Tributary width (trans bay width):	6000 mm
No of transverse bays:	9
Analytical time period:	1.97 sec

28.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

28.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	20.1 m
Dimension along X, b_1 (col-to-col):	30 m
Dimension along Y, b_2 (col-to-col):	54 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.71 sec
Time period, $T_{a,Y}$:	0.71 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.40
Avrg response accn coeff, $(S_a/g)_y$:	1.40
Design Seis. coeff, $(A_h)_x$:	0.0506
Design Seis. coeff, $(A_h)_y$:	0.0506

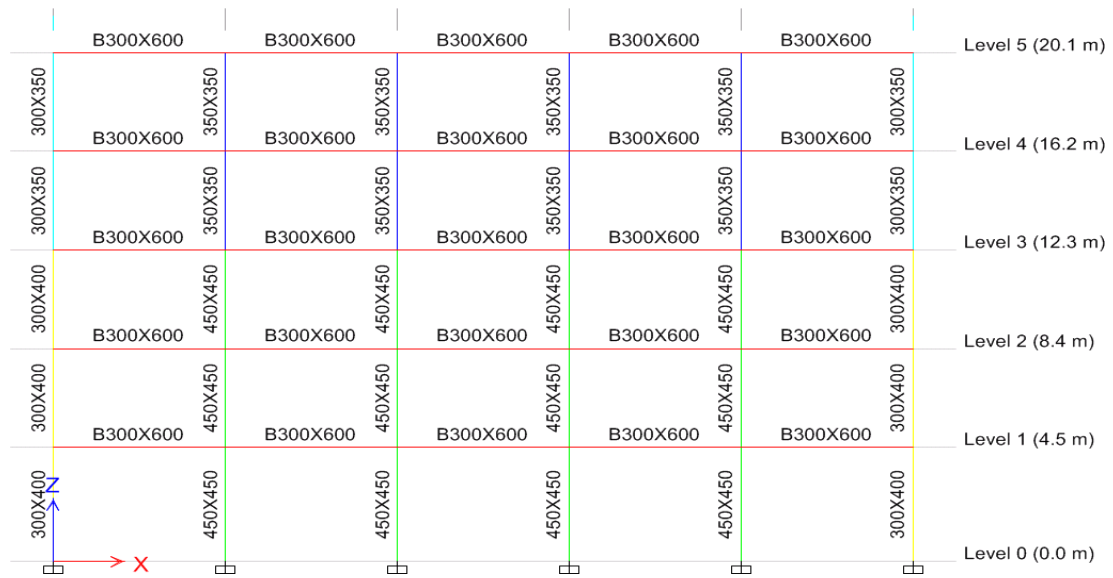


Fig. 28a. Beam column sizes for building ID 2445

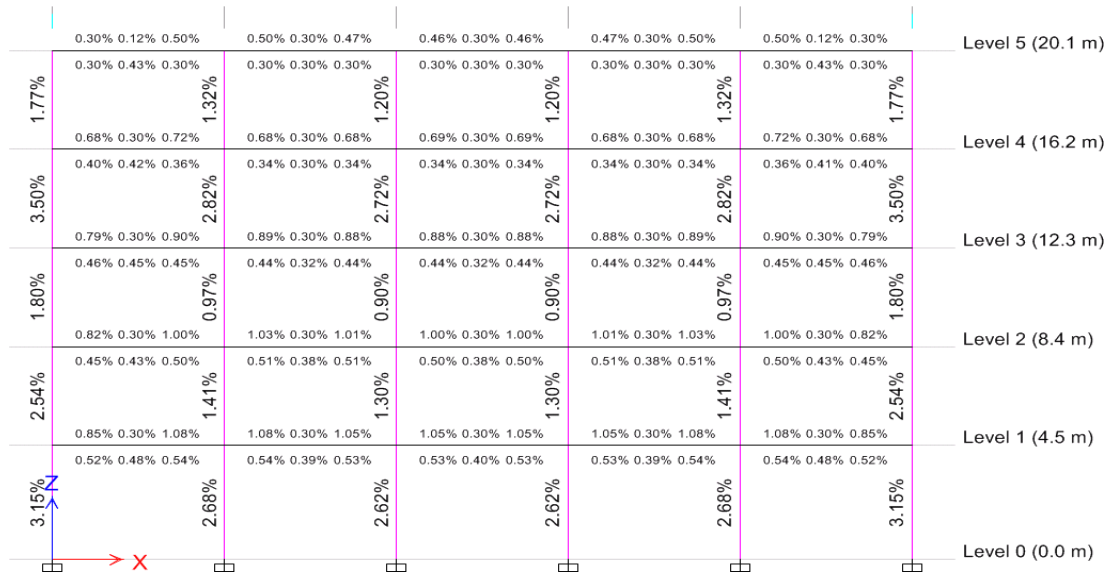


Fig. 28b. Required longitudinal reinforcement for building ID 2445

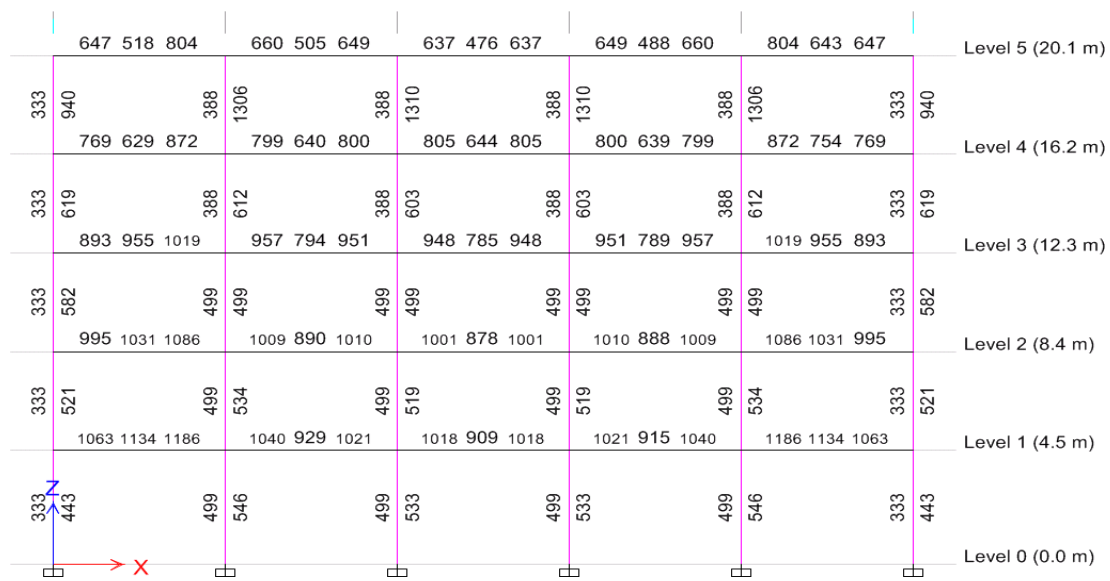
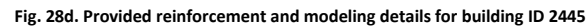


Fig. 28c. Required transverse reinforcement for building ID 2445



29.1. General building configuration and loading inputs

Building Id:	2447
No of stories:	6
No of Bays:	5
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	200 mm
Tributary width (trans bay width):	6000 mm
No of transverse bays:	9
Analytical time period:	2.28 sec

29.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

29.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	24 m
Dimension along X, b_1 (col-to-col):	30 m
Dimension along Y, b_2 (col-to-col):	54 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.81 sec
Time period, $T_{a,Y}$:	0.81 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.23
Avrg response accn coeff, $(S_a/g)_y$:	1.23
Design Seis. coeff, $(A_h)_x$:	0.0443
Design Seis. coeff, $(A_h)_y$:	0.0443



