

Chapter-5

STRUCTURAL SAFETY AND SERVICES

5.0 STRUCTURAL DESIGN

The structural design of foundation, masonry, timber, plain concrete, reinforced concrete, pre-stressed concrete and structural steel be carried out in accordance with Part-VI structural design, section-1 loads, section-2 foundation, section-3 wood, section-4 masonry, section-5 concrete and section-6 steel of National Building Code of India taking into consideration all relevant Indian Standards prescribed by Bureau of Indian Standards including the Indian Standard given in IS-Code 1893-1984, 13920-1993, 4326-1993, 13828-1993, 13827-1993 and 13935-1993 for structural safety.

5.1. QUALITY OF MATERIALS AND WORKMANSHIP

All material and workmanship shall be of good conforming generally to accepted standards of public works department and Indian standard specification and codes as included in Part-V Building Materials and Part-VII Construction practices and safety of National Building Code of India.

5.2. ALTERNATIVE MATERIALS, METHODS OF DESIGN AND CONSTRUCTION AND TESTS

5.2.1 The provision of the Bye-Laws are not intended to prevent the use of any material or method of design or construction not specifically prescribed by the bye-law provided any such alternative has been approved. The building materials approved by B.I.S. or any statutory body will form part of the approved building material and technology as part of the Bye-Laws.

5.3. BUILDING SERVICES

- 5.3.1.** The Planning design and installation of electrical installations, air conditioning installation of lifts and escalators can be carried out in accordance with Part-VIII Building Services, section-2 electrical installation, section-3 air conditioning and heating, section-5 installation of lifts and escalators of National Building Code of India. However deviations from National Building Code can be done as per good Engineering practices.
- 5.3.2.** The number and type of lifts to be provided in different buildings shall be as given in Appendix-D & D-1.
- 5.3.3.** The requirements of electric sub-station are also given in Appendix-D2. The provision of electric sub-station shall also require approval from Electricity Board.

5.4. PLUMBING SERVICES

- 5.4.1.** The planning, design, construction and installation of water supply, drainage and sanitation and gas supply system shall be in accordance with Part-IX Plumbing Services, section-1 water supply; section-2 drainage and sanitation and section-3 gas supply of National Building Code of India.
- 5.4.2** Requirement of water supply for various occupancies in buildings shall be as given in table 5.1, 5.2, and 5.3.
- 5.4.3** Requirement of sanitary fittings and installations for different occupancies in buildings shall be as given in table 5.4 to 5.15. For calculation of occupancy, the clause 4.1 be referred.

Table 5.1 Per capita water requirement for various Occupancies/Uses

Sl. No.	Type of Occupancy	Consumption per head per day (in lt.)
1	Residential	
	a) In living units	135
	b) Hotels with lodging accommodation (per bed)	180
2	Educational	
	a) Day schools	45
	b) Boarding Schools	135

Sl. No.	Type of Occupancy	Consumption per head per day (in lt.)
3	Institutional (Medical Hospitals) a) No. of beds not exceeding 100 b) No. of beds exceeding 100 c) Medical quarters and hostels	340 450 135
4	Assembly- Cinema theatres, auditoria, etc. (per seat accommodation)	15
5	Government or semi public business	45
6	Mercantile (Commercial) a) Restaurants (per seat) b) Other business building	70 45
7	Industrial a) Factories where bath-rooms are to be provided b) Factories where bath-rooms are not to be provided	45 30
8	Storage (including Warehouses)	30
9	Hazardous	30
10	Intermediate Stations (excluding mail and express stops).	45(25)*
11	Junction Station	70(45)*
12	Terminal Stations	45
13	International and Domestic Airports	70

* The values in parenthesis are for such stations, where bathing facilities are not provided.

Note: The number of persons for Sl. No. 10 to 13 shall be determined by the average number of passenger handled by the station daily; due consideration may be given to the staff and workers likely to use the facilities.

