Technical Report 2019

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

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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 × effective depth). Transverse reinforcement is marked in the units of mm^2/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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.91	sec
Time period, Ta_Y:	0.91	sec
Avrg response accn coeff, (Sa/g)_x:	1.10	
Avrg response accn coeff, (Sa/g)_y:	1.10	
Design Seis. coeff, (Ah)_x:	0.0176	
Design Seis. coeff, (Ah)_y:	0.0176	

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

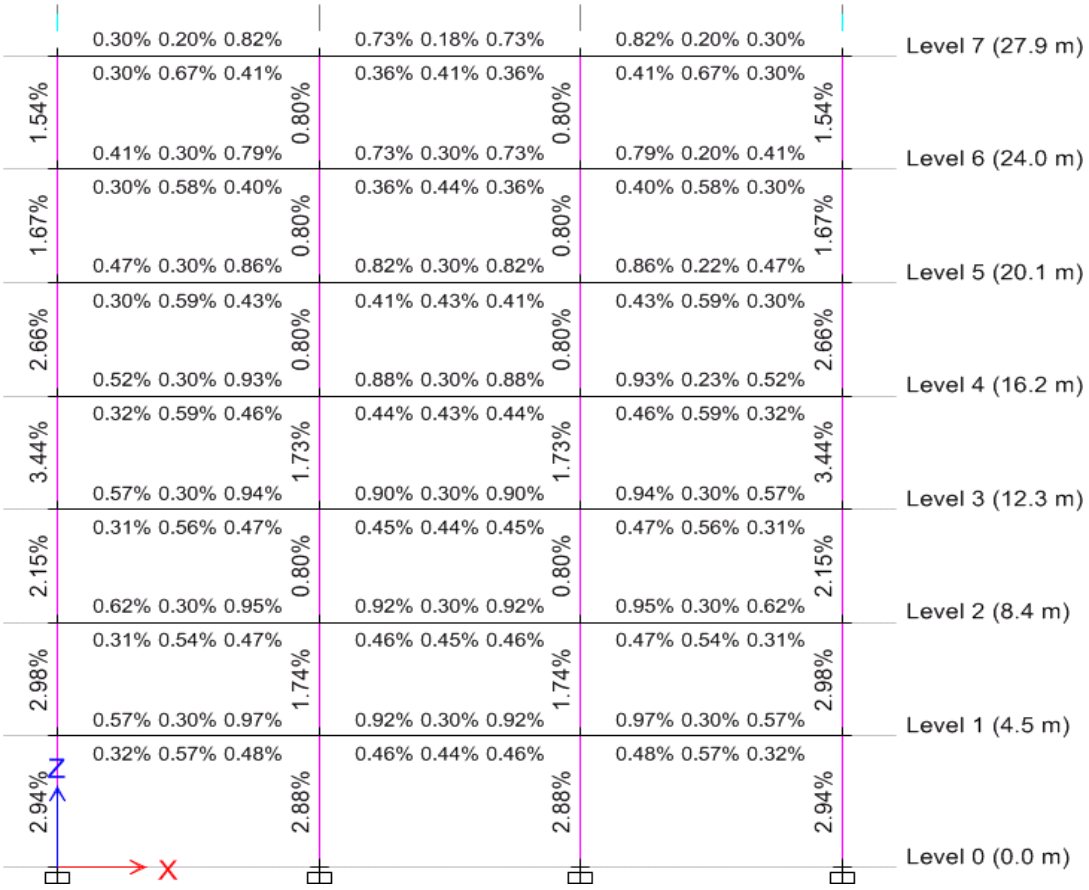

Fig. 1b. Required longitudinal reinforcement for building ID 2207

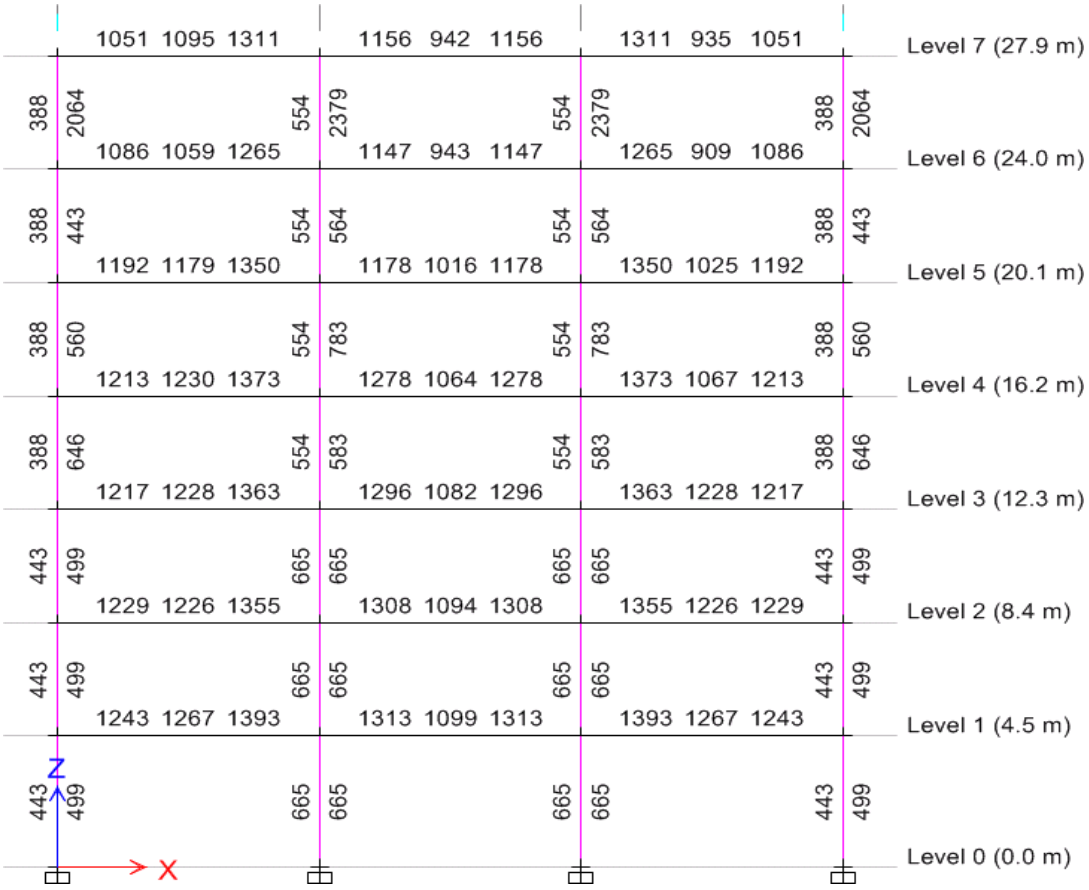

Fig. 1c. Required transverse reinforcement for building ID 2207

Bldg ID- 2207 | **Seismic code IS 1893-1 (2002)** | **Detailing Special 13920 (1993)**

	Grid 1		Grid 2		Grid 3		Grid 4	
	= width (mm)	350	350	350	350	350	350	
	= depth (mm)	750	750	750	750	750	750	
	= ρ_{top}	0.0082	0.0073	0.0045	0.0038	0.0082	0.0071	0.0046
	= ρ_{bot}	0.0071	0.0045	0.0038		0.0071	0.0046	
	= ρ_{sh}	0.0046	0.0038			0.0046		
	= s (mm)	125	150			125		
	= Bay Width (mm)	8200	8200			8200		
Level 7 (27.9 m)								
B (mm) =	350	T 4 Y 25 + 1 Y 16	500	T 2 Y 25 + 3 Y 20	500	T 4 Y 25 + 1 Y 16	350	
D (mm) =	400	B 3 Y 25 + 2 Y 16	500	B 3 Y 20 + 2 Y 12	500	B 3 Y 25 + 2 Y 16	400	
$\rho_{s,tot}$ =	0.0172	Stirrups 4-L Y 8	0.0086	Stirrups 4-L Y 8	0.0086	Stirrups 4-L Y 8	0.0172	
ρ = ρ' =	0.0057	8 Y 16 + 2	0.0030	4 Y 16 + 2	0.0030	4 Y 16 +	0.0057	8 Y 16 +
ρ_{sh} =	0.0120	4 Y 16 2	0.0063	12 Y 12 3	0.0063	12 Y 12	0.0120	4 Y 16
s (mm) =	75	Y 10	100	Y 10	100	Y 10	75	Y 10
floor ht (mm) =	3900	4	3900	4	3900	4	3900	4
	= width (mm)	350	350	350	350	350	350	
	= depth (mm)	750	750	750	750	750	750	
	= ρ_{top}	0.0082	0.0073	0.0045	0.0038	0.0082	0.0060	0.0046
	= ρ_{bot}	0.0060	0.0045	0.0038		0.0060	0.0046	
	= ρ_{sh}	0.0046	0.0038			0.0046		
	= s (mm)	125	150			125		
	= Bay Width (mm)	8200	8200			8200		
Level 6 (24.0 m)								
B (mm) =	350	T 4 Y 25 + 1 Y 16	500	T 2 Y 25 + 3 Y 20	500	T 4 Y 25 + 1 Y 16	350	
D (mm) =	400	B 5 Y 20	500	B 3 Y 20 + 2 Y 12	500	B 5 Y 20	400	
$\rho_{s,tot}$ =	0.0172	Stirrups 4-L Y 8	0.0086	Stirrups 4-L Y 8	0.0086	Stirrups 4-L Y 8	0.0172	
ρ = ρ' =	0.0057	8 Y 16 + 2	0.0030	4 Y 16 + 2	0.0030	4 Y 16 +	0.0057	8 Y 16 +
ρ_{sh} =	0.0120	4 Y 16 2	0.0063	12 Y 12 3	0.0063	12 Y 12	0.0120	4 Y 16
s (mm) =	75	Y 10	100	Y 10	100	Y 10	75	Y 10
floor ht (mm) =	3900	4	3900	4	3900	4	3900	4
	= width (mm)	350	350	350	350	350	350	
	= depth (mm)	750	750	750	750	750	750	
	= ρ_{top}	0.0087	0.0087	0.0045	0.0038	0.0087	0.0060	0.0041
	= ρ_{bot}	0.0060	0.0045	0.0038		0.0060	0.0041	
	= ρ_{sh}	0.0041	0.0038			0.0041		
	= s (mm)	140	150			140		
	= Bay Width (mm)	8200	8200			8200		
Level 5 (20.1 m)								
B (mm) =	350	T 4 Y 25 + 1 Y 20	500	T 4 Y 25 + 1 Y 20	500	T 4 Y 25 + 1 Y 20	350	
D (mm) =	400	B 5 Y 20	500	B 3 Y 20 + 2 Y 12	500	B 5 Y 20	400	
$\rho_{s,tot}$ =	0.0269	Stirrups 4-L Y 8	0.0086	Stirrups 4-L Y 8	0.0086	Stirrups 4-L Y 8	0.0269	
ρ = ρ' =	0.0090	8 Y 20 + 2	0.0030	4 Y 16 + 2	0.0030	4 Y 16 +	0.0090	8 Y 20 +
ρ_{sh} =	0.0120	4 Y 20 2	0.0063	12 Y 12 3	0.0063	12 Y 12	0.0120	4 Y 20
s (mm) =	75	Y 10	100	Y 10	100	Y 10	75	Y 10
floor ht (mm) =	3900	4	3900	4	3900	4	3900	4
	= width (mm)	350	350	350	350	350	350	
	= depth (mm)	750	750	750	750	750	750	
	= ρ_{top}	0.0093	0.0092	0.0045	0.0038	0.0093	0.0060	0.0041
	= ρ_{bot}	0.0060	0.0045	0.0038		0.0060	0.0041	
	= ρ_{sh}	0.0041	0.0038			0.0041		
	= s (mm)	140	150			140		
	= Bay Width (mm)	8200	8200			8200		
Level 4 (16.2 m)								
B (mm) =	350	T 5 Y 25 +	500	T 3 Y 25 + 3 Y 20	500	T 5 Y 25 +	350	
D (mm) =	400	B 5 Y 20	500	B 3 Y 20 + 2 Y 12	500	B 5 Y 20	400	
$\rho_{s,tot}$ =	0.0370	Stirrups 4-L Y 8	0.0183	Stirrups 4-L Y 8	0.0183	Stirrups 4-L Y 8	0.0370	
ρ = ρ' =	0.0140	8 Y 25 + 4	0.0058	12 Y 20 + 4	0.0058	12 Y 20 +	0.0140	8 Y 25 +
ρ_{sh} =	0.0120	4 Y 20	0.0063	4 Y 16 1	0.0063	4 Y 16	0.0120	4 Y 20
s (mm) =	75	Y 10	100	Y 10	100	Y 10	75	Y 10
floor ht (mm) =	3900	4	3900	4	3900	4	3900	4
	= width (mm)	350	350	350	350	350	350	
	= depth (mm)	750	750	750	750	750	750	
	= ρ_{top}	0.0097	0.0093	0.0047	0.0038	0.0097	0.0060	0.0041
	= ρ_{bot}	0.0060	0.0047	0.0038		0.0060	0.0041	
	= ρ_{sh}	0.0041	0.0038			0.0041		
	= s (mm)	140	150			140		
	= Bay Width (mm)	8200	8200			8200		
Level 3 (12.3 m)								
B (mm) =	400	T 2 Y 32 + 3 Y 20	600	T 5 Y 25 +	600	T 2 Y 32 + 3 Y 20	400	
D (mm) =	450	B 5 Y 20	600	B 2 Y 20 + 3 Y 16	600	B 5 Y 20	450	
$\rho_{s,tot}$ =	0.0249	Stirrups 4-L Y 8	0.0127	Stirrups 4-L Y 8	0.0127	Stirrups 4-L Y 8	0.0249	
ρ = ρ' =	0.0089	4 Y 25 + 2	0.0040	12 Y 20 + 4	0.0040	12 Y 20 +	0.0089	4 Y 25 +
ρ_{sh} =	0.0105	8 Y 20 2	0.0052	4 Y 16 1	0.0052	4 Y 16	0.0105	8 Y 20
s (mm) =	75	Y 10	100	Y 10	100	Y 10	75	Y 10
floor ht (mm) =	3900	4	3900	4	3900	4	3900	4
	= width (mm)	350	350	350	350	350	350	
	= depth (mm)	750	750	750	750	750	750	
	= ρ_{top}	0.0097	0.0093	0.0051	0.0038	0.0097	0.0056	0.0041
	= ρ_{bot}	0.0056	0.0051	0.0038		0.0056	0.0041	
	= ρ_{sh}	0.0041	0.0038			0.0041		
	= s (mm)	140	150			140		
	= Bay Width (mm)	8200	8200			8200		
Level 2 (8.4 m)								
B (mm) =	400	T 2 Y 32 + 3 Y 20	600	T 5 Y 25 +	600	T 2 Y 32 + 3 Y 20	400	
D (mm) =	450	B 4 Y 20 + 1 Y 16	600	B 3 Y 20 + 2 Y 16	600	B 4 Y 20 + 1 Y 16	400	
$\rho_{s,tot}$ =	0.0327	Stirrups 4-L Y 8	0.0194	Stirrups 4-L Y 8	0.0194	Stirrups 4-L Y 8	0.0327	
ρ = ρ' =	0.0109	8 Y 25 + 2	0.0071	4 Y 32 + 2	0.0071	4 Y 32 +	0.0109	8 Y 25 +
ρ_{sh} =	0.0105	4 Y 25 2	0.0052	12 Y 20 3	0.0052	12 Y 20	0.0105	4 Y 25
s (mm) =	75	Y 10	100	Y 10	100	Y 10	75	Y 10
floor ht (mm) =	3900	4	3900	4	3900	4	3900	4
	= width (mm)	350	350	350	350	350	350	
	= depth (mm)	750	750	750	750	750	750	
	= ρ_{top}	0.0097	0.0093	0.0051	0.0038	0.0097	0.0060	0.0041
	= ρ_{bot}	0.0060	0.0051	0.0038		0.0060	0.0041	
	= ρ_{sh}	0.0041	0.0038			0.0041		
	= s (mm)	140	150			140		
	= Bay Width (mm)	8200	8200			8200		
Level 1 (4.5 m)								
B (mm) =	400	T 2 Y 32 + 3 Y 20	600	T 5 Y 25 +	600	T 2 Y 32 + 3 Y 20	400	
D (mm) =	450	B 5 Y 20	600	B 3 Y 20 + 2 Y 16	600	B 5 Y 20	450	
$\rho_{s,tot}$ =	0.0327	Stirrups 4-L Y 8	0.0303	Stirrups 4-L Y 8	0.0303	Stirrups 4-L Y 8	0.0327	
ρ = ρ' =	0.0109	8 Y 25 + 2	0.0098	12 Y 32 + 4	0.0098	12 Y 32 +	0.0109	8 Y 25 +
ρ_{sh} =	0.0105	4 Y 25 2	0.0052	4 Y 20 1	0.0052	4 Y 20	0.0105	4 Y 25
s (mm) =	75	Y 10	100	Y 10	100	Y 10	75	Y 10
floor ht (mm) =	4500	4	4500	4	4500	4	4500	4
Level 0 (0.0 m)								
Grade beam depth (mm)		750						

Fig. 1d. Provided reinforcement and modeling details 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, Ec_col:	32048.2	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	1.35	sec
Time period, Ta_Y:	1.35	sec
Avrg response accn coeff, (Sa/g)_x:	0.74	
Avrg response accn coeff, (Sa/g)_y:	0.74	
Design Seis. coeff, (Ah)_x:	0.0118	
Design Seis. coeff, (Ah)_y:	0.0118	

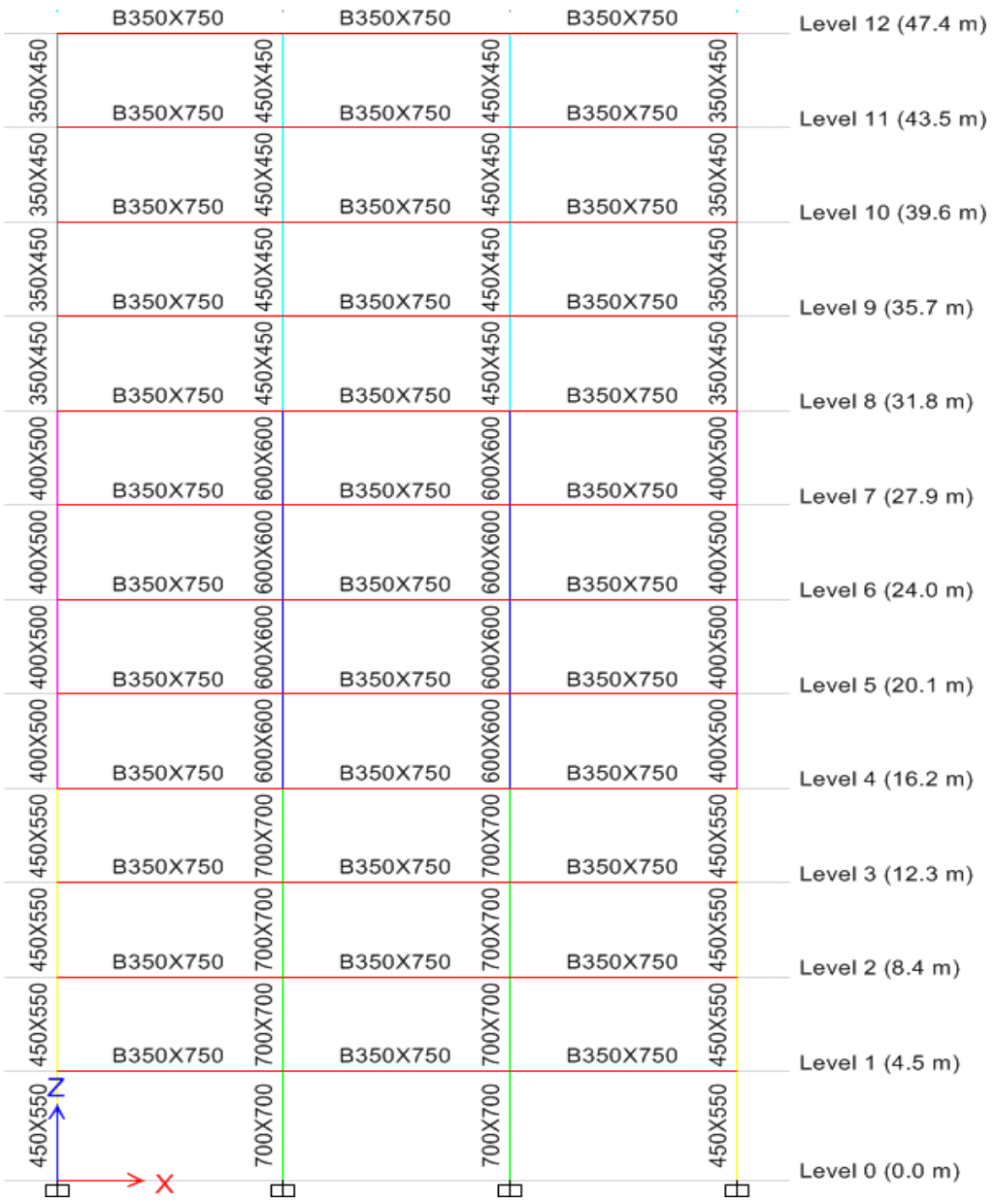

Fig. 2a. Beam column sizes for building ID 2209

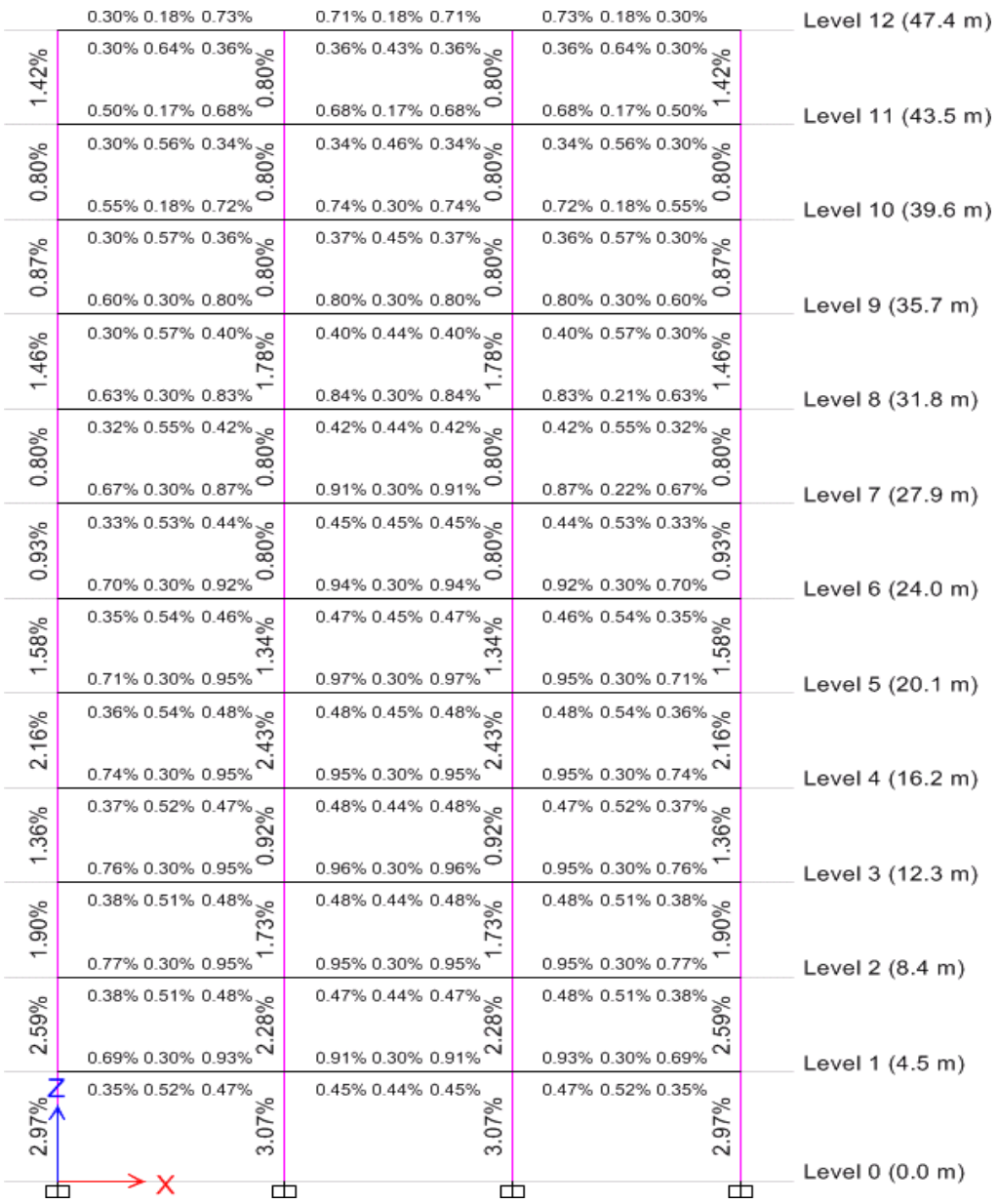

Fig. 2b. Required longitudinal reinforcement for building ID 2209

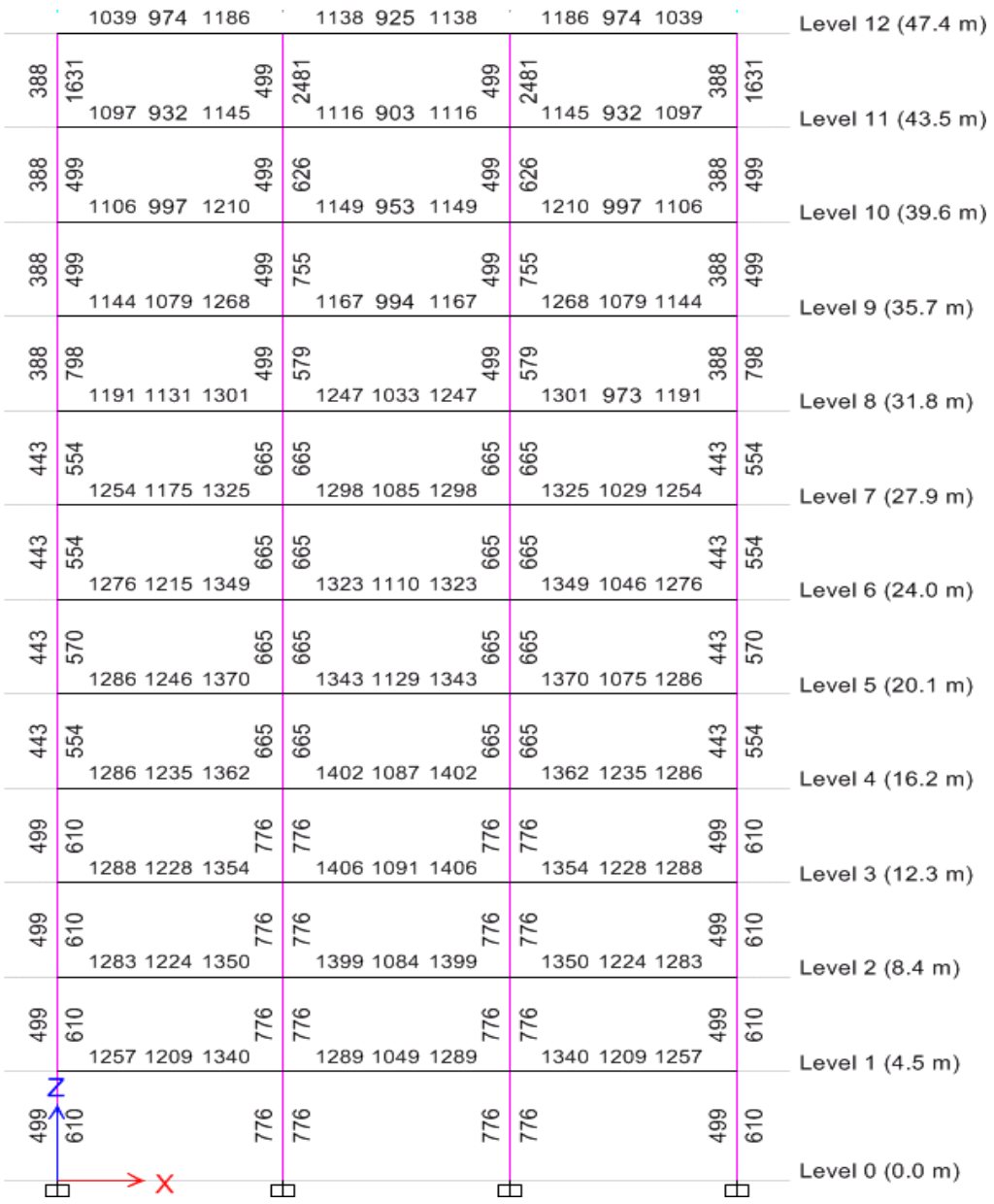

Fig. 2c. Required transverse reinforcement for building ID 2209

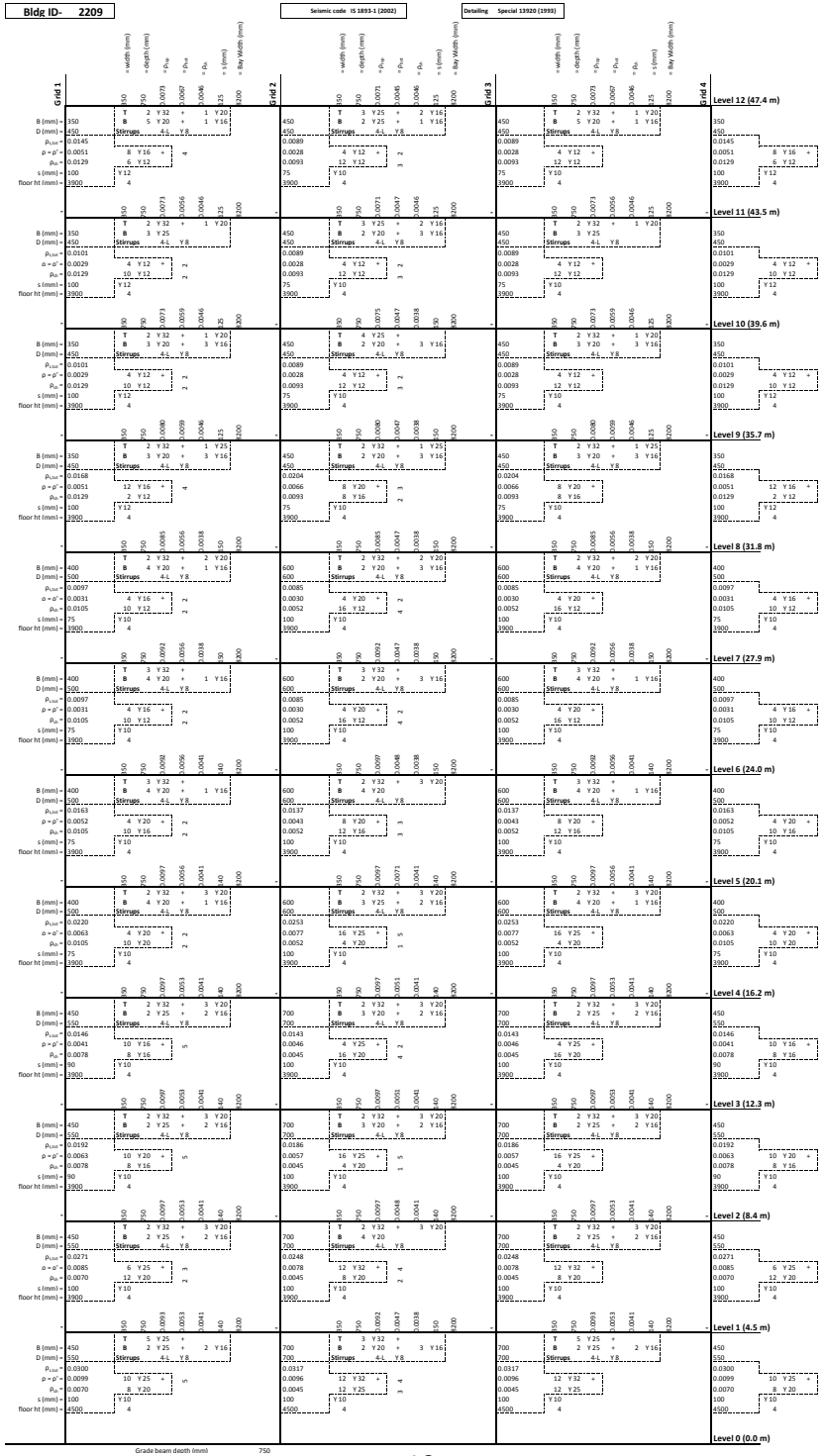

Fig. 2d. Provided reinforcement and modeling details for building ID 2209

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.37	sec
Time period, Ta_Y:	0.37	sec
Avrg response accn coeff, (Sa/g)_x:	2.50	
Avrg response accn coeff, (Sa/g)_y:	2.50	
Design Seis. coeff, (Ah)_x:	0.0600	
Design Seis. coeff, (Ah)_y:	0.0600	

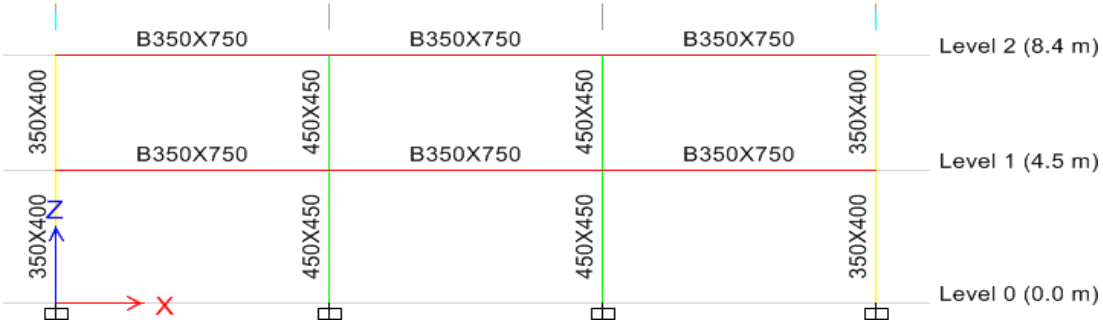

Fig. 3a. Beam column sizes for building ID 2211

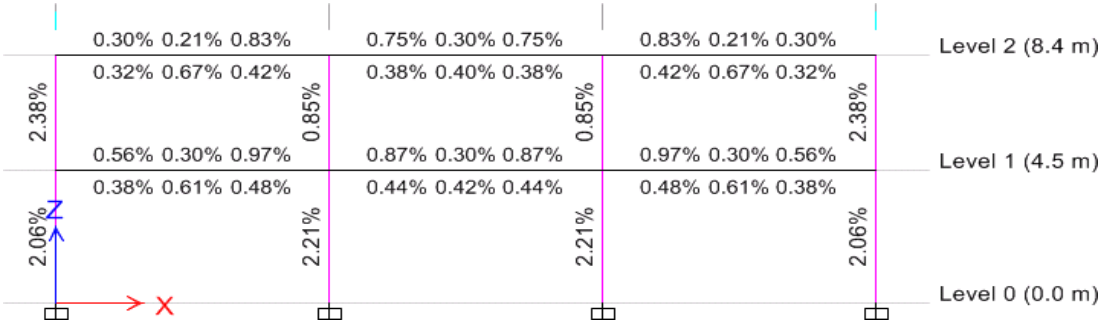

Fig. 3b. Required longitudinal reinforcement for building ID 2211

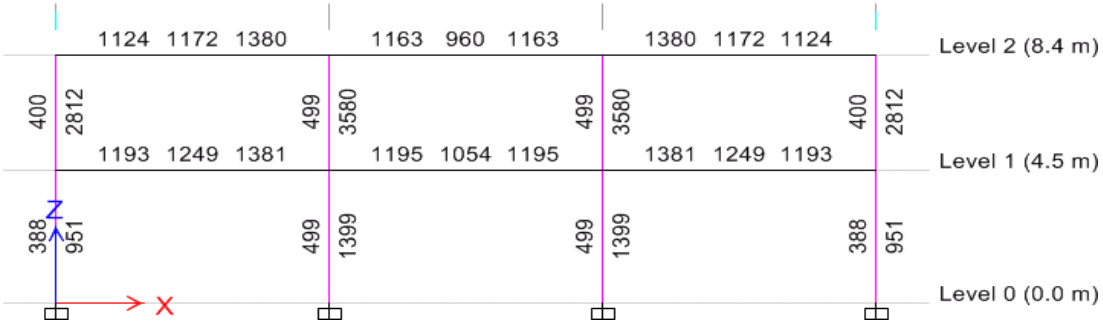

Fig. 3c. Required transverse reinforcement for building ID 2211

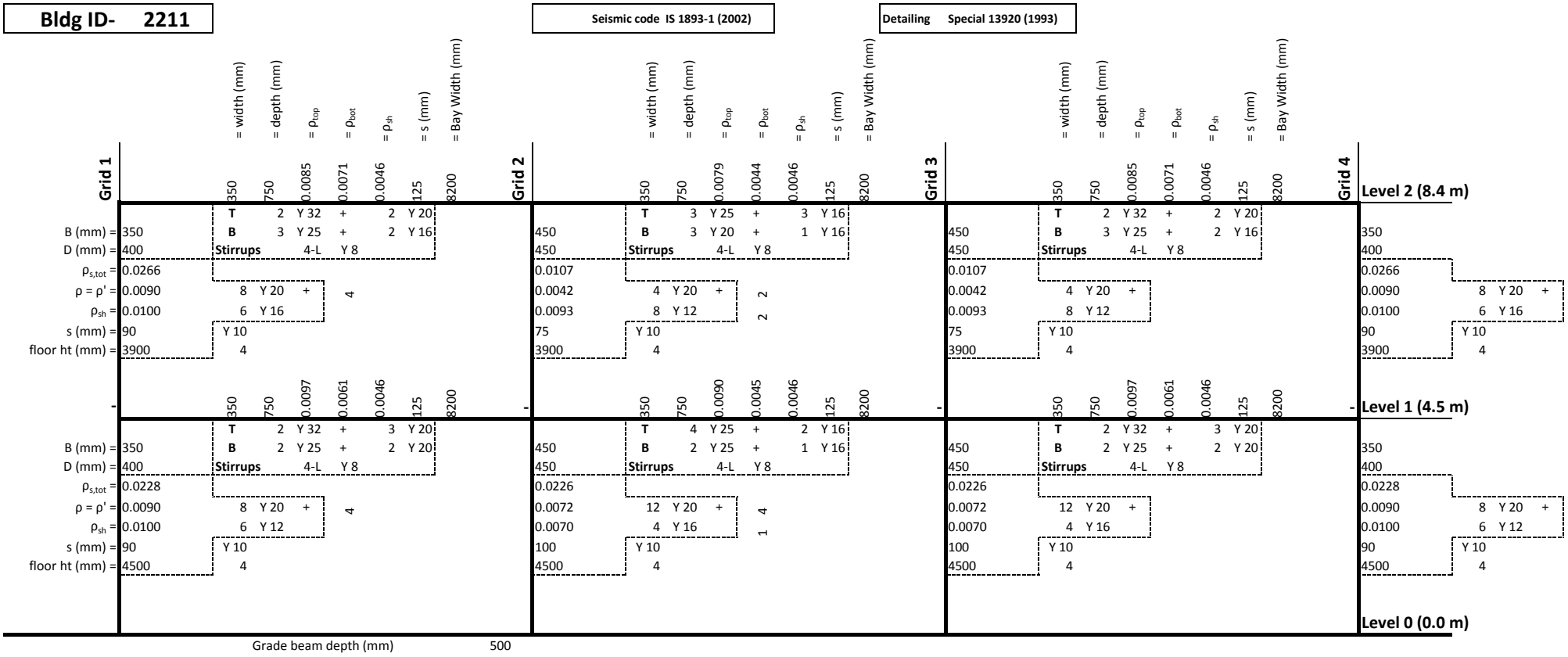

Fig. 3d. Provided reinforcement and modeling details for building ID 2211

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.61	sec
Time period, Ta_Y:	0.61	sec
Avrg response accn coeff, (Sa/g)_x:	1.65	
Avrg response accn coeff, (Sa/g)_y:	1.65	
Design Seis. coeff, (Ah)_x:	0.0396	
Design Seis. coeff, (Ah)_y:	0.0396	

