"Impact of New IS 1893 & Related Codes on Design of tall Buildings, Including Trend Setting Structures"

Conference on "Planning and Design of Tall Buildings including Earthquake and Wind Effects"

By

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THE NATIONAL BUILDING CODE OF INDIA (NBC) 2015 IS LIKELY TO BE RELEASED BY BUREAU OF INDIAN STANDARDS DURING DECEMBER 2016 / JANUARY 2017. THE VARIOUS SECTIONS OF THIS NBC HAVE UNDER GONE CHANGES AS PER LATEST TECHNOLOGIES AND USER REQUIREMENTS.

THE DOCUMENT CED 39 (AND CORRESPONDING I.S. 1893) ON “CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (PART-1 – GENERAL PROVISIONS FOR ALL STRUCTURES AND SPECIFIC PROVISIONS FOR BUILDINGS) HAS UNDERGONE TREMENDOUS CHANGES FOR STRUCTURAL DESIGN REQUIREMENTS.

IS 13920: 2016 CODE ON “DUCTILE DESIGN AND DETAILING OF REINFORCED CONCRETE STRUCTURES SUBJECTED TO SEISMIC FORCES” HAS ALREADY BEEN ISSUED BY BUREAU OF INDIAN STANDARDS. THIS CODE HAS ALSO INCLUDED MANY CLAUSES WHICH SHALL HAVE FAR REACHING REPERCUSSIONS.

THE DRAFT CODE CED 38 (10639) ON "CRITERIA FOR STRUCTURAL SAFETY OF TALL BUILDINGS” (NEWLY INTRODUCED FOR FIRST TIME IN INDIA) IS UNDER WIDE CIRCULATION FOR COMMENTS.

THUS THE THREE CODES CAN BE TERMED AS NEW ERA FOR STRUCTURAL DESIGN REQUIREMENTS AND ARCHITECTURAL PLANNING TO ACHIEVE SAFETY OF STRUCTURES DURING EARTHQUAKES AND INTERACTION BETWEEN ARCHITECTS AND STRUCTURAL ENGINEERS WOULD BECOME MUCH MORE IMPORTANT.

THE PRESENTATION SHALL FOCUS ON ***"IMPACT OF NEW IS 1893 AND RELATED CODES ON DESIGN OF TALL BUILDINGS, INCLUDING BUILDINGS UNDER CONSTRUCTION"***

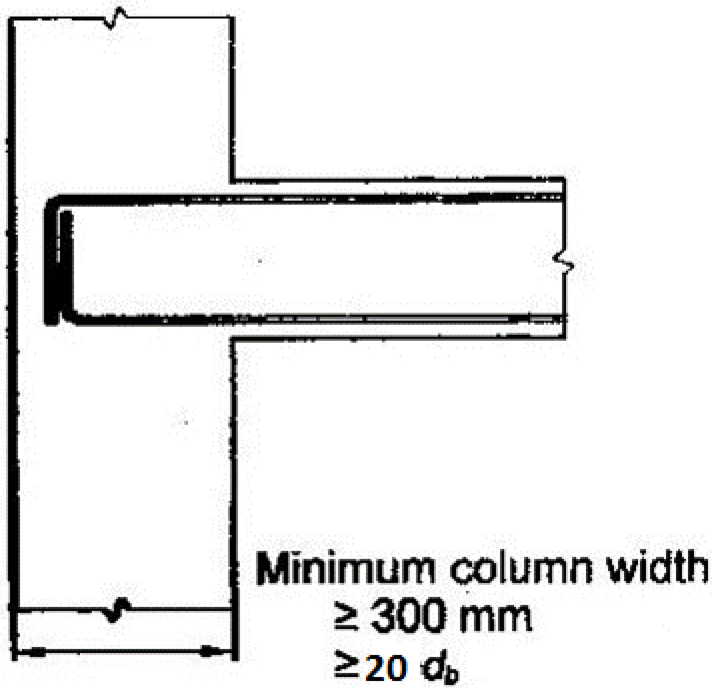
WITH THE CONSTRUCTION OF TALL BUILDINGS THE CONCEPT OF PROOF CHECKING/ PEER REVIEW OF STRUCTURAL DESIGNS BECAME IMPORTANT. SIMILARLY DIFFERENT TYPES OF FORM WORK AND CONSTRUCTION TECHNOLOGIES WERE ADOPTED FOR FASTER CONSTRUCTION

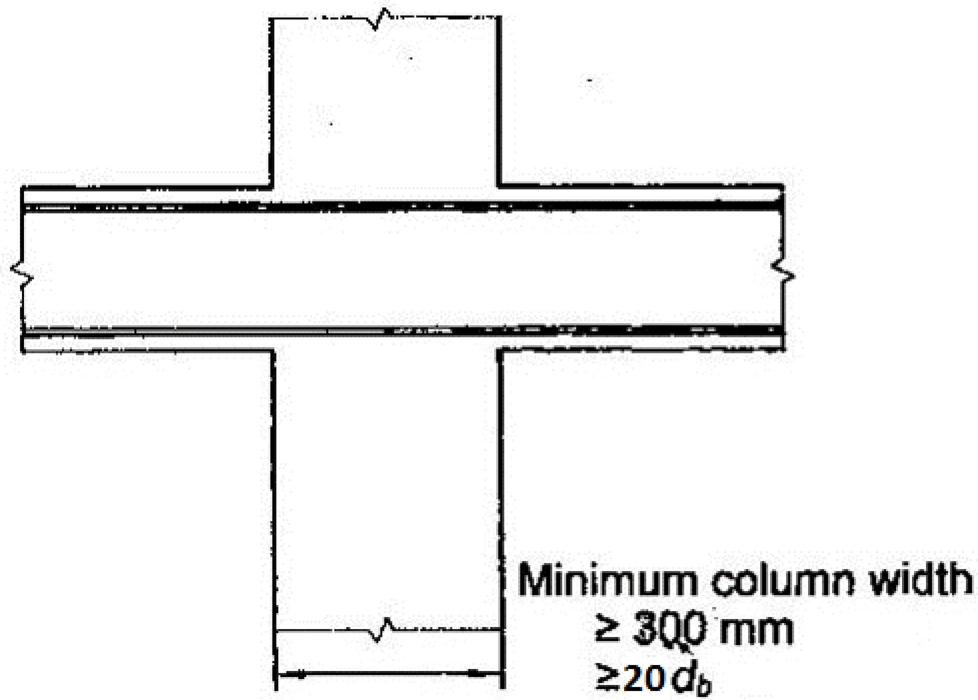
AS PER IS 13920 : 2016

THE MINIMUM DIMENSION OF A COLUMN SHALL NOT BE LESS THAN,

a) 20 D_B, WHERE D_B IS DIAMETER OF THE LARGEST DIAMETER LONGITUDINAL REINFORCEMENT BAR IN THE BEAM PASSING THROUGH OR ANCHORING INTO THE COLUMN AT THE JOINT, OR