Table 5.2 Flushing Storage Capacities

Sl. No.	Classification of Building	Storage Capacity
1.	For tenements having common convenience	900 lt. net per w.c. seat
2.	For residential premises other than tenement having common conveniences	270 lt. net for one w.c. seat each and 180 lt. for each additional seat in the same flat.
3.	For factories and workshops	900 lt. per w.c. seat and 180 lt. per urinal seat.
4.	For cinemas, public assembly hall, etc.	900 lt. per w.c. seat and 350 lt. per urinal seat.

Table 5.3 Domestic Storage Capacities

Sl. No.	No. of Floors	Storage Capacity	Remarks
For premises occupied tenements with common conveniences:			
1.	Ground floor	Nil	Provided down take fittings are installed
2.	Floors 2, 3,4, 5 and upper floors	500 lt.. per tenement	
For premises occupied as flats or blocks			
1.	Ground floor	Nil	Provided down take fittings are installed
2.	Floors 2, 3, 4, 5 and upper floors	500 lt. per tenement	

Note 1: If the premises are situated at a place higher than the road level in front of the premises, storage at ground level shall be provided on the same lines as on floors.

2: The above storage may be permitted to be installed provided that the total domestic storage calculated on the above basis is not less than the storage calculated on the number of down take fittings according to scale given below:

<i>Down take taps</i>	<i>70 lt. each</i>
<i>Showers</i>	<i>135 lt. each</i>
<i>Bathtubs</i>	<i>200 lt. each</i>

Table 5.4 Sanitation requirements for shops and Commercial Offices

Sl. No.	Sanitary Unit / Fittings	For Personnel
1.	Water closet	One for every 25 persons or part thereof exceeding 15 (including employees and customers). For female personnel 1 per every 15 persons or part thereof exceeding 10.
2.	Drinking Water Fountain	One for every 100 person with a minimum of one on each floor.
3.	Wash Basin	One for every 25 persons or part thereof.
4.	Urinals	Same as Sl. No. 3 of Table 5.9
5.	Cleaners' Sink	One per floor minimum, preferably in or adjacent to sanitary rooms.

Note: Number of customers for the purpose of the above calculation shall be the average number of persons in the premises for a time interval of one hour during the peak period. For male-female calculation a ratio of 1: 1 may be assumed.

Table-5.5 Sanitary Requirements for Hotels

Sl. No.	Sanitary Unit	For Residential Public staff	For non residential Staff	
			For male	For female
1.	Water Closet (W.C.)	One per 8 Person omitting occupants of the attached water closet minimum of 2 if both sexes are lodged	1 for 1-15 persons 2 for 16-35 persons 3 for 36-65 persons 4 for 66-100 persons	1 for 1-12 persons 2 for 13-25 persons 3 for 26-40 persons 4 for 41-57 persons 5 for 58-77 persons 6 for 78-100 persons
2.	Ablution Taps	One in each W.C	One in each W.C	One in each W.C.
3.	Urinals	Nil	Nil upto 6 persons 1 for 7-20 persons 2 for 21-45 persons 3 for 46-70 persons 4 for 71-100 persons	Nil
4.	Wash Basins	One per 10 persons omitting each basin installed in the room suits	1 for 15 persons 2 for 16-35 persons 3 for 36-65 persons 4 for 66-100 persons	1 for 1-12 2 for 13-25 3 for 26-40 4 for 41-57 5 for 58-77 6 for 78-100
5.	Baths	One per 10 persons omitting occupants of room with bath in suits	Nil	Nil
6.	Stop Sinks	One per 30 Bed rooms (one per floor minimum)	Nil	Nil
7.	Kitchen Sink	One in each Kitchen	One in each Kitchen	One in each Kitchen