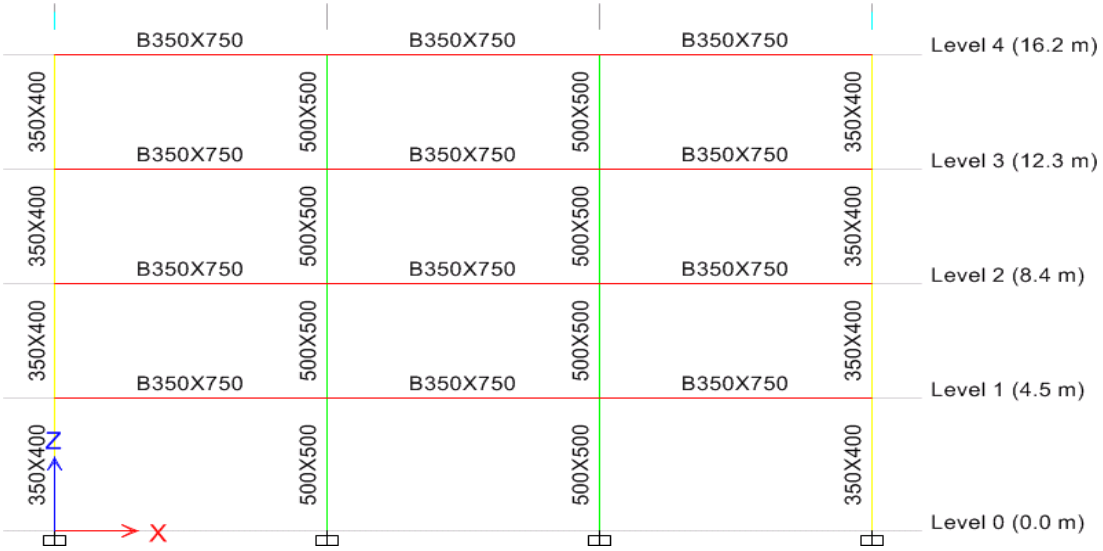

Fig. 4a. Beam column sizes for building ID 2213

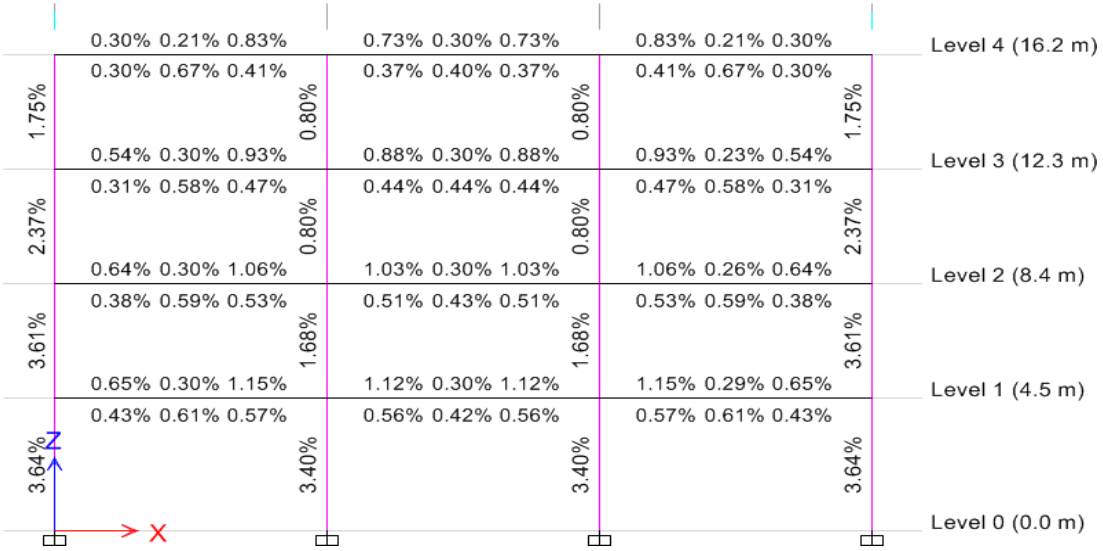

Fig. 4b. Required longitudinal reinforcement for building ID 2213

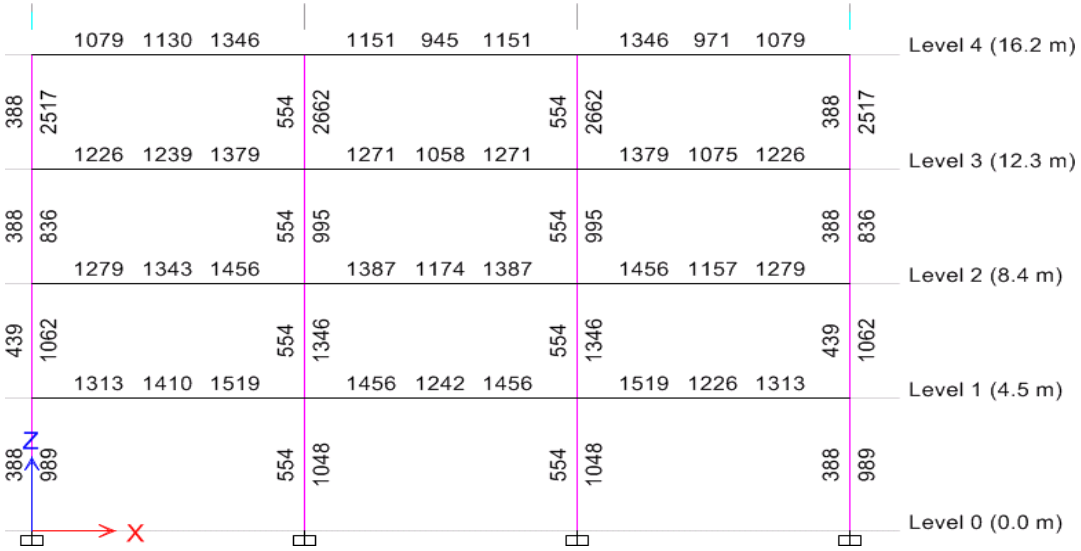

Fig. 4c. Required transverse reinforcement for building ID 2213

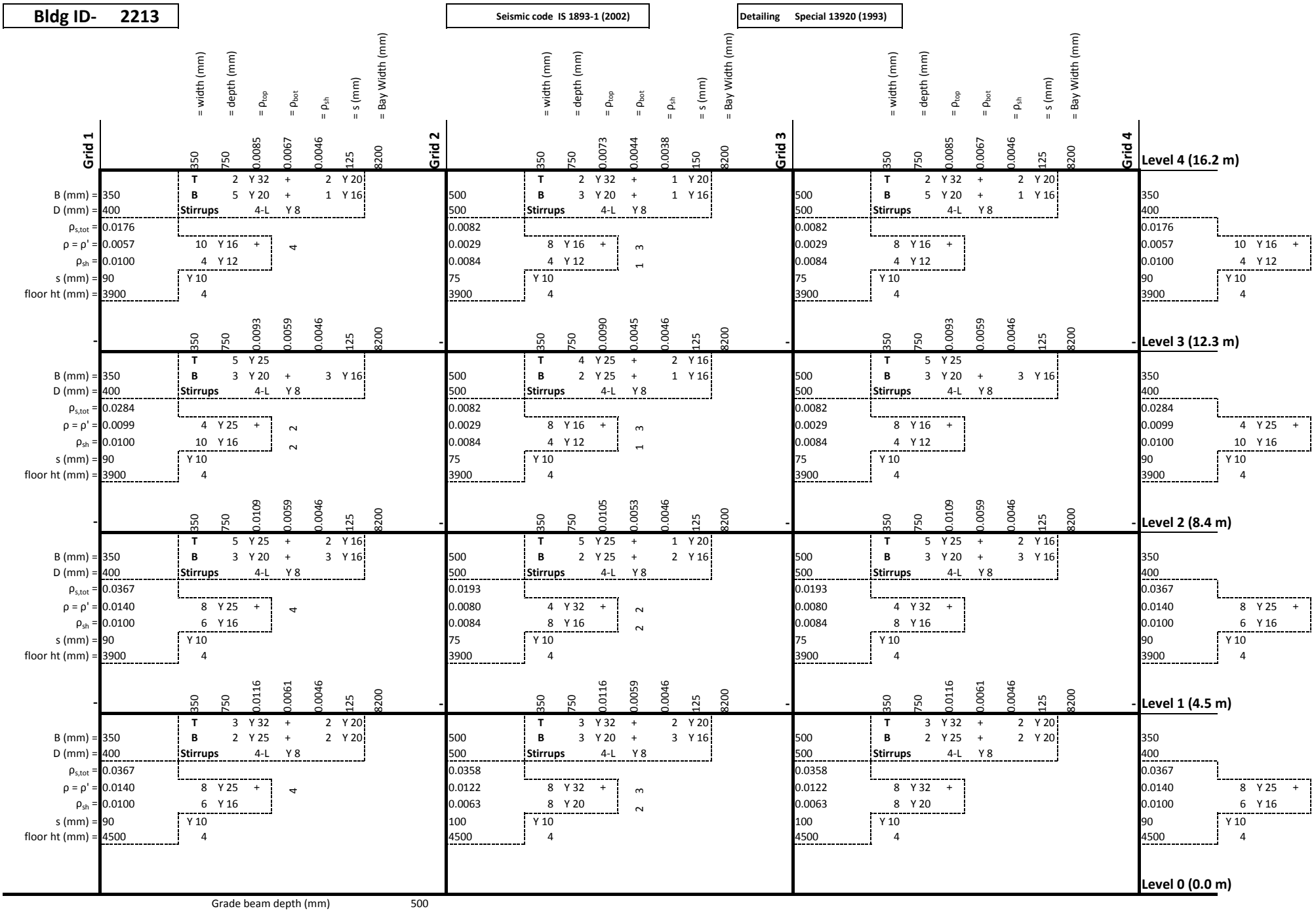

Fig. 4d. Provided reinforcement and modeling details for building ID 2213

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.71	sec
Time period, Ta_Y:	0.71	sec
Avrg response accn coeff, (Sa/g)_x:	1.40	
Avrg response accn coeff, (Sa/g)_y:	1.40	
Design Seis. coeff, (Ah)_x:	0.0337	
Design Seis. coeff, (Ah)_y:	0.0337	

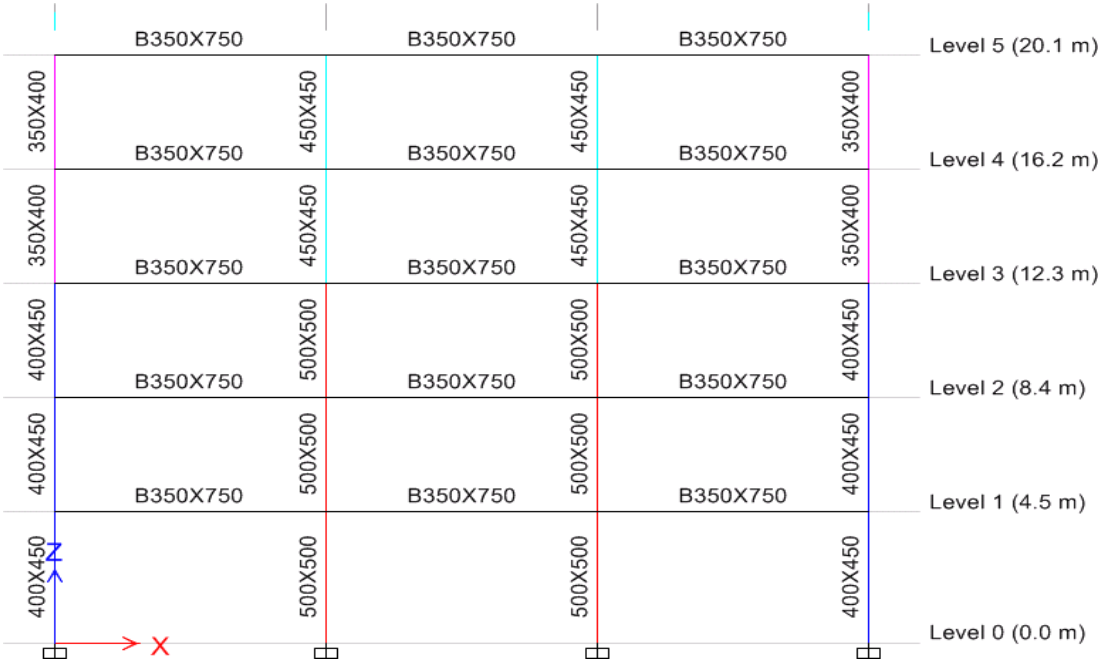

Fig. 5a. Beam column sizes for building ID 2451

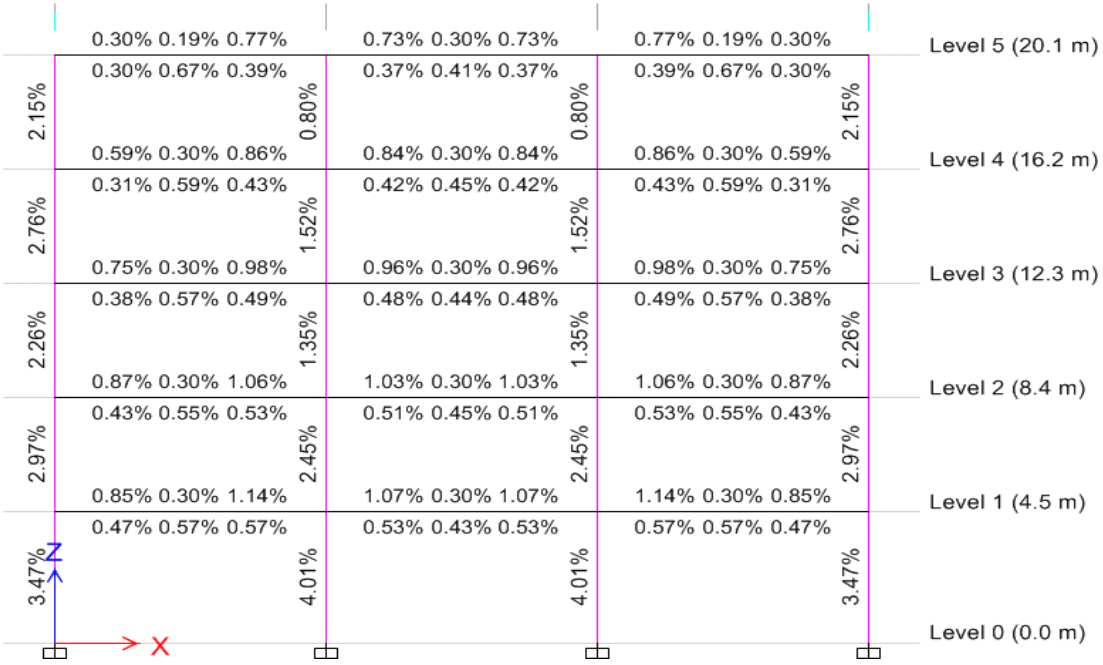

Fig. 5b. Required longitudinal reinforcement for building ID 2451

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

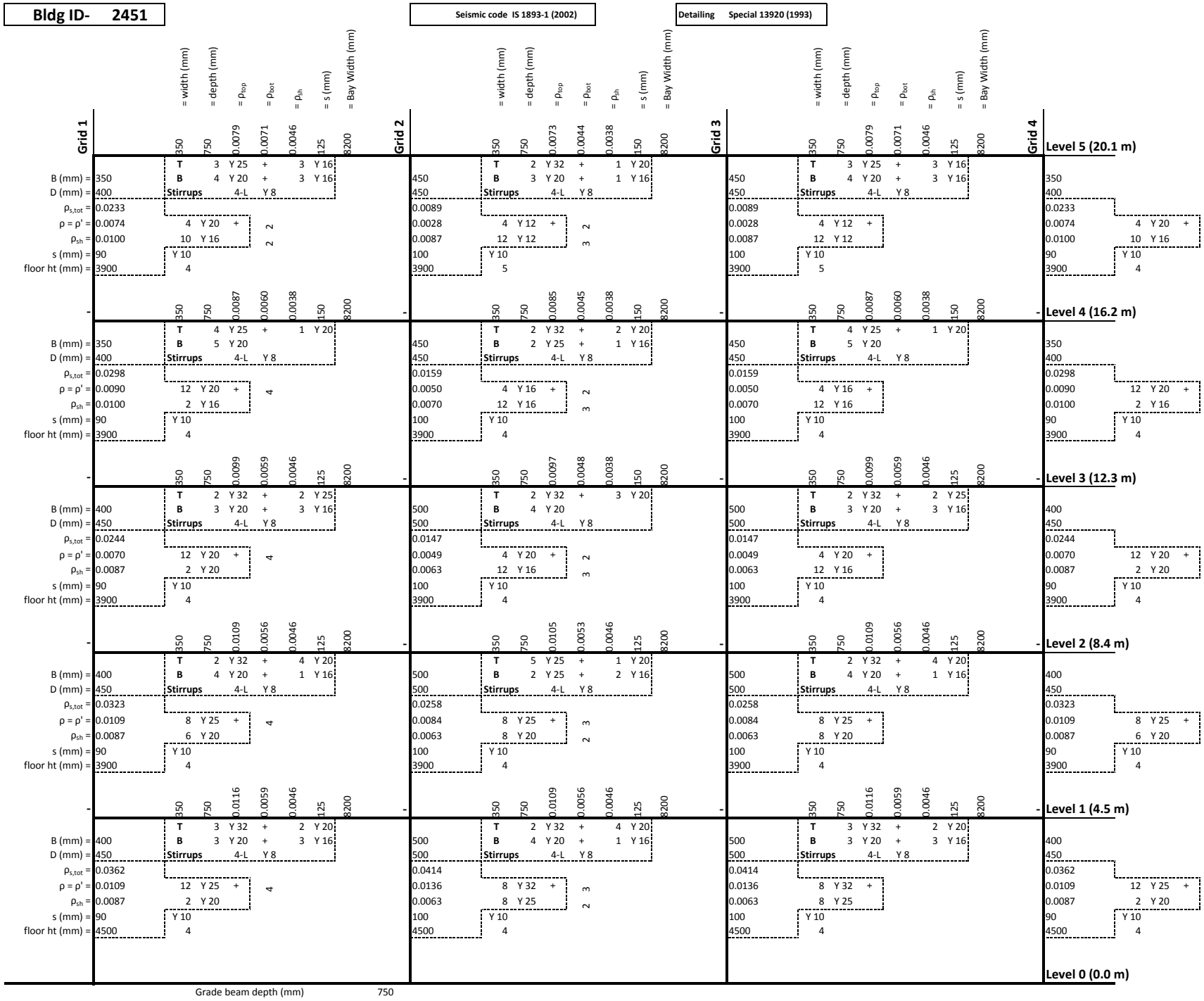

Fig. 5d. Provided reinforcement and modeling details for building ID 2451

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.81	sec
Time period, Ta_Y:	0.81	sec
Avrg response accn coeff, (Sa/g)_x:	1.23	
Avrg response accn coeff, (Sa/g)_y:	1.23	
Design Seis. coeff, (Ah)_x:	0.0295	
Design Seis. coeff, (Ah)_y:	0.0295	

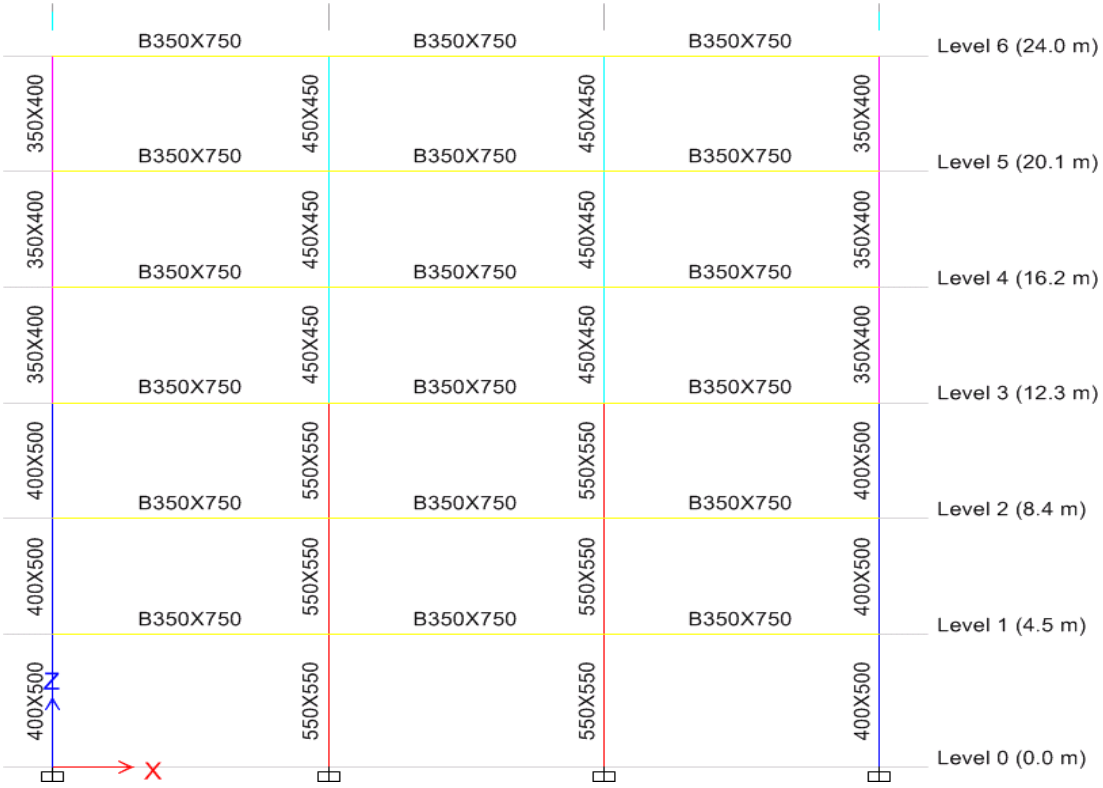

Fig. 6a. Beam column sizes for building ID 2453

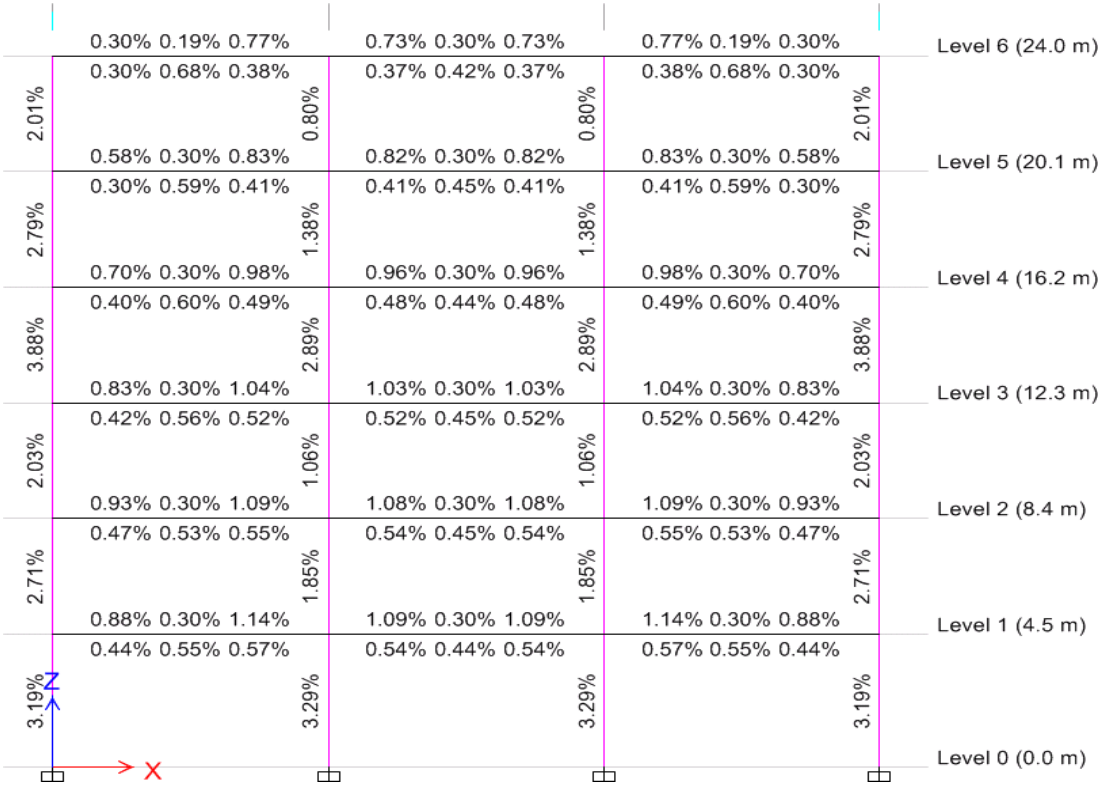

Fig. 6b. Required longitudinal reinforcement for building ID 2453

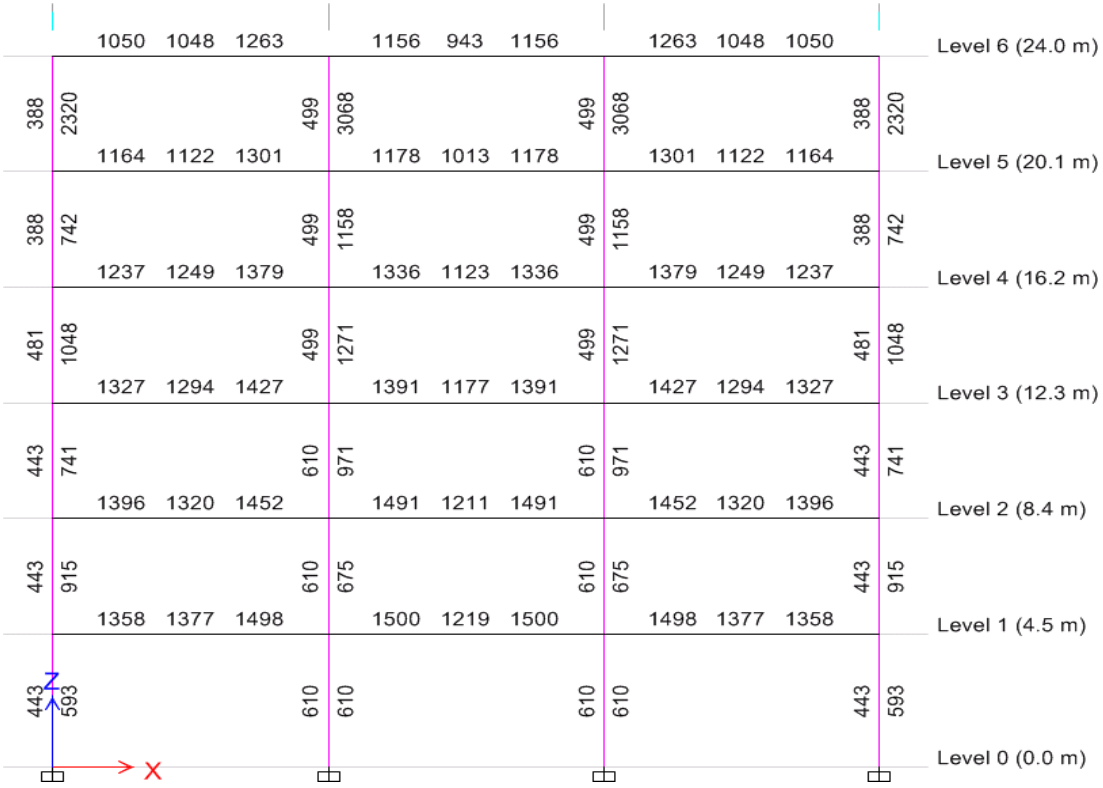

Fig. 6c. Required transverse reinforcement for building ID 2453

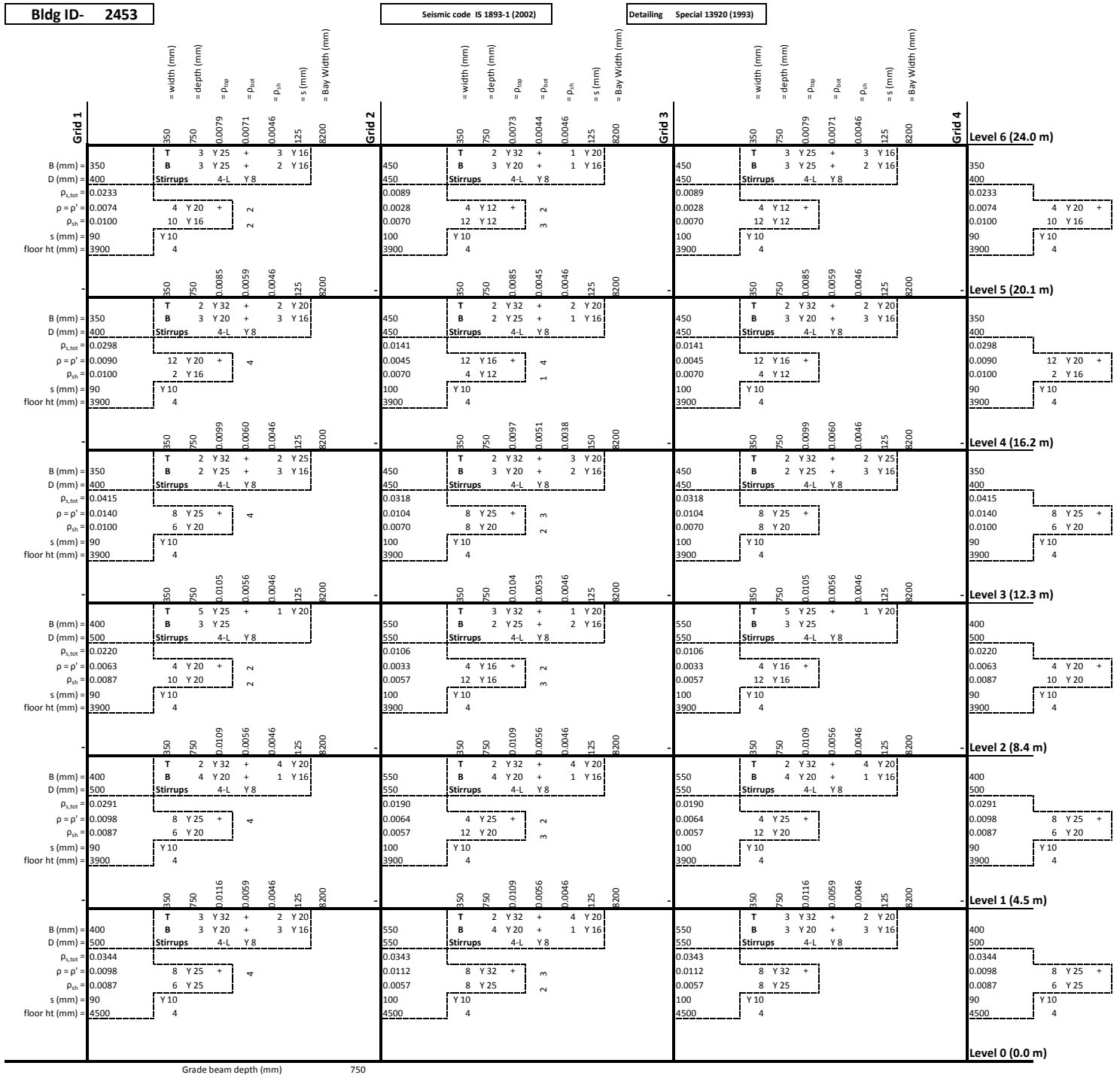

Fig. 6d. Provided reinforcement and modeling details for building ID 2453

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.91	sec
Time period, Ta_Y:	0.91	sec
Avrg response accn coeff, (Sa/g)_x:	1.10	
Avrg response accn coeff, (Sa/g)_y:	1.10	
Design Seis. coeff, (Ah)_x:	0.0264	
Design Seis. coeff, (Ah)_y:	0.0264	

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

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

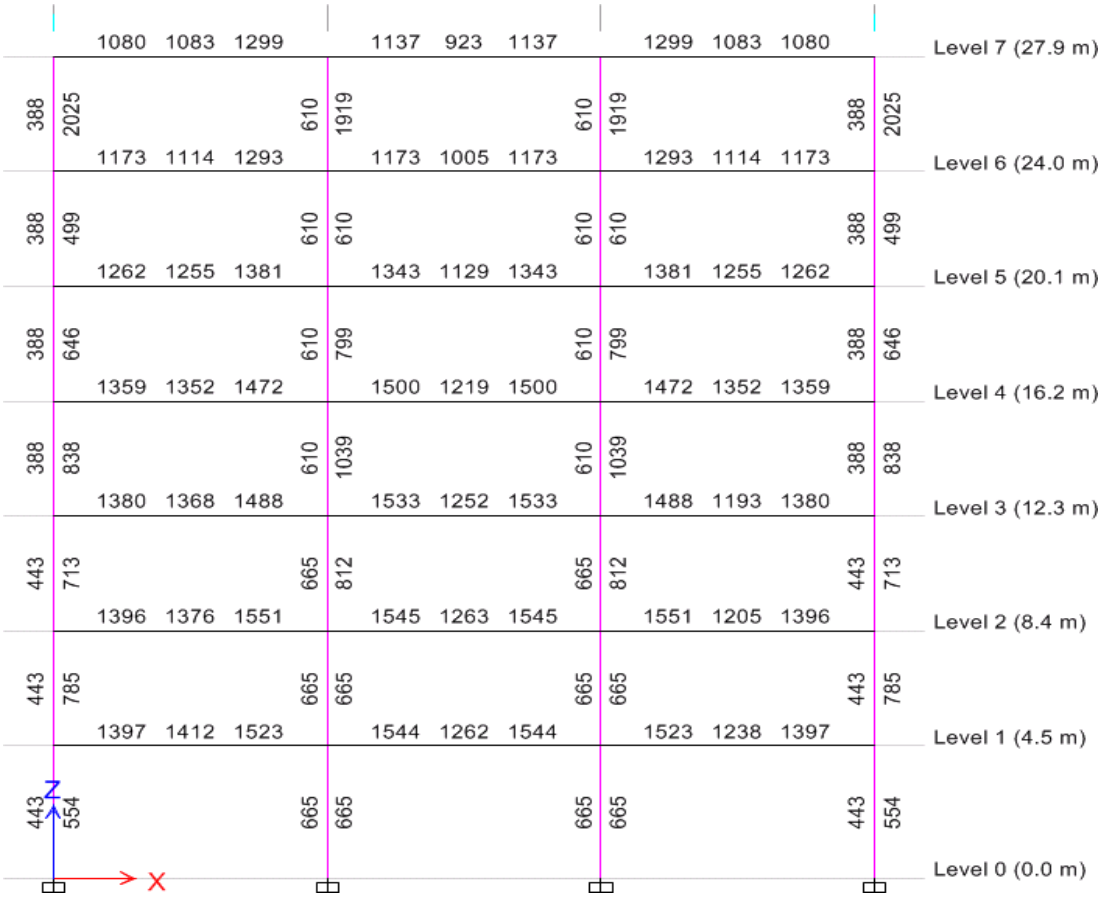

Fig. 7c. Required transverse reinforcement for building ID 2215

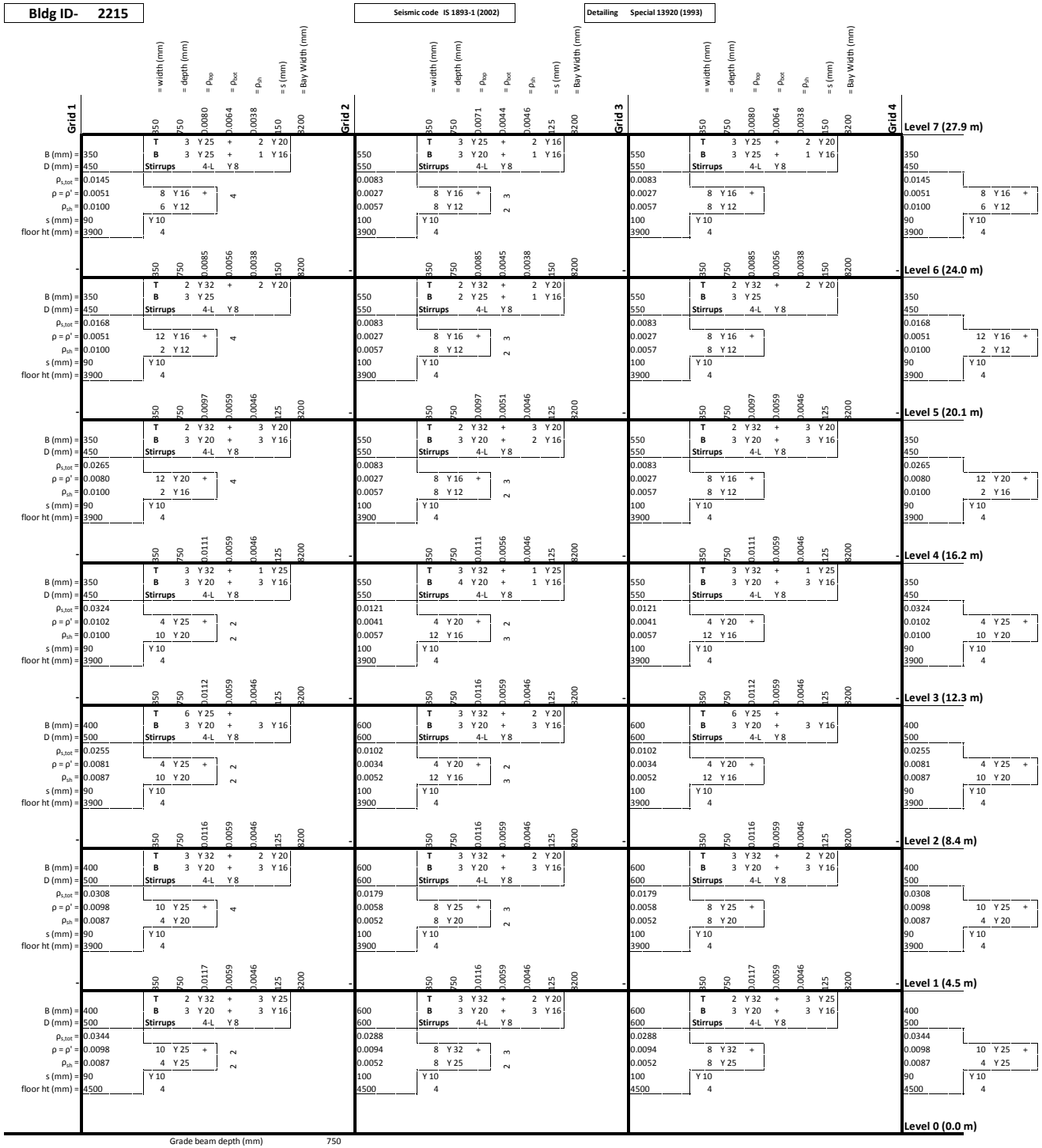

Fig. 7d. Provided reinforcement and modeling details for building ID 2215

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, Ec_col:	32048.2	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	1.35	sec
Time period, Ta_Y:	1.35	sec
Avrg response accn coeff, (Sa/g)_x:	0.74	
Avrg response accn coeff, (Sa/g)_y:	0.74	
Design Seis. coeff, (Ah)_x:	0.0177	
Design Seis. coeff, (Ah)_y:	0.0177	