Fig. 29a. Beam column sizes for building ID 2447

	0.30% 0.11% 0.46%	0.49% 0.30% 0.47%	0.46% 0.30% 0.46%	0.47% 0.30% 0.49%	0.46% 0.11% 0.30%	Level 6 (24.0 m)
1.38%	0.30% 0.43% 0.30%	0.30% 0.30% 0.30%	0.30% 0.30% 0.30%	0.30% 0.30% 0.30%	0.30% 0.43% 0.30%	
	0.54% 0.30% 0.64%	0.70% 0.30% 0.70%	0.69% 0.30% 0.69%	0.70% 0.30% 0.70%	0.64% 0.30% 0.54%	Level 5 (20.1 m)
2.09%	0.30% 0.38% 0.32%	0.35% 0.30% 0.35%	0.35% 0.30% 0.35%	0.35% 0.30% 0.35%	0.32% 0.38% 0.30%	
	0.71% 0.30% 0.84%	0.90% 0.30% 0.89%	0.88% 0.30% 0.88%	0.89% 0.30% 0.90%	0.84% 0.30% 0.71%	Level 4 (16.2 m)
2.78%	0.40% 0.40% 0.42%	0.45% 0.33% 0.45%	0.44% 0.32% 0.44%	0.45% 0.33% 0.45%	0.42% 0.40% 0.40%	
	0.89% 0.30% 0.96%	0.99% 0.30% 0.99%	0.99% 0.30% 0.99%	0.99% 0.30% 0.99%	0.96% 0.30% 0.89%	Level 3 (12.3 m)
1.90%	0.48% 0.46% 0.48%	0.50% 0.37% 0.50%	0.49% 0.37% 0.49%	0.50% 0.37% 0.50%	0.48% 0.42% 0.48%	
	1.02% 0.30% 1.04%	1.04% 0.30% 1.05%	1.05% 0.30% 1.05%	1.05% 0.30% 1.04%	1.04% 0.30% 1.02%	Level 2 (8.4 m)
2.46%	0.53% 0.48% 0.52%	0.52% 0.39% 0.52%	0.52% 0.39% 0.52%	0.52% 0.39% 0.52%	0.52% 0.43% 0.53%	
	1.02% 0.30% 1.12%	1.07% 0.30% 1.06%	1.07% 0.30% 1.07%	1.06% 0.30% 1.07%	1.12% 0.30% 1.02%	Level 1 (4.5 m)
	0.62% 0.54% 0.56%	0.53% 0.39% 0.53%	0.53% 0.40% 0.53%	0.53% 0.40% 0.53%	0.56% 0.47% 0.62%	
3.37%						Level 0 (0.0 m)