Table 5.5 contd. For Public Rooms

Sl. No.	Sanitary Unit	For Male	For Female
1.	Water Closet	One per 100 persons upto 400 persons; for over 400 add at the rate of one per 250 persons or part thereof.	Two for 10 persons upto 200 persons; over 200 add at the rate of one per 100 persons or part thereof.
2.	Ablution Taps	One in each W.C.	One in each W.C.
3.	Urinals	One for 50 persons or part thereof.	Nil, upto 6 persons 1 for 7-20 persons 2 for 21-45 persons 3 for 46-70 persons 4 for 71-100 persons
4.	Wash Basins	One per W.C. and urinal provided	One per W.C. provided
5.	Baths	--	--

Sl. No.	Sanitary Unit	For Male	For Female
6.	Stop Sinks	--	--
7.	Kitchen Sink	One in each Kitchen	One in each Kitchen

Note: i) It may be assumed that the two-thirds of the number are males and one-third females

ii) One water tap with drainage arrangements shall be provided for every 50 persons or part thereof in the vicinity of water closet and urinals.

Table 5.6 Sanitation Requirements for Educational Occupancy

Sl. No.	Sanitary Unit	Boarding Institution		Other Educational Institution	
		For Boys	For Girls	For Boys	For Girls
1.	Water Closet (W.C.)	--	--	--	--
2.	Ablution Taps	One in each W.C.	One in each W.C.	One in each W.C.	One in each W.C.
3.	Urinals	One per every 25 pupils or part thereof	--	One per every 20 pupils or part thereof	--
4.	Wash Basins	One for every 8 pupils or part thereof	One for every 6 pupils or part thereof	One for every 40 pupils or part thereof	One for every 40 pupils or part thereof
5.	Baths	One for every 8 pupils or part thereof	One for every 6 pupils or part thereof	--	--
6.	Drinking Water Fountains	One for every 50 pupils or part thereof	One for every 50 pupils or part thereof	One for every 50 pupils or part thereof	One for every 50 pupils or part thereof
7.	Sink Cleaner's	One per Floor minimum	One per Floor minimum	One per Floor minimum	One per Floor minimum

Nursery Schools

Sl. No.	Sanitary Unit	Requirement
1.	Water Closet	--
2.	Ablution Taps	One in each W.C.
3.	Urinals	--
4.	Wash Basins	One for every 15 pupils or part thereof
5.	Baths	One bath sink per 40 pupils
6.	Drinking Water Fountains	One for every 50 pupils or part thereof
7.	Sink Cleaner's	--

Note: 1. One water tap with draining arrangements shall be provided for every 50 persons or part thereof, in the vicinity of water closets and urinal.

2. For teaching staff, the schedule of sanitary units to be provided shall be the same as in case of office buildings (Table 5.9).

Table 5.7 Sanitation Requirements for Institutional (Medical) Occupancy- Hospital

Sl. No.	Sanitary Unit	Hospitals With indoor Patient Ward	Hospitals With outdoor Patient Wards	
		For Males & females	For Males	For Females
1.	Water Closet (W.C.)	One for every 6 beds or part thereof	One for every 100 persons or part thereof	Two for every 100 persons or part thereof
2.	Ablution taps	One in each W.C.	One in each W.C.	One in each W.C.
3.	Wash Basins	Two upto 30 bed; add one for every additional 30 bed; or part thereof	One for every 100 persons or part thereof	One for every 100 persons or part thereof.
4.	Baths with Shower	One bath with shower for every 8 beds or part thereof.	--	--
5.	Bed pan washing sink	One for each ward	-	--
6.	Cleaner' Sinks	One for each ward	One per floor minimum	One per floor minimum
7.	Kitchen sinks & dish Washers (where Kitchen is provided)	One for each ward	--	--
8.	Urinals	--	One for every 50 persons or part thereof	--

Table 5.7 contd. Administrative Buildings

Sl. No.	Sanitary Unit	For Males	For Females
1.	Water Closet (W.C.)	One for every 25 persons or part thereof	One for every 15 persons or part thereof
2.	Ablution Taps	One in each W.C.	One in each W.C.
3.	Wash Basins	One for every 25 persons or part thereof	One for every 25 persons or part thereof
4.	Baths with Shower	One on each floor	One on each floor
5.	Bed pan washing sink	--	--
6.	Cleaner' Sinks	One per floor minimum	One per floor minimum