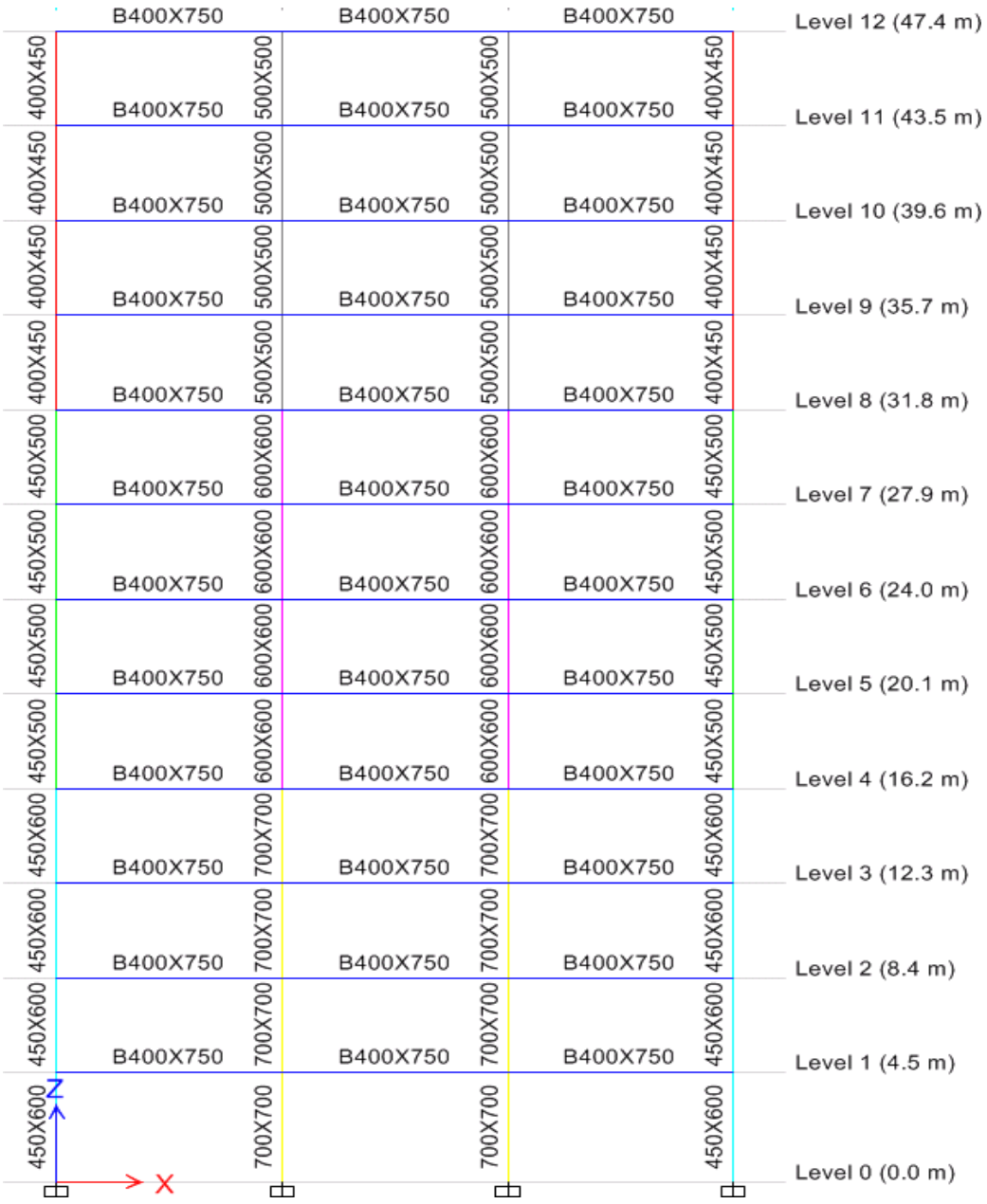

Fig. 8a. Beam column sizes for building ID 2217

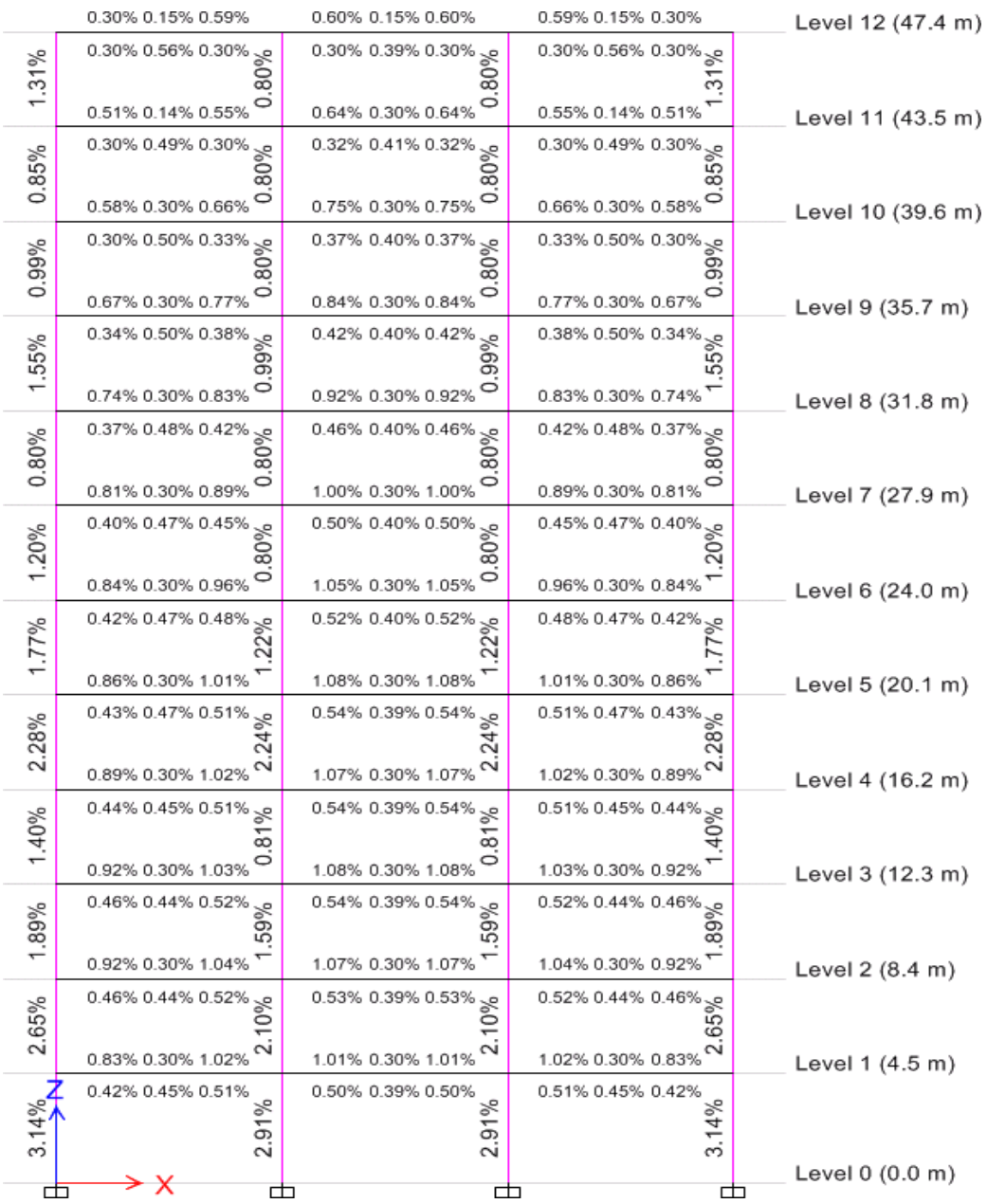

Fig. 8b. Required longitudinal reinforcement for building ID 2217

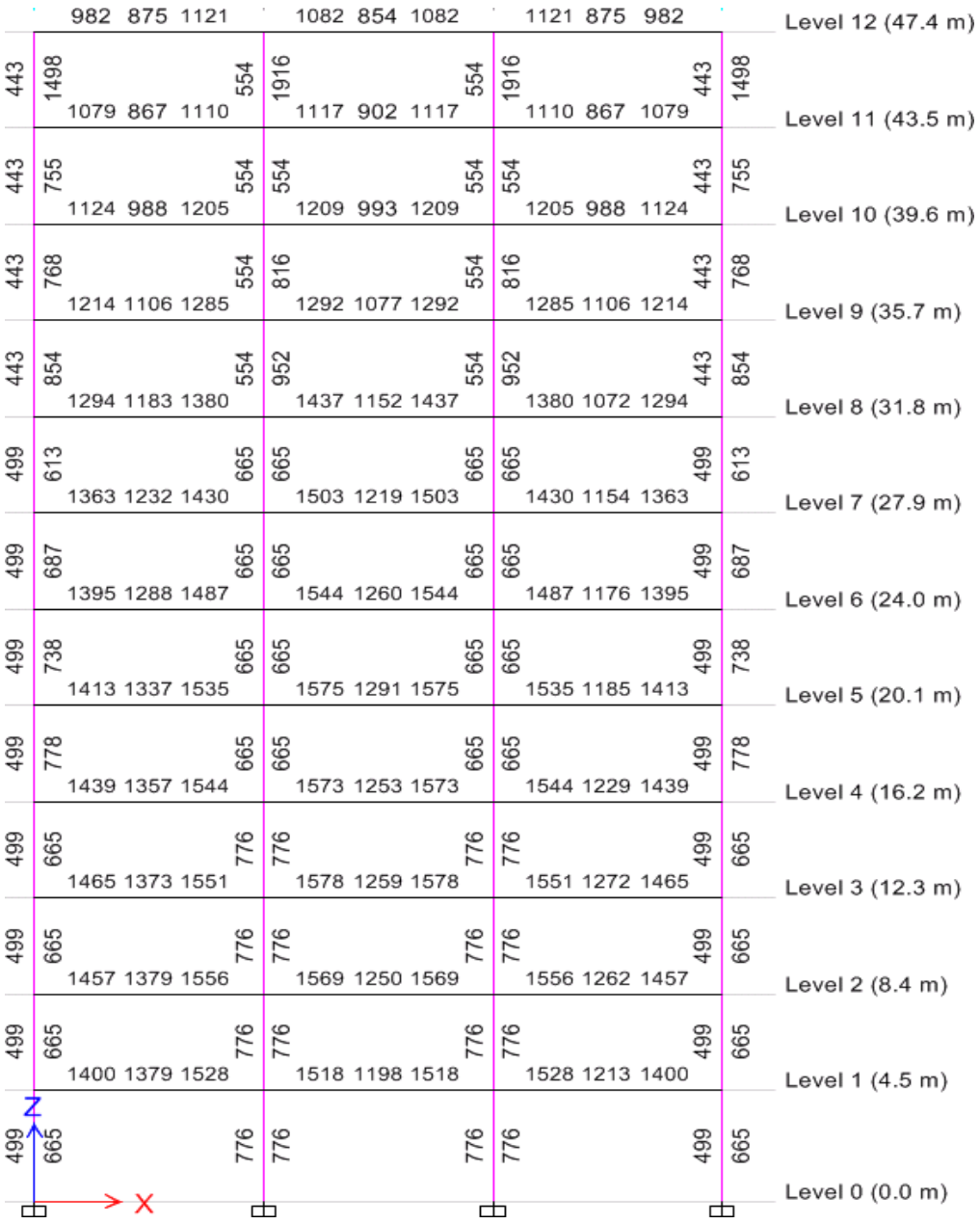

Fig. 8c. Required transverse reinforcement for building ID 2217

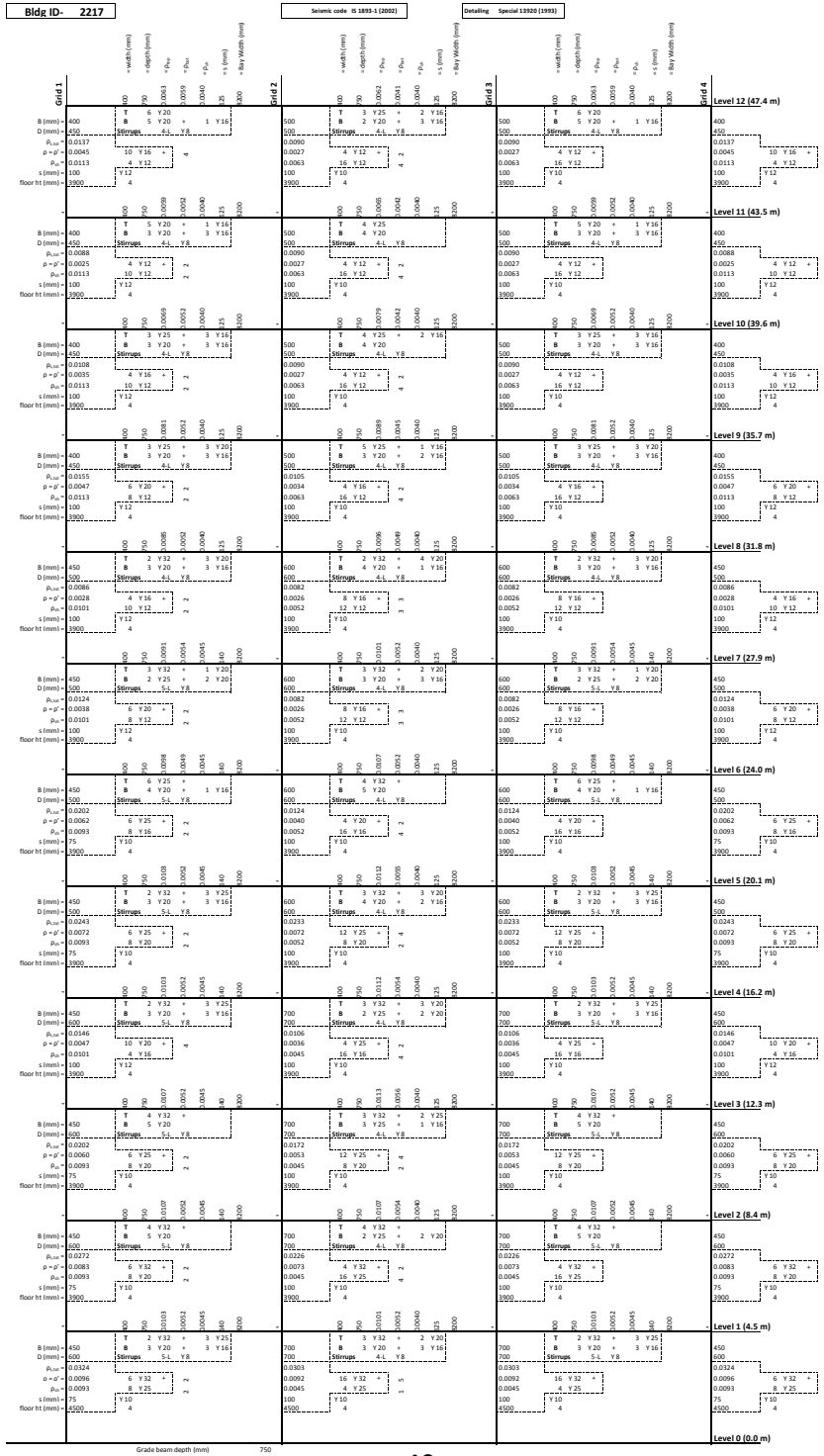

Fig. 8d. Provided reinforcement and modeling details for building ID 2217

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.37	sec
Time period, Ta_Y:	0.37	sec
Avrg response accn coeff, (Sa/g)_x:	2.50	
Avrg response accn coeff, (Sa/g)_y:	2.50	
Design Seis. coeff, (Ah)_x:	0.0900	
Design Seis. coeff, (Ah)_y:	0.0900	

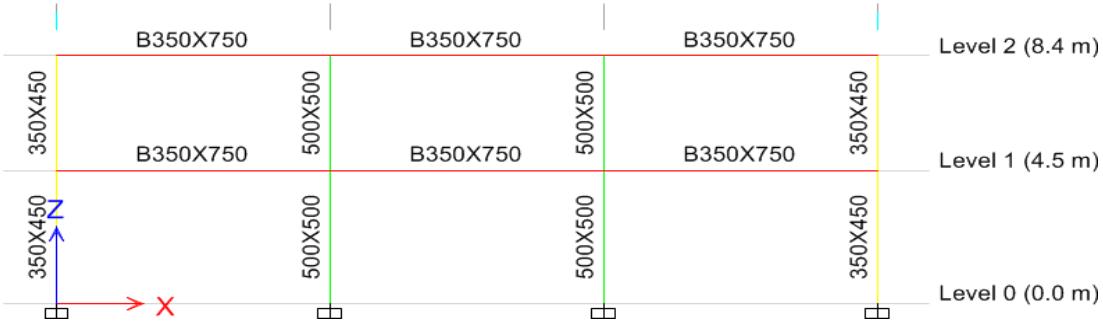

Fig. 9a. Beam column sizes for building ID 2219

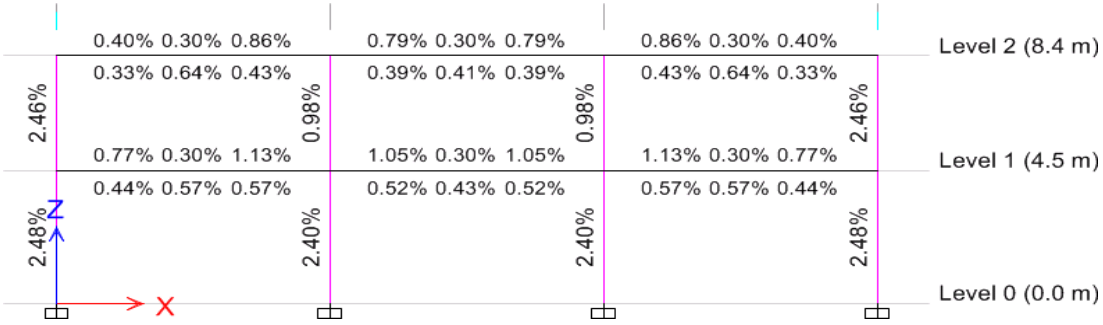

Fig. 9b. Required longitudinal reinforcement for building ID 2219

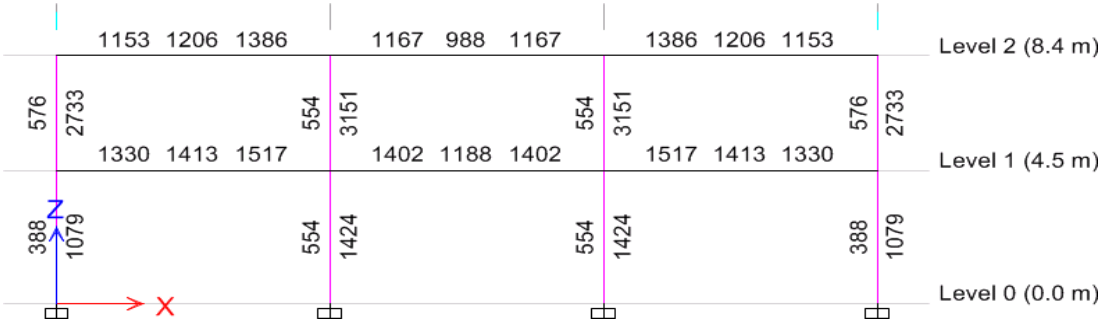

Fig. 9c. Required transverse reinforcement for building ID 2219

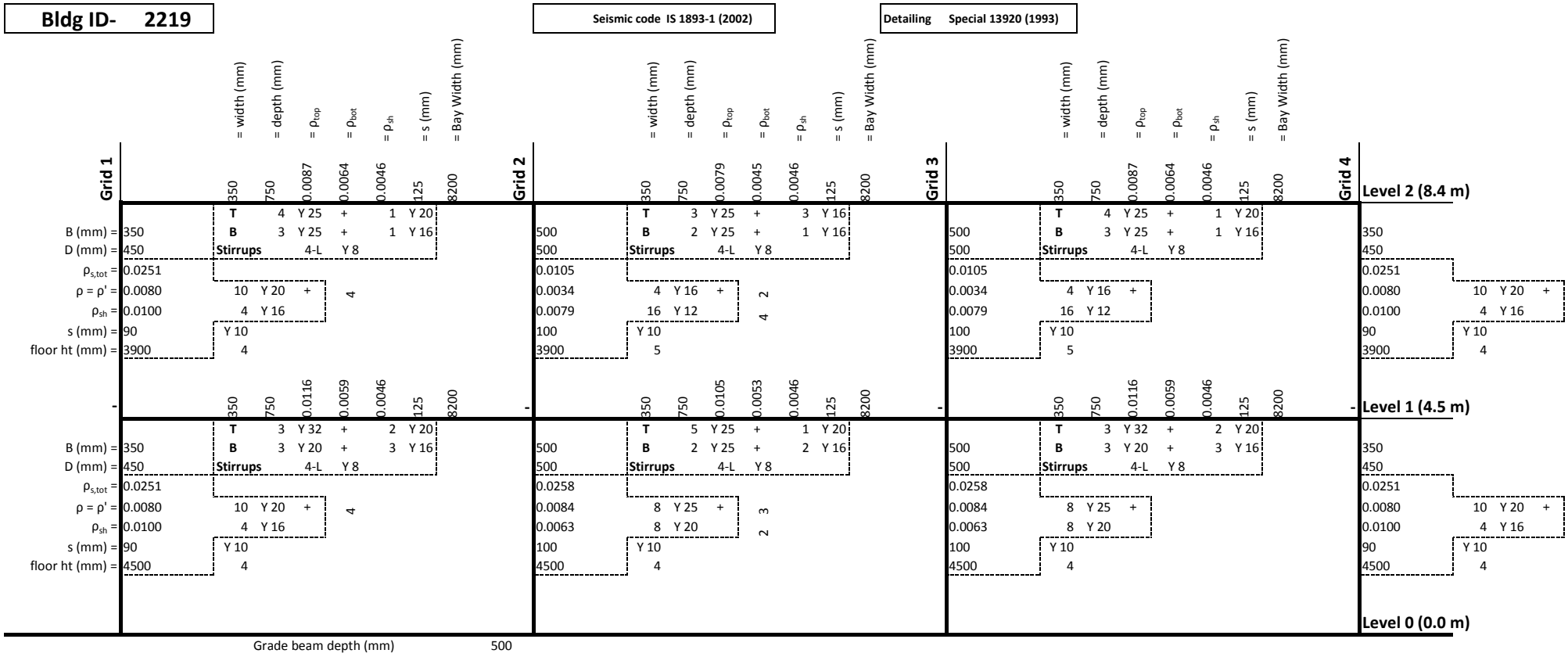

Fig. 9d. Provided reinforcement and modeling details for building ID 2219

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.61	sec
Time period, Ta_Y:	0.61	sec
Avrg response accn coeff, (Sa/g)_x:	1.65	
Avrg response accn coeff, (Sa/g)_y:	1.65	
Design Seis. coeff, (Ah)_x:	0.0594	
Design Seis. coeff, (Ah)_y:	0.0594	

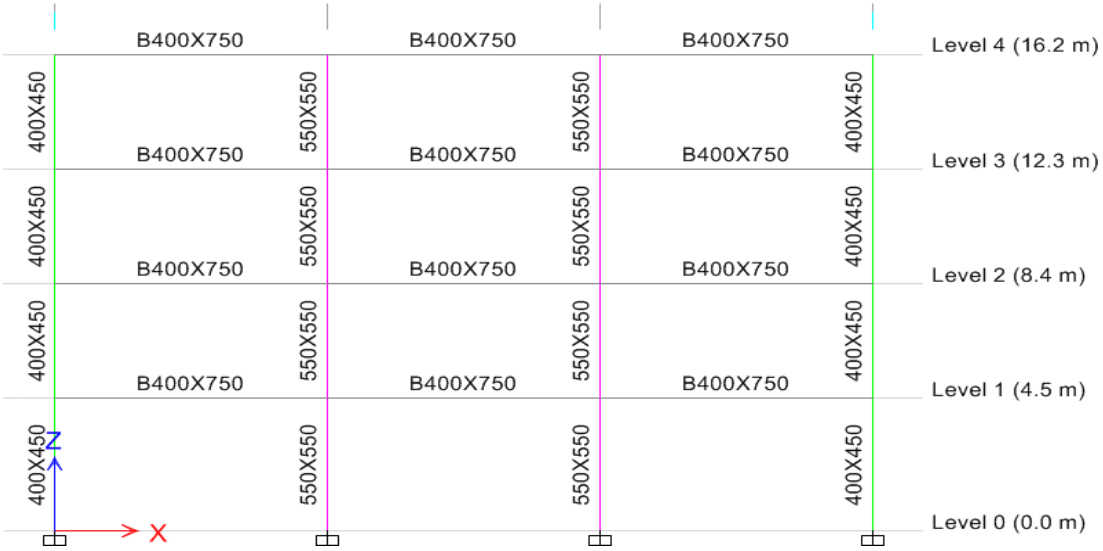

Fig. 10a. Beam column sizes for building ID 2221

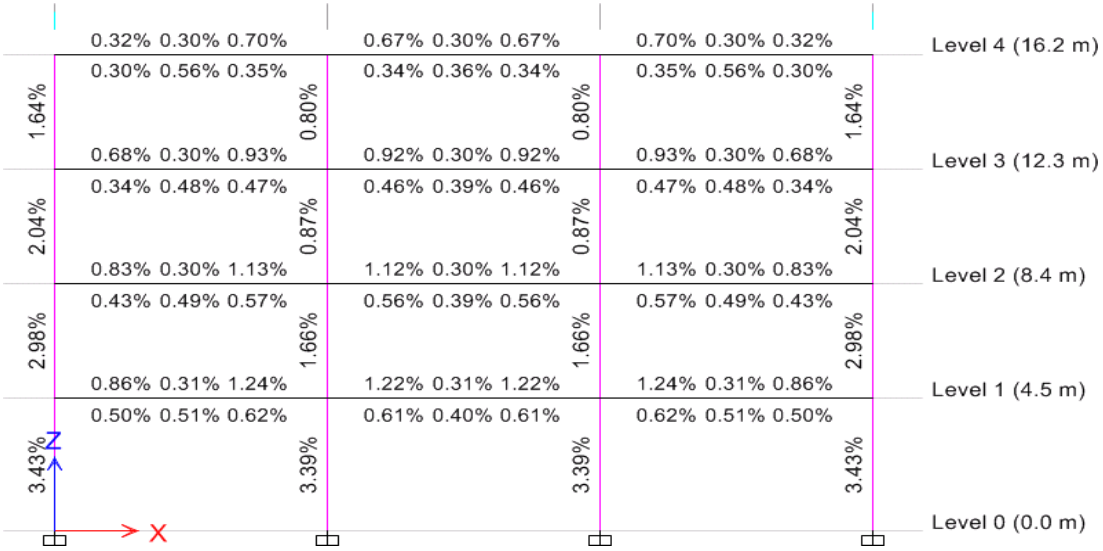

Fig. 10b. Required longitudinal reinforcement for building ID 2221

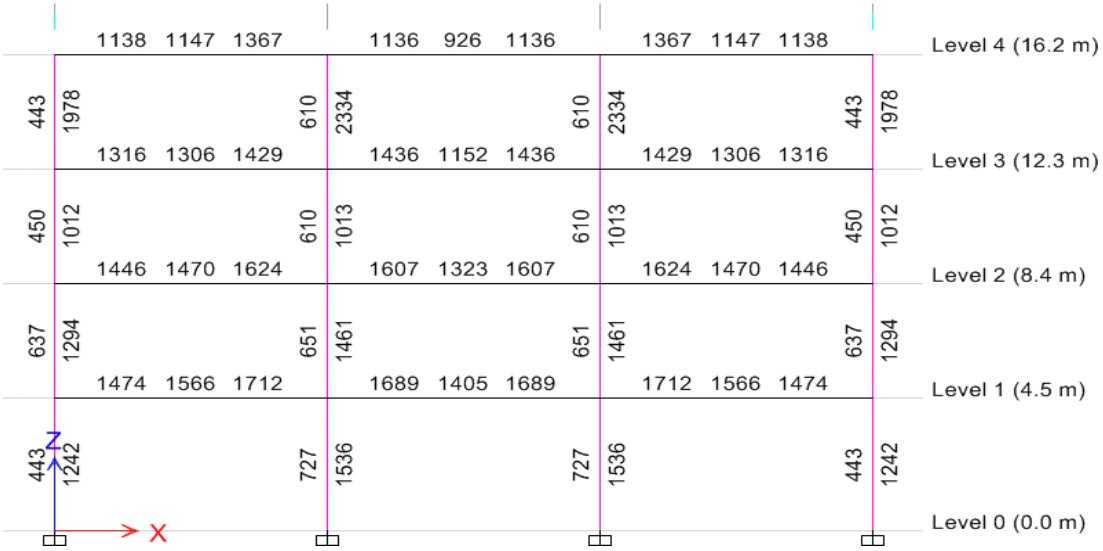

Fig. 10c. Required transverse reinforcement for building ID 2221

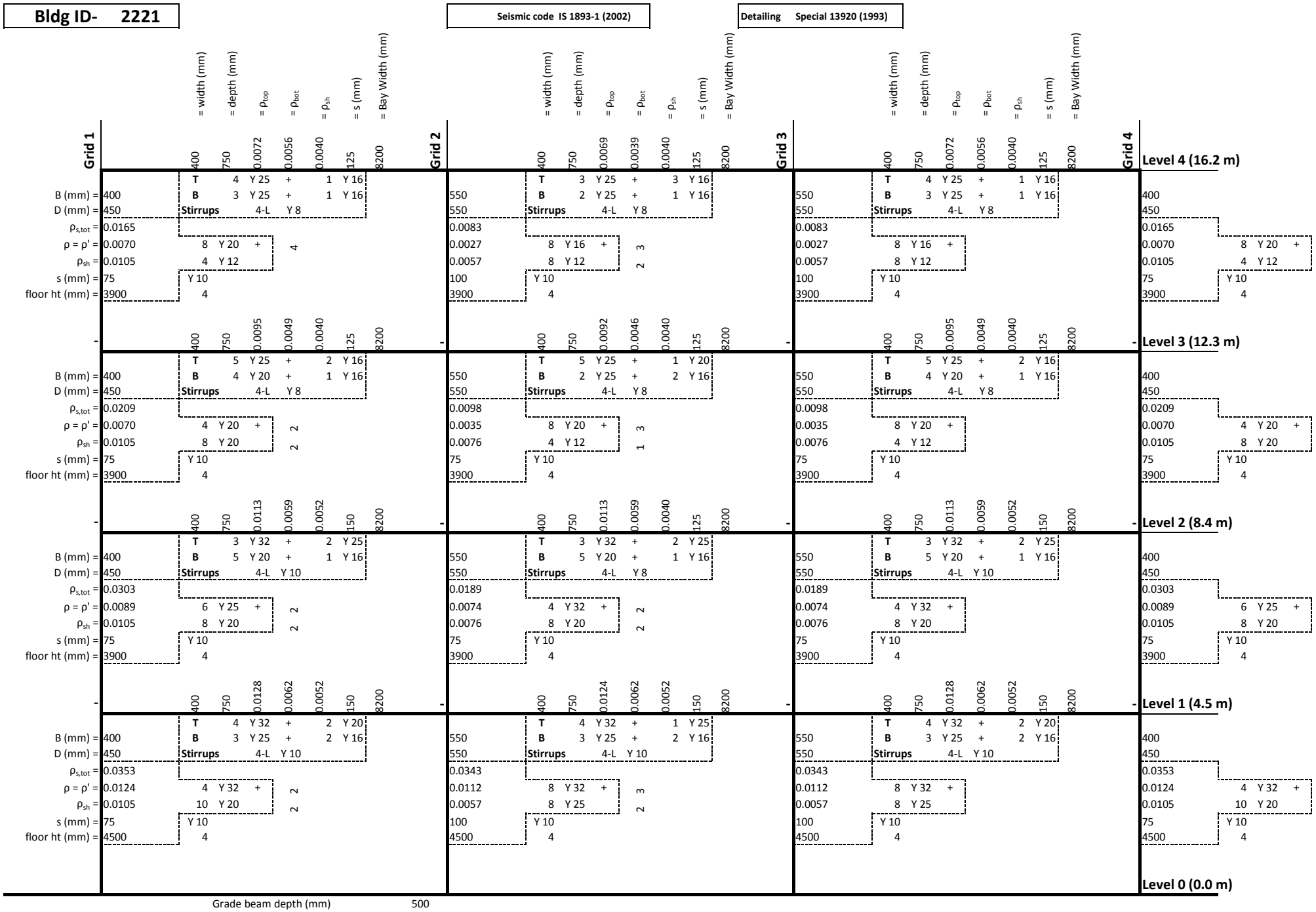

Fig. 10d. Provided reinforcement and modeling details for building ID 2221

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.71	sec
Time period, Ta_Y:	0.71	sec
Avrg response accn coeff, (Sa/g)_x:	1.40	
Avrg response accn coeff, (Sa/g)_y:	1.40	
Design Seis. coeff, (Ah)_x:	0.0506	
Design Seis. coeff, (Ah)_y:	0.0506	

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

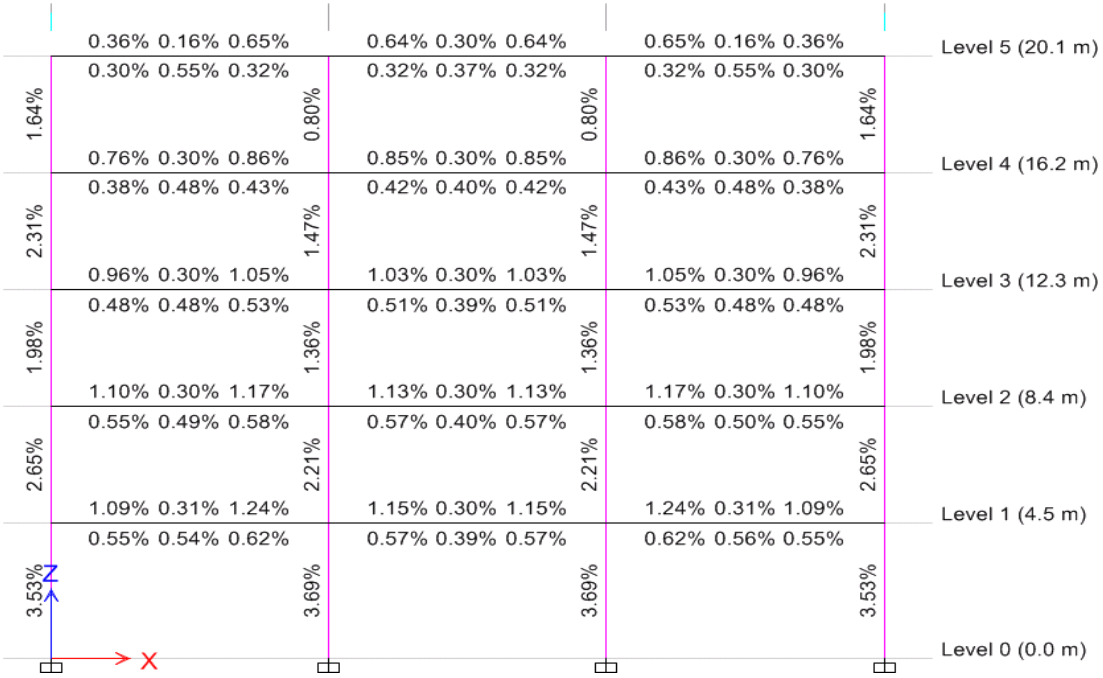

Fig. 11b. Required longitudinal reinforcement for building ID 2433

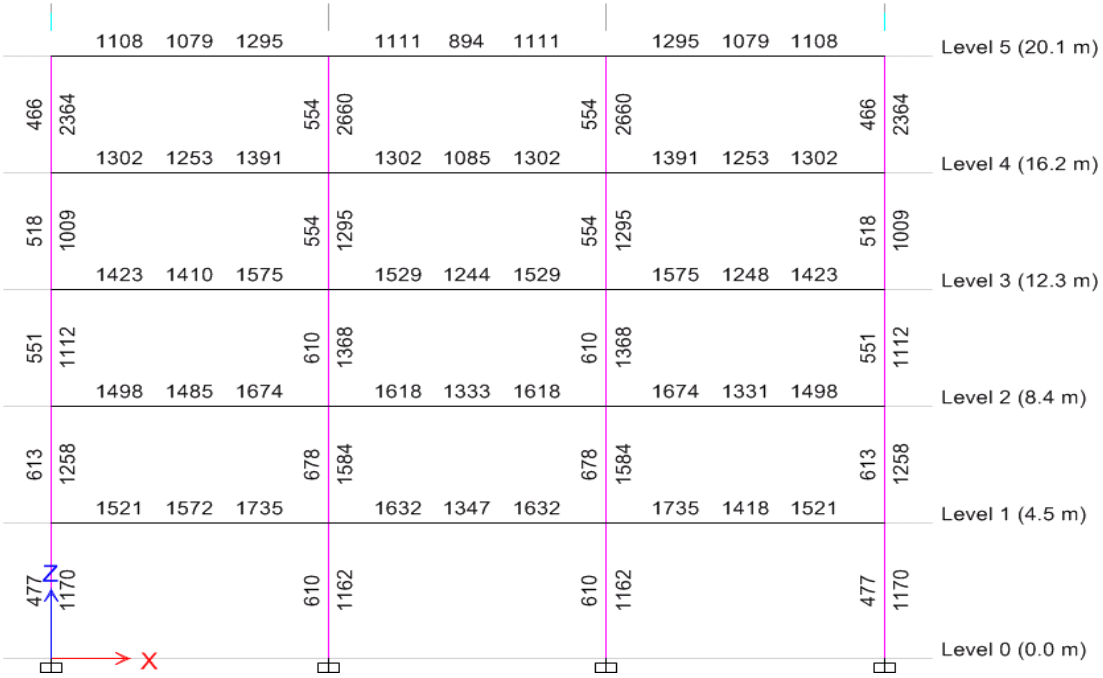

Fig. 11c. Required transverse reinforcement for building ID 2433

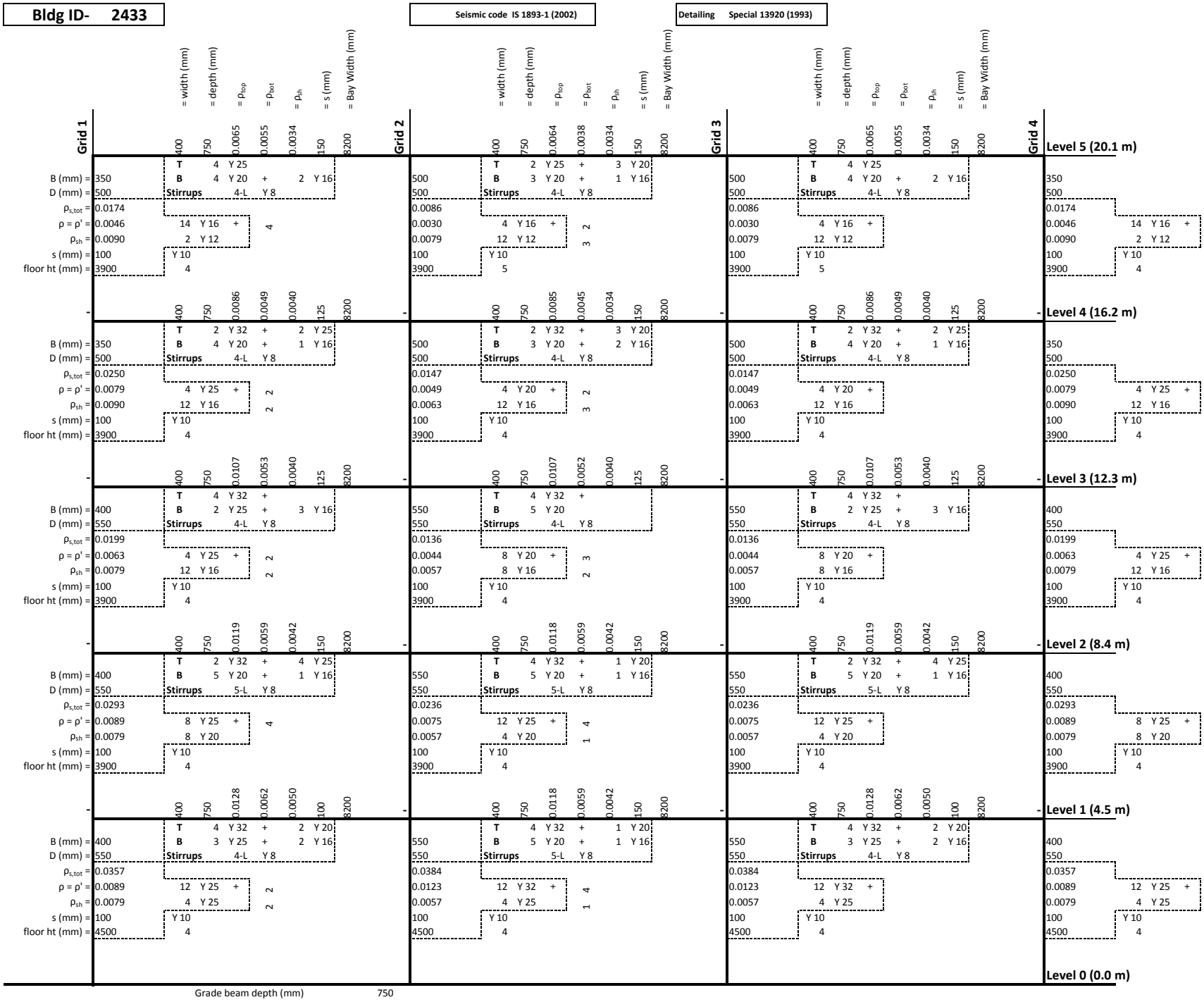

Fig. 11d. Provided reinforcement and modeling details for building ID 2433

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.81	sec
Time period, Ta_Y:	0.81	sec
Avrg response accn coeff, (Sa/g)_x:	1.23	
Avrg response accn coeff, (Sa/g)_y:	1.23	
Design Seis. coeff, (Ah)_x:	0.0443	
Design Seis. coeff, (Ah)_y:	0.0443	