B) 300 MM


Minimum column width
≥ 300 mm
≥20 d_b


Minimum column width
≥ 300 mm
≥20 d_b

THUS MINIMUM COLUMN WIDTH HAS TO BE 300 MM FURTHER FOR BEAMS HAVING 20MM BAR DIA. THE COLUMN WIDTH HAS TO BE 400MM. SIMILARLY FOR 25MM BAR DIA IN BEAMS THE COLUMN WIDTH HAS TO BE 500MM

IT WILL HAVE MAJOR EFFECT ON ARCHITECTURAL PLANNING

AS PER IS 13920

IN THE CALCULATION OF DESIGN SHEAR FORCE CAPACITY OF RC BEAMS, CONTRIBUTIONS OF THE FOLLOWING SHALL NOT BE CONSIDERED:

a) BENT UP BARS,

b) INCLINED LINKS, AND

c) CONCRETE IN THE RC SECTION.

AS PER CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (PART-1 – GENERAL PROVISIONS FOR ALL STRUCTURES AND SPECIFIC PROVISIONS FOR BUILDINGS)

FORWARD

AS PER REVISED CODE IS 1893 (PART 1) : 2016

STRUCTURES DESIGNED AS PER THIS STANDARD ARE EXPECTED TO SUSTAIN DAMAGE DURING STRONG EARTHQUAKE GROUND SHAKING. THE PROVISIONS OF THIS STANDARD ARE INTENDED FOR EARTHQUAKE RESISTANT DESIGN OF ONLY NORMAL STRUCTURES.

AS PER EXISTING CODE IS 1893 (PART 1) : 2002

IT IS NOT INTENDED IN THIS STANDARD TO LAY DOWN REGULATION SO THAT NO STRUCTURE SHALL SUFFER ANY DAMAGE DURING EARTHQUAKE OF ALL MAGNITUDES. IT HAS BEEN ENDEAVOURED TO ENSURE THAT, AS FAR AS POSSIBLE, STRUCTURES ARE ABLE TO RESPOND, WITHOUT STRUCTURAL DAMAGE TO SHOCKS OF MODERATE INTENSITIES AND WITHOUT TOTAL COLLAPSE TO SHOCKS OF HEAVY INTENSITIES.

AS PER REVISED CODE IS 1893 (PART 1) : 2016

TO CONTROL THE SERIOUS LOSS OF LIFE AND PROPERTY, BASE ISOLATION OR OTHER ADVANCED TECHNIQUES MAY BE ADOPTED. CURRENTLY, THE INDIAN STANDARD IS UNDER PREPARATION FOR DESIGN OF SUCH BUILDINGS; UNTIL THE STANDARD BECOMES AVAILABLE, SPECIALIST LITERATURE SHOULD BE CONSULTED FOR DESIGN, DETAIL, INSTALLATION AND MAINTENANCE OF SUCH BUILDINGS.

AS PER EXISTING CODE IS 1893 (PART 1) : 2002

BASE ISOLATION AND ENERGY ABSORBING DEVICES MAY BE USED FOR EARTHQUAKE RESISTANT DESIGN. ONLY STANDARD DEVICES HAVING DETAILED EXPERIMENTAL DATA ON THE PERFORMANCE SHOULD BE USED. THE DESIGNER MUST DEMONSTRATE BY DETAILED ANALYSES THAT THESE DEVICES PROVIDE SUFFICIENT PROTECTION TO THE BUILDINGS AND EQUIPMENT AS ENVISAGED IN THIS STANTARD. PERFORMANCE OF LOCALLY ASSEMBLED ISOLATION AND ENERGY ABSORBING DEVICES SHOULD BE EVALUATED ECPERIMENTALLY BEFORE THEY ARE USED IN PRACTICE. DESIGN OF BUILDINGS AND EQUIPMENT USING SUCH DEVICE SHOULD BE REVIEWED BY THE COMPETENT AUTHORITY.

REVISED CODE IS 1893- CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (PART-1 – GENERAL PROVISIONS FOR ALL STRUCTURES AND SPECIFIC PROVISIONS FOR BUILDINGS)

IMPORTANCE FACTOR

S. NO. (1)	STRUCTURE (2)	I (3)
1.	IMPORTANT SERVICE AND COMMUNITY BUILDINGS OR STRUCTURES (FOR EXAMPLE, CRITICAL GOVERNANCE BUILDINGS, SCHOOL), SIGNATURE STRUCTURES, MONUMENT STRUCTURES, LIFELINE AND EMERGENCY STRUCTURES (FOR EXAMPLE, HOSPITALS, TELEPHONE EXCHANGES, TELEVISION STATIONS, RADIO STATIONS, BUS STATIONS, METRO RAIL STRUCTURE AND METRO RAIL STATIONS, RAILWAY STATIONS, AIRPORTS, WATER MAIN LINES AND WATER TANKS, FOOD CHAIN STRUCTURES, FUEL STATIONS, ELECTRICITY STATIONS, FIRE STATIONS, AND BRIDGES), AND LARGE COMMUNITY HALLS (FOR EXAMPLE, CINEMA HALLS, SHOPPING MALLS, ASSEMBLY HALLS AND SUBWAY STATIONS) AND POWER STATIONS.	1.5
2.	RESIDENTIAL OR COMMERCIAL BUILDINGS OR STRUCTURES, WITH OCCUPANCY MORE THAN 200 PERSONS	1.2
3.	ALL OTHER BUILDINGS OR STRUCTURES	1.0
4.	BUILDINGS WITH MIXED OCCUPANCIES (DIFFERENT I FACTOR APPLICABLE FOR THE RESPECTIVE OCCUPANCIES)	LARGER OF THE I VALUES