Sl. No.	Sanitary Unit	For Males	For Females
7.	Kitchen sinks & dish Washers (where Kitchen is provided)	One for each floor	One for each floor
8.	Urinals	Nil upto 6 persons 1 for 7-20 persons 2 for 21-45 persons 3 for 46-70 persons 4 for 71-100 persons From 101 to 200 persons add at the rate of 3%; for over 200 persons add at the rate of 2.5%.	--

Table-5.8 Sanitation Requirements for Institutional (Medical) Occupancy- (staff quarters and Hostels)

Sl. No.	Sanitary Unit	Doctor's Dormitories		Nurses Hostel
		For Male Staff	For female staff	
1.	Water Closet	One for 4 persons	One for 4 persons	One for 4 persons or part thereof
2.	Ablution Taps	One in each W.C.	One in each W.C.	One in each W.C.
3.	Wash Basins	One for every 8 persons or part thereof	One for every 8 persons or part thereof	One for every 8 persons or part thereof
4.	Bath (with shower)	One for every 4 persons or part thereof	One for every 4 persons or part thereof	One for every 4 persons or part thereof
5.	Cleaner' Sinks	One per floor minimum	One per floor minimum	One per floor minimum

Table: 5.9 Sanitation Requirements for Governmental and Public Business Occupancy and Offices

Sl. No.	Sanitary Unit	For Male Personnel	For female Personnel
1.	Water Closet (W.C.)	One for 25 persons or part thereof	One for 15 persons or part thereof
2.	Ablution taps	One in each W.C.	One in each W.C.
3.	Urinals	Nil upto 6 persons 1 for 7-20 persons 2 for 21-45 persons 3 for 46-70 persons 4 for 71-100 persons From 101 to 200 add at the rate of 3%; For over 200 persons add at the rate of 2.5%.	--
4.	Wash Basins	One for every 25 persons or part thereof	--
5.	Drinking water fountains	One for every 100 persons with a minimum of one on each floor	--
6.	Baths	Preferably one on each floor	--
7.	Cleaner's Sinks	One per floor minimum; preferably in or adjacent to sanitary rooms.	--

Note: One water tap with drainage arrangements shall be provided for every 50 persons or part thereof in the vicinity of water closet and urinals.

Table-5.10 Sanitation Requirements for Residences

Sl. No.	Sanitary Unit	Dwelling with individual conveniences	Dwelling without individual conveniences
1.	Bath Room	One provided with water tap	One for every two tenement
2.	Water Closet (W.C.)	One	One for every two tenement
3.	Sink (or Nahani) in the Floor	One	--
4.	Water Tap	One	One with drainage arrangement in each tenement One in common bath rooms and common water closet.

Note: Where only one water closet is provided in a dwelling, the bath and water closet shall be separately accommodated.

Table: -5.11 Sanitation Requirements for Assembly Occupancy Buildings (Cinema, Theaters, Auditoria. etc.)

Sl. No.	Sanitary Unit	For Public		For Staff	
		Male	Female	Male	Female
1	Water Closet	One for 100 persons upto 400 persons. For over 400 persons, add at the rate of 1 per 250 persons or part thereof	Two per 100 persons upto 200 persons. For over 200 persons add at the rate of 1 per 100 persons or part thereof	One for 15 persons. Two for 16-35 persons	One for 1-12 persons. Two for 13-25 persons
2	Ablution Taps	One in each W.C.	One in each W.C.	One in each WC	One in each WC
3	Urinals	One for 50 persons or part thereof	—	Nil upto 6 persons One for 7-20 persons Two for 21-45 persons	—
4	Wash Basins	One for every 200 persons or part thereof	One for every 200 persons or part thereof	One for 1-15 persons Two for 16-35	One for 1-12 persons Two for 13-25 persons
5	Drinking Water Fountain	One per 100 persons or part thereof			

Note: - i) One water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water closets and urinals.

ii) It may be assumed that two thirds of the number are males and one third females.