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

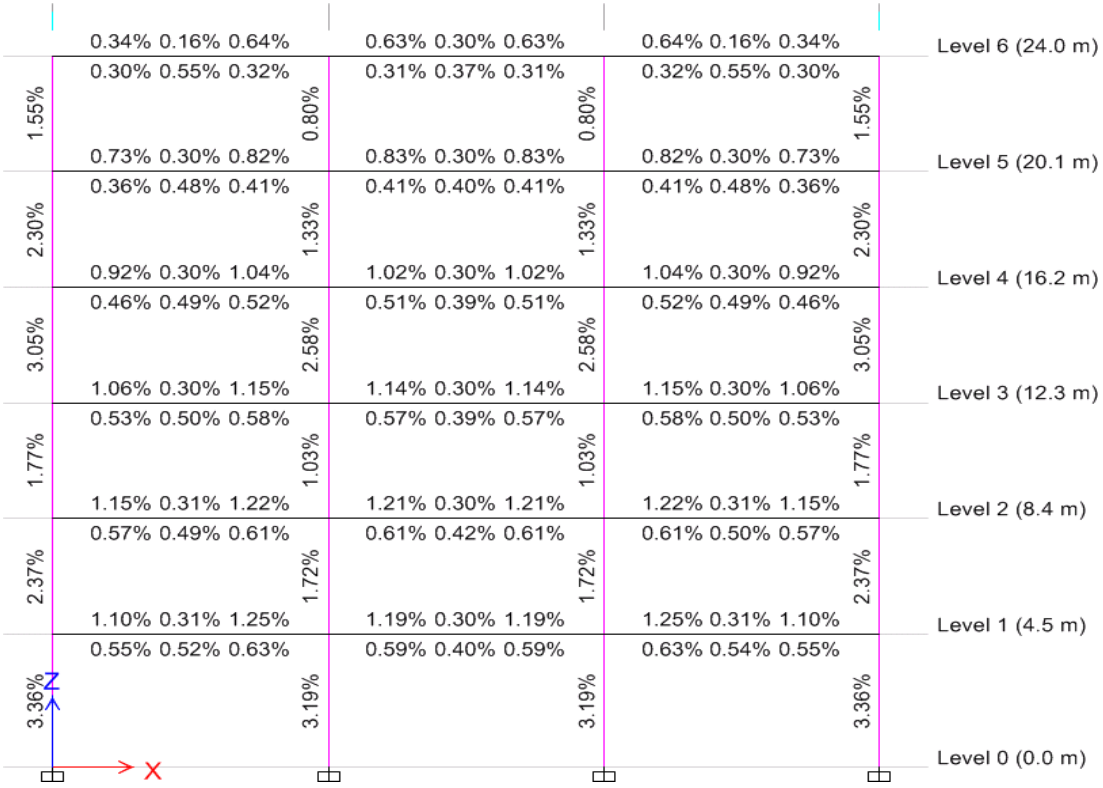

Fig. 12b. Required longitudinal reinforcement for building ID 2435

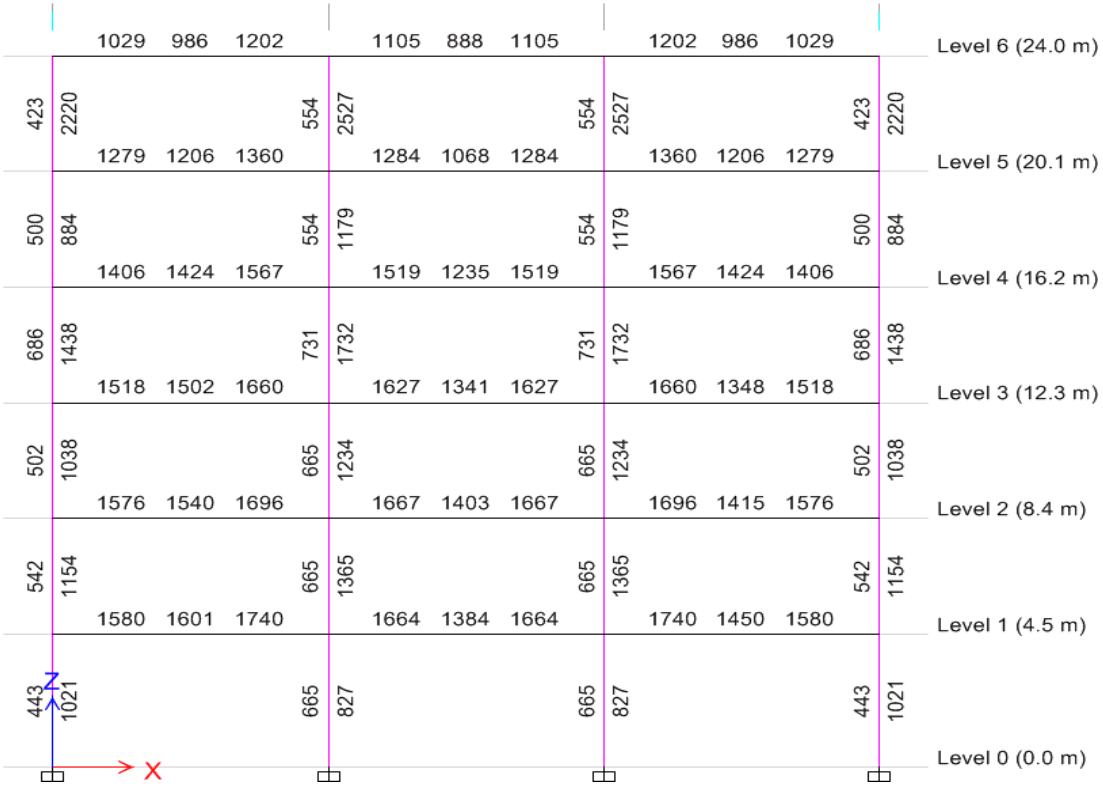

Fig. 12c. Required transverse reinforcement for building ID 2435

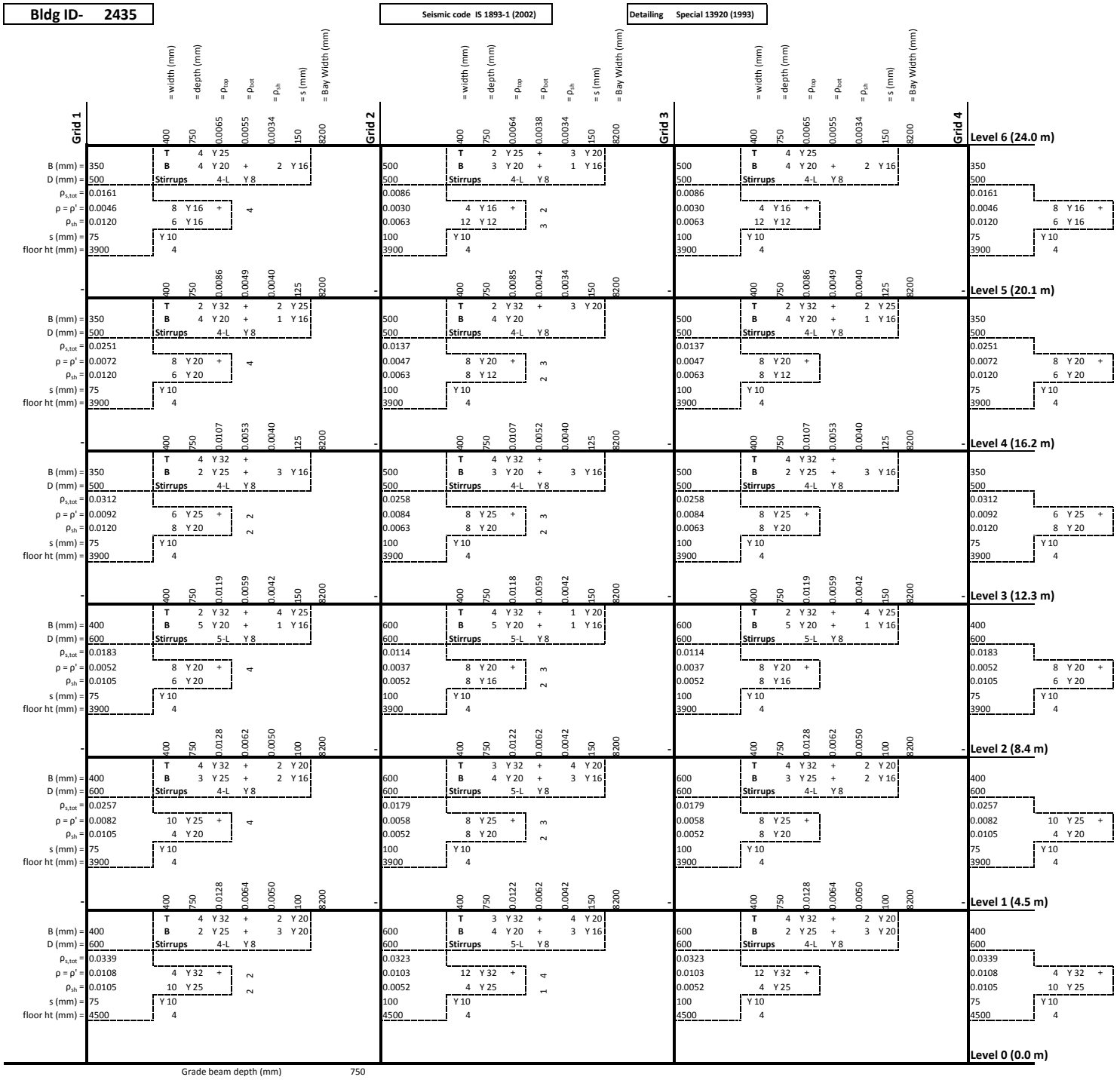

Fig. 12d. Provided reinforcement and modeling details for building ID 2435

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.91	sec
Time period, Ta_Y:	0.91	sec
Avrg response accn coeff, (Sa/g)_x:	1.10	
Avrg response accn coeff, (Sa/g)_y:	1.10	
Design Seis. coeff, (Ah)_x:	0.0395	
Design Seis. coeff, (Ah)_y:	0.0395	

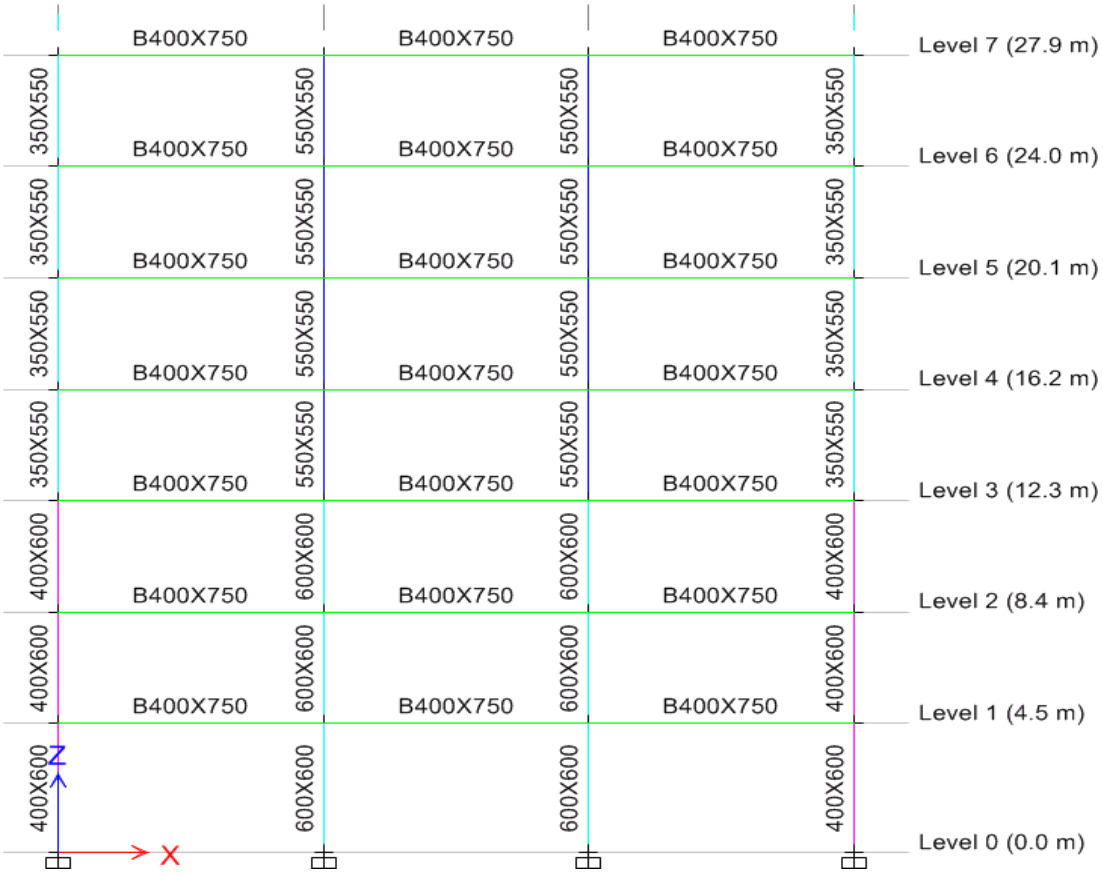

Fig. 13a. Beam column sizes for building ID 2223

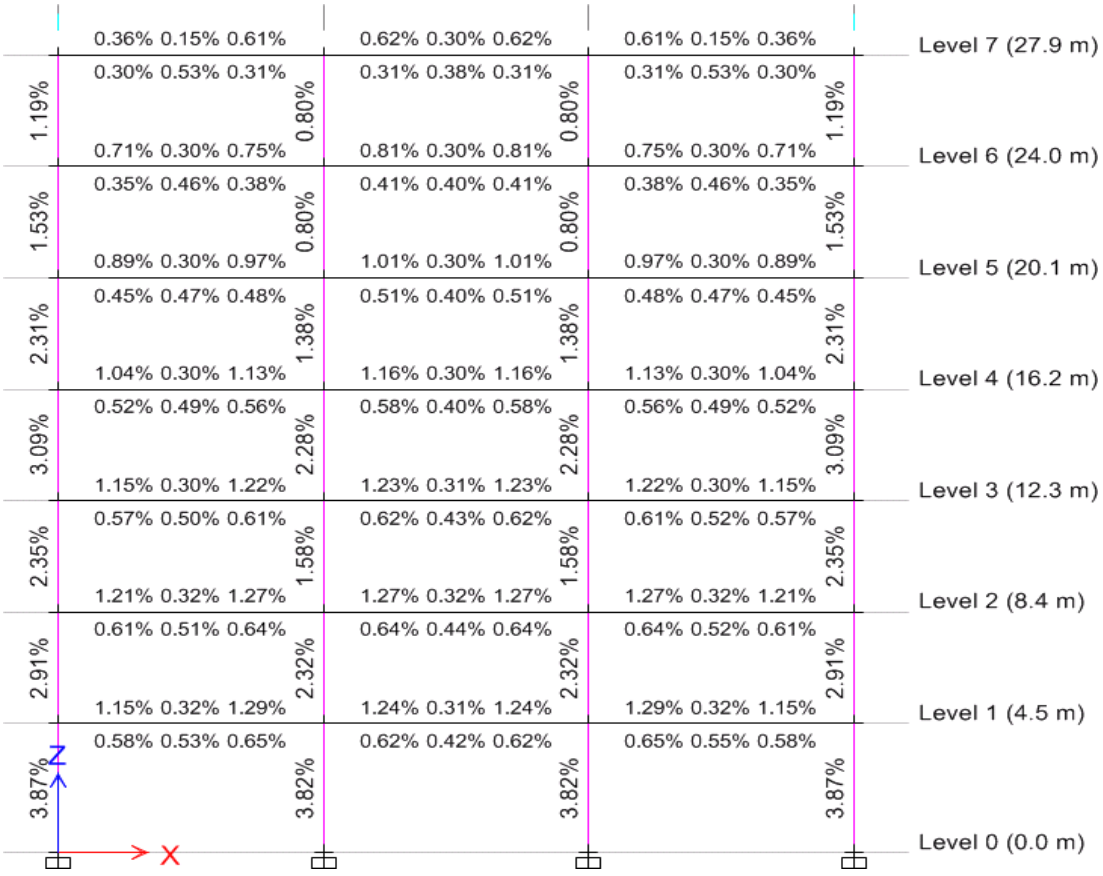

Fig. 13b. Required longitudinal reinforcement for building ID 2223

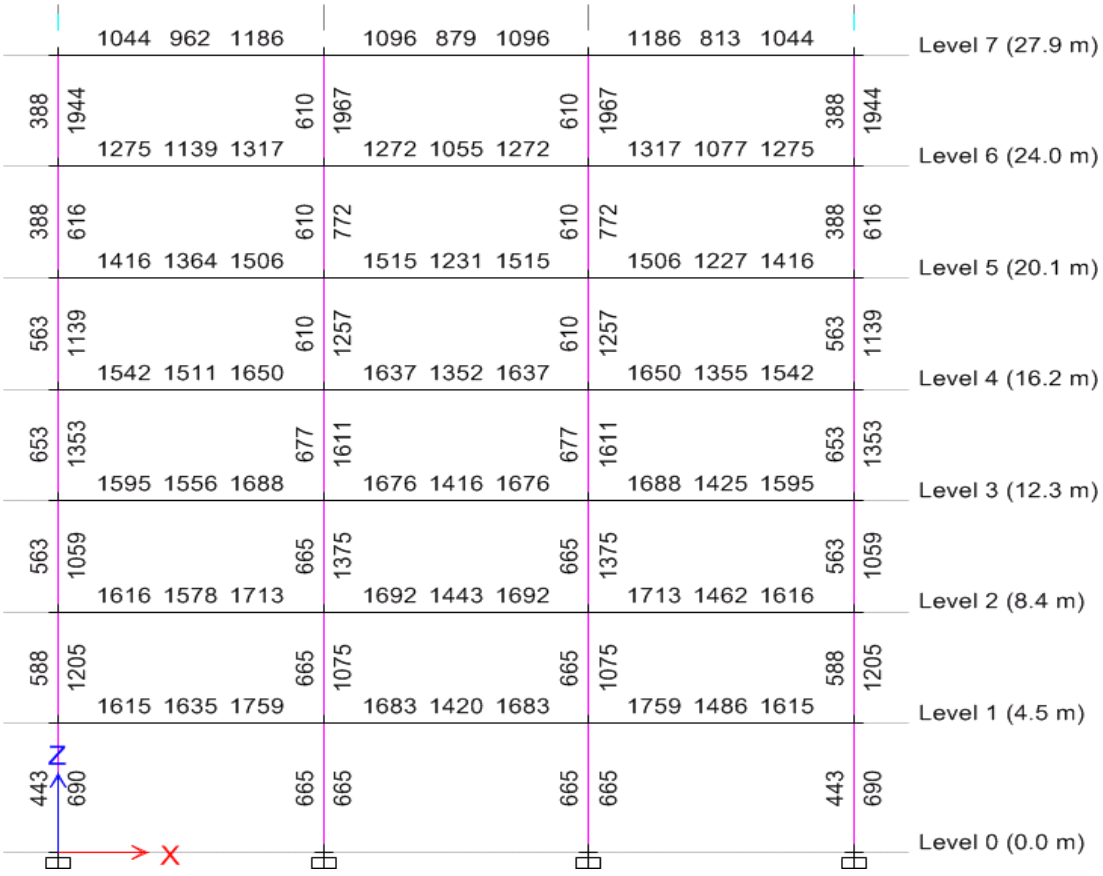

Fig. 13c. Required transverse reinforcement for building ID 2223

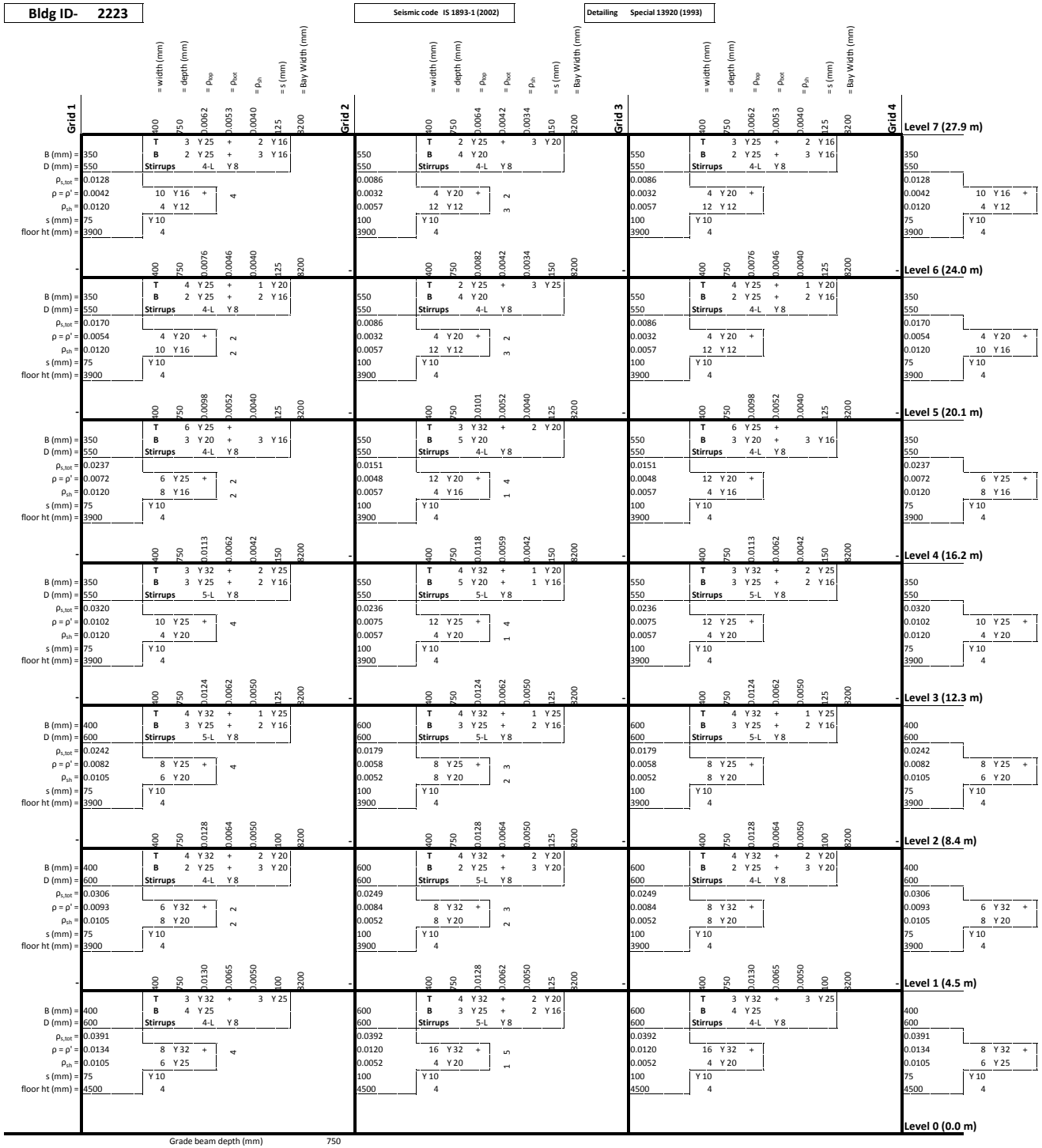

Fig. 13d. Provided reinforcement and modeling details for building ID 2223

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	1.00	sec
Time period, Ta_Y:	1.00	sec
Avrg response accn coeff, (Sa/g)_x:	1.00	
Avrg response accn coeff, (Sa/g)_y:	1.00	
Design Seis. coeff, (Ah)_x:	0.0358	
Design Seis. coeff, (Ah)_y:	0.0358	

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

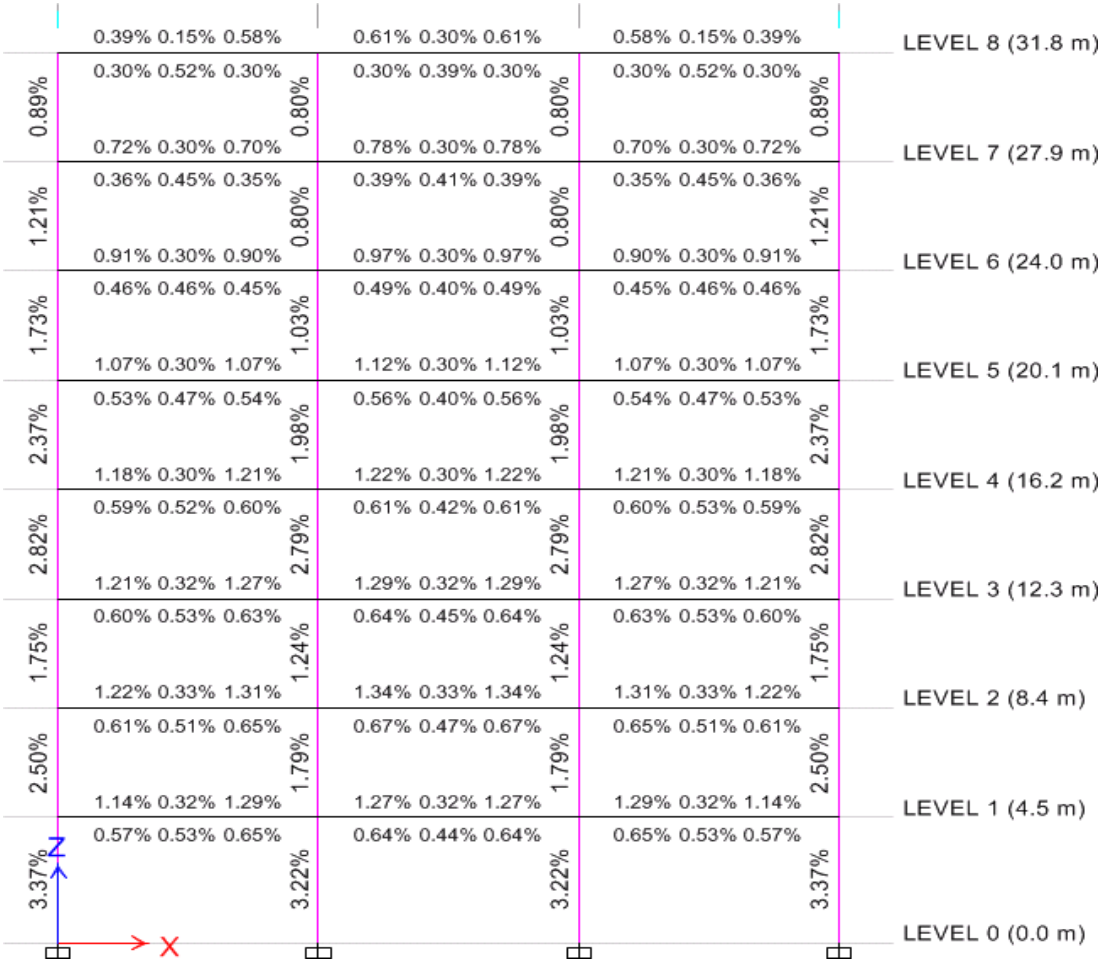

Fig. 14b. Required longitudinal reinforcement for building ID 2457

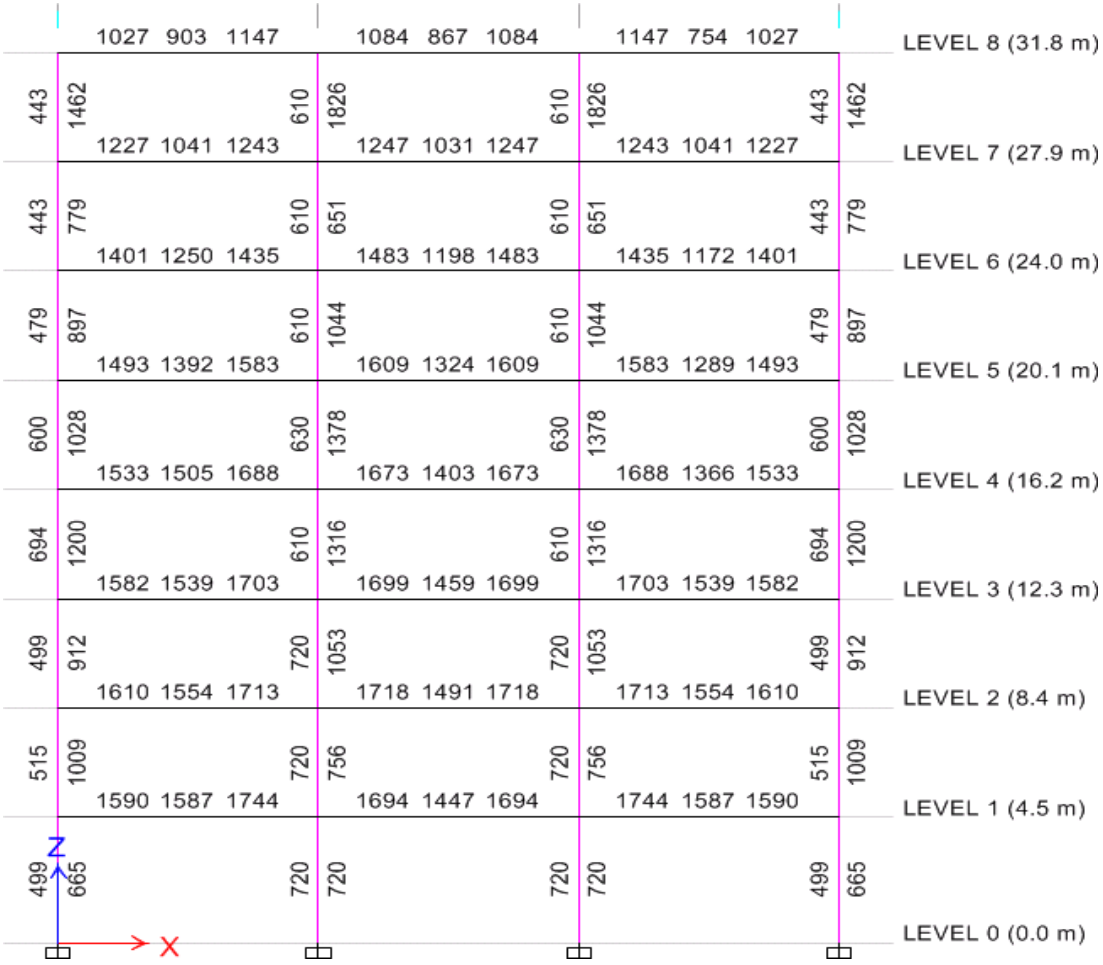

Fig. 14c. Required transverse reinforcement for building ID 2457

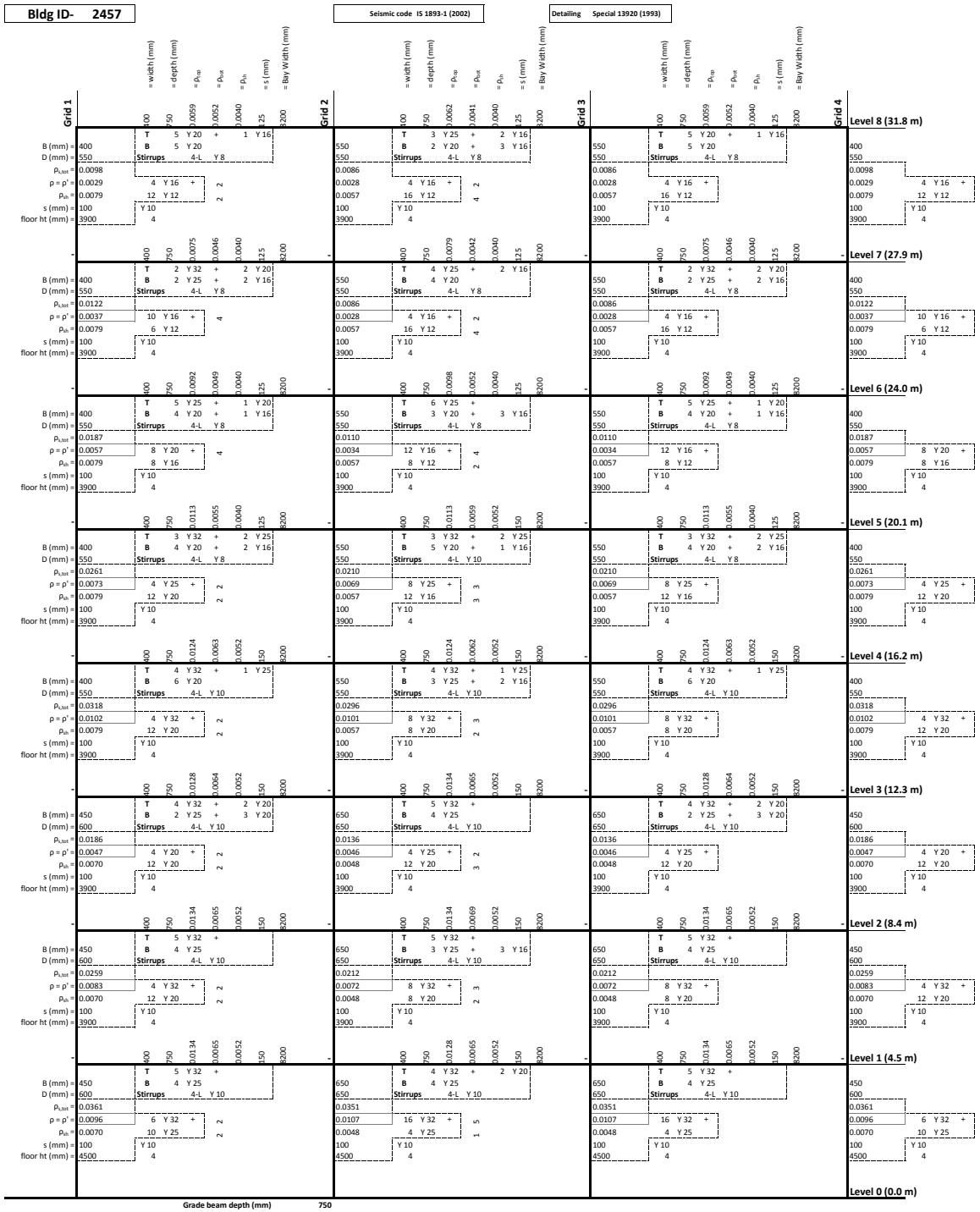

Fig. 14d. Provided reinforcement and modeling details for building ID 2457

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	1.10	sec
Time period, Ta_Y:	1.10	sec
Avrg response accn coeff, (Sa/g)_x:	0.91	
Avrg response accn coeff, (Sa/g)_y:	0.91	
Design Seis. coeff, (Ah)_x:	0.0329	
Design Seis. coeff, (Ah)_y:	0.0329	

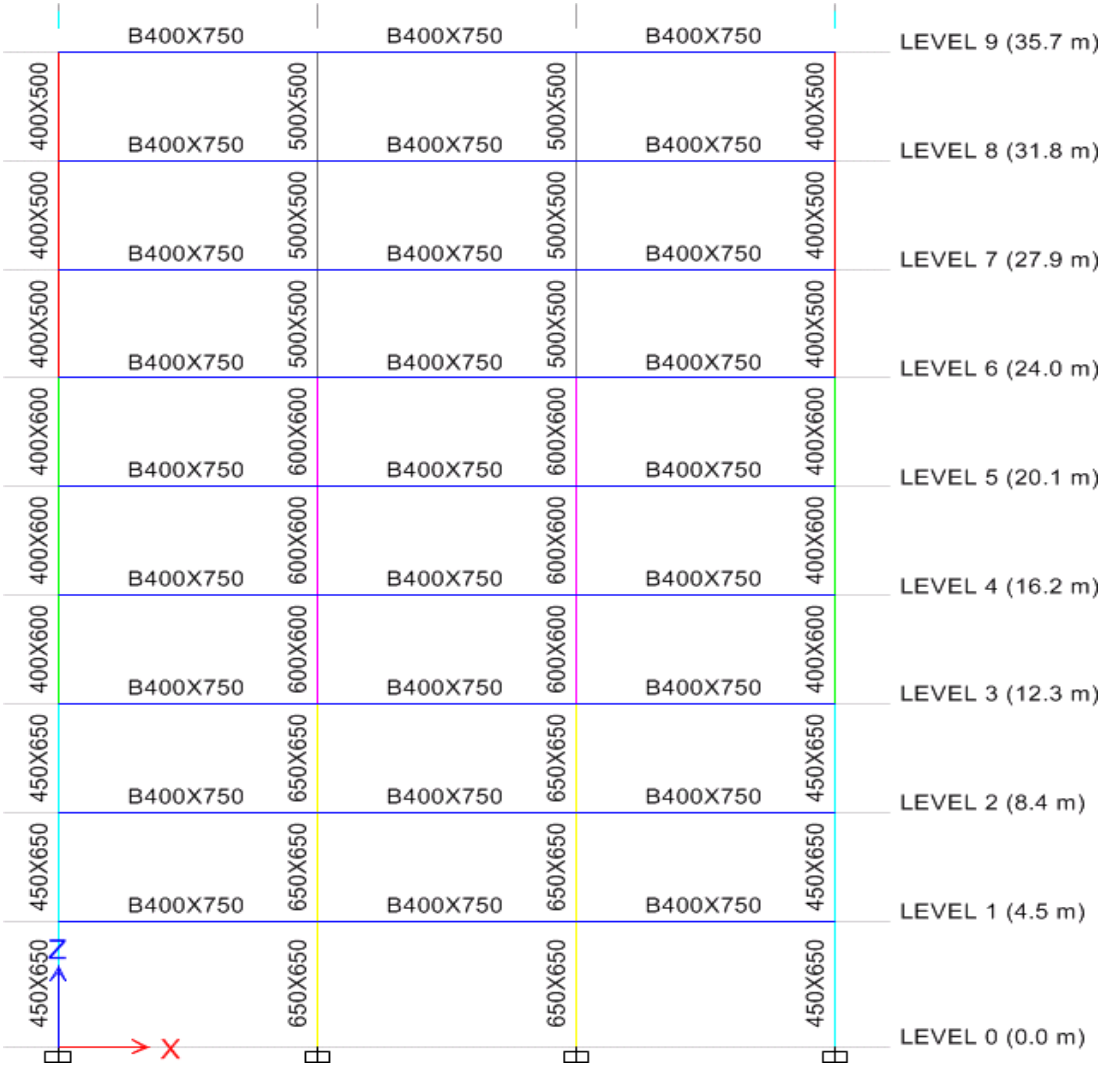

Fig. 15a. Beam column sizes for building ID 2459

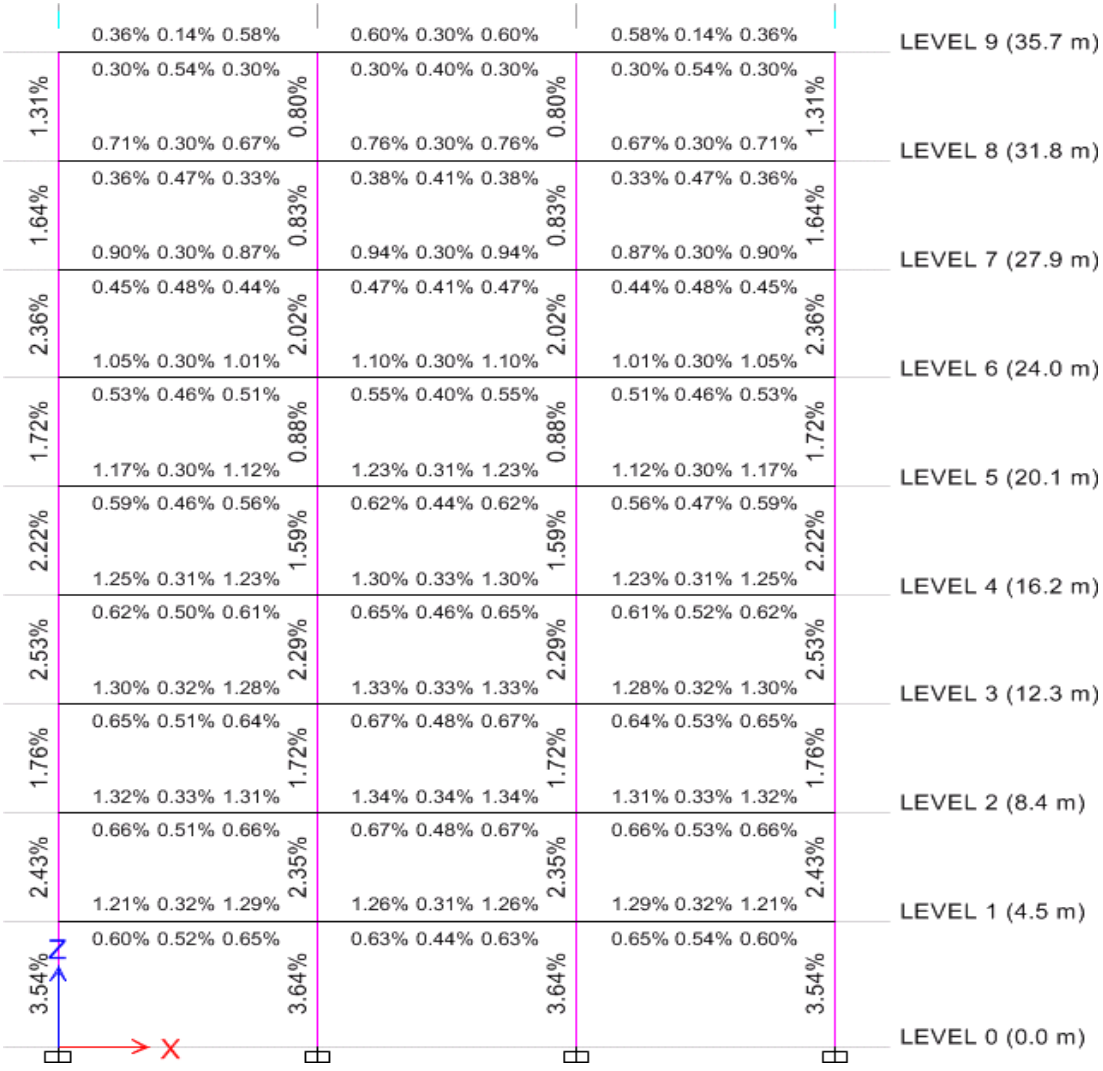

Fig. 15b. Required longitudinal reinforcement for building ID 2459

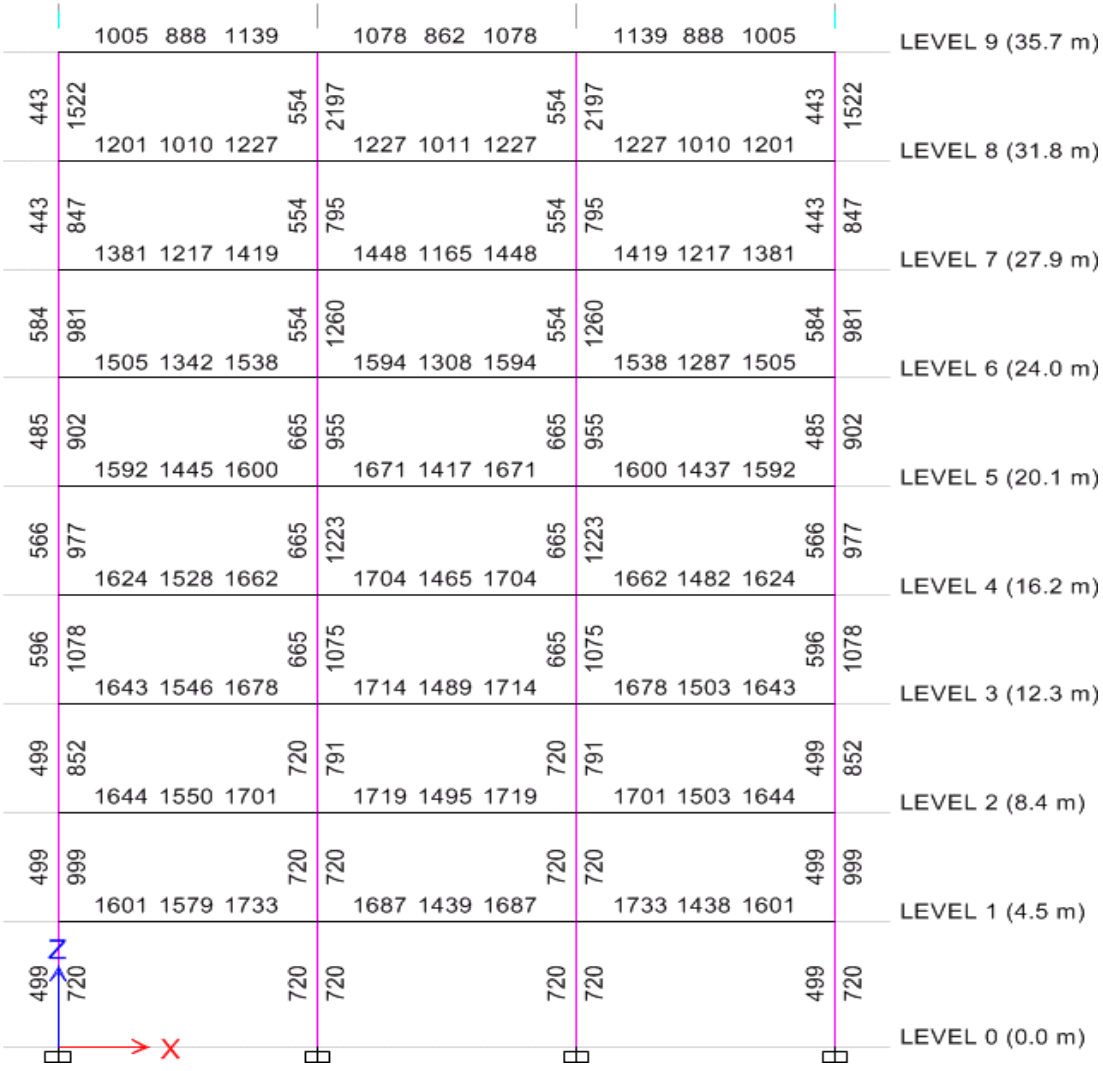

Fig. 15c. Required transverse reinforcement for building ID 2459

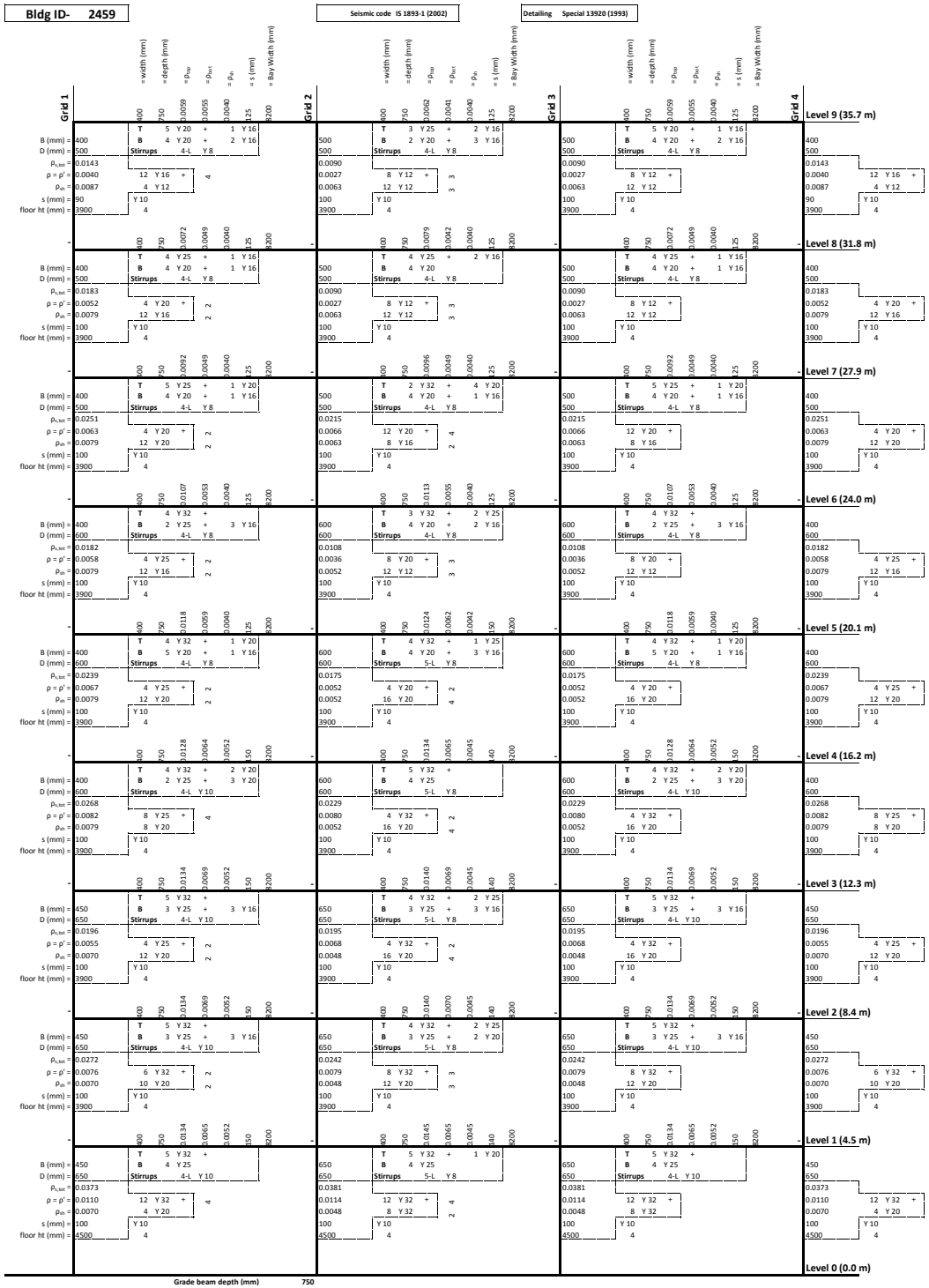

Fig. 15d. Provided reinforcement and modeling details for building ID 2459

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, Ec_col:	32048.2	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	1.18	sec
Time period, Ta_Y:	1.18	sec
Avrg response accn coeff, (Sa/g)_x:	0.84	
Avrg response accn coeff, (Sa/g)_y:	0.84	
Design Seis. coeff, (Ah)_x:	0.0304	
Design Seis. coeff, (Ah)_y:	0.0304	