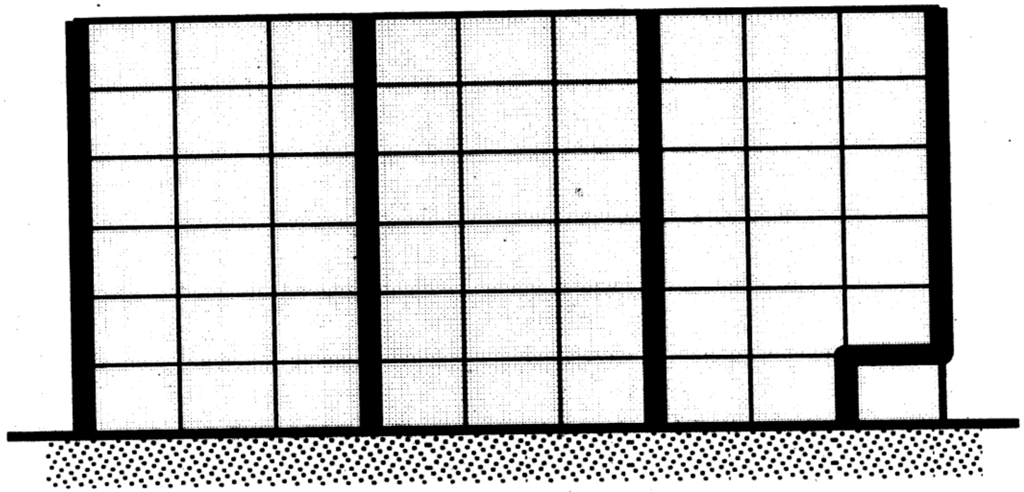
S. NO. 2 & 4 WOULD AFFECT THE NEW BUILDINGS DESIGNS

AS PER EXISTING CODE IS 1893 (PART 1) : 2002

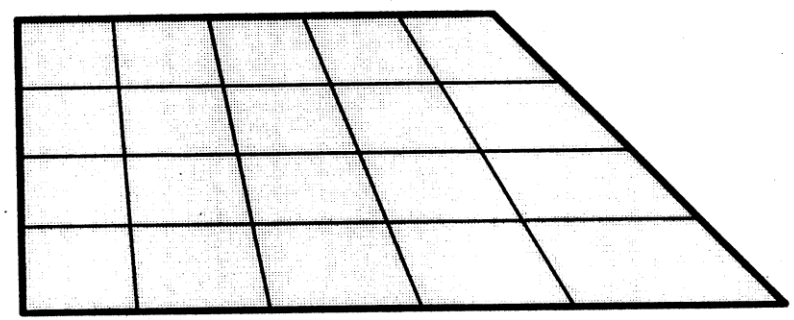
TABLE 6 IMPORTANCE FACTORS, I (CLAUSE 6.4.2)

S. NO.	STRUCTURE	IMPORTANCE FACTOR
(1)	(2)	(3)
I)	IMPORTANT SERVICE AND COMMUNITY BUILDINGS, SUCH AS HOSPITALS, SCHOOLS MONUMENTAL STRUCTURES, EMERGENCY BUILDINGS LIKE TELEPHONE EXCHANGE, TELEVISION STATIONS, RADIO STATIONS, RAILWAY STATIONS, FIRE STATION BUILDINGS, LARGE COMMUNITY HALLS LIKE CINEMAS, ASSEMBLY HALLS AND SUBWAY STATIONS, POWER STATIONS	1.5
II)	ALL OTHER BUILDINGS	1.0

IRREGULAR BUILDINGS

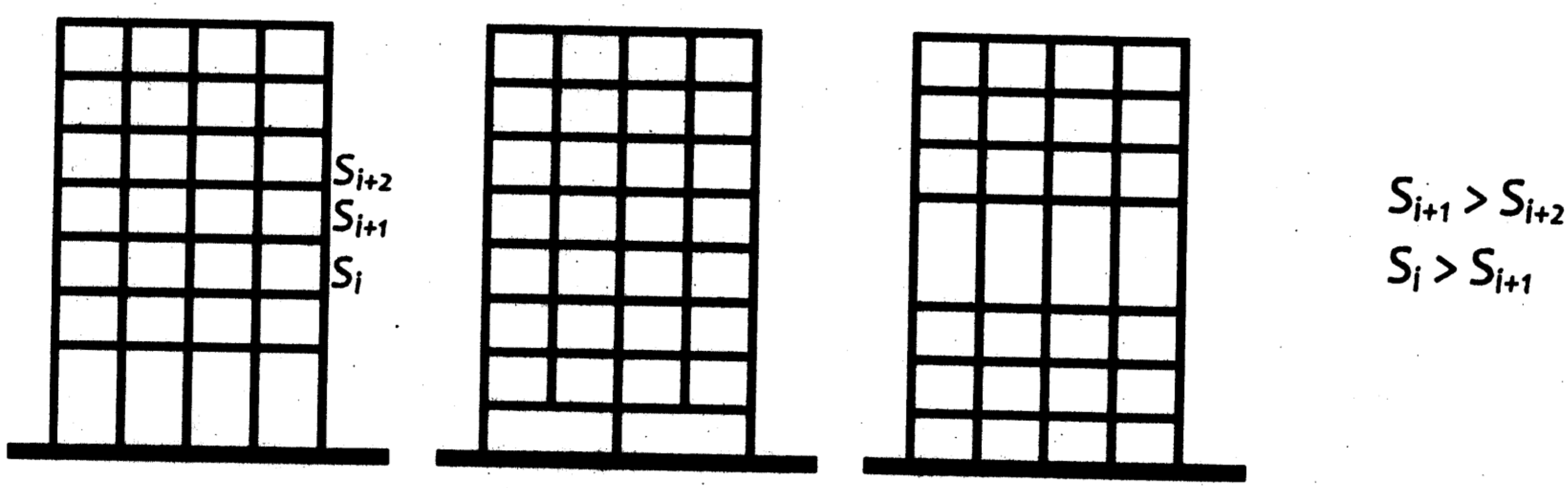


(D)



(E)

DEFINITIONS OF IRREGULAR BUILDINGS – PLAN IRREGULARITIES:
(A) TORSIONAL IRREGULARITY, (B) RE-ENTRANT CORNERS,
(C) FLOOR SLABS WITH EXCESSIVE CUT-OUT OR OPENING,
(D) OUT-OF-PLANE OFFSETS, AND (E) NON-PARALLEL SYSTEM