Table: -5.12 Sanitation Requirements for Assembly Occupancy Buildings (Art, Galleries, Libraries and Museums)

Sl. No.	Sanitary Unit	For Public		For Staff	
		Male	Female	Male	Female
1	Water Closet (W.C.)	One for 200 persons upto 400 persons. For over 200 persons, add at the rate of 1 per 250 persons or part thereof	One per 100 persons upto 200 persons. For over 200 persons, add at the rate of 1 per 150 persons or part thereof	One for 1-15 persons. Two for 16-35 persons	One for 1-12 persons. Two for 13-25 persons
2	Ablution Taps	One in each W.C.	One in each W.C.	One in each W.C	One in each W.C
3	Urinals	One for 50 persons or part thereof	--	Nil upto 6 persons One for 7-20 persons Two for 21-45 persons	--
4	Wash Basins	One for every 200 persons or part thereof. For over 400 persons, add at the rate of 1 per 250 persons or part thereof.	One for every 200 persons or part thereof. For over 200 persons, add at the rate of 1 per 150 persons or part thereof	One for 1-15 persons Two for 16-35	One for 1-12 persons Two for 13-25 persons
5	Cleaner's Sink	One per floor, minimum			
6	Drinking Water Fountain	One per 100 persons or part thereof			

Note: It may be assumed that two thirds of the number are males and one third females.

Table 5.13 Sanitation Requirements for Restaurant

Sl. No.	Sanitary Unit	For Public		For Staff	
		Male	Female	Male	Female
1.	Water Closet (W.C.)	One per 50 seats upto 200 seats. For over 200 seats, add at the rate of 1 per 100 seats or part thereof	One per 50 seats upto 200 seats. For over 200 seats, add at the rate of 1 per 100 seats or part thereof	1 for 15 persons. 2 for 16-35 persons. 3 for 36-65 persons. 4 for 66-100 persons.	1 per 1-12 persons. 2 for 13-25 persons. 3 for 26-40 persons. 4 for 41-57 persons. 5 for 58-77 persons. 6 for 78-100 persons.
2.	Ablution Taps	One in each W.C.	One in each W.C.	One in each W.C.	One in each W.C.
3.	Urinals	One for 50 persons or part thereof	--	Nil upto 6 persons. 1 for 7-20 persons. 2 for 21-45 persons. 3 for 46-70 persons. 4 for 71-100 persons.	--
4.	Wash Basins	One for every water closet			
5.	Kitchen Sinks & Dish Washer	One per each Kitchen			
6.	Service Sink	One in the restaurant			

Note: - i) It may be assumed that two thirds of the numbers are males and one-third females.

ii) One water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water closets and urinal.

Table: -5.14 Sanitation Requirements for Factories

Sl. No.	Sanitary Unit	For Male Personnel	For female Personnel
1.	Water Closet	1 for 15 persons 2 for 16-35 persons 3 for 36-65 persons. 4 for 66-100 persons. For 101 to 200 persons add at rate of 3%. From over 200 persons, add at the rate of 2.5%.	1 for 1-12 persons 1 for 13-25 persons. 2 for 26-40 persons. 3 for 41-57 persons. 4 for 58-77 persons. 5 for 78-100 persons. For 101 to 200 persons, add at the rate of 5%. From over 200 persons add at the rate of 4%.
2.	Ablution Taps	One in each W.C	One in each W.C.
3.	Urinals	Nil upto 6 persons 1 for 7-20 persons 2 for 21-45 persons 3 for 46-70 persons 4 for 71-100 persons From 101 to 200 persons add at the rate of 3%; for over 200 persons add at the rate of 2.5%.	--
4.	Washing Taps with draining arrangement	One for every 25 persons or part thereof	
5.	Drinking Water Fountains	One for every 100 persons with a minimum of one on each floor	
6.	Baths Preferably Showers	As required for particular trade or occupation	