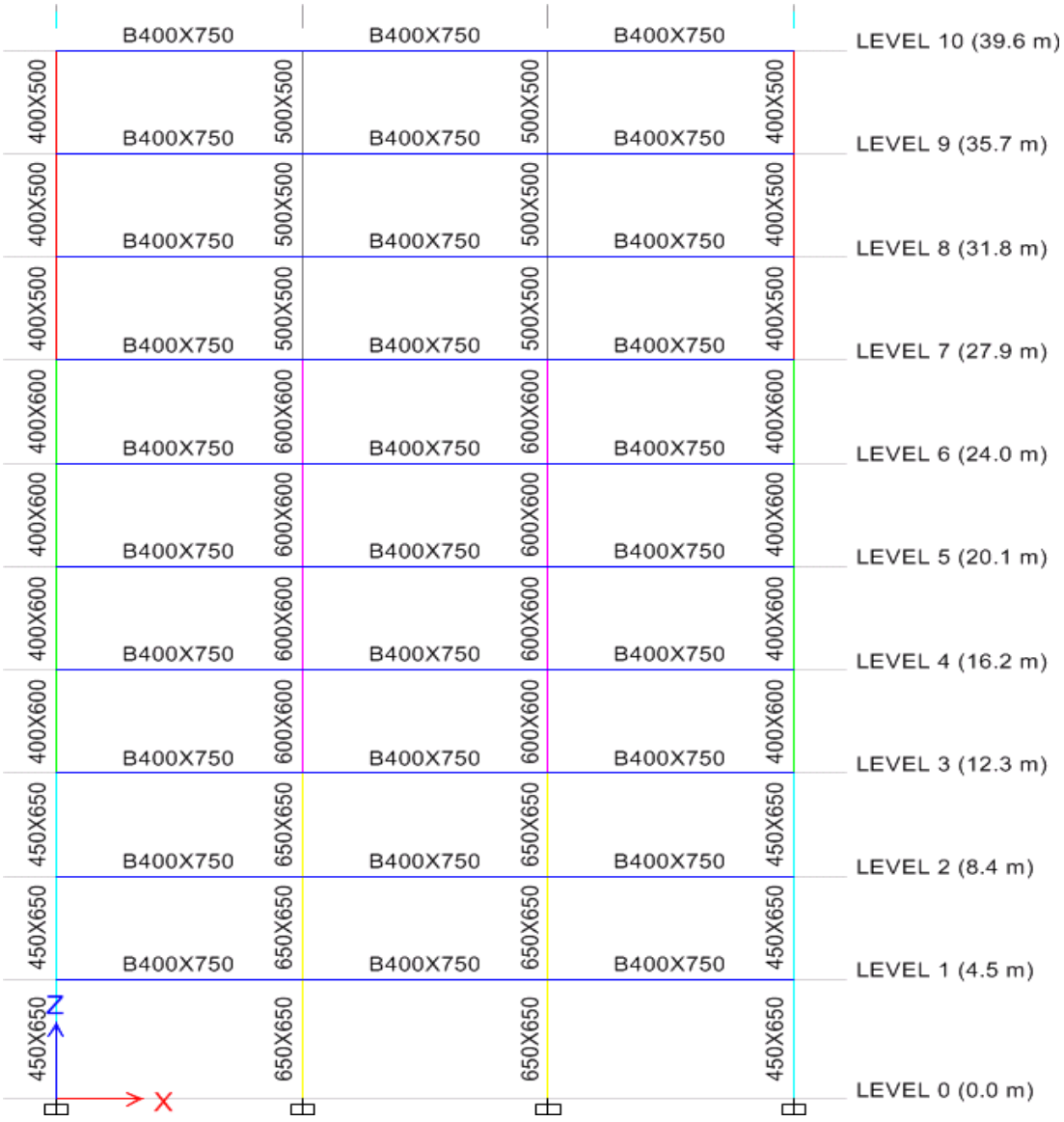

Fig. 16a. Beam column sizes for building ID 2461

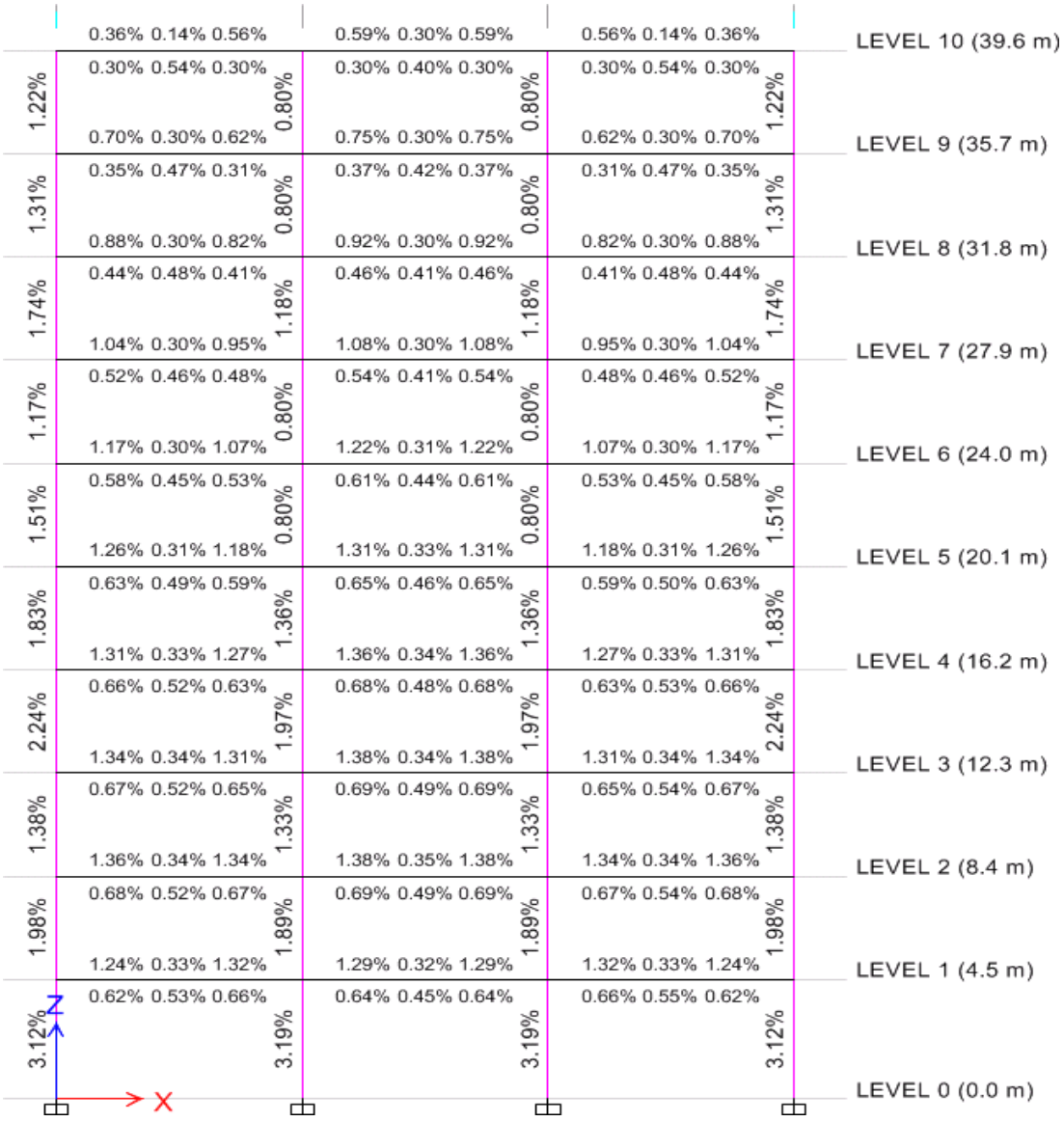

Fig. 16b. Required longitudinal reinforcement for building ID 2461

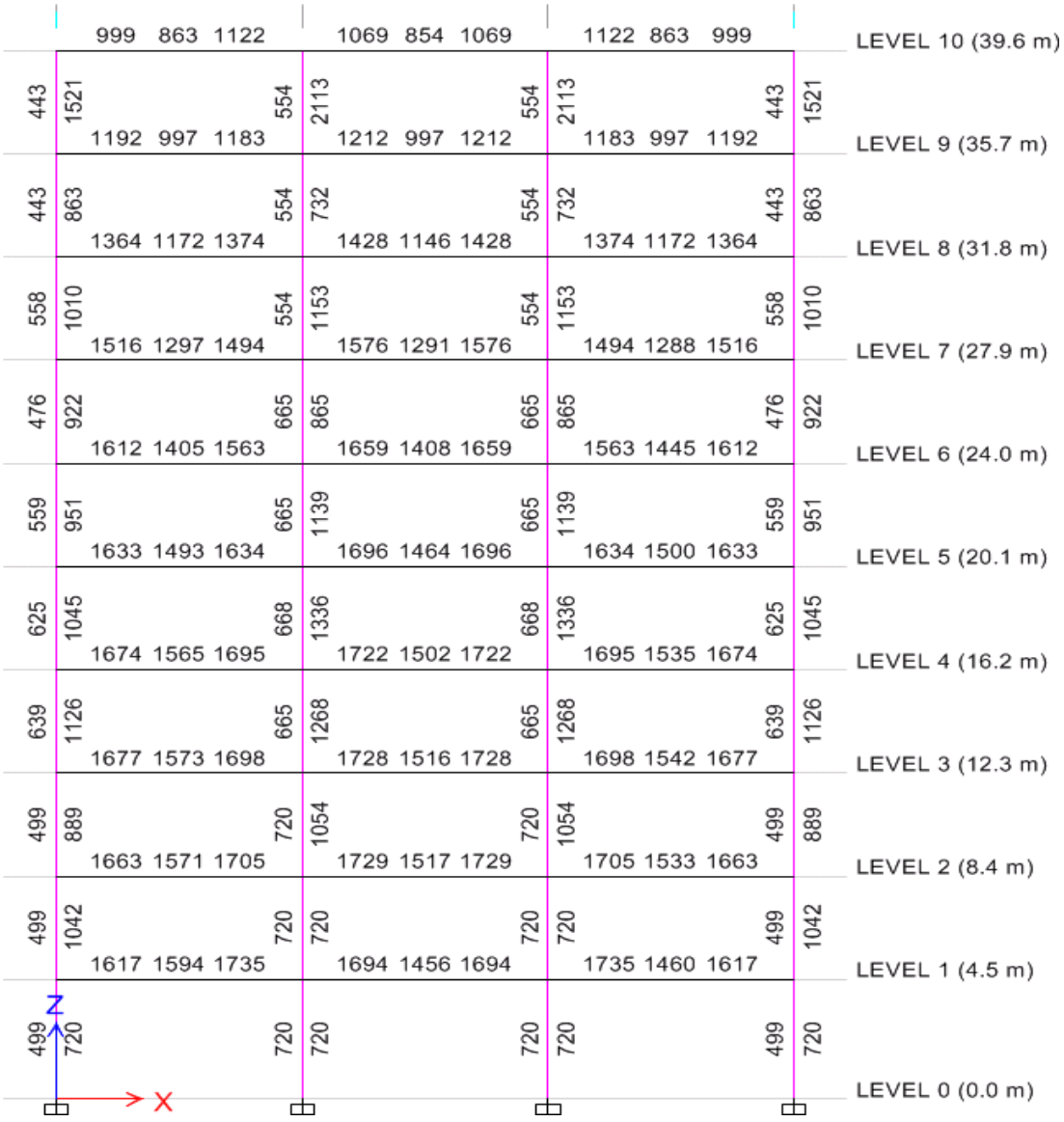

Fig. 16c. Required transverse reinforcement for building ID 2461

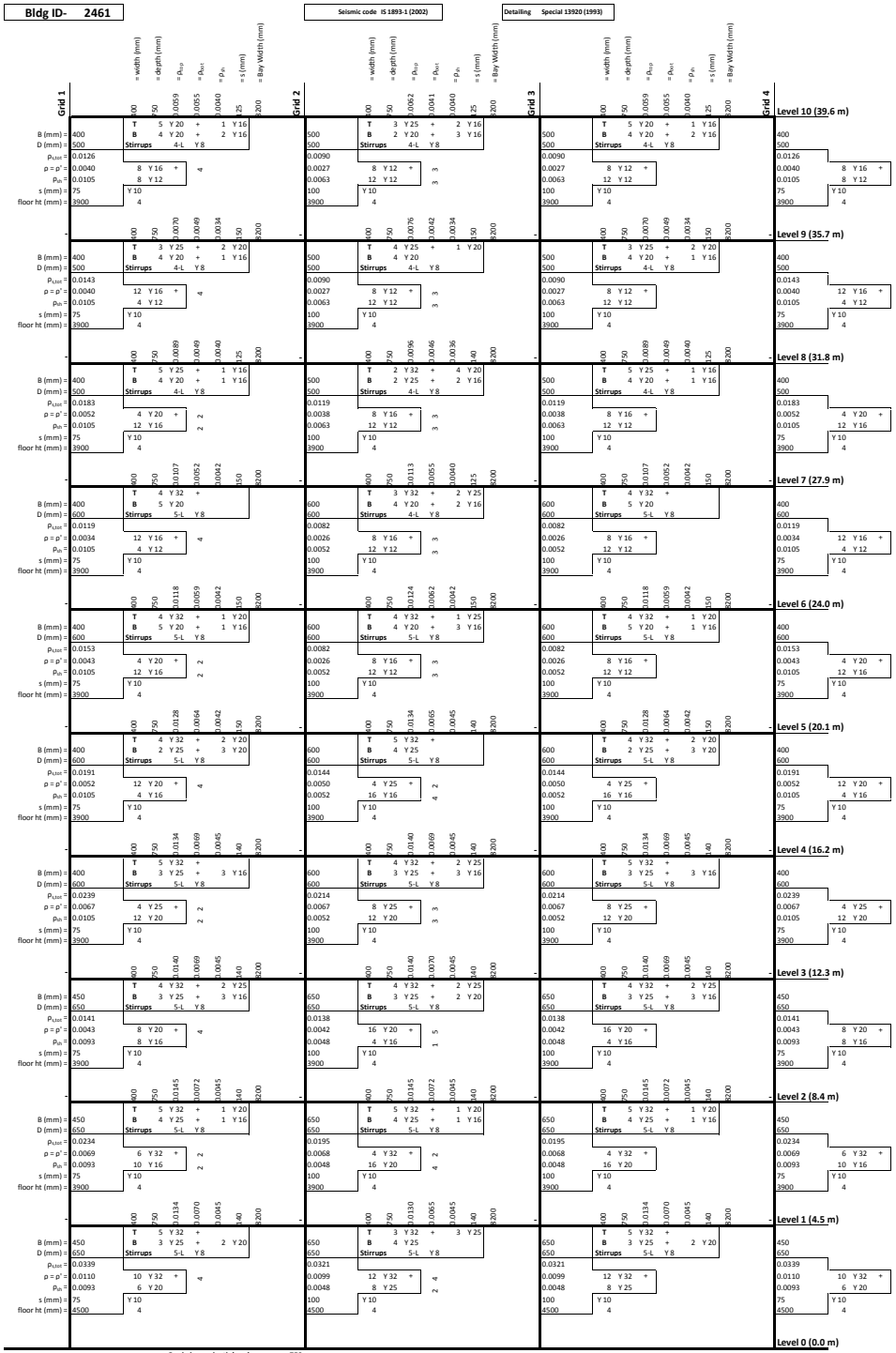

Fig. 16d. Provided reinforcement and modeling details for building ID 2461

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, Ec_col:	32048.2	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	1.27	sec
Time period, Ta_Y:	1.27	sec
Avrg response accn coeff, (Sa/g)_x:	0.79	
Avrg response accn coeff, (Sa/g)_y:	0.79	
Design Seis. coeff, (Ah)_x:	0.0283	
Design Seis. coeff, (Ah)_y:	0.0283	

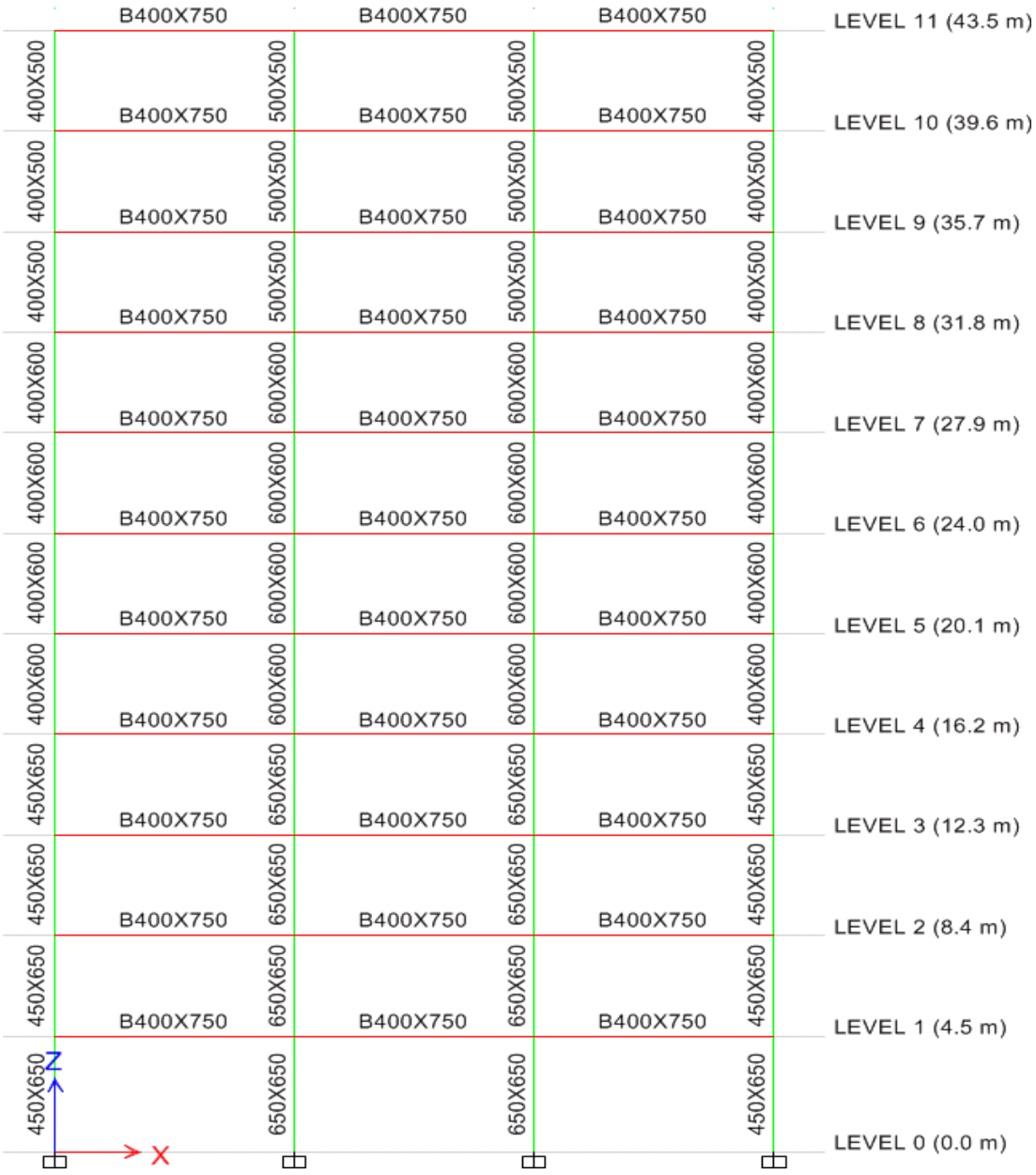

Fig. 17a. Beam column sizes for building ID 2463

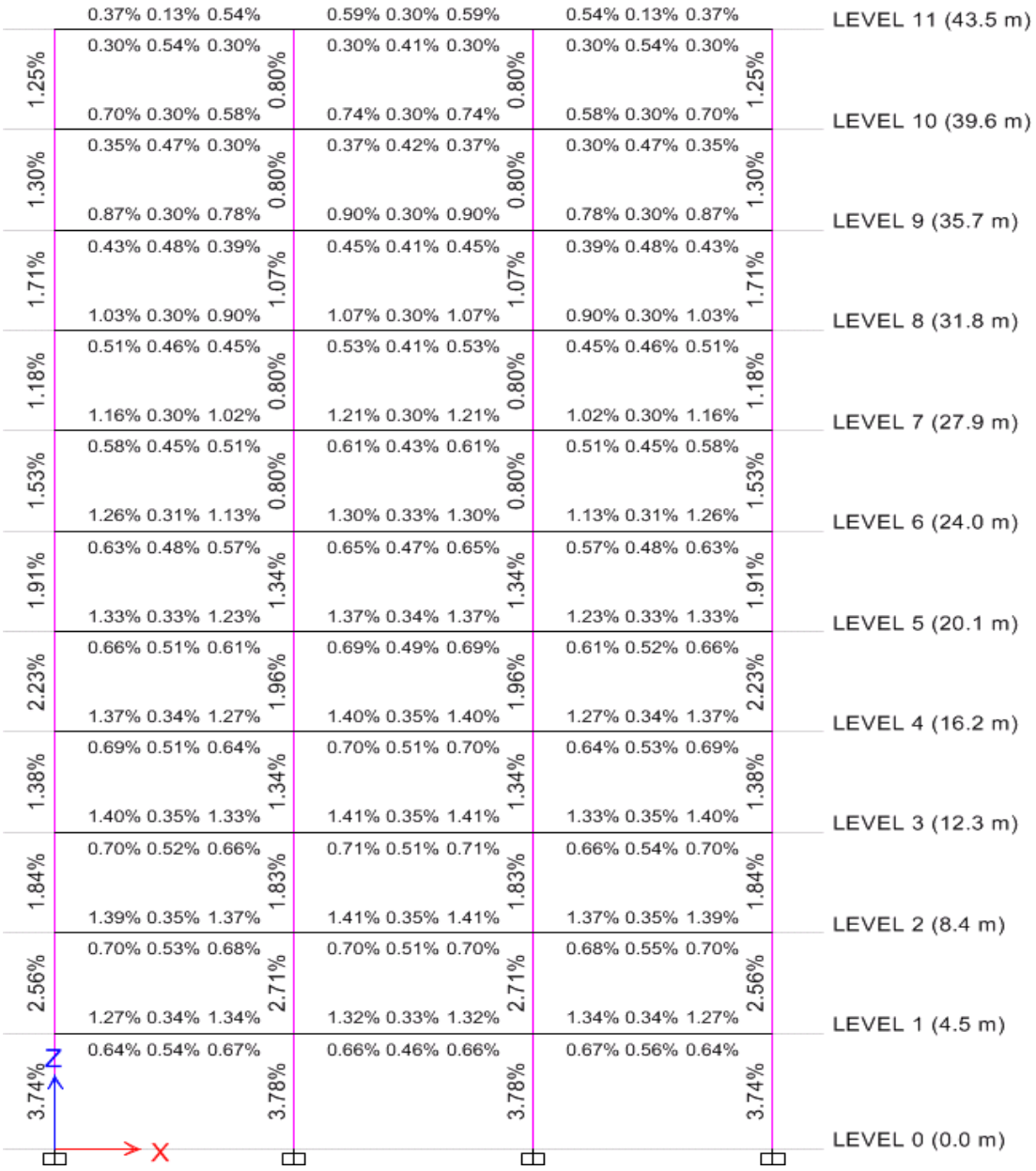

Fig. 17b. Required longitudinal reinforcement for building ID 2463

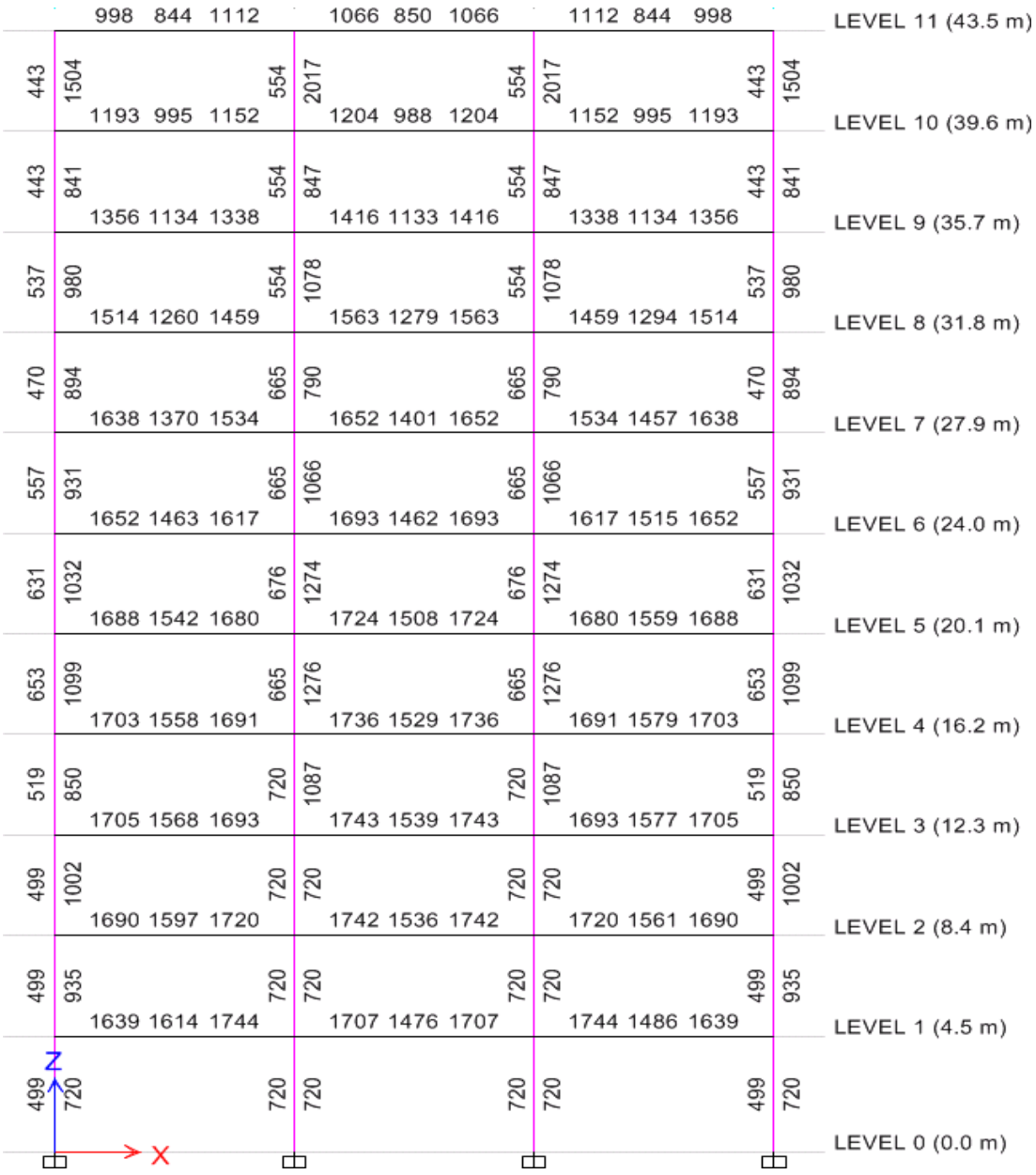

Fig. 17c. Required transverse reinforcement for building ID 2463

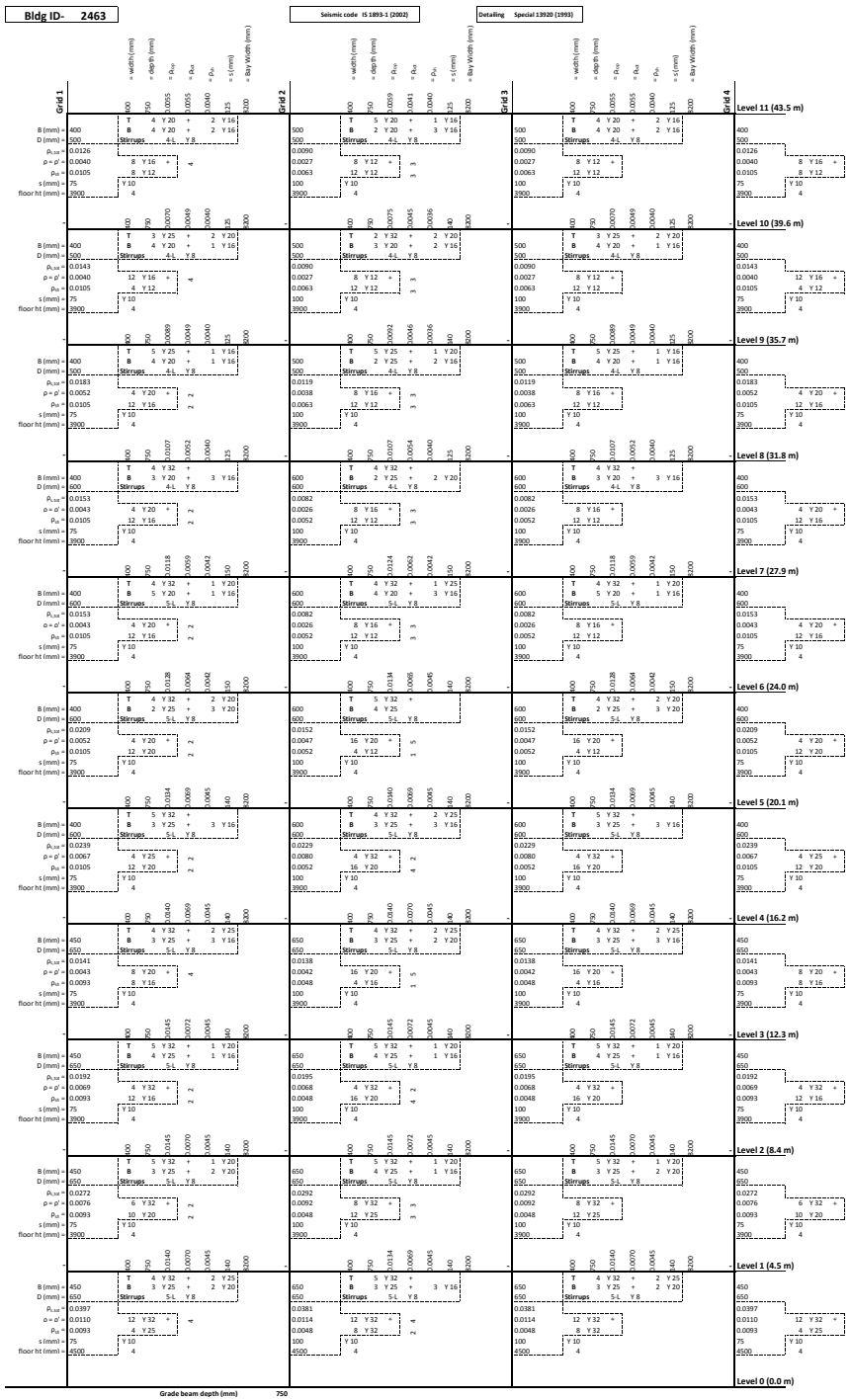

Fig. 17d. Provided reinforcement and modeling details for building ID 2463

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, Ec_col:	32048.2	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	24.6	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	1.35	sec
Time period, Ta_Y:	1.35	sec
Avrg response accn coeff, (Sa/g)_x:	0.74	
Avrg response accn coeff, (Sa/g)_y:	0.74	
Design Seis. coeff, (Ah)_x:	0.0266	
Design Seis. coeff, (Ah)_y:	0.0266	