Fig. 29b. Required longitudinal reinforcement for building ID 2447

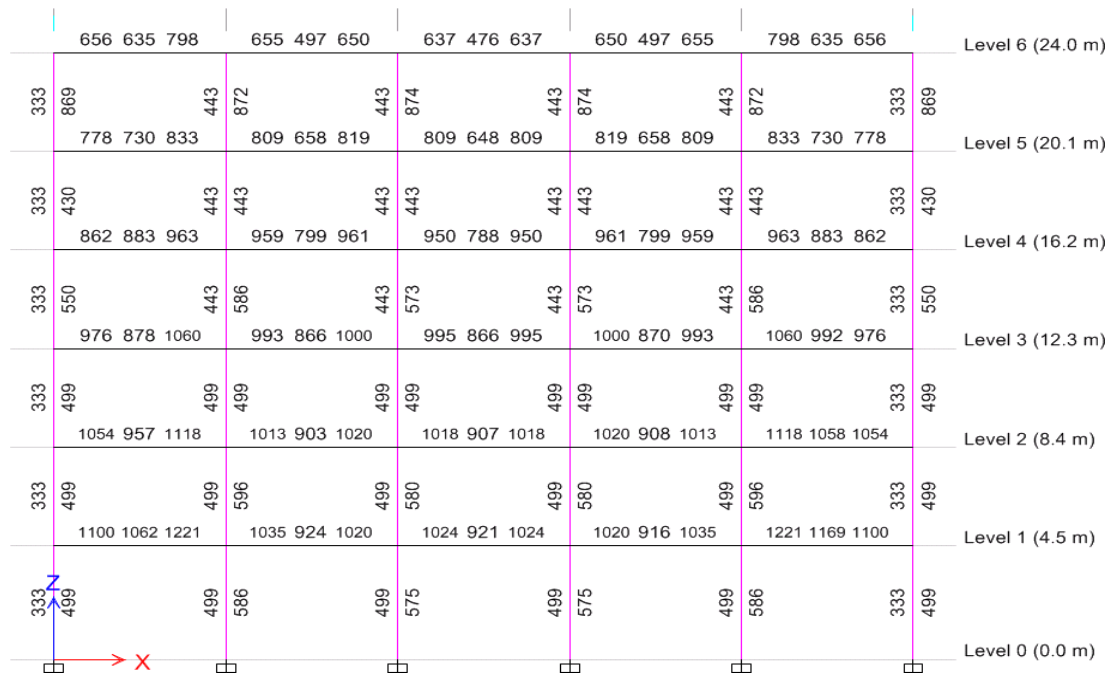


Fig. 29c. Required transverse reinforcement for building ID 2447

30.1. General building configuration and loading inputs

Building Id:	2237
No of stories:	7
No of Bays:	5
Seismic zone (as per IS 1893-1):	V
Soil Strata:	Rocky or Hard Soil
Live Load:	4 kPa
Load due to (partition + MEP + FF):	2 kPa
Slab thickness:	200 mm
Tributary width (trans bay width):	6000 mm
No of transverse bays:	9
Analytical time period:	2.61 sec

30.2. Material and modeling details

Column conc grade, f_{ck} :	40 MPa
Column conc expected, $f_{ck,exp}$:	48.2 MPa
Beam conc grade, f_{ck} :	40 MPa
Beam conc expected, $f_{ck,exp}$:	48.2 MPa
Concrete Young's modulus, $E_{c,col}$:	29166.6 MPa
Concrete Young's modulus, $E_{c,beam}$:	29166.6 MPa
Concrete ult strain, ϵ_{cu}	0.0035
Long steel grade:	500 MPa
Long steel expected str:	600 MPa
Transverse steel grade:	500 MPa
Trans steel expected str:	600 MPa
Steel's modulus of elasticity, E_s :	200000 MPa
Clear cover to trans. steel in column:	40 mm
Clear cover to trans. steel in beam:	25 mm

30.3. Design base shear (as per IS 1893-1)

Zone factor, Z :	0.36
Importance factor, I :	1
Response Reduction, R :	5
Height, H :	27.9 m
Dimension along X, b_1 (col-to-col):	30 m
Dimension along Y, b_2 (col-to-col):	54 m
Building type:	RCC bare frame
Soil Strata:	Rocky or Hard Soil
Time period, $T_{a,X}$:	0.91 sec
Time period, $T_{a,Y}$:	0.91 sec
Avrg response accn coeff, $(S_a/g)_x$:	1.10
Avrg response accn coeff, $(S_a/g)_y$:	1.10
Design Seis. coeff, $(A_h)_x$:	0.0395
Design Seis. coeff, $(A_h)_y$:	0.0395



Fig. 30a. Beam column sizes for building ID 2237

		0.30% 0.11% 0.42%	0.48% 0.30% 0.46%	0.46% 0.30% 0.46%	0.46% 0.30% 0.48%	0.42% 0.11% 0.30%	Level 7 (27.9 m)
	1.37%	0.30% 0.44% 0.30%	0.30% 0.30% 0.30%	0.30% 0.30% 0.30%	0.30% 0.30% 0.30%	0.30% 0.44% 0.30%	
		0.52% 0.30% 0.58%	0.67% 0.30% 0.68%	0.67% 0.30% 0.67%	0.68% 0.30% 0.67%	0.58% 0.30% 0.52%	Level 6 (24.0 m)
	2.15%	0.30% 0.39% 0.30%	0.33% 0.30% 0.34%	0.33% 0.30% 0.33%	0.34% 0.30% 0.33%	0.30% 0.39% 0.30%	
		0.70% 0.30% 0.78%	0.87% 0.30% 0.87%	0.86% 0.30% 0.86%	0.87% 0.30% 0.87%	0.78% 0.30% 0.70%	Level 5 (20.1 m)
	2.98%	0.38% 0.39% 0.39%	0.44% 0.32% 0.43%	0.43% 0.31% 0.43%	0.43% 0.32% 0.44%	0.39% 0.39% 0.38%	
		0.86% 0.30% 0.91%	0.99% 0.30% 0.99%	0.99% 0.30% 0.99%	0.99% 0.30% 0.99%	0.91% 0.30% 0.86%	Level 4 (16.2 m)
	1.89%	0.44% 0.43% 0.45%	0.49% 0.38% 0.50%	0.49% 0.37% 0.49%	0.50% 0.36% 0.49%	0.45% 0.43% 0.44%	
		0.98% 0.30% 1.00%	1.07% 0.30% 1.07%	1.07% 0.30% 1.07%	1.07% 0.30% 1.07%	1.00% 0.30% 0.98%	Level 3 (12.3 m)
	2.27%	0.49% 0.46% 0.50%	0.53% 0.41% 0.54%	0.53% 0.40% 0.53%	0.54% 0.40% 0.53%	0.50% 0.46% 0.49%	
		1.02% 0.30% 1.08%	1.12% 0.31% 1.12%	1.11% 0.30% 1.11%	1.12% 0.30% 1.12%	1.08% 0.30% 1.02%	Level 2 (8.4 m)
	2.78%	0.54% 0.49% 0.54%	0.56% 0.42% 0.56%	0.56% 0.42% 0.56%	0.56% 0.42% 0.56%	0.54% 0.49% 0.54%	
		1.01% 0.30% 1.15%	1.14% 0.32% 1.13%	1.13% 0.31% 1.13%	1.13% 0.31% 1.14%	1.15% 0.30% 1.01%	Level 1 (4.5 m)
		0.62% 0.53% 0.58%	0.57% 0.42% 0.56%	0.57% 0.43% 0.57%	0.56% 0.43% 0.57%	0.58% 0.53% 0.62%	
3.56%							Level 0 (0.0 m)