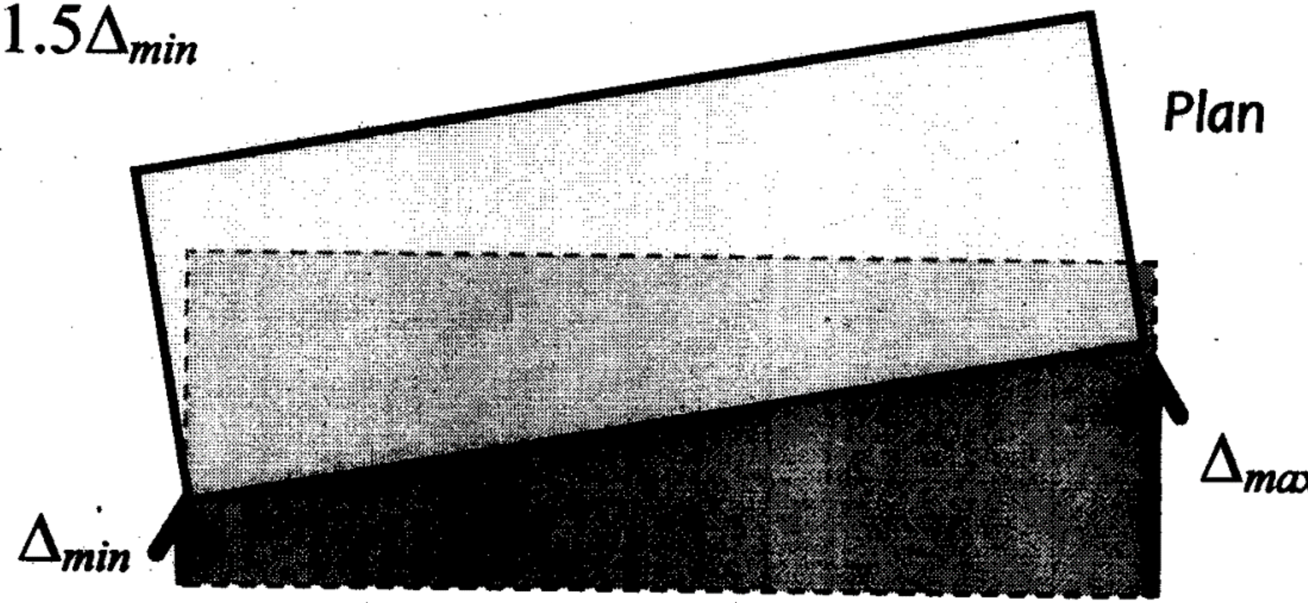
(F)

DEFINITIONS OF IRREGULAR BUILDINGS – VERTICALIRREGULARITIES: (A) LATERAL STIFFNESS IRREGULARITY IN TWO PRINCIPAL HORIZONTAL DIRECTIONS, (B) STIFFNESS IRREGULARITY (SOFT STOREY), (C) MASS IRREGULARITY, (D) VERTICAL GEOMETRIC IRREGULARITY, (E) IN-PLANE DISCONTINUITY IN VERTICAL ELEMENTS RESISTING LATERAL FORCE, AND (F) DISCONTINUITY IN CAPACITY (WEAK STOREY)

PLAN IRREGULARITIES (SEE FIGURE)

A BUILDING IS SAID TO BE TORSIONALLY IRREGULAR, WHEN MAXIMUM HORIZONTAL DISPLACEMENT OF ANY FLOOR IN THE DIRECTION OF THE LATERAL FORCE AT ONE END OF THE FLOOR IS MORE THAN 1.5 TIMES ITS MINIMUM HORIZONTAL DISPLACEMENT AT THE FAR END OF THE SAME IN THAT DIRECTION.

$$\Delta_{max} > 1.5\Delta_{min}$$



TORSIONAL IRREGULARITY

IN TORSIONALLY IRREGULAR BUILDINGS, WHEN THE RATIO OF MAXIMUM HORIZONTAL DISPLACEMENT AT THE OTHER END IS IN THE RANGE

(1)1.5 – 2.5, THREE- DIMENSIONAL DYNAMIC ANALYSIS METHOD SHALL BE ADOPTED; AND

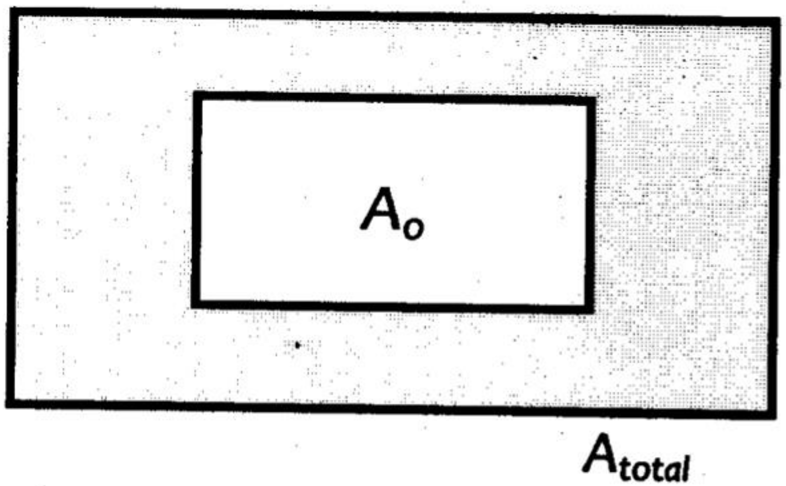
(2)MORE THAN 2.5. THE BUILDING PLAN SHALL HAVE TO BE REVISED

THUS INTERACTION BETWEEN ARCHITECT AND STRUCTURAL ENGINEER WOULD BE REQUIRED.

AS PER EXISTING IS 1893 (PART – 1) – 2002

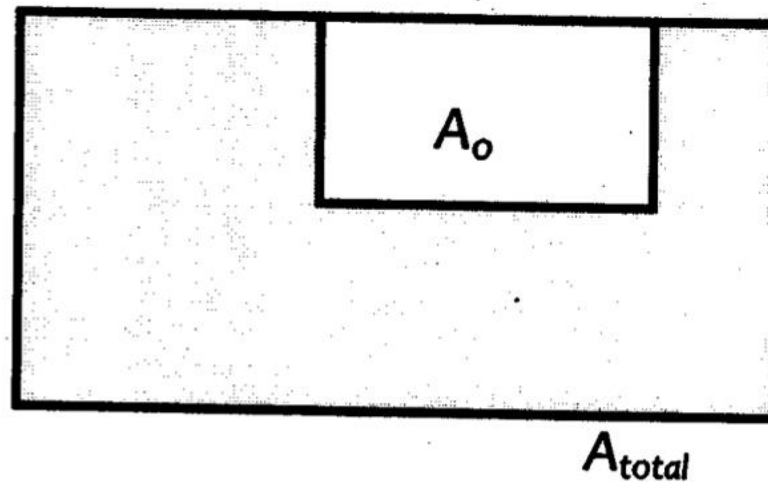
TORSIONAL IRREGULARITY TO BE CONSIDERED TO EXIST WHEN THE MAXIMUM STOREY DRIFT, COMPUTED WITH DESIGN ECCENTRICITY, AT ONE END OF THE STRUCTURES TRANSVERSE TO AN AXIS IS MORE THAN 1.2 TIMES THE AVERAGE OF THE STOREY DRIFTS AT THE TWO ENDS OF THE STRUCTURE

AT ANY STOREY, THE MINIMUM WIDTH OF FLOOR SLAB ALONG ANY SECTION AFTER DEDUCTION OF OPENINGS SHALL NOT BE LESS THAN 5 M. AND, THE MINIMUM WIDTH OF THE SLAB BEYOND AN OPENING TO EDGE OF SLAB SHALL NOT BE LESS THAN 2 M. FURTHER, THE CUMULATIVE WIDTH OF THE SLAB AT ANY LOCATION SHALL NOT BE LESS THAN 50% OF THE FLOOR WIDTH