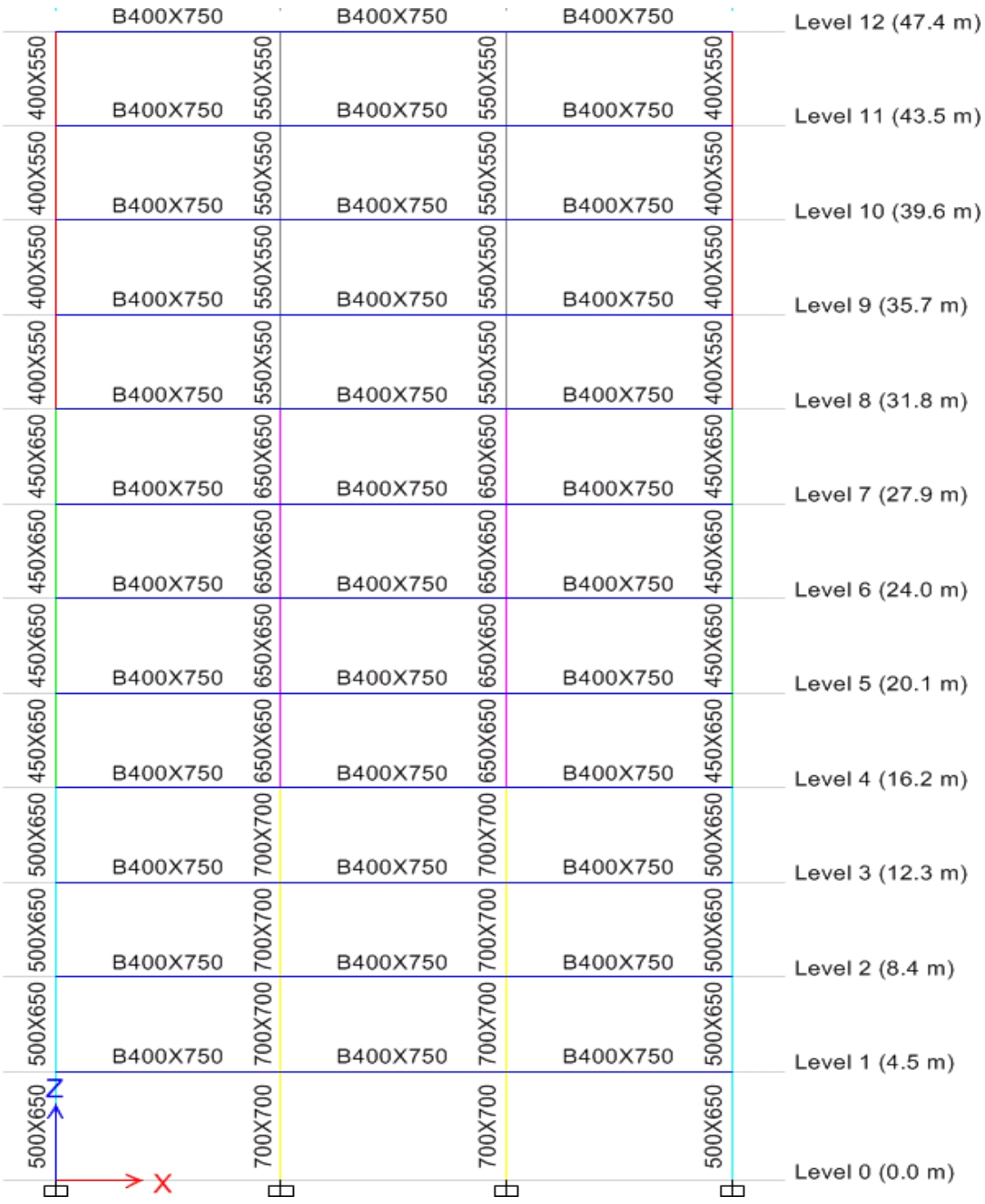

Fig. 18a. Beam column sizes for building ID 2225

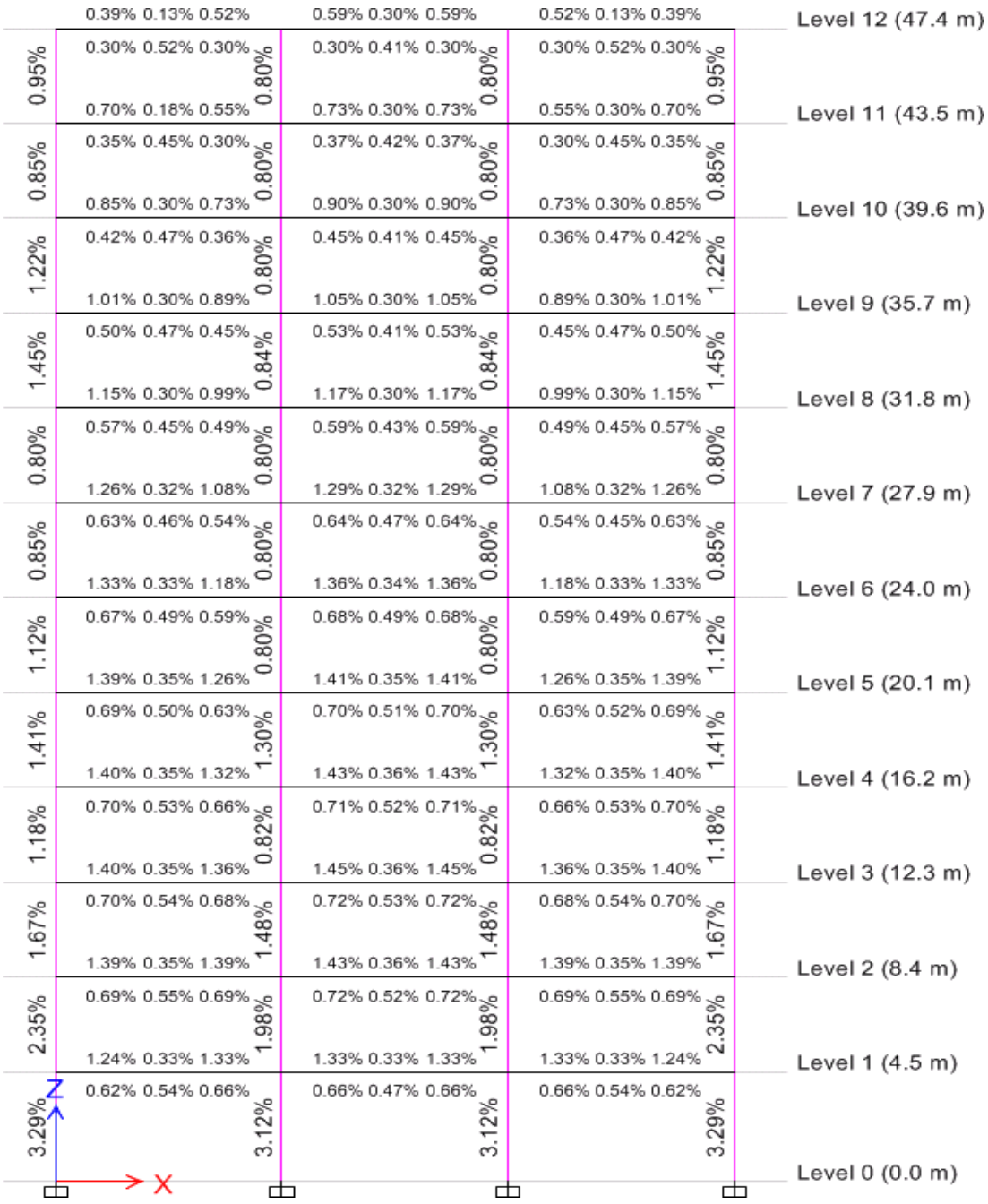

Fig. 18b. Required longitudinal reinforcement for building ID 2225

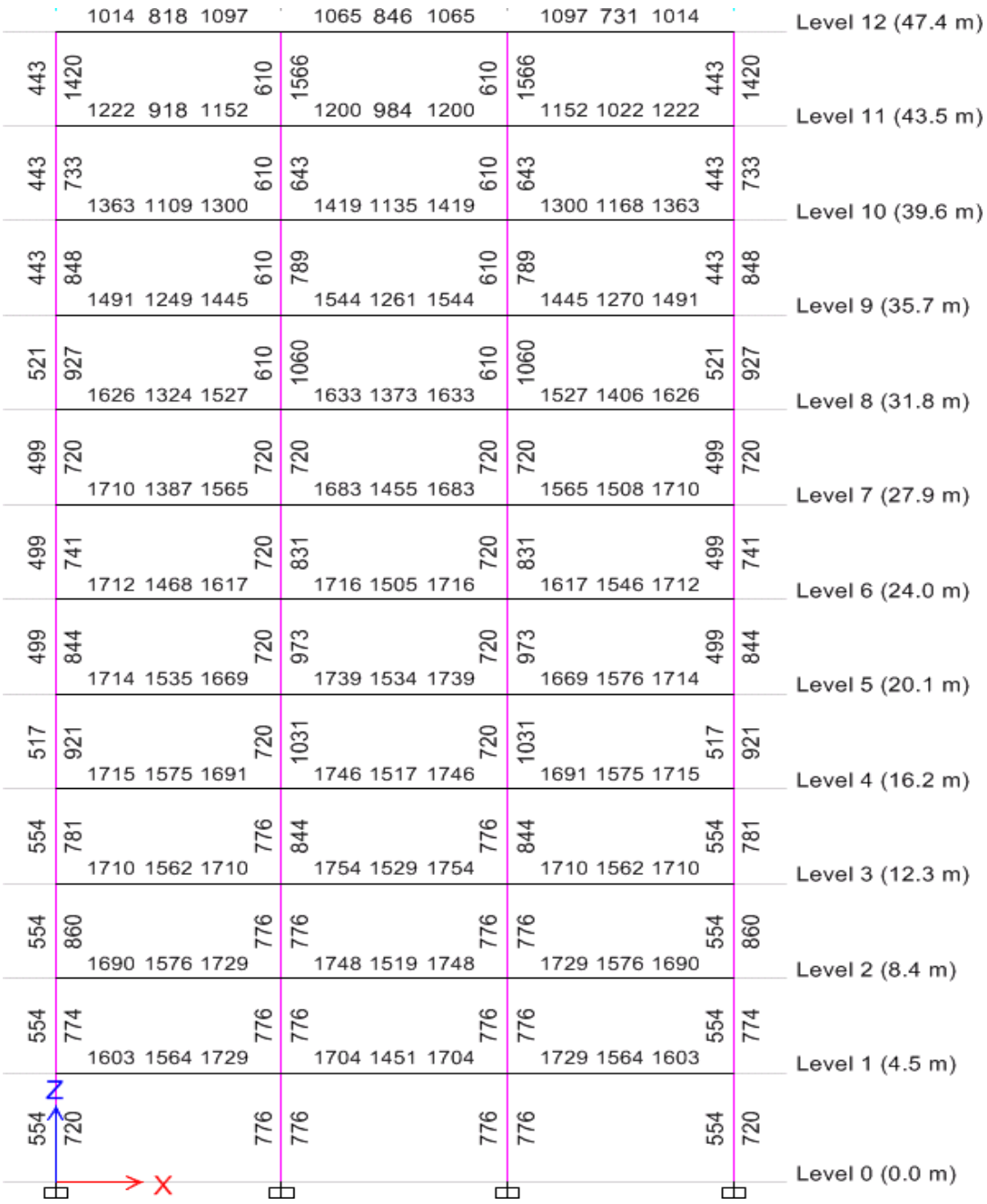

Fig. 18c. Required transverse reinforcement for building ID 2225

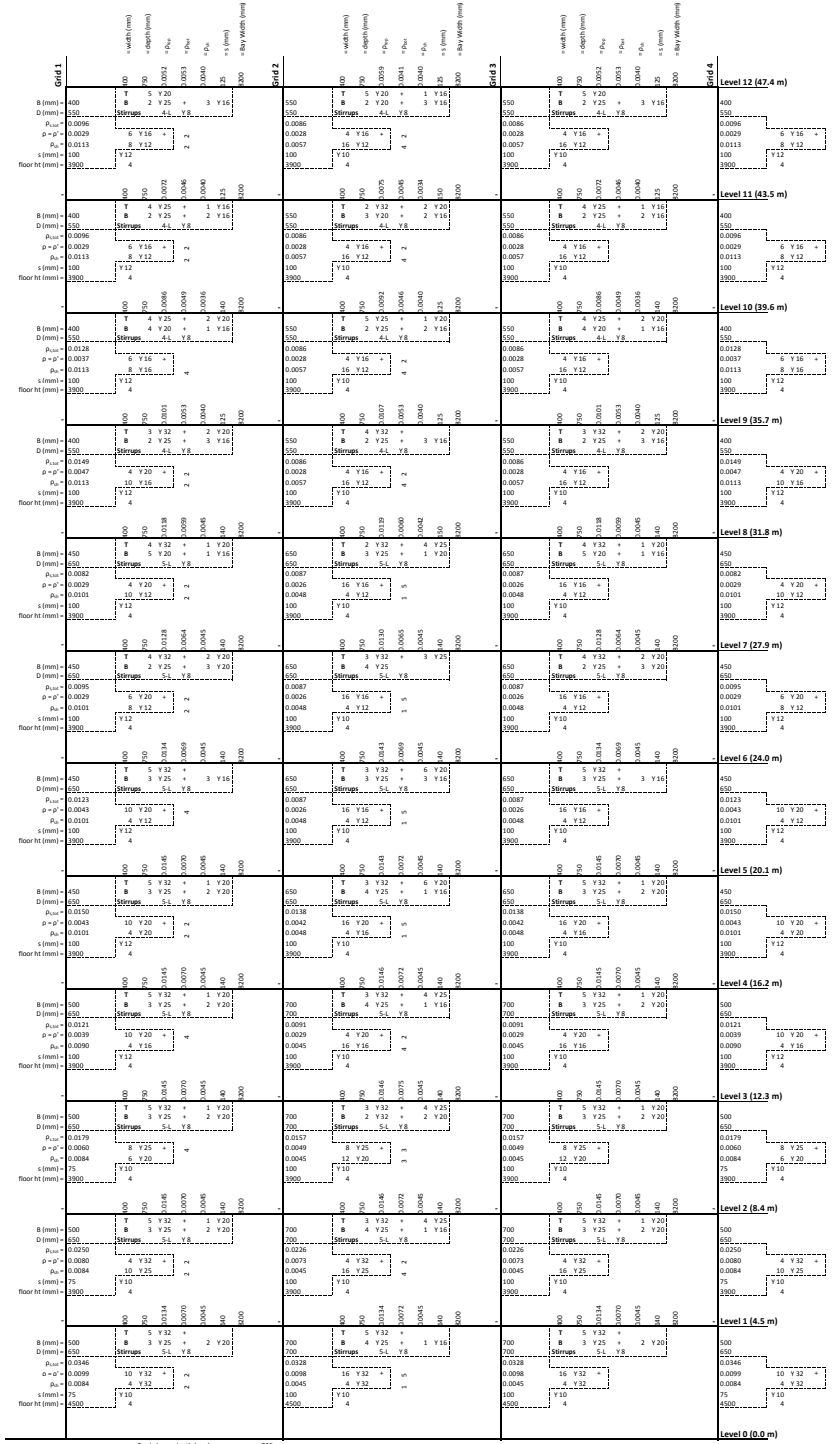

Fig. 18d. Provided reinforcement and modeling details for building ID 2225

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	41	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.61	sec
Time period, Ta_Y:	0.61	sec
Avrg response accn coeff, (Sa/g)_x:	1.65	
Avrg response accn coeff, (Sa/g)_y:	1.65	
Design Seis. coeff, (Ah)_x:	0.0594	
Design Seis. coeff, (Ah)_y:	0.0594	

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

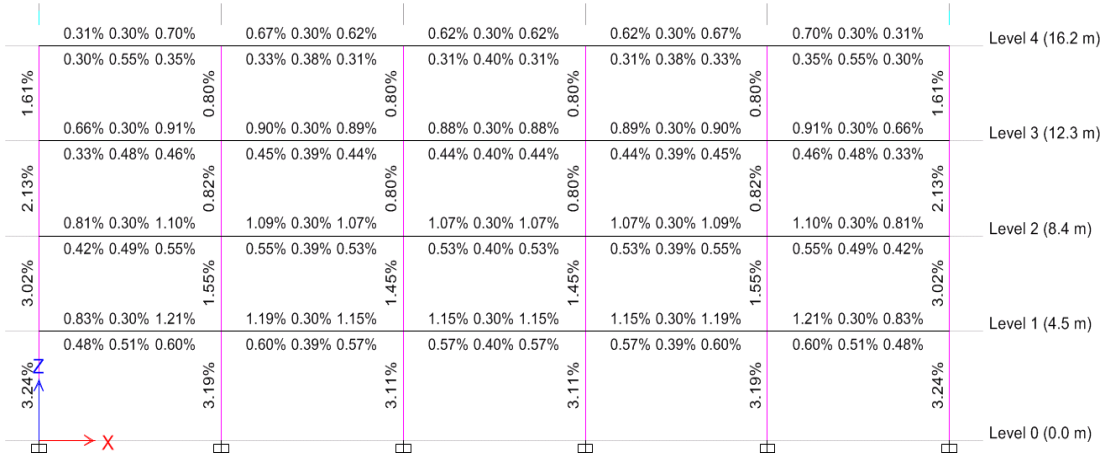

Fig. 19b. Required longitudinal reinforcement for building ID 2227

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

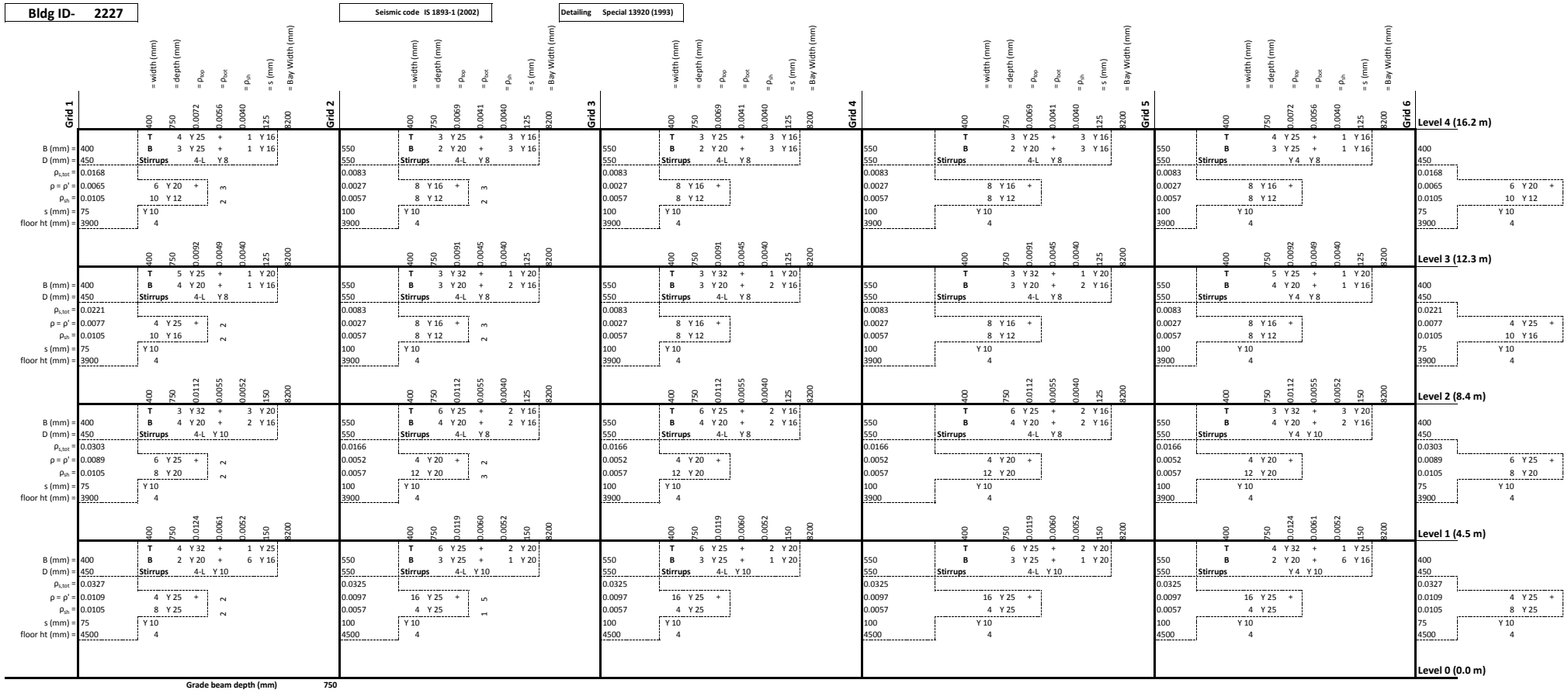

Fig. 19d. Provided reinforcement and modeling details for building ID 2227

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	41	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.71	sec
Time period, Ta_Y:	0.71	sec
Avrg response accn coeff, (Sa/g)_x:	1.40	
Avrg response accn coeff, (Sa/g)_y:	1.40	
Design Seis. coeff, (Ah)_x:	0.0506	
Design Seis. coeff, (Ah)_y:	0.0506	

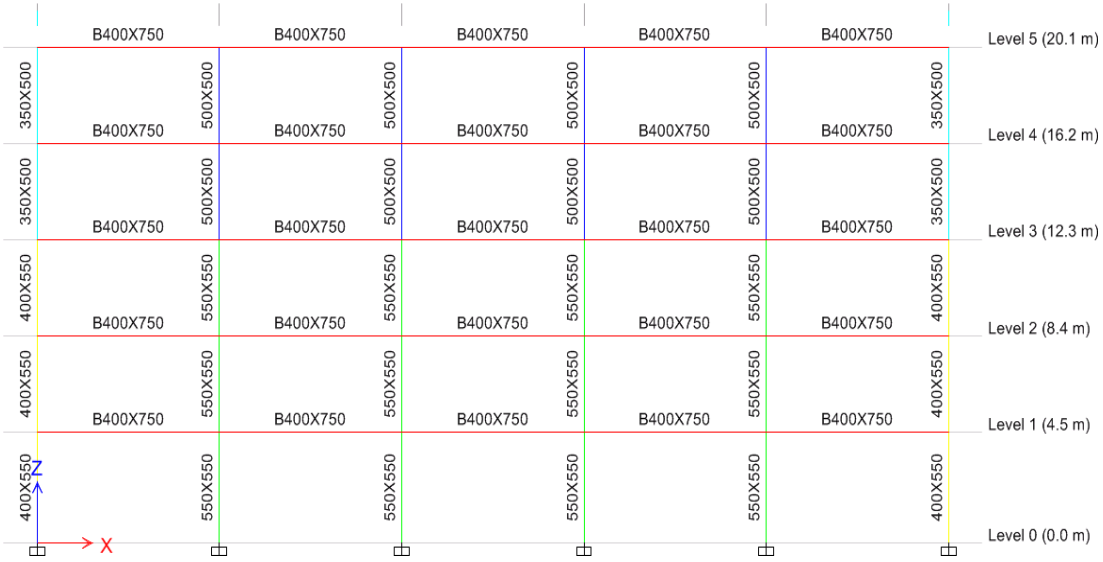

Fig. 20a. Beam column sizes for building ID 2437

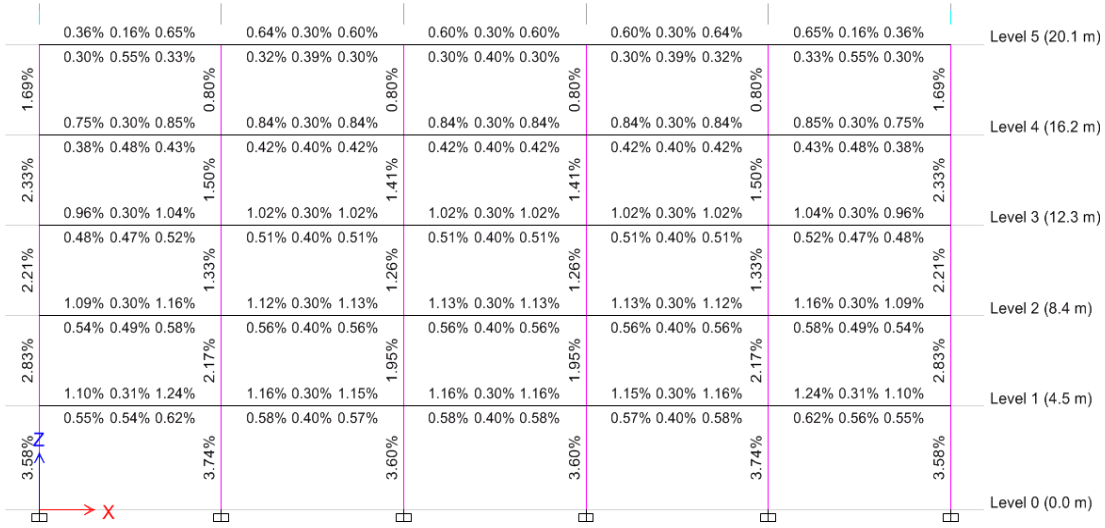

Fig. 20b. Required longitudinal reinforcement for building ID 2437

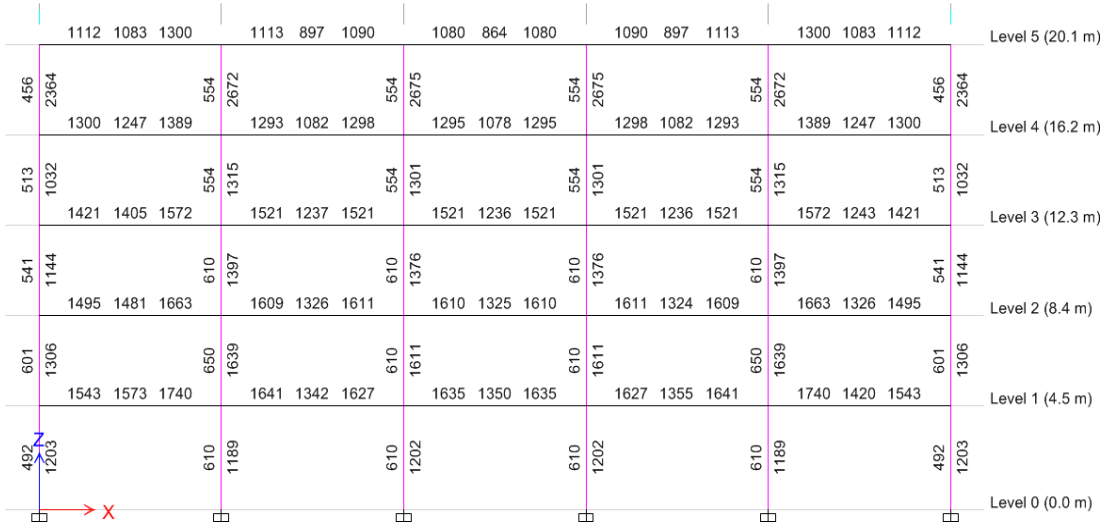

Fig. 20c. Required transverse reinforcement for building ID 2437

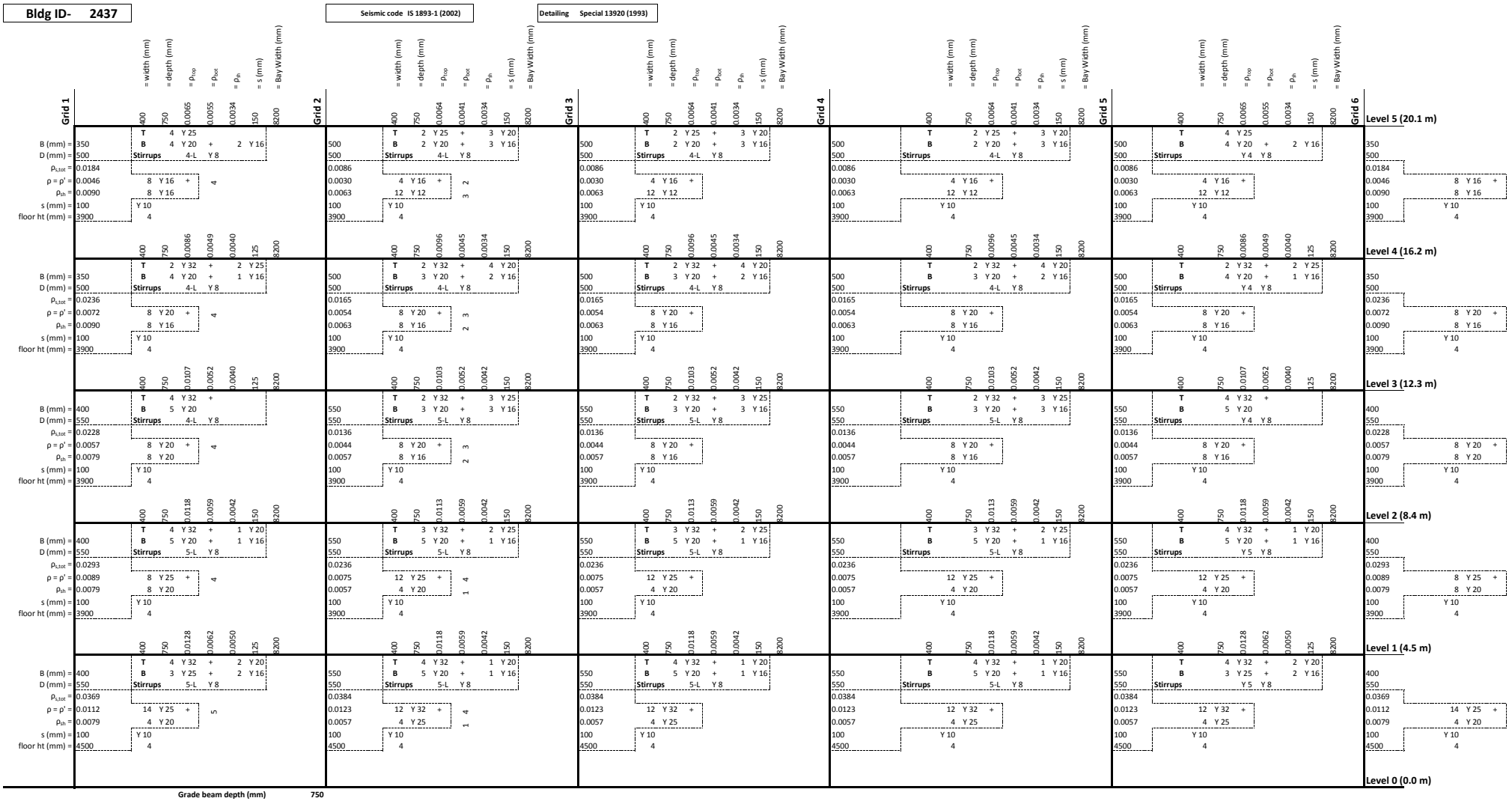

Fig. 20d. Provided reinforcement and modeling details for building ID 2437

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	41	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.81	sec
Time period, Ta_Y:	0.81	sec
Avrg response accn coeff, (Sa/g)_x:	1.23	
Avrg response accn coeff, (Sa/g)_y:	1.23	
Design Seis. coeff, (Ah)_x:	0.0443	
Design Seis. coeff, (Ah)_y:	0.0443	

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

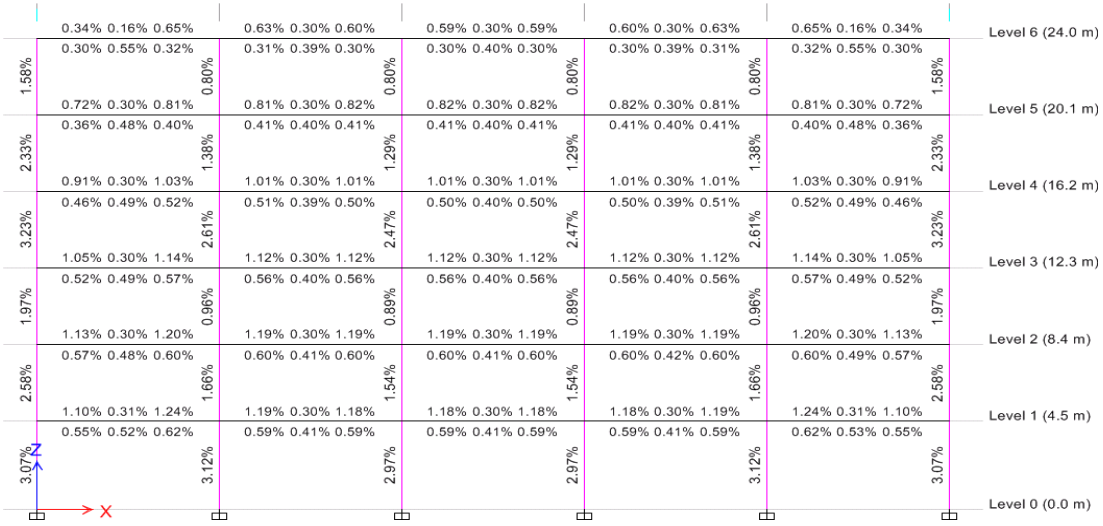

Fig. 21b. Required longitudinal reinforcement for building ID 2439

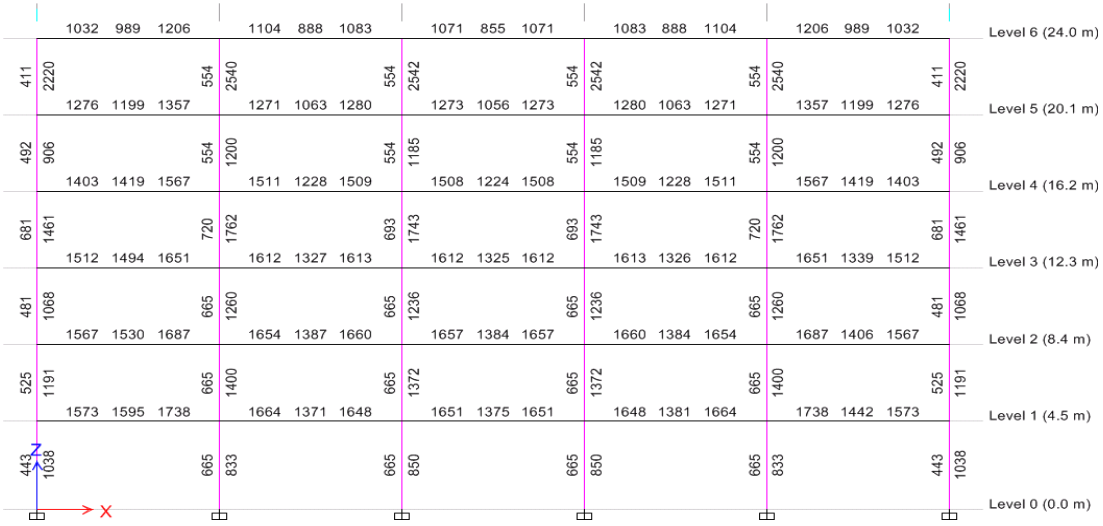

Fig. 21c. Required transverse reinforcement for building ID 2439

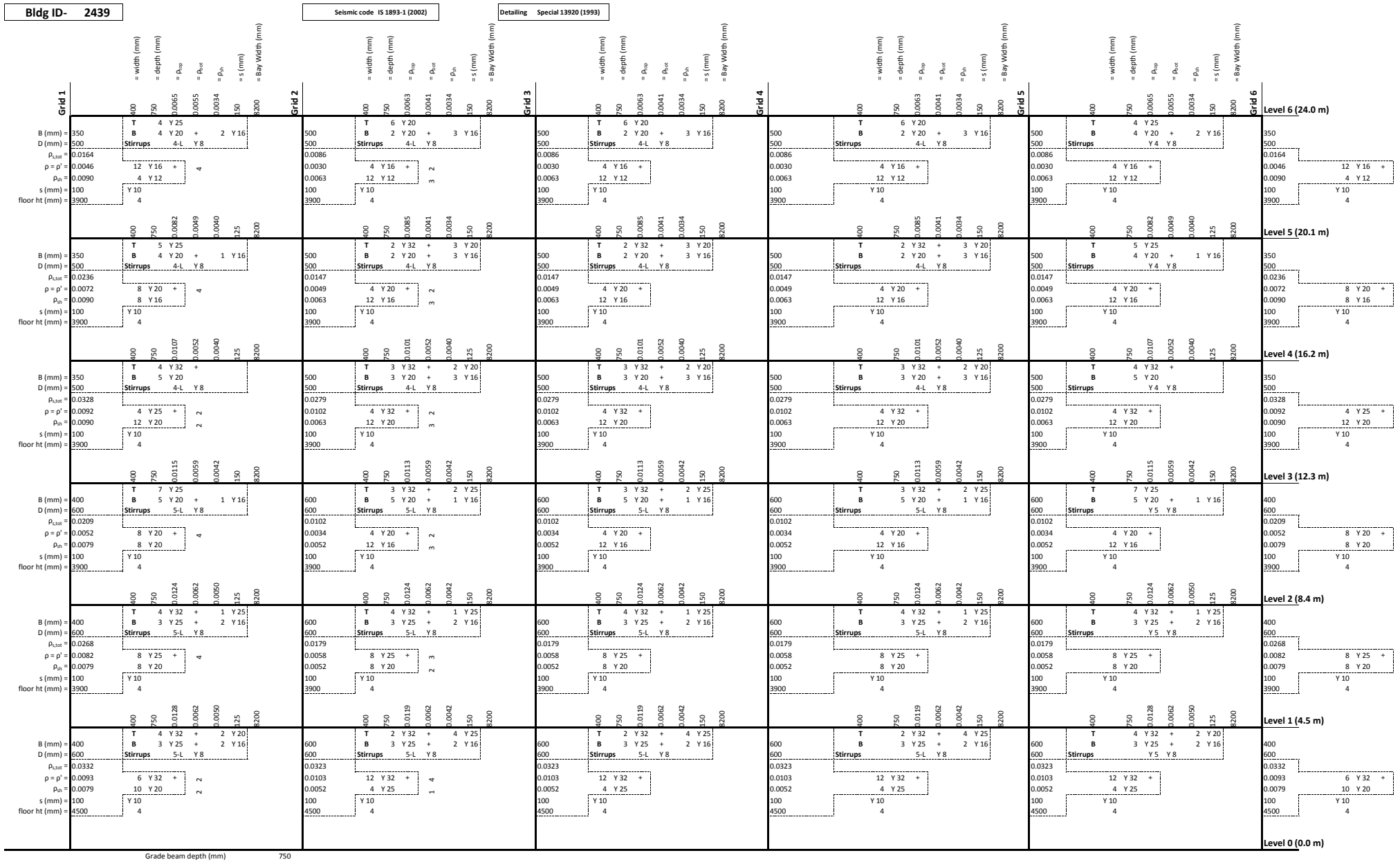

Fig. 21d. Provided reinforcement and modeling details for building ID 2439

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	41	m
Dimension along Y, b2 (col-to-col):	73.8	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.91	sec
Time period, Ta_Y:	0.91	sec
Avrg response accn coeff, (Sa/g)_x:	1.10	
Avrg response accn coeff, (Sa/g)_y:	1.10	
Design Seis. coeff, (Ah)_x:	0.0395	
Design Seis. coeff, (Ah)_y:	0.0395	

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

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

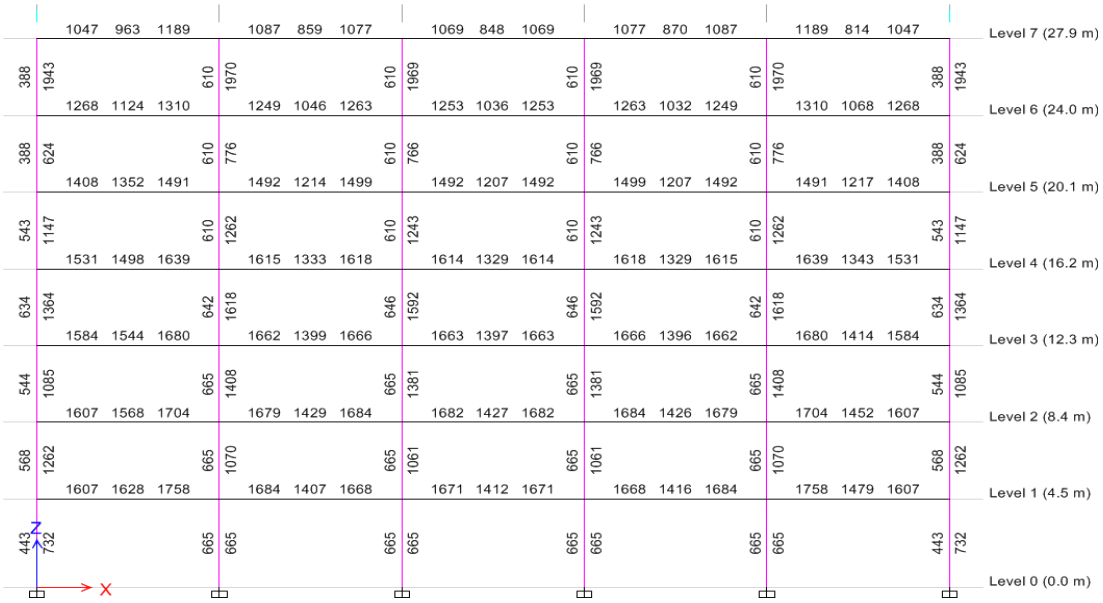

Fig. 22c. Required transverse reinforcement for building ID 2229

Bldg ID- 2229 | **Seismic code IS 1893-1 (2002)** | **Detailing Special 13920 (1993)**

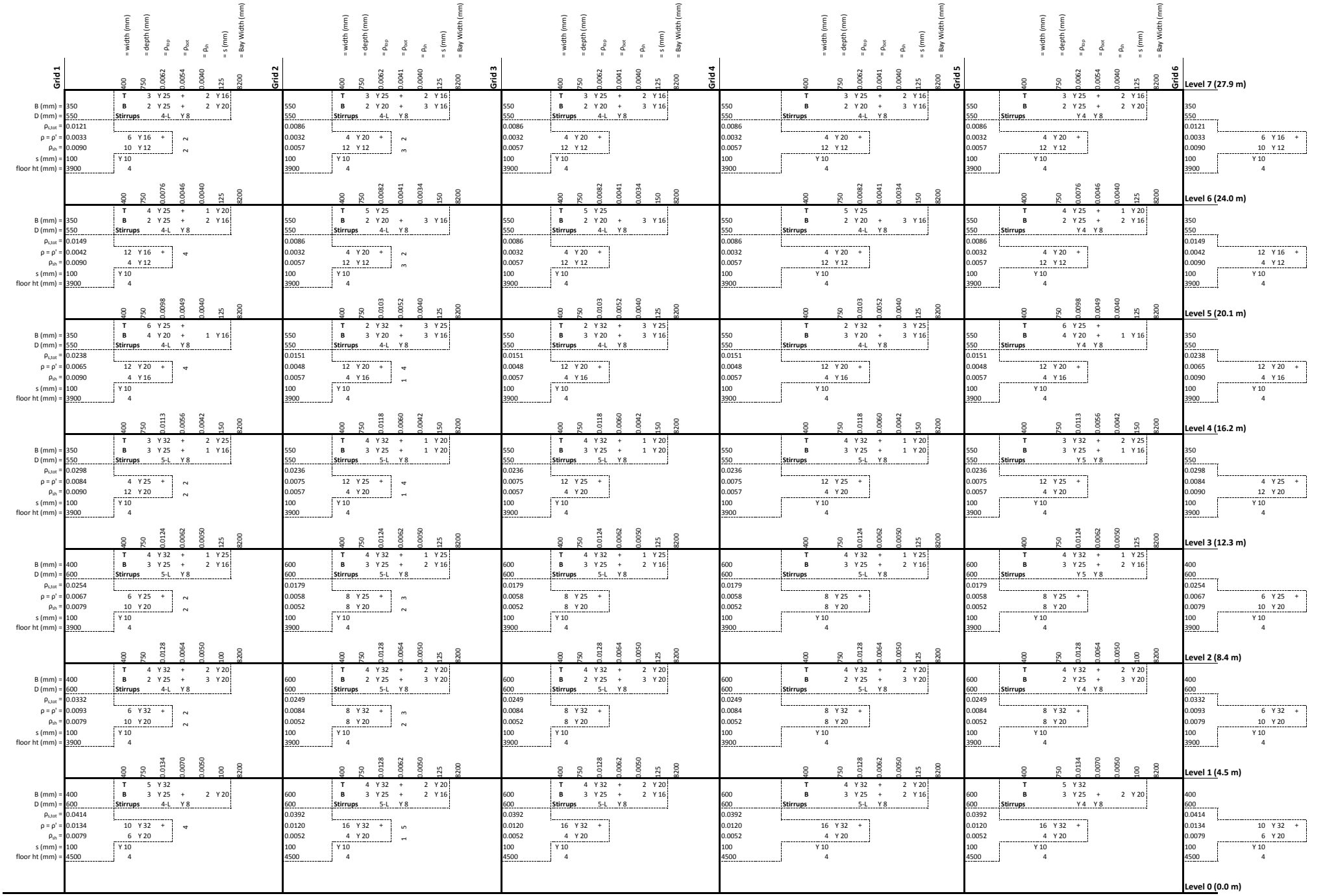

Fig. 22d. Provided reinforcement and modeling details for building ID 2229

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	18	m
Dimension along Y, b2 (col-to-col):	54	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.61	sec
Time period, Ta_Y:	0.61	sec
Avrg response accn coeff, (Sa/g)_x:	1.65	
Avrg response accn coeff, (Sa/g)_y:	1.65	
Design Seis. coeff, (Ah)_x:	0.0594	
Design Seis. coeff, (Ah)_y:	0.0594	