Fig. 30b. Required longitudinal reinforcement for building ID 2237

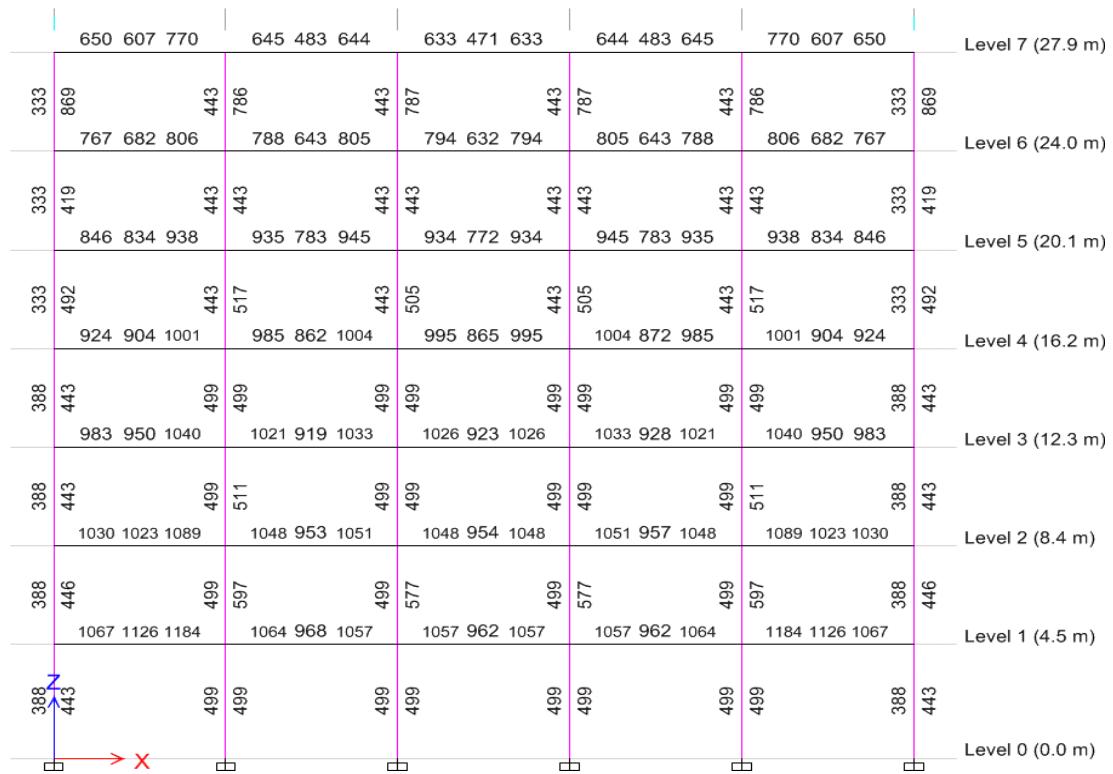


Fig. 30c. Required transverse reinforcement for building ID 2237