Opening located anywhere in the slab

Plan



Opening located along any edge of the slab

Plan

<u>FLOOR SLABS HAVING EXCESSIVE CUT-OUT AND OPENINGS A0</u>

TABLE 6 RESPONSE REDUCTION FACTOR R FOR BUILDING SYSTEMS (CLAUSE 7.2.1)

S. No. (1)	Lateral Load Resisting System (2)	R (3)
Moment Frame Systems		
1.	RC Buildings with Ordinary Moment Resisting Frame (OMRF)[1]	3.0
2.	RC Buildings with Special Moment – Resisting Frame (SMRF)	5.0
3.	Steel buildings with Ordinary Moment Resisting Frame (OMRF)[1]	3.0
4.	Steel Buildings with Special Moment Resisting Frame (SMRF)	5.0
Braced Frame Systems		
5.	Buildings with Ordinary Braced Frame having Concentric Braces	4.0
6.	Buildings with Special Braced Frame having Concentric Braces	4.5
7.	Buildings with Special Braced Frame having Eccentric Braces	5.0

S. No. (1)	Lateral Load Resisting System (2)	R (3)
Structural Wall Systems		
8.	Load Bearing Masonry Buildings	
	(a) Unreinforced Masonry (designed as per IS 1905) without horizontal RC Seismic Bands	1.5
	(a) Unreinforced Masonry (designed as per IS 1905) with horizontal RC Seismic Bands	2.0
	(a) Unreinforced Masonry (designed as per IS 1905) with horizontal RC Seismic Bands and vertical reinforcing bars at corners of rooms and jambs of openings (with reinforcement as per IS 4326)	2.5
	(a) Reinforced Masonry [refer SP 7 (Part 6) Section 4]	3.0
	(a) Confined Masonry	3.0
9.	Buildings with Ordinary RC Structural Walls[1]	3.0
10.	Buildings with Ductile RC Structural Walls	4.0

S. No. (1)	Lateral Load Resisting System (2)	R (3)
Dual Systems		
11.	Buildings with Ordinary RC Structural Walls and RC OMRFs[1]	3.0
12.	Buildings with Ordinary RC Structural Walls and RC SMRFs[1]	4.0
13.	Buildings with Ductile RC Structural Walls with RC OMRFs[1]	4.0
14.	Buildings with Ductile RC Structural Walls with RC SMRFs	5.0
Flat Slab – Structural Wall Systems		
15.	RC Building with (a) Ductile RC Structural Walls (which are designed to resist 100% of the design lateral force), (b) perimeter RC SMRFs (which are designed to independency resist 25% of the design lateral force), and (c) Preferable an outrigger and belt truss system connecting the core Ductile RC Structural Walls and the perimeter RC SMRFS[1] (d) Punching shear shall be taken care and drift at the roof be limited to 0.1%	3.0

AS PER EXISTING CODE IS 1893 (PART 1) : 2002

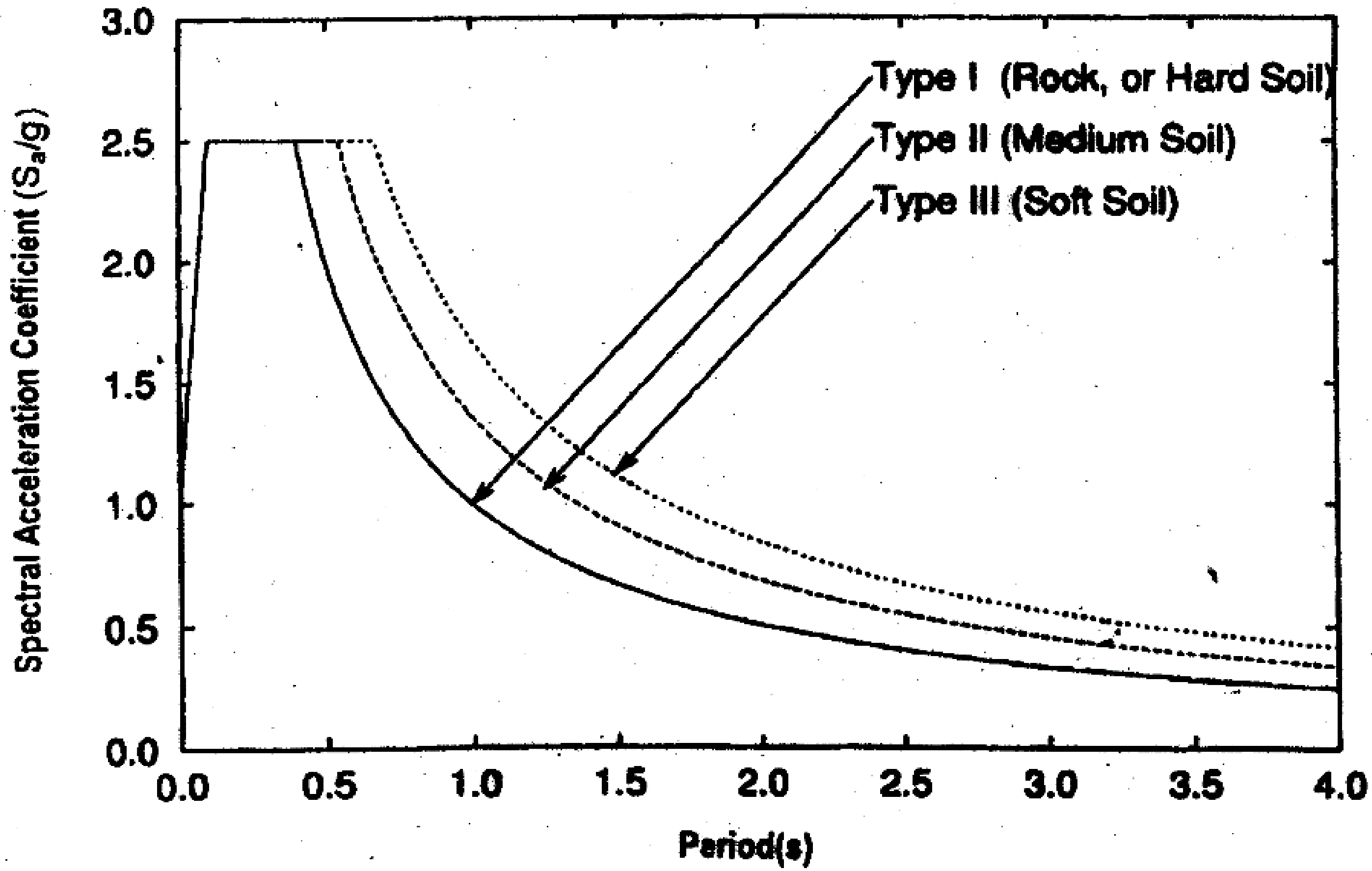
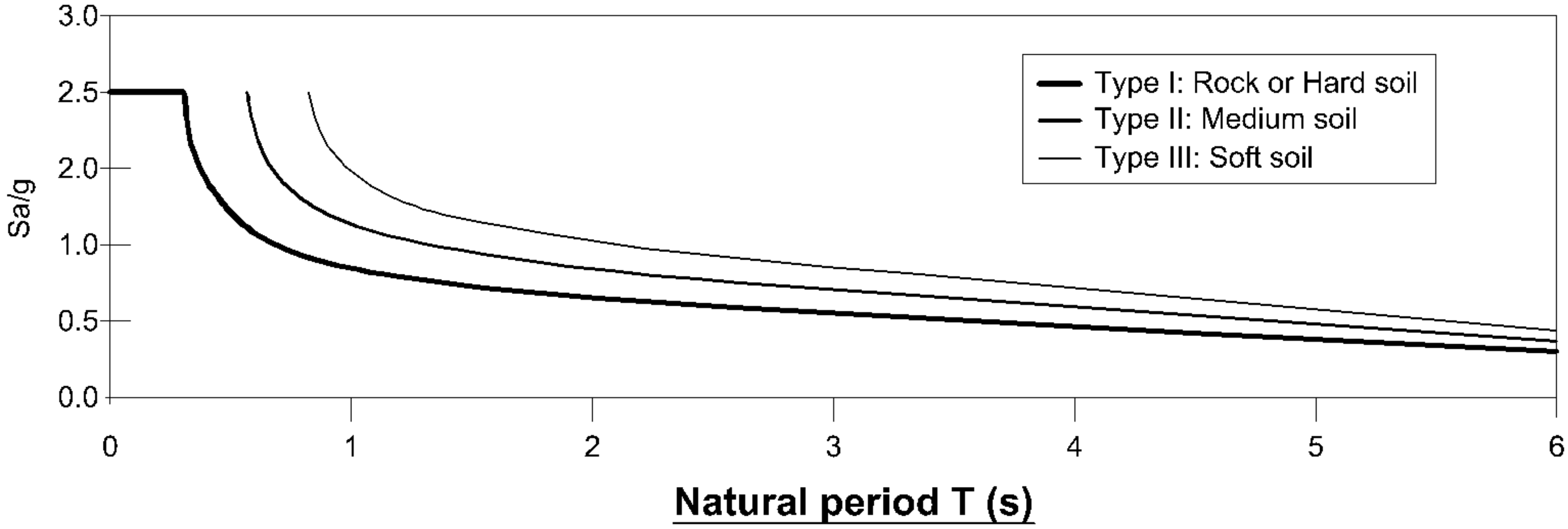