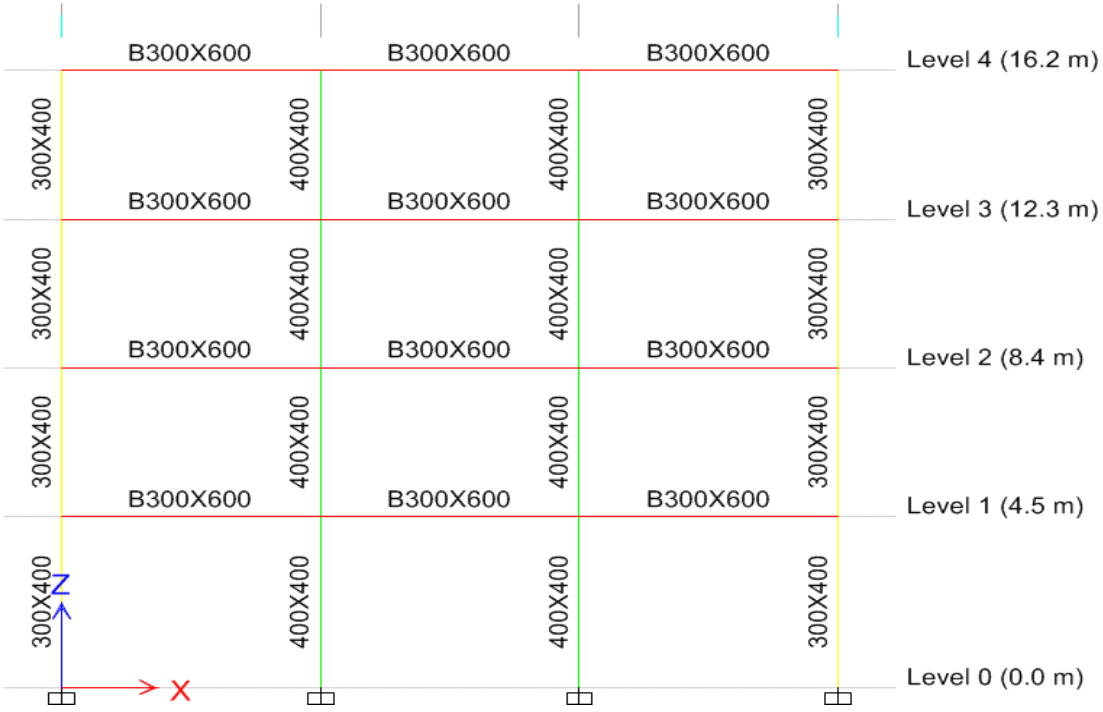

Fig. 23a. Beam column sizes for building ID 2231

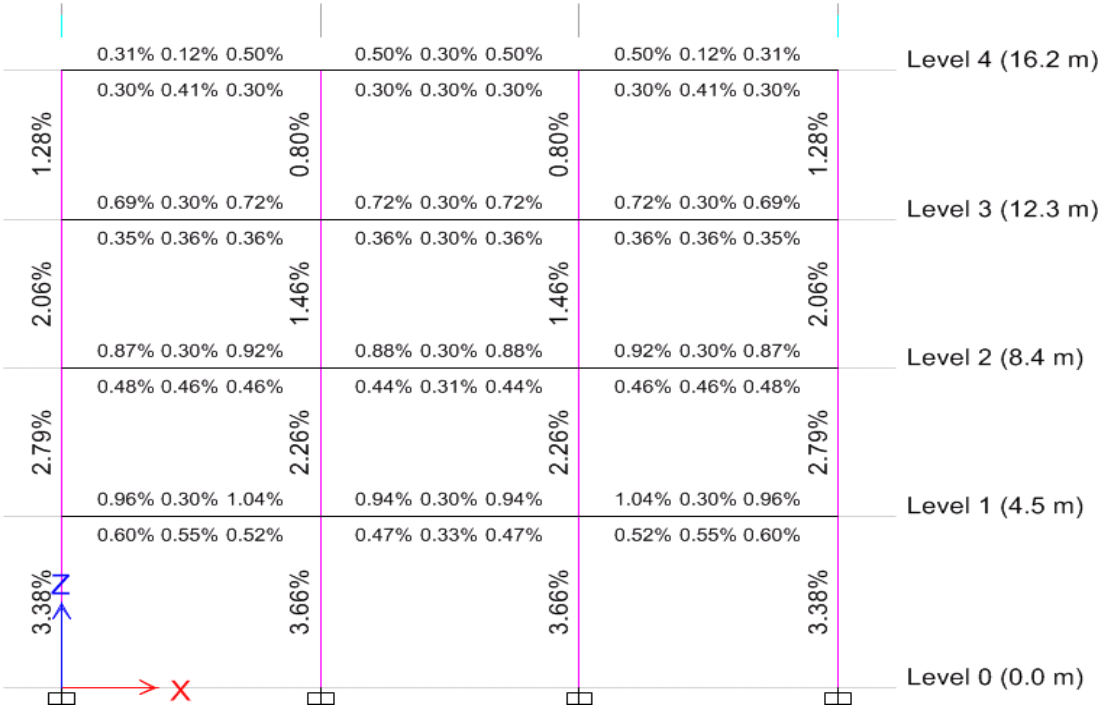

Fig. 23b. Required longitudinal reinforcement for building ID 2231

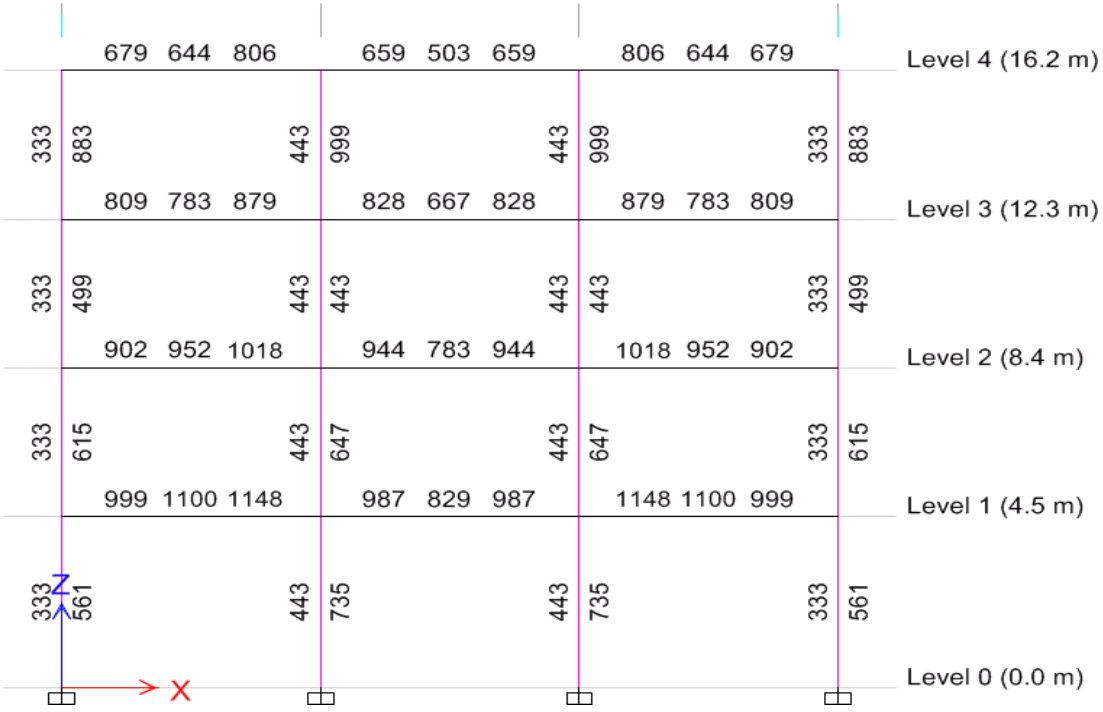

Fig. 23c. Required transverse reinforcement for building ID 2231

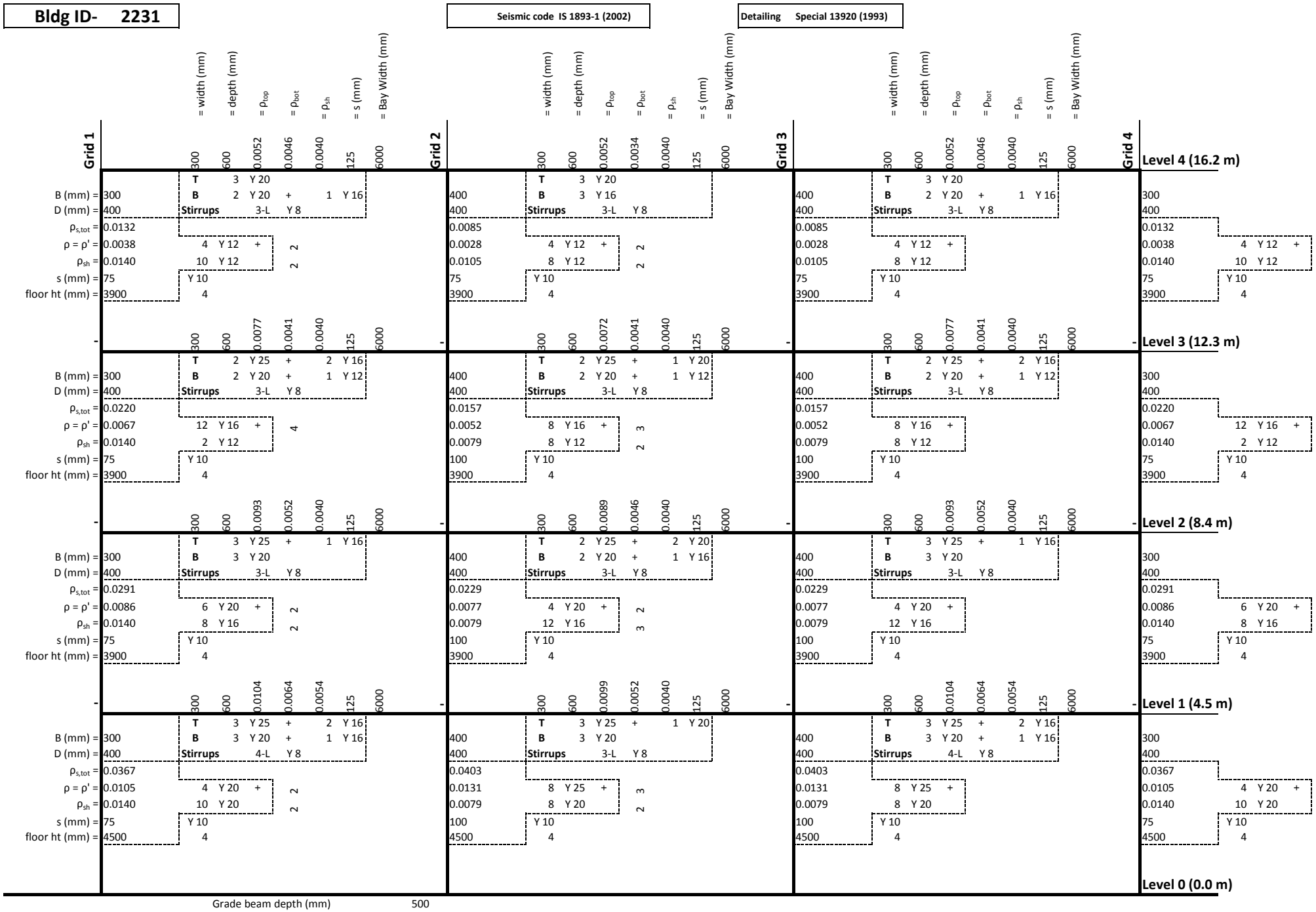

Fig. 23d. Provided reinforcement and modeling details for building ID 2231

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	18	m
Dimension along Y, b2 (col-to-col):	54	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.71	sec
Time period, Ta_Y:	0.71	sec
Avrg response accn coeff, (Sa/g)_x:	1.40	
Avrg response accn coeff, (Sa/g)_y:	1.40	
Design Seis. coeff, (Ah)_x:	0.0506	
Design Seis. coeff, (Ah)_y:	0.0506	

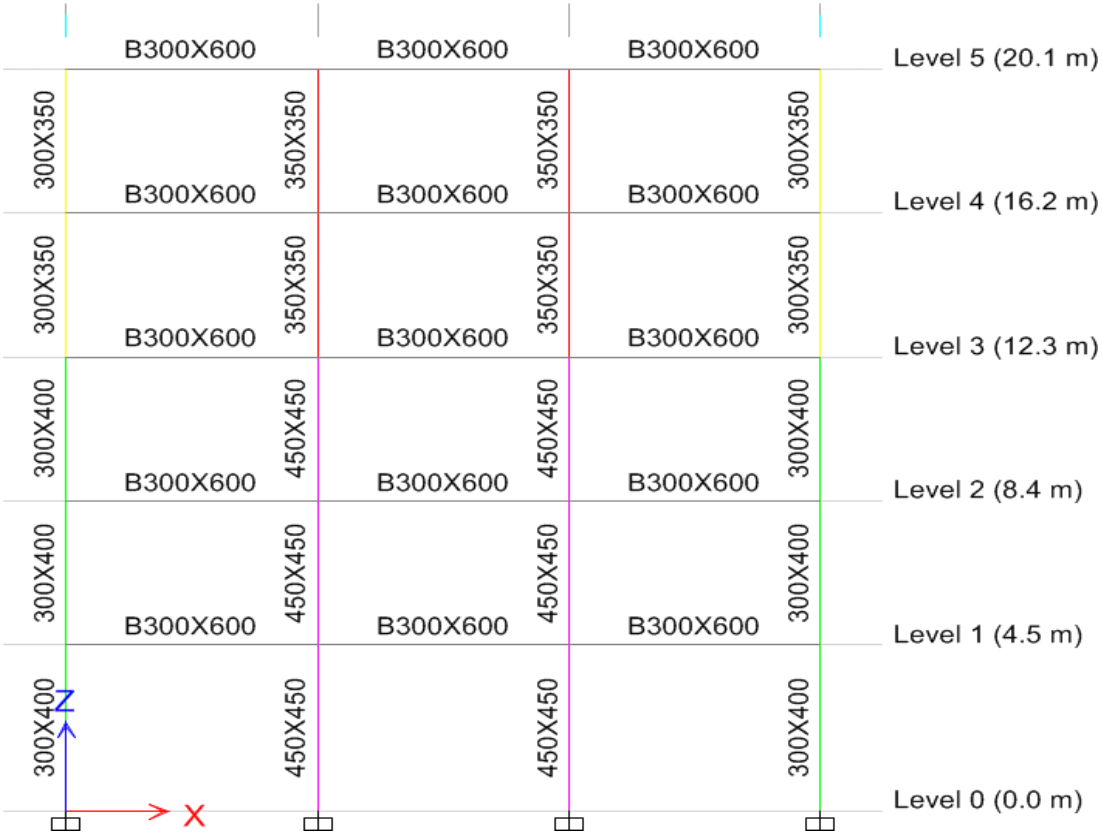

Fig. 24a. Beam column sizes for building ID 2441

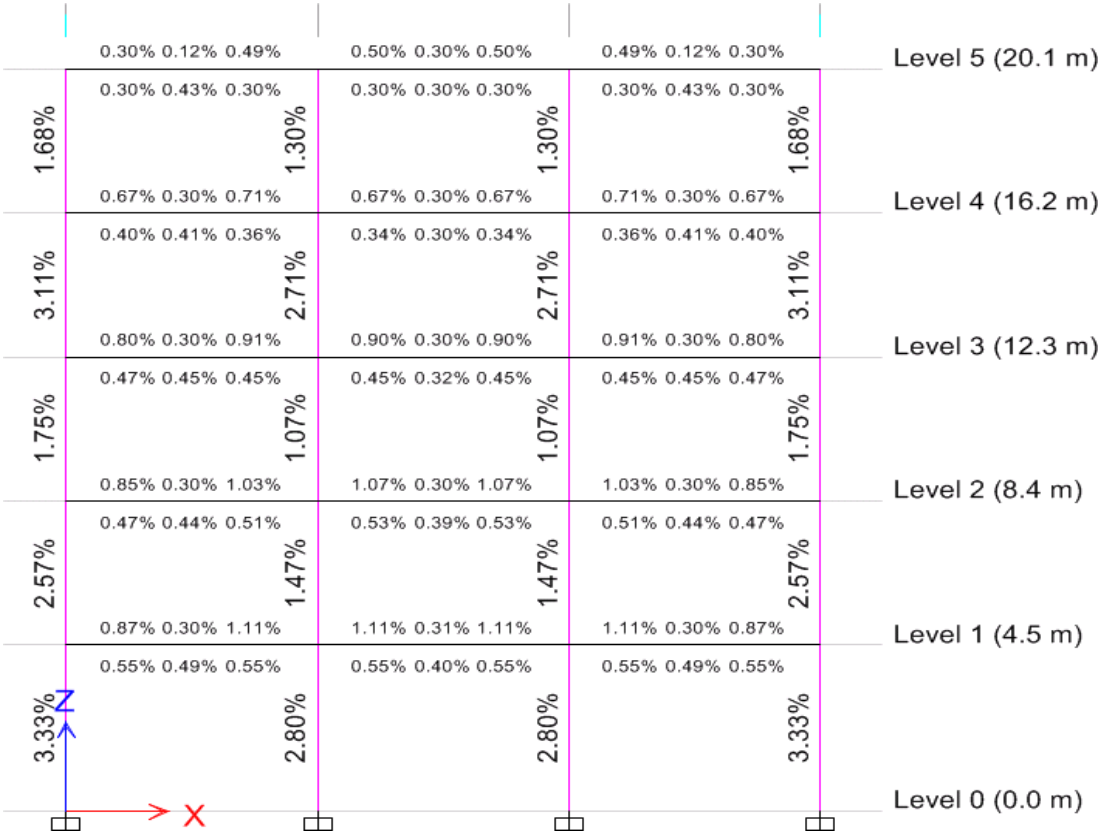

Fig. 24b. Required longitudinal reinforcement for building ID 2441

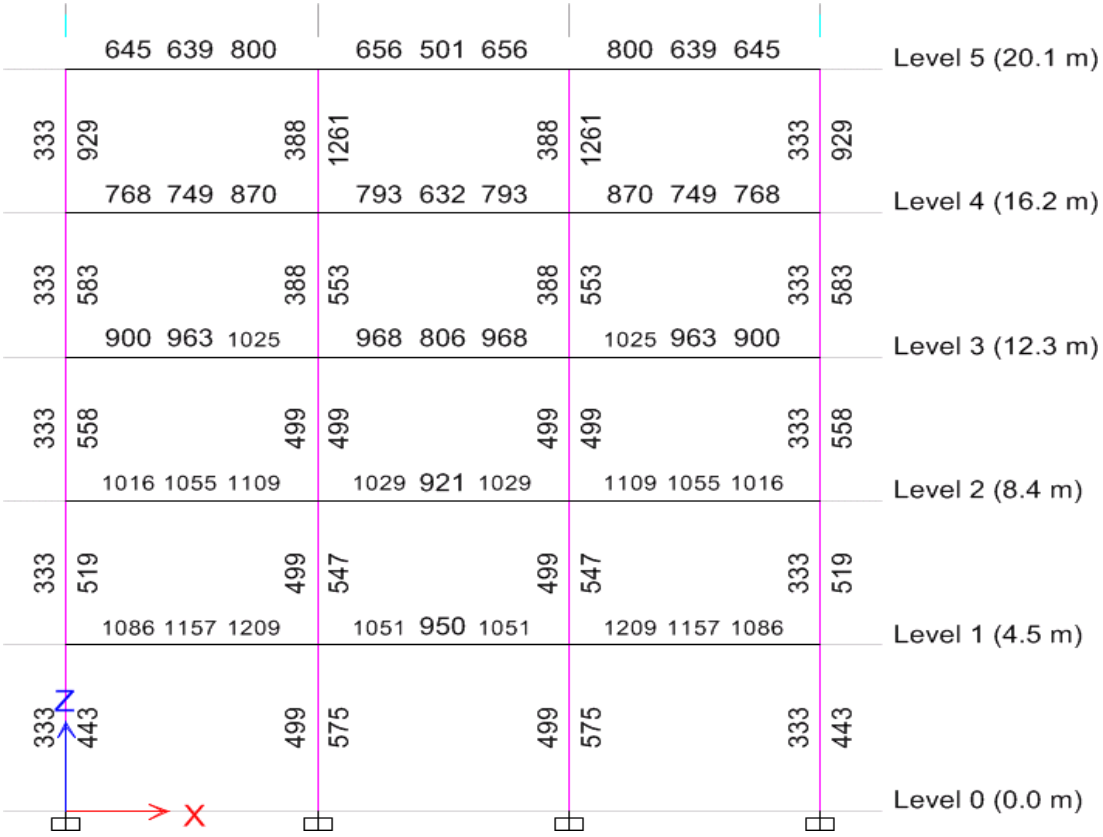

Fig. 24c. Required transverse reinforcement for building ID 2441

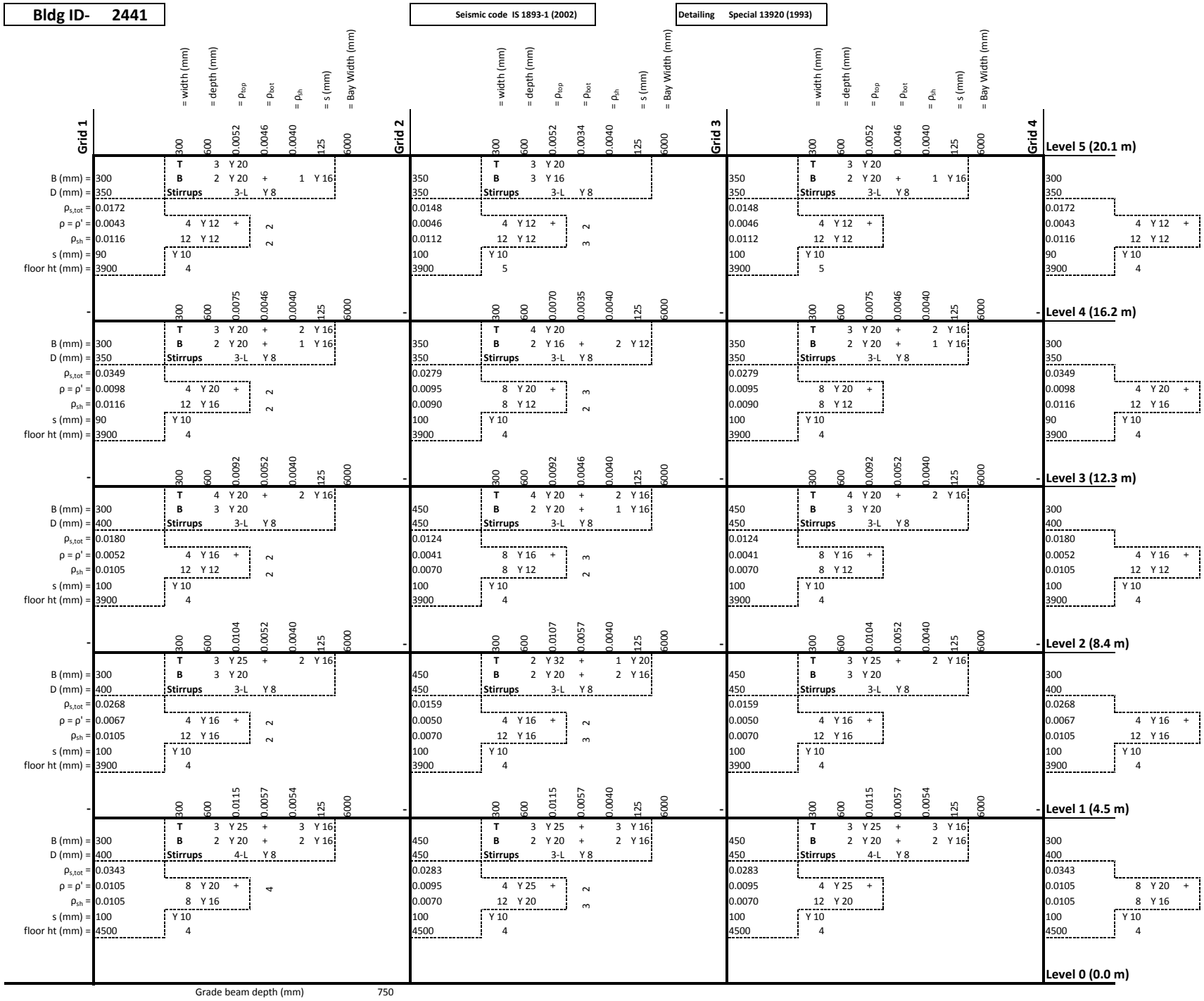

Fig. 24d. Provided reinforcement and modeling details for building ID 2441

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	18	m
Dimension along Y, b2 (col-to-col):	54	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.81	sec
Time period, Ta_Y:	0.81	sec
Avrg response accn coeff, (Sa/g)_x:	1.23	
Avrg response accn coeff, (Sa/g)_y:	1.23	
Design Seis. coeff, (Ah)_x:	0.0443	
Design Seis. coeff, (Ah)_y:	0.0443	

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

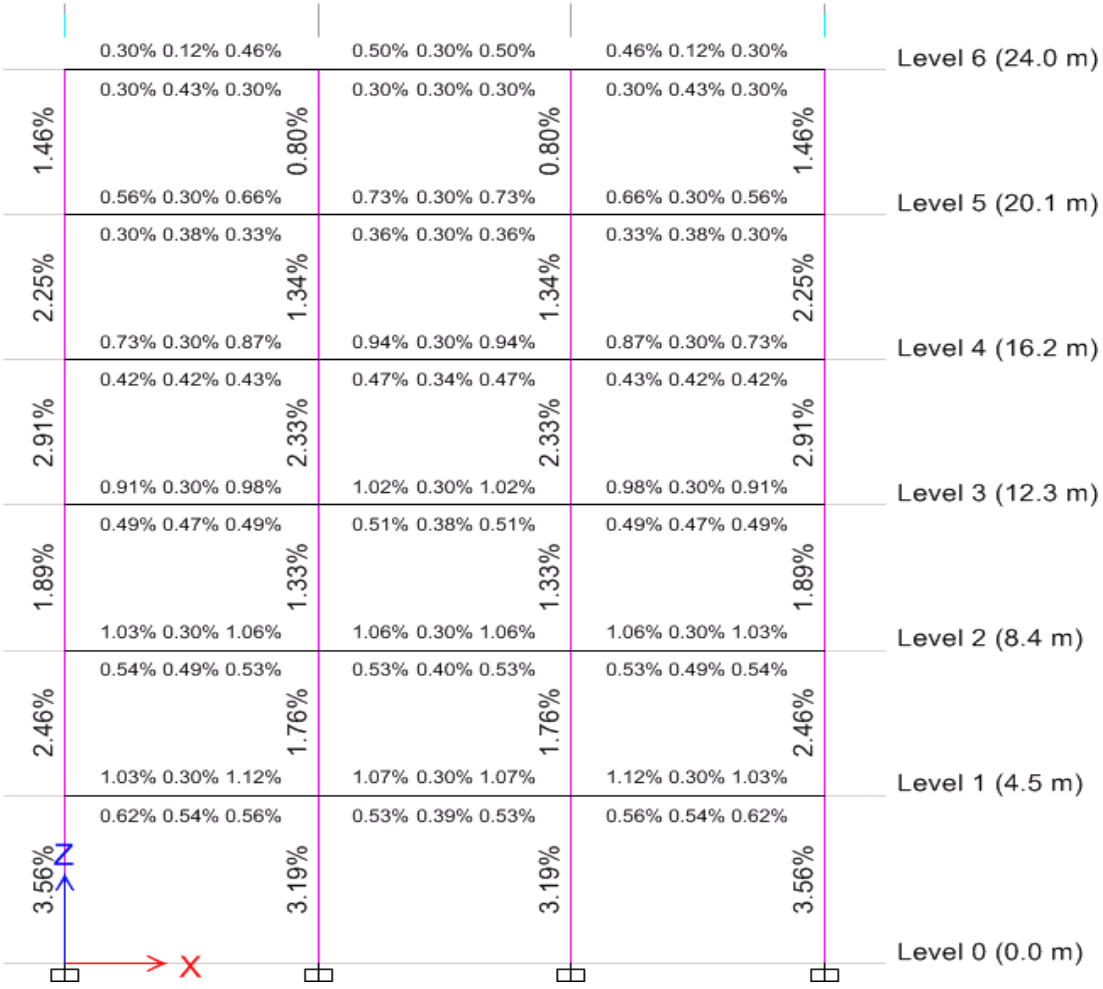

Fig. 25b. Required longitudinal reinforcement for building ID 2443

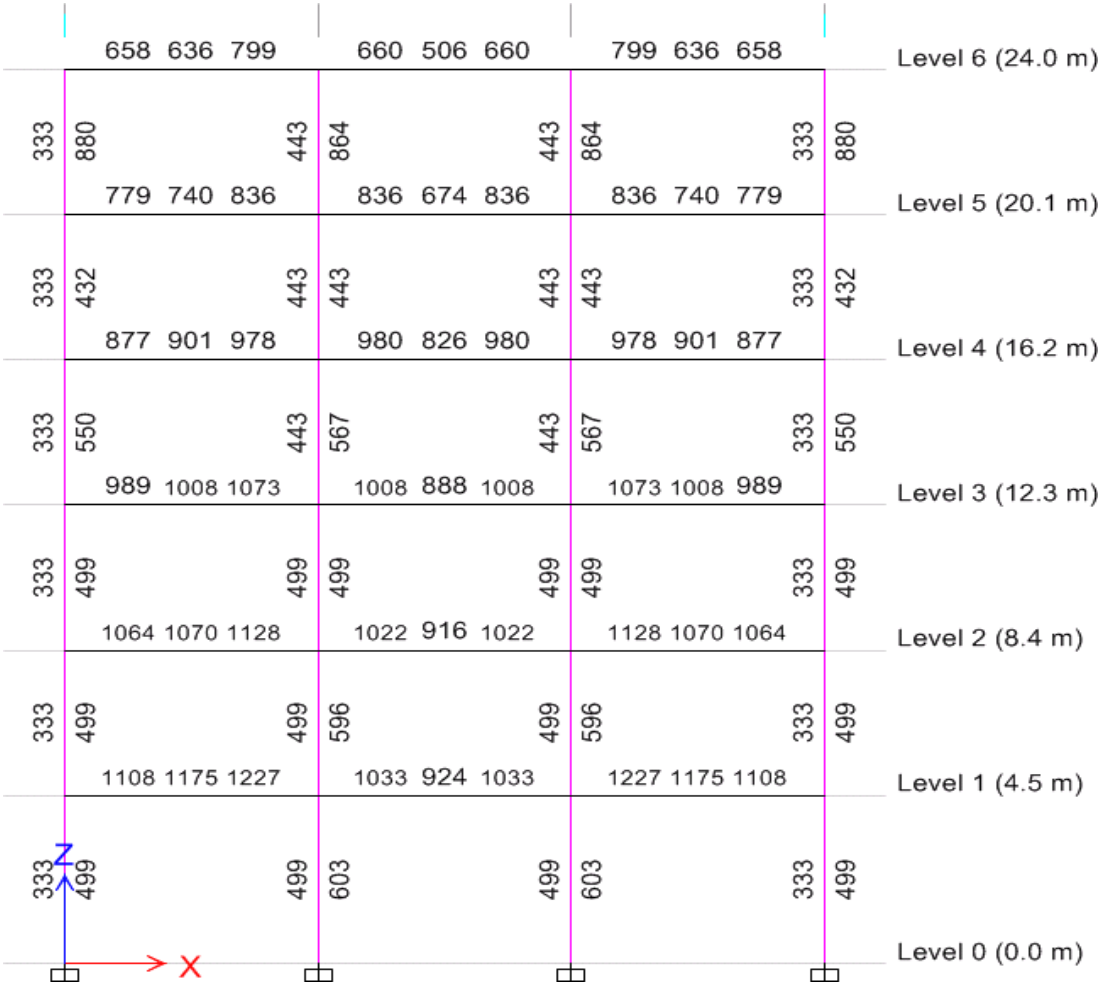

Fig. 25c. Required transverse reinforcement for building ID 2443

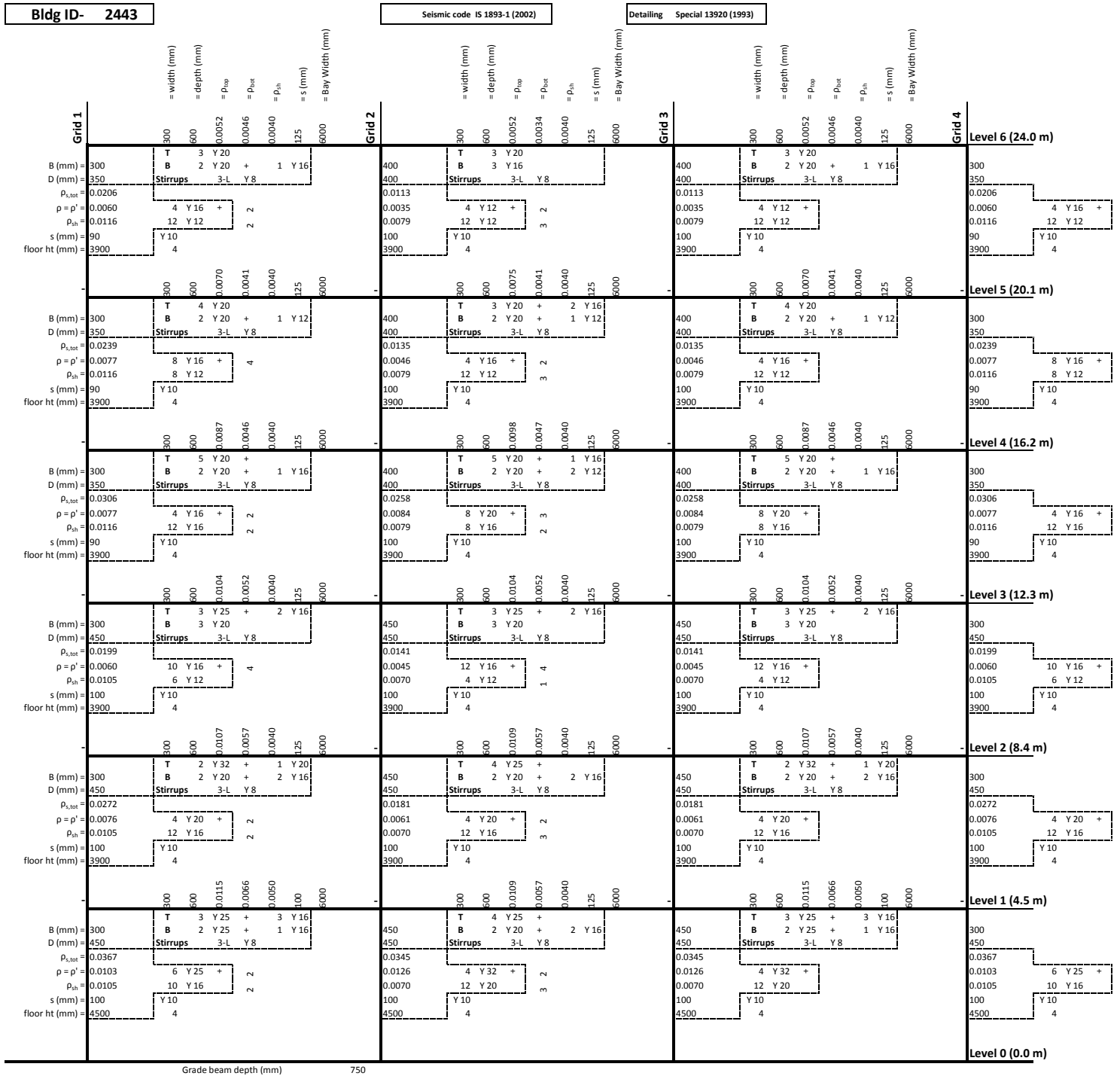

Fig. 25d. Provided reinforcement and modeling details for building ID 2443

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	18	m
Dimension along Y, b2 (col-to-col):	54	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.91	sec
Time period, Ta_Y:	0.91	sec
Avrg response accn coeff, (Sa/g)_x:	1.10	
Avrg response accn coeff, (Sa/g)_y:	1.10	
Design Seis. coeff, (Ah)_x:	0.0395	
Design Seis. coeff, (Ah)_y:	0.0395	

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

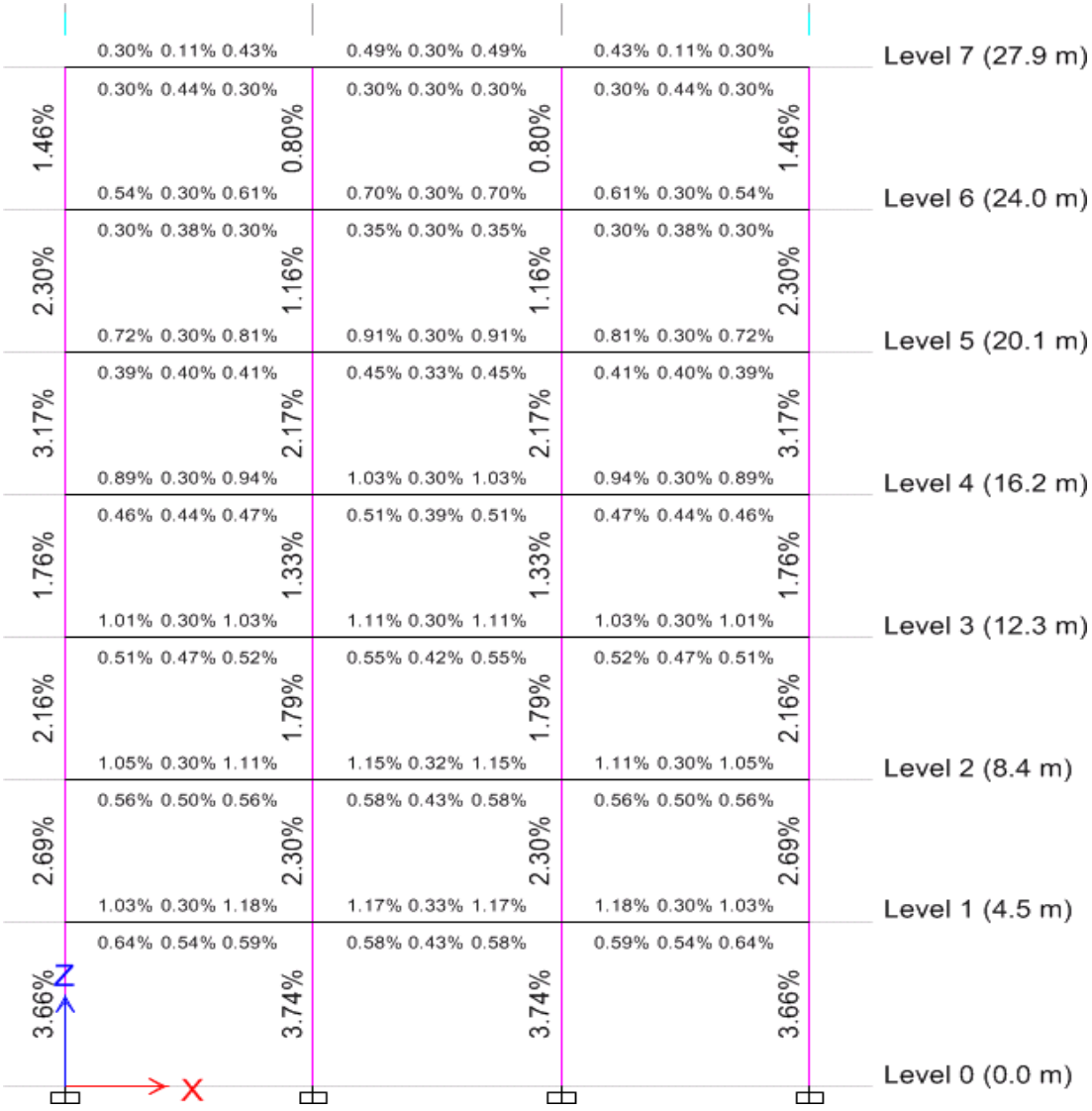

Fig. 26b. Required longitudinal reinforcement for building ID 2233

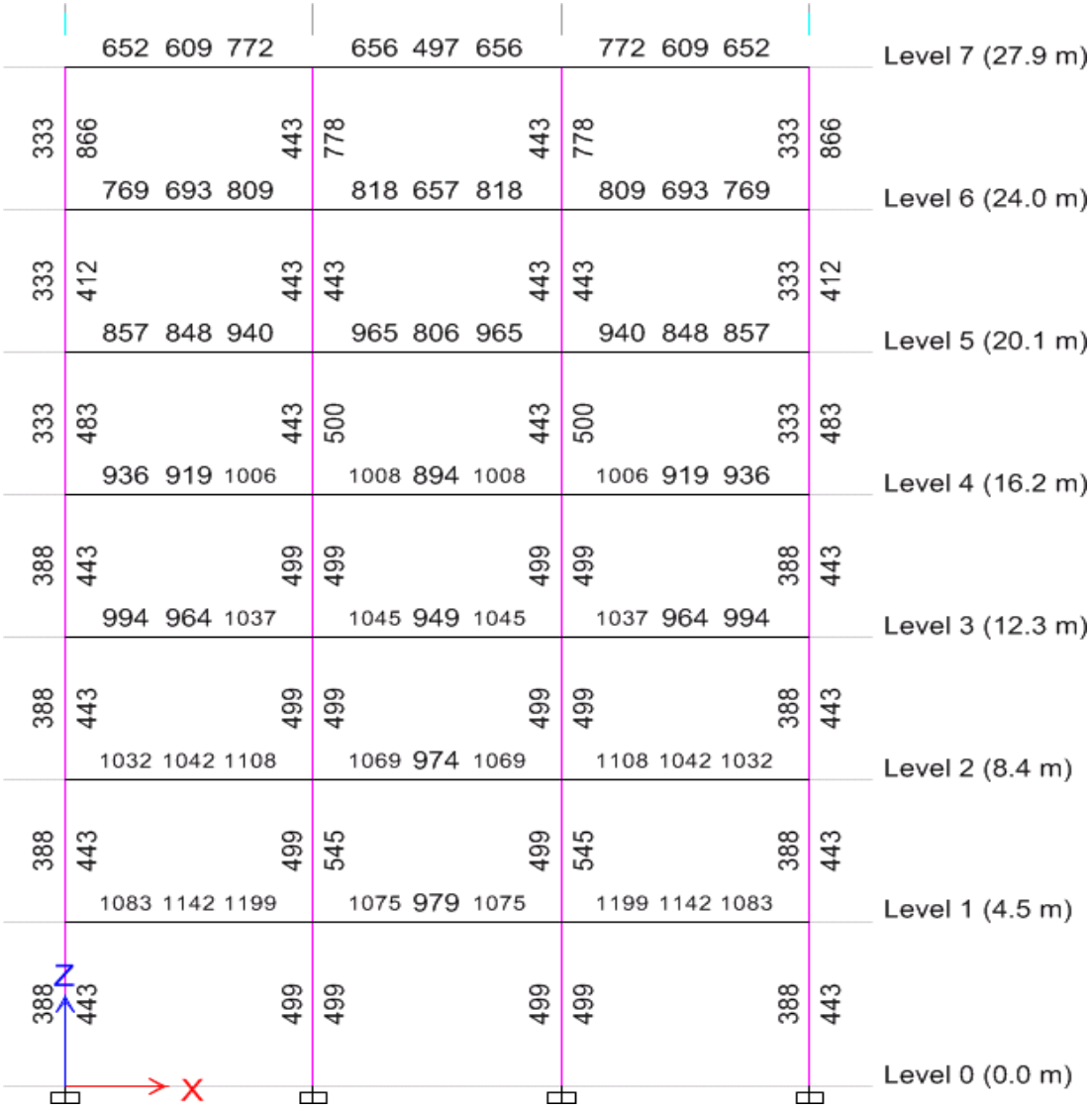

Fig. 26c. Required transverse reinforcement for building ID 2233

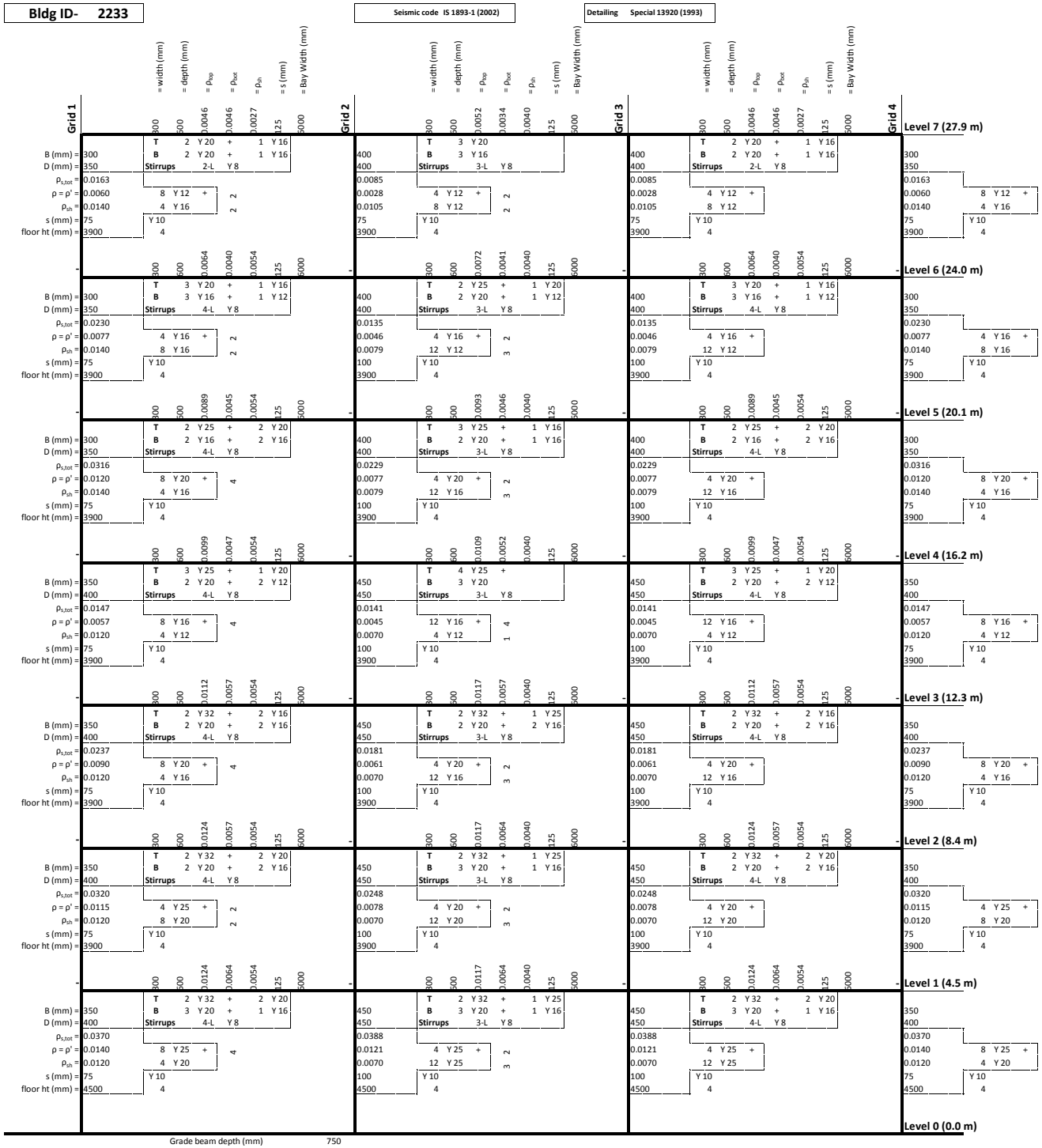

Fig. 26d. Provided reinforcement and modeling details for building ID 2233

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	30	m
Dimension along Y, b2 (col-to-col):	54	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.61	sec
Time period, Ta_Y:	0.61	sec
Avrg response accn coeff, (Sa/g)_x:	1.65	
Avrg response accn coeff, (Sa/g)_y:	1.65	
Design Seis. coeff, (Ah)_x:	0.0594	
Design Seis. coeff, (Ah)_y:	0.0594	

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

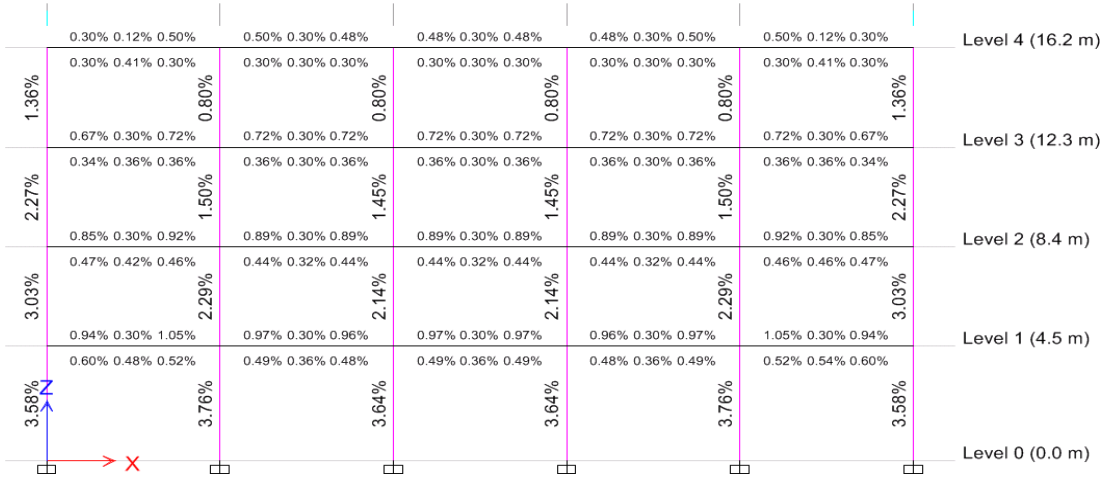

Fig. 27b. Required longitudinal reinforcement for building ID 2235

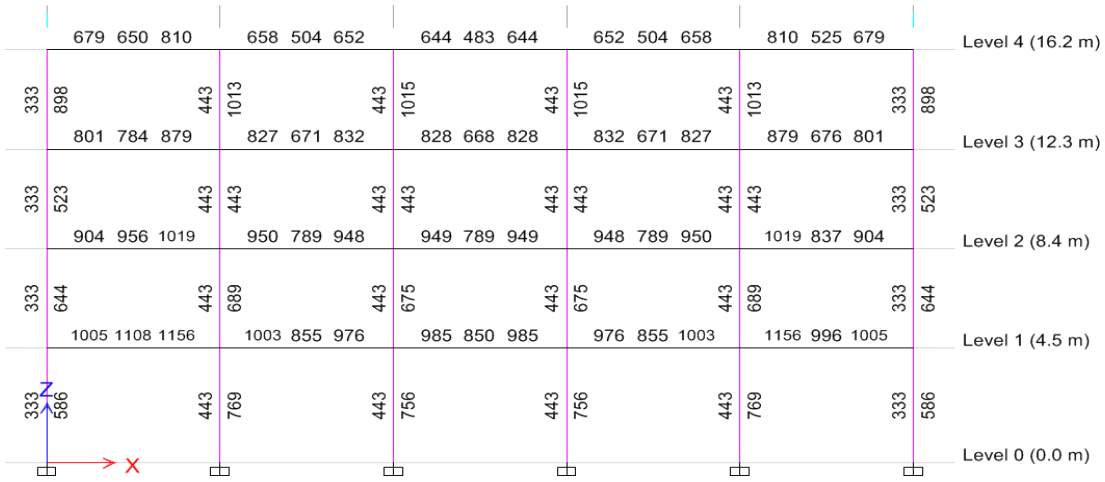

Fig. 27c. Required transverse reinforcement for building ID 2235

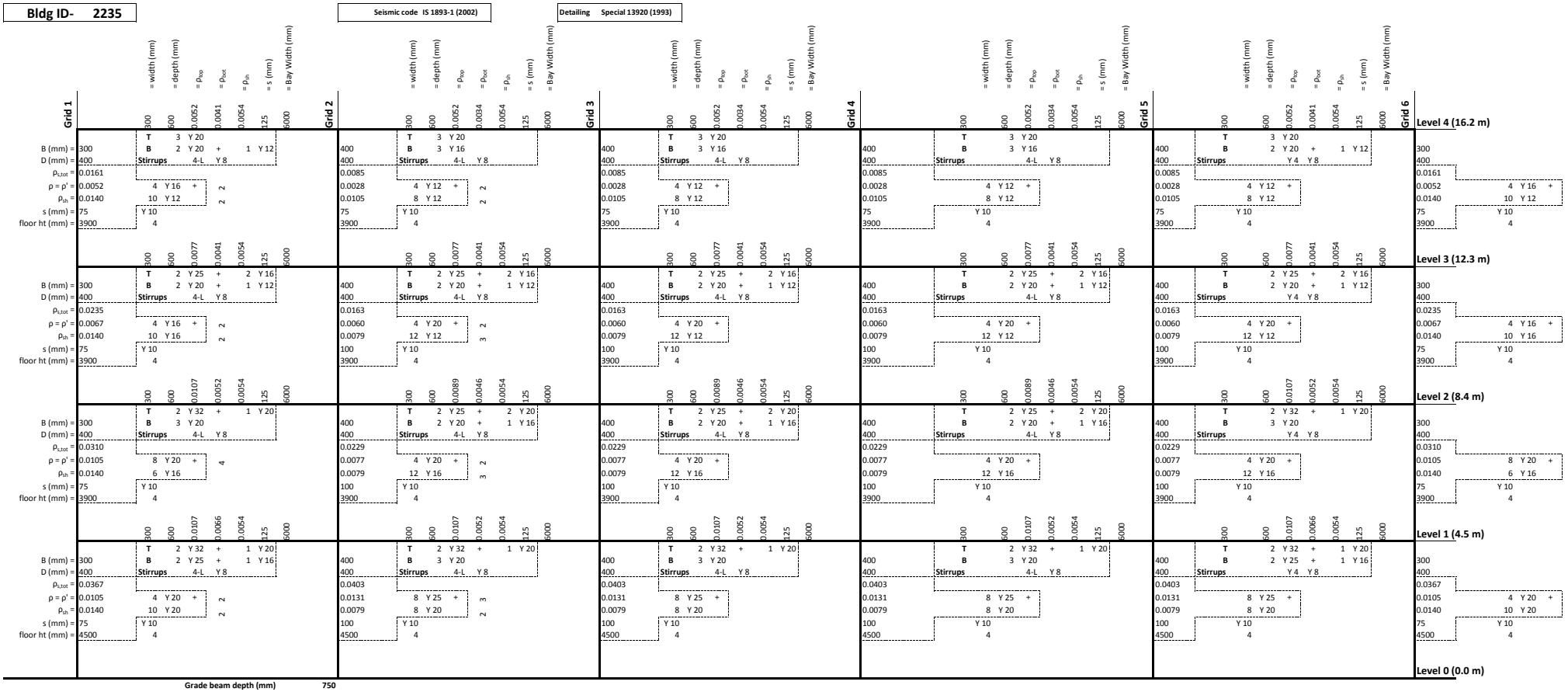

Fig. 27d. Provided reinforcement and modeling details for building ID 2235

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	30	m
Dimension along Y, b2 (col-to-col):	54	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.71	sec
Time period, Ta_Y:	0.71	sec
Avrg response accn coeff, (Sa/g)_x:	1.40	
Avrg response accn coeff, (Sa/g)_y:	1.40	
Design Seis. coeff, (Ah)_x:	0.0506	
Design Seis. coeff, (Ah)_y:	0.0506	

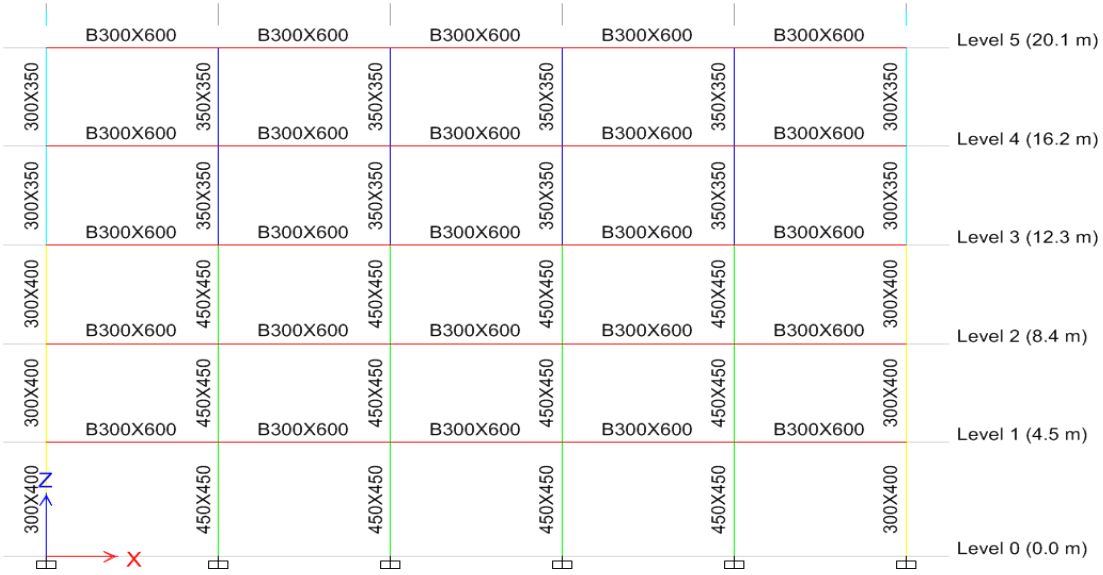

Fig. 28a. Beam column sizes for building ID 2445

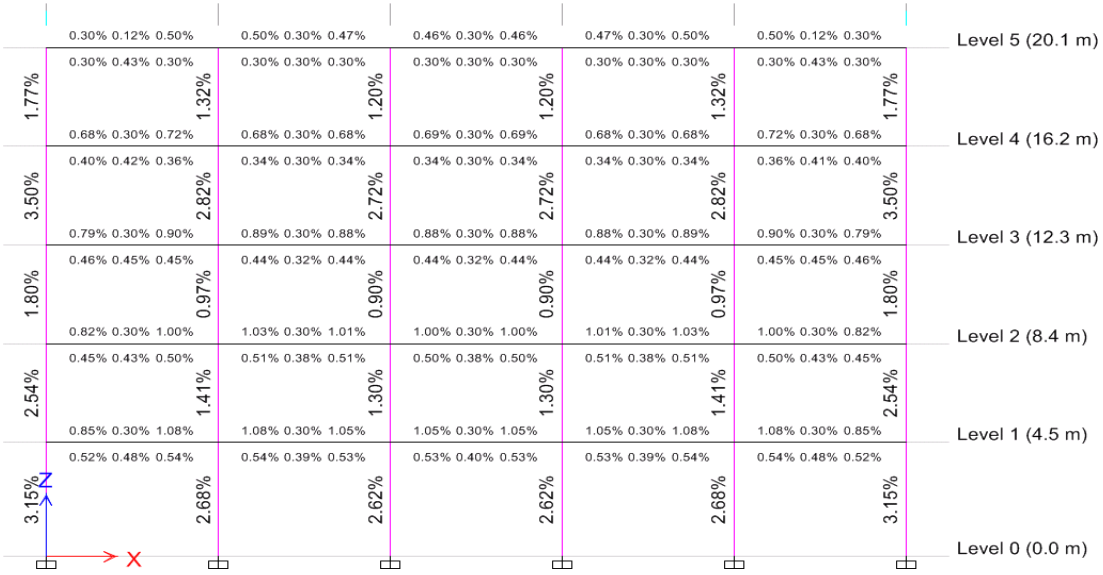

Fig. 28b. Required longitudinal reinforcement for building ID 2445

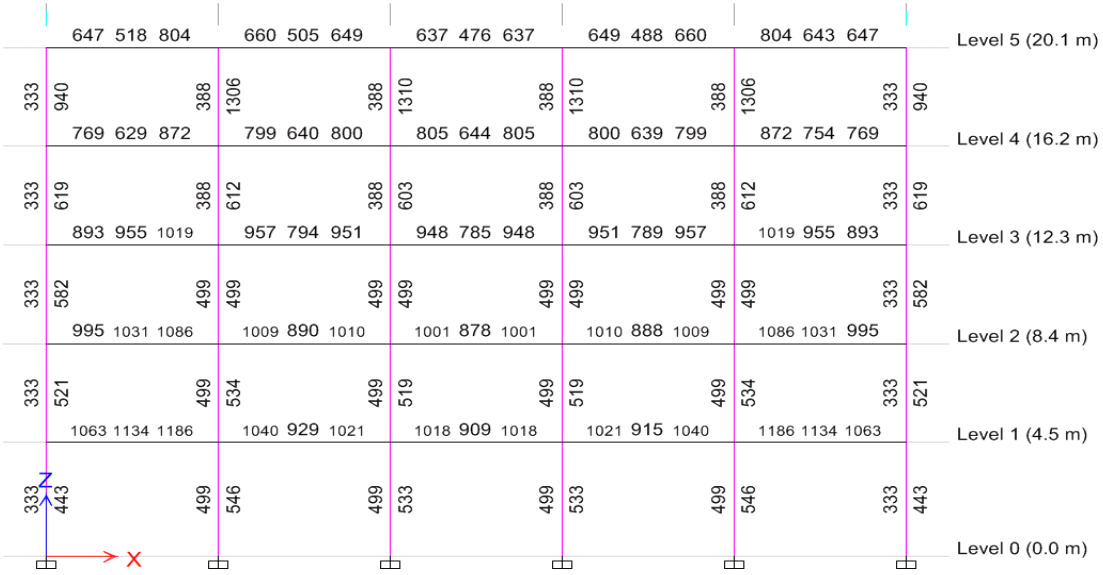

Fig. 28c. Required transverse reinforcement for building ID 2445

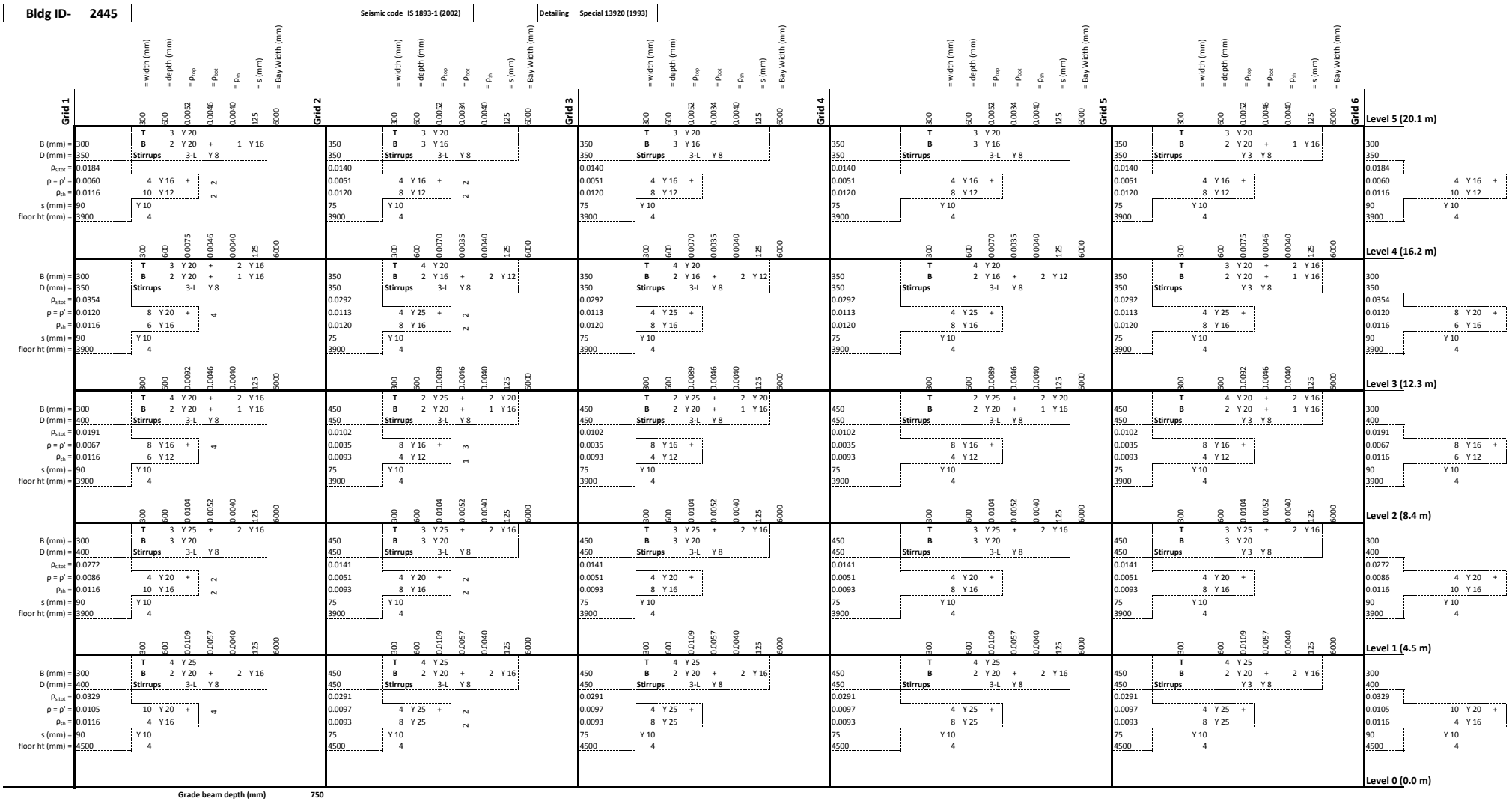

Fig. 28d. Provided reinforcement and modeling details for building ID 2445

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	30	m
Dimension along Y, b2 (col-to-col):	54	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.81	sec
Time period, Ta_Y:	0.81	sec
Avrg response accn coeff, (Sa/g)_x:	1.23	
Avrg response accn coeff, (Sa/g)_y:	1.23	
Design Seis. coeff, (Ah)_x:	0.0443	
Design Seis. coeff, (Ah)_y:	0.0443	

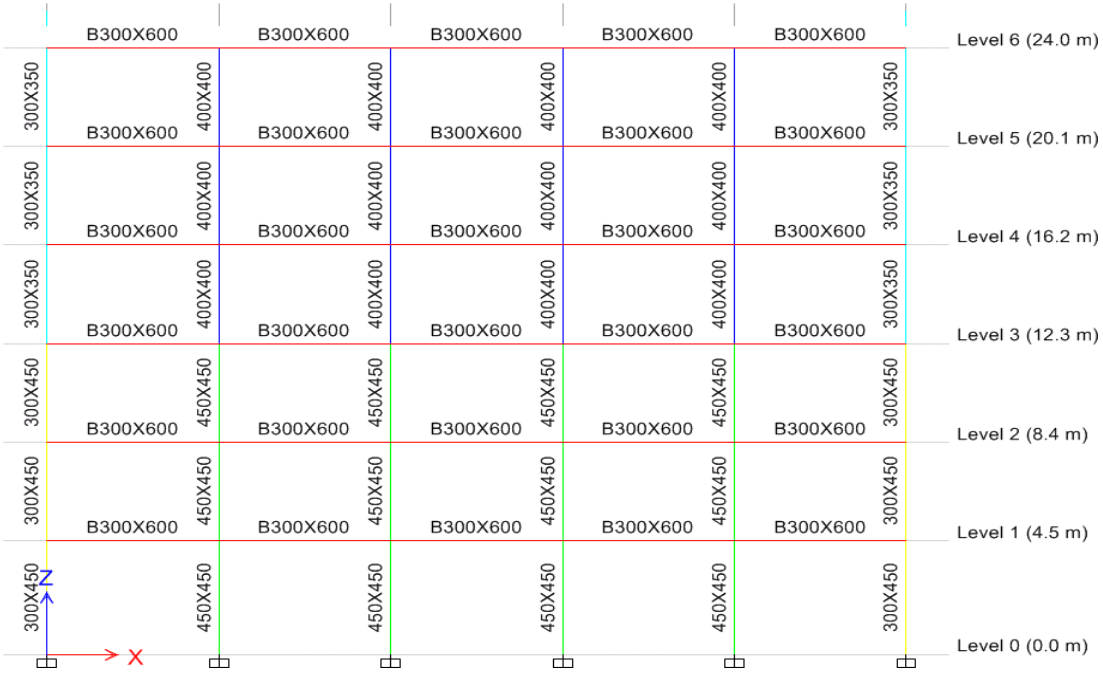

Fig. 29a. Beam column sizes for building ID 2447

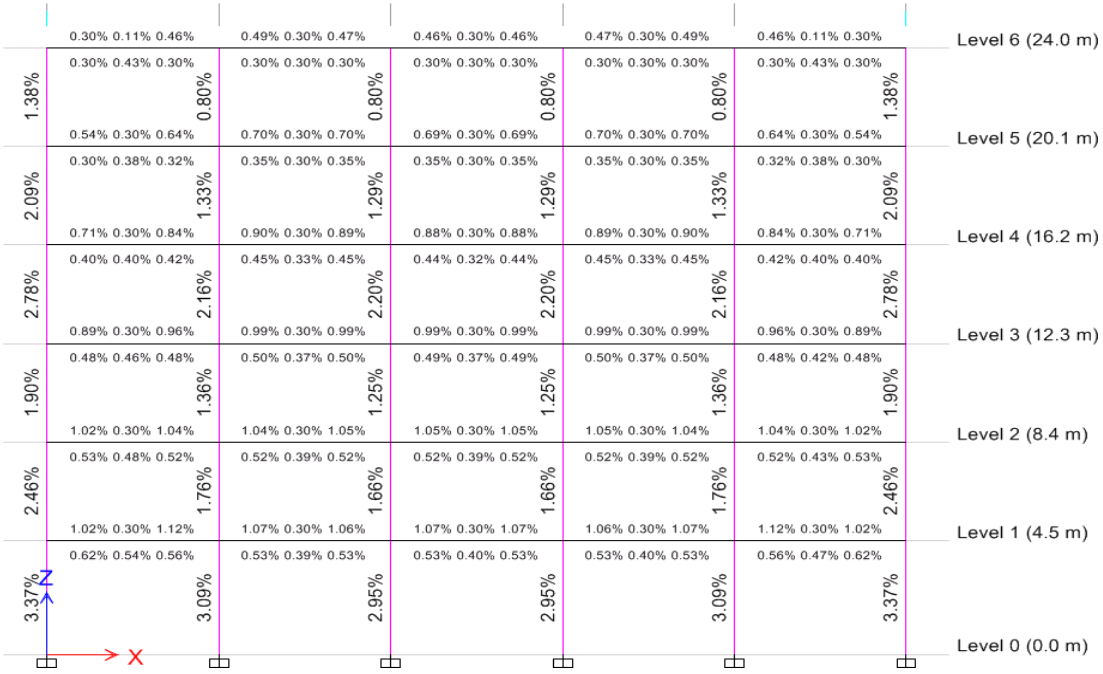

Fig. 29b. Required longitudinal reinforcement for building ID 2447

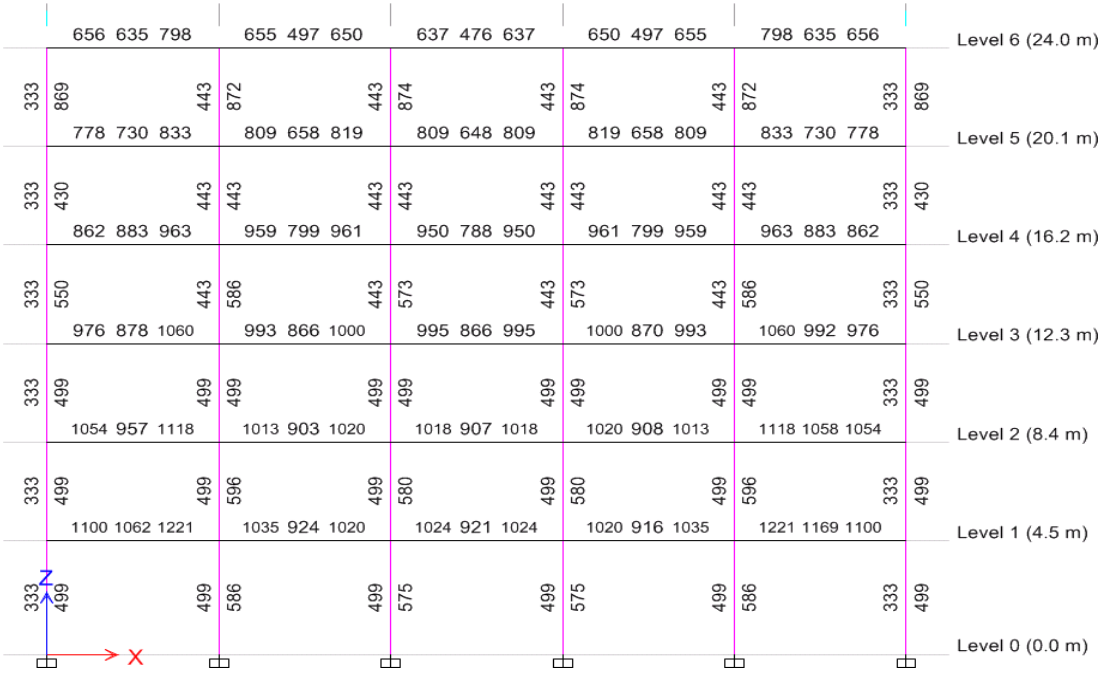

Fig. 29c. Required transverse reinforcement for building ID 2447

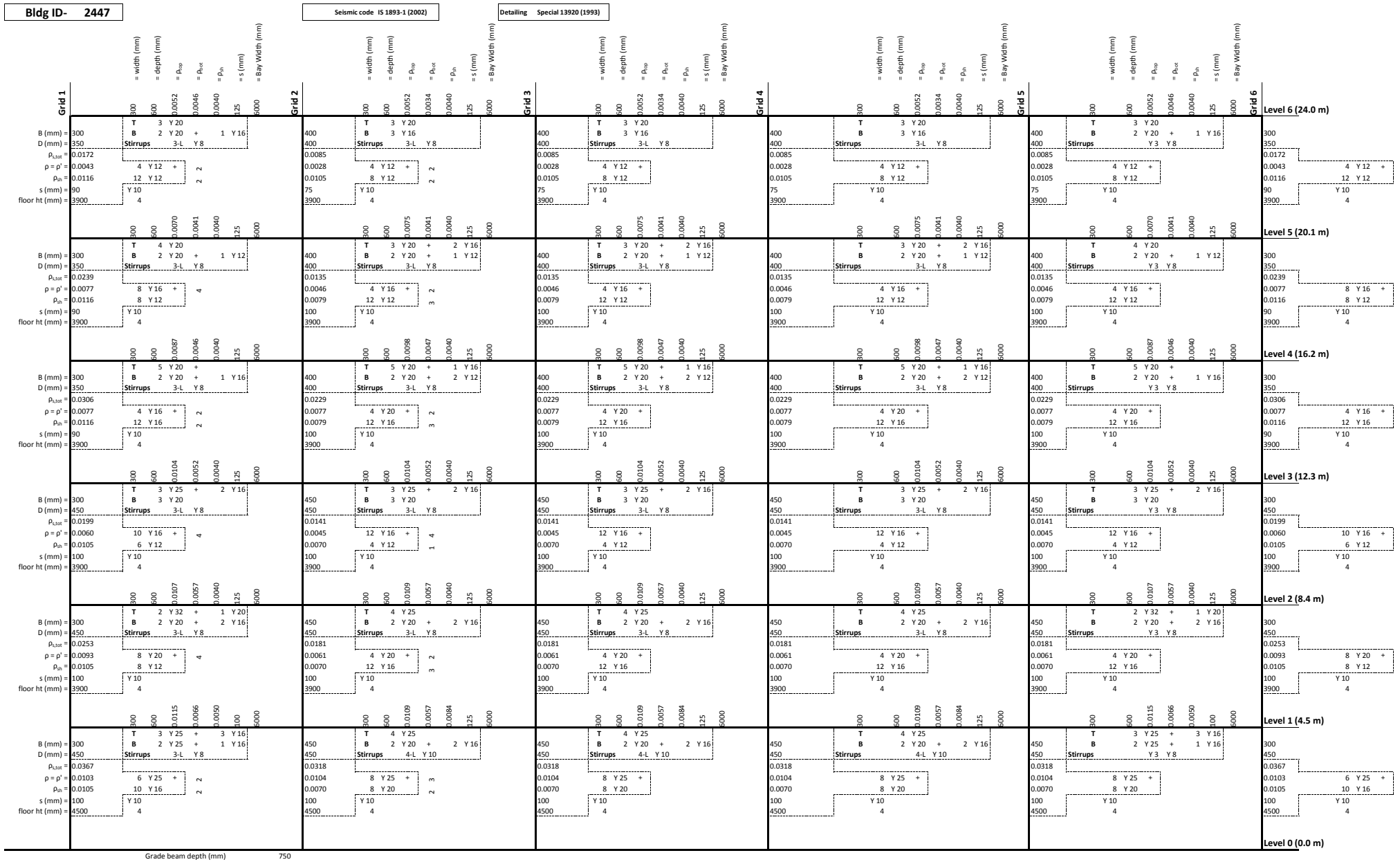

Fig. 29d. Provided reinforcement and modeling details for building ID 2447

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, Ec_col:	29166.6	MPa
Concrete Young's modulus, Ec_beam:	29166.6	MPa
Concretele 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, Es:	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, b1 (col-to-col):	30	m
Dimension along Y, b2 (col-to-col):	54	m
Building type:	RCC bare frame	
Soil Strata:	Rocky or Hard Soil	
Time period, Ta_X:	0.91	sec
Time period, Ta_Y:	0.91	sec
Avrg response accn coeff, (Sa/g)_x:	1.10	
Avrg response accn coeff, (Sa/g)_y:	1.10	
Design Seis. coeff, (Ah)_x:	0.0395	
Design Seis. coeff, (Ah)_y:	0.0395	

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

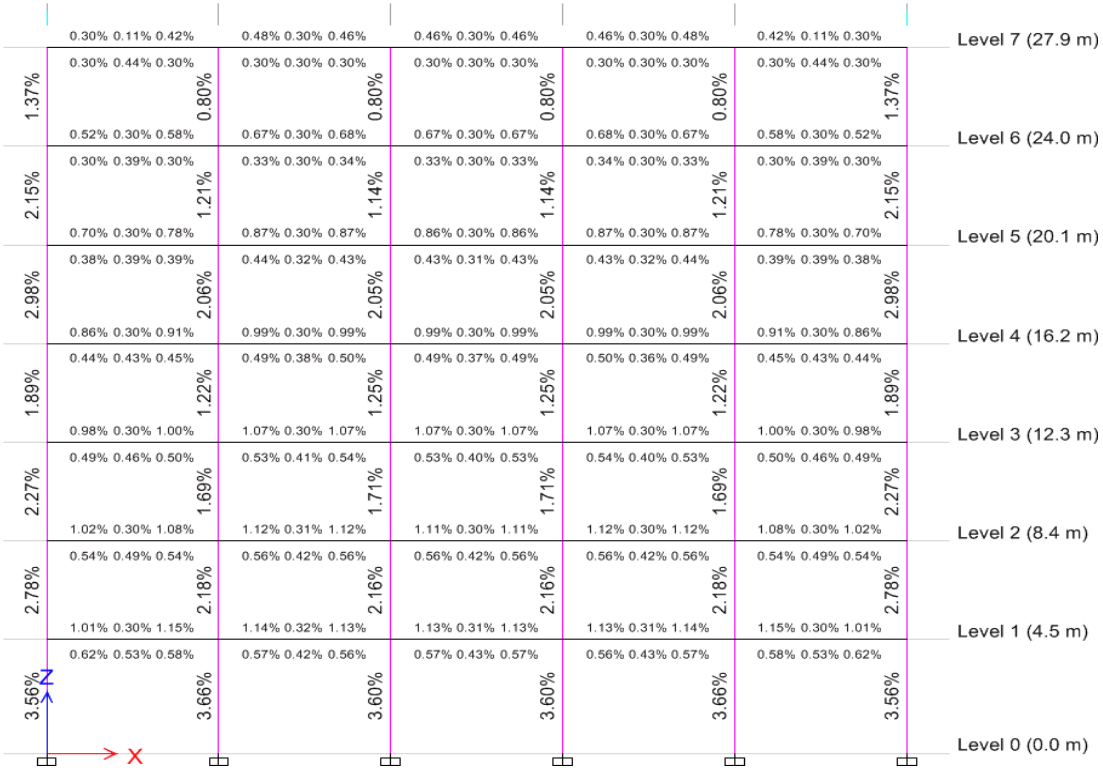

Fig. 30b. Required longitudinal reinforcement for building ID 2237

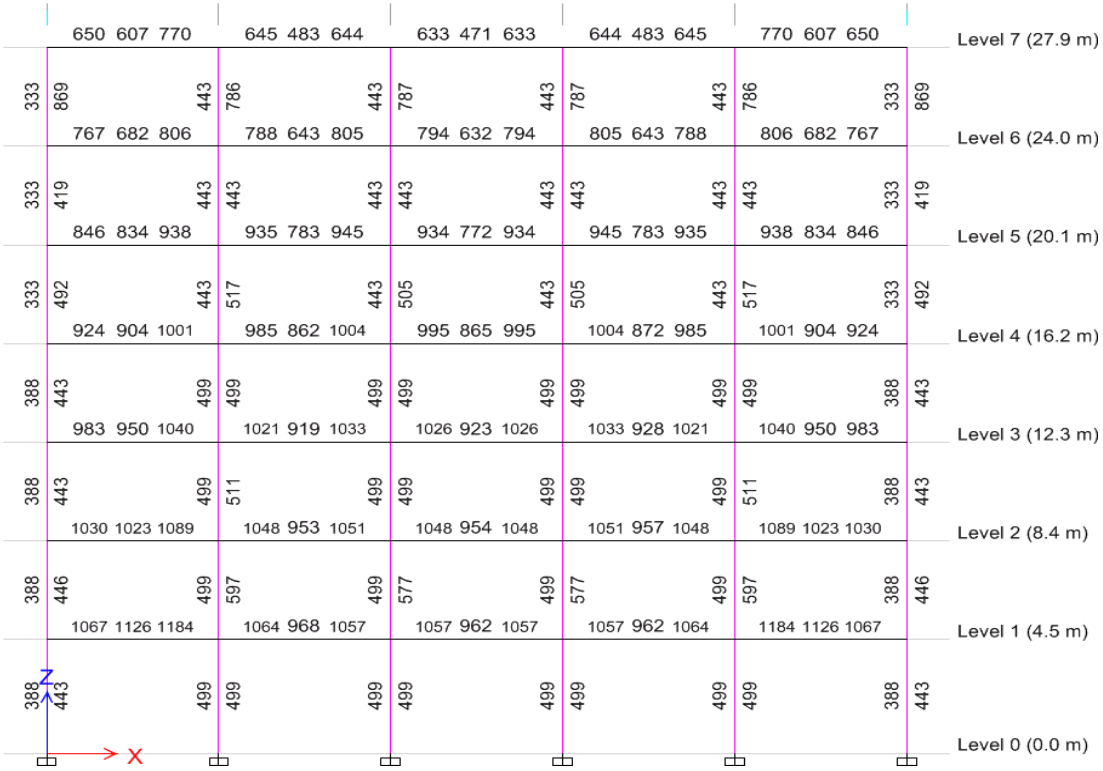

Fig. 30c. Required transverse reinforcement for building ID 2237

Bldg ID- 2237 | **Seismic code IS 1893-1 (2002)** | **Detailing Special 13920 (1993)**

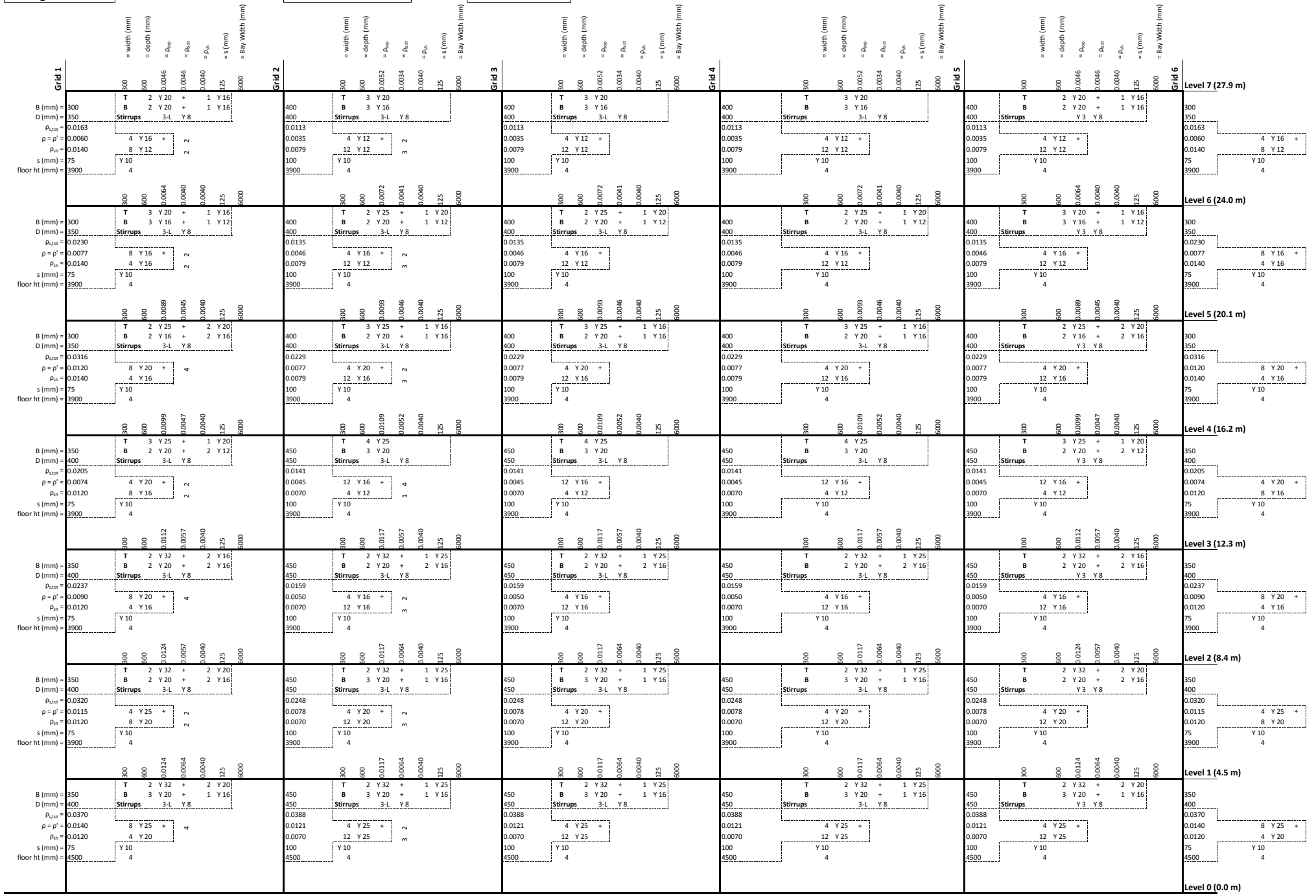

Fig. 30d. Provided reinforcement and modeling details for building ID 2237