FIG. 2 RESPONSE SPECTRA FOR ROCK AND SOIL SITES FOR 5 PERCENT DAMPING

AS PER REVISED CODE IS 1893 (PART 1) : 2016

$\left[\frac{S_a}{g}\right]$ = DESIGN ACCELERATION COEFFICIENT CORRESPONDING **TO 5 PERCENT DAMPING** FOR DIFFERENT SOIL



AS PER EXISTNING IS 1893 (PART 1) : 2002

THE VALUE OF DAMPING FOR BUILDINGS MAY BE TAKEN AS 2 AND 5 PERCENT OF THE CRITICAL, FOR THE PURPOSES OF DYNAMIC ANALYSIS OF STEEL AND REINFORCED CONCRETE BUILDINGS, RESPECTIVELY.

HOWEVER IN THE REVISED CODE DAMPING IS 5% FOR BOTH STEEL AND RCC.

AS PER EXISTING CODE IS 1893 (PART 1) : 2002

TABLE 3 MULTIPLYING FACTORS FOR OBTAINING VALUES FOR OTHER DAMPING (CLAUSE 6.4.2)

Damping Percent	0	2	5	7	10	15	20	25	30
Factors	3.20	1.40	1.00	0.90	0.80	0.70	0.60	0.55	0.50

IN THE REVISED CODE THE TABLE HAS BEEN DELETED.

FLOATING OR STUB COLUMNS

SUCH COLUMNS ARE LIKELY TO CAUSE CONCENTRATED DAMAGE IN THE STRUCTURE.

AS PER EXISTING CODE IS 1893 (PART 1) : 2002

A) ***STIFFNESS IRREGULARITY – SOFT STOREY***

A SOFT STOREY IS ONE IN WHICH THE LATERAL STIFFNESS IS LESS THAN 70 PERCENT OF THAT IN THE STOREY ABOVE OR LESS THAN 80 PERCENT OF THE AVERAGE LATERAL STIFFNESS OF THE THREE STOREYS ABOVE

B) ***STIFFNESS IRREGULARITY –EXTREME SOFT STOREY***

A EXTREME SOFT STOREY IS ONE IN WHICH THE LATERAL STIFFNESS IS LESS THAN 60 PERCENT OF THAT IN THE STOREY ABOVE OR LESS THAN 70 PERCENT OF THE AVERAGE STIFFNESS OF THE THREE STOREYS ABOVE. FOR EXAMPLE, BUILDINGS ON STILTS WILL FALL UNDER THIS CATEGORY.

AS PER REVISED CODE IS 1893 (PART 1) : 2016

SOFT STOREY –

IS ONE IN WHICH THE LATERAL STIFFNESS IS LESS THAN THAT IN THE STOREY ABOVE. THE STOREY LATERAL STIFFNESS IS THE TOTAL STIFFNESS OF ALL SEISMIC FORCE RESISTING ELEMENTS RESISTING LATERAL EARTHQUAKE SHAKING EFFECTS IN THE CONSIDERED DIRECTION.

AS PER EXISTING CODE IS 1893 (PART 1) : 2002

DISCONTINUITY IN CAPACITY – WEAK STOREY

A WEAK STOREY IS ONE IN WHICH THE STOREY LATERAL STRENGTH IS LESS THAN 80 PERCENT OF THAT IN THE STOREY ABOVE, THE STOREY LATERAL STRENGTH IS THE TOTAL STRENGTH OF ALL SEISMIC FORCE RESISTING ELEMENTS SHARING THE STOREY SHEAR IN THE CONSIDERED DIRECTION.

AS PER NEW CODE IS 1893 (PART 1) : 2016

WEAK STOREY –

IS ONE IN WHICH THE STOREY LATERAL STRENGTH (CUMULATIVE DESIGN SHEAR STRENGTH OF ALL STRUCTURAL MEMBERS OTHER THAN THAT OF URM INFILLS) IS LESS THAN THAT IN THE STOREY ABOVE. THE STOREY LATERAL STRENGTH IS THE TOTAL STRENGTH OF ALL SEISMIC FORCE RESISTING ELEMENTS SHARING THE LATERAL STOREY SHEAR IN THE CONSIDERED DIRECTION.

DESIGN VERTICAL EARTHQUAKE EFFECTS

EFFECTS DUE TO VERTICAL EARTHQUAKE SHAKING SHALL BE CONSIDERED WHEN ANY OF THE FOLLOWING CONDITIONS APPLY:

1. STRUCTURE IS LOCATED IN SEISMIC ZONE IV OR V;
2. STRUCTURE HAS VERTICAL OR PLAN IRREGULARITIES;
3. STRUCTURE IS RESTED ON SOFT SOIL;
4. BRIDGES;
5. STRUCTURE HAS LONG SPANS; OR
6. STRUCTURE HAS LARGE HORIZONTAL OVERHANGS OF STRUCTURAL MEMBERS OR SUB- SYSTEMS.

TABLE 8: MINIMUM DESIGN EARTHQUAKE HORIZONTAL LATERAL FORCE BUILDINGS CLAUSE 7.5.1)

Seismic Zone (1)	P (%) (2)
II	0.7
III	1.1
IV	1.6
V	2.4

(a) BARE MRF BUILDINGS (WITHOUT ANY MASONRY OR ANY OTHER INFILLS)

$$Ta = \begin{cases} 0.075h^{0.75} & \text{for RC MRF building} \\ 0.080h^{0.75} & \text{for RC – Steel Composite MRE building} \\ 0.085h^{0.75} & \text{for Steel MRF building} \end{cases}$$

(b) BUILDINGS WITH RC STRUCTURAL WALLS

$$Ta = \frac{0.075h^{0.75}}{\sqrt{A_w}}$$

IN WHICH,

H = HEIGHT OF BUILDING (IN METERS) AS DEFINED IN 7.6.2(A),

A_{WI} = EFFECTIVE CROSS- SECTIONAL AREA (M^2) OF WALL *I* IN FIRST STOREY OF BUILDING; AND

L_{WI} = LENGTH (M) OF STRUCTURAL WALL *I* IN FIRST STOREY IN THE CONSIDERED DIRECTION OF LATERAL FORCES, AND

N_W = NUMBER OF WALLS IN THE CONSIDERED DIRECTION OF EARTHQUAKE SHAKING.

THE VALUE OF L_{WI}/H TO BE USED IN THIS EQUATION SHALL NOT EXCEED 0.9 BUT NOT LESS THAN 7.6.3 (C)

AS PER REVISED CODE IS 1893 (PART 1) : 2016

(c) ALL OTHER BUILDINGS -

$$T_a = \frac{0.09h}{\sqrt{d}},$$

WHERE

H = HEIGHT OF BUILDING, IN METERS, AS DEFINED IN 7.6.2 (A); AND

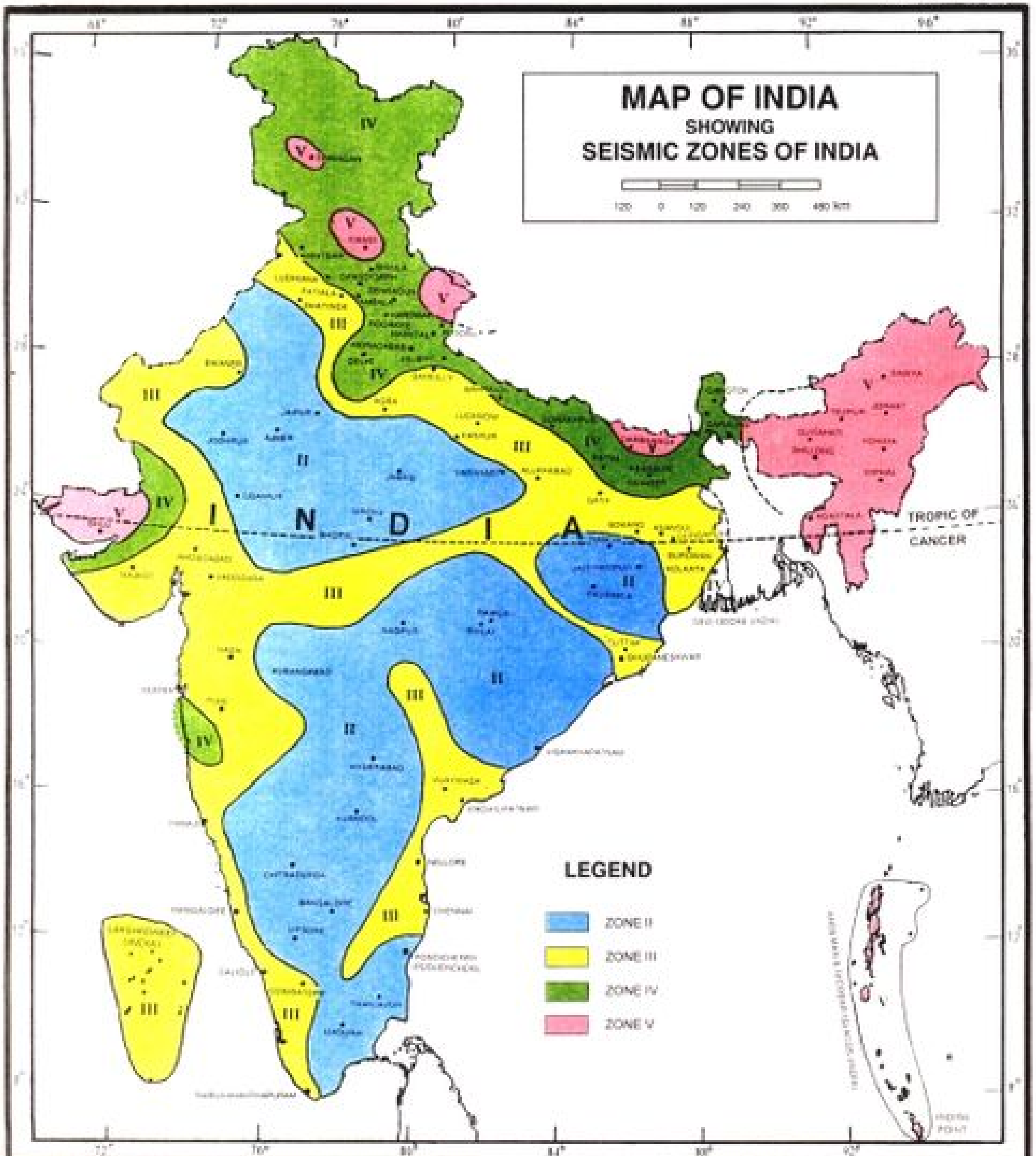
D = BASE DIMENSION (IN M) OF THE BUILDING AT THE PLINTH LEVEL ALONG THE CONSIDERED DIRECTION OF EARTHQUAKE SHAKING.

AS PER DRAFT CED 38 – CRITERIA FOR STRUCTURAL SAFETY OF TALL BUILDINGS:-

TALL BUILDING - IT IS A BUILDING OF HEIGHT GREATER THAN 45M, BUT LESS THAN 250M, NORMALLY INTENDED TO BE USED AS RESIDENTIAL, OFFICE AND OTHER COMMERCIAL BUILDINGS.

SUPER TALL BUILDING – IT IS A BUILDING OF HEIGHT GREATER THAN 250M.

HEIGHT LIMIT FOR STRUCTURAL SYSTEMS - THE MAXIMUM BUILDING HEIGHT (IN M) SHALL NOT EXCEED VALUES GIVEN IN TABLE 1 FOR BUILDINGS WITH DIFFERENT STRUCTURAL SYSTEMS.



NOTE : Towns falling at the boundary of zones demarcation line between two zones shall be considered in High Zone.

TABLE 1 MAXIMUM VALUES OF HEIGHT H ABOVE TOP OF BASE LEVEL OF BUILDINGS WITH DIFFERENT STRUCTURAL SYSTEMS

Structural System					
SEISMIC ZONE	STRUCTURAL WALL SYSTEM + FLAT SLAB FLOOR SYSTEM WITH PERIMETER MOMENT FRAME	MOMENT FRAME SYSTEM	MOMENT FRAME + STRUCTURAL WALL SYSTEM	STRUCTURAL WALL SYSTEM	STRUCTURAL WALL + TUBE FRAME SYSTEM
(1)	(2)	(3)	(4)	(5)	(6)
V	NOT ALLOWED	NOT ALLOWED	100 M	100 M	150 M
IV	NOT ALLOWED	NOT ALLOWED	100 M	100 M	150 M
III	70 M	60 M	160 M	160 M	220 M
II	100 M	80 M	180 M	180 M	250 M

SLENDERNESS RATIO

THE MAXIMUM VALUES OF THE RATIO OF HEIGHT H TO MINIMUM BASE WIDTH SHALL NOT EXCEED VALUES GIVEN IN TABLE 2.

Structural System					
Seismic Zone	Structural Wall System + Flat Slab Floor System with perimeter Moment Frame	Moment Frame System	Moment Frame + Structural Wall System	Structural Wall System	Structural Wall + Tube Frame System
(1)	(2)	(3)	(4)	(5)	(6)
V	Not Allowed	Not Allowed	8	8	9
IV	Not Allowed	Not Allowed	8	8	9
III	5	4	8	8	10
II	6	5	9	9	10

PLAN ASPECT RATIO

THE MAXIMUM PLAN ASPECT RATIO (L/B) OF THE OVERALL BUILDING SHALL NOT EXCEED 5.0

LATERAL ACCELERATION

FROM SERVICEABILITY CONSIDERATIONS, (HUMAN COMFORT) UNDER STANDARD WIND LOADS WITH RETURN PERIOD OF 10 YEARS, THE MAXIMUM STRUCTURAL PEAK COMBINED LATERAL ACCELERATION *AMAX* IN THE BUILDING FOR ALONG AND ACROSS WIND ACTIONS AT ANY FLOOR LEVEL SHALL NOT EXCEED VALUES GIVEN IN TABLE 4, WITHOUT OR WITH THE USE OF WIND DAMPERS IN THE BUILDING.

TABLE 4 PERMISSIBLE PEAK COMBINED ACCELERATION

Building Use	Maximum Peak Combined Acceleration a_{max} (m/s^2)
Residential	0.15
Office / Commercial	0.25

FLOOR SYSTEMS

MATERIAL

ALL FLOOR SLABS SHALL BE CAST-IN-SITU. PRECAST FLOOR SYSTEMS WITHOUT A MINIMUM SCREED OF 75 MM CONCRETE SHALL NOT BE USED IN SEISMIC ZONES III, IV AND V, BUT CAN BE USED IN SEISMIC ZONE II.

STRUCTURE MODELLING

- RIGID END OFFSETS OF LINEAR MEMBERS IN THE JOINT REGION, WHEN CENTERLINE MODELING IS ADOPTED;
- CRACKED CROSS SECTIONAL AREA PROPERTIES AS PER TABLE 6; AND
- P-Δ EFFECTS

TABLE 6 CRACKED RC SECTION PROPERTIES

Structural Element	Un-factored Loads		Factored Loads	
	Area	Moment of Inertia	Area	Moment of Inertia
(1)	(2)	(3)	(4)	(5)
Slabs	1.0 A_g	0.36 I_g	1.00 A_g	0.25 I_g
Beams	1.0 A_g	0.7 I_g	1.00 A_g	0.35 I_g
Columns	1.0 A_g	0.9 I_g	1.00 A_g	0.70 I_g
Walls	1.0 A_g	0.9 I_g	1.00 A_g	0.70 I_g

IN THE FINAL VERSION OF THE DRAFT TALL BUILDING CODE THERE MAY BE SOME CHANGES BUT THE PHOLOSOPHY OF THE NEW CODE HAS TO BE APPRECIATED.

CONCLUDING REMARKS

THUS NEW EARTHQUAKE RESISTANT DESIGN OF STRUCTURES CODES HAVE SPECIFIED NEW GUIDELINES FOR SAFETY BOTH FOR ARCHITECTS AND STRUCTURAL CONSULTANTS. OVERALL IT WOULD BE A GOOD CODE TO FOLLOW.

HOWEVER IT WOULD RESULT IN INCREASE OF EARTHQUAKE FORCES IN LARGE NUMBER OF CASES.

THE MAIN PROBLEM WOULD BE THAT THE EXISTING BUILDINGS, RECENTLY COMPLETED BUILDINGS AS WELL AS BUILDINGS UNDER CONSTRUCTION DESIGNED BASED ON IS 1893 (PART - 1) - 2002 WOULD BE UNSAFE AS PER NEW IS 1893 CODE.

THIS WOULD RESULT IN ANXIETY IN THE MINDS OF OWNERS, STRUCTURAL DESIGNERS AND THE PEOPLE WHO WOULD USE IT / LIVE IN THEM.

FURTHER, AT THE TIME OF ISSUE OF COMPILATION CERTIFICATE OF THE BUILDING, THE AUTHORITIES REQUIRE STRUCTURAL SAFETY CERTIFICATE FOR STRUCTURAL DESIGN AS PER CODES PUBLISHED BY BUREAU OF INDIAN STANDARDS INCLUDING LATEST REVISIONS AND AMENDMENTS.

THANK YOU