- Note: i) For many trades of a dirty or dangerous character, more extensive provisions are required.
- ii) One water tap with draining arrangement shall be provided for every 50 persons or part thereof in the vicinity of water closet and urinal
- iii) Crèches where provided shall be fitted with water closets (One for 10 persons or part thereof), wash basins (1 for 15 persons or part thereof) and drinking water tap with drinking arrangement for every 50 persons or part thereof

Table 5.15 Sanitary Requirements for Large Stations and Airports

Sl. No.	Place	W.C. for Males	W.C. for Females	Urinals for Males only
1.	Junction Stations, Intermediate Stations and Substations	3 for first 1000 persons and 1 for subsequent 1000 persons or part thereof.	4 for first 100 persons and 1 for every additional 1000 persons or part thereof.	4 for every 1000 person and 1 for every additional 1000 persons or part thereof.
2.	Terminal Stations and Bus Terminals	4 for first 1000 persons and 1 for every additional 1000 persons or part thereof.	5 for every 1000 person and 1 for every additional 200 persons or part thereof.	6 for every 1000 person and 1 for every additional 1000 persons or part thereof.
3.	Domestic Airports Min.	2*	4*	2*
	For 200 persons	5	8	6
	For 400 persons	9	15	12
	For 600 persons	12	20	16
	For 800 persons	16	26	20
	For 1000 persons	18	29	22
4.	Internal Airports			
	For 200 persons	6	10	8
	For 600 persons	12	20	16
	For 1000 persons	18	29	22

Note: i) Provision for wash basins, baths including shower stalls, shall be in accordance with part ix section 2- Drainage and Sanitation of National Building Code of India.

ii) At least one Indian style water closet shall be provided in each toilet. Assume 60 males and 40 females in any area.

Notes for general guidance for water supply arrangements:

1. For new construction of plots : Provision shall be made for under ground tank for the storage of water, having capacity at 200 lt. per person with adequate pumping arrangements to supply water to upper floors. Filter water connection will be allowed only for use of drinking and bathing needs. For other purposes i.e. flushing and gardening etc., the individual shall be required to have its own arrangements of tube well water within his own premises. While according sanction to Layout Plan, the Authority shall make a special mention that provision for space shall be kept for the

- construction of under ground reservoir of adequate capacity along with booster pumping station.
2. Arrangements as given in 1 above shall also be provided in Group Housing Societies.
 3. The plumbing arrangement in case of new constructions shall be made in a way that the potable water shall be used for drinking, cooking & bathing only and for rest of the uses, provision for ground water can be made with dual piping system.
 4. Low capacity cistern should preferably be provided instead of normal 12.5 lt. capacity.
 5. *Water Harvesting:* Water harvesting through storing of water runoff including rainwater in all new buildings on plots of 100 sq.mt. and above will be mandatory. The plans submitted to the local bodies shall indicated the system of storm water drainage along with points of collection of rain water in surface reservoirs or in recharge wells.
 6. All building having a minimum discharge of 10,000 lt. and above per day shall incorporate waste water recycling system. The recycled water should be used for horticultural purposes.
 7. *Installation of Solar Assisted Water Heating System in Functional Buildings:*
 - i. No new building in the following categories in which there is a system of installation for supplying hot water shall be built unless the system of the installation is also having an auxiliary solar assisted water heating system:-
 - a) Hospitals and Nursing Home
 - b) Hotels, Lodges, and Guest Houses, Group Housing with the plot area of 4000 sq. mt.
 - c) Hostels of Schools, Colleges and Training Centres with more than 100 Students.
 - d) Barracks of armed forces, paramilitary forces and police
 - e) Individual residential buildings having more than 150 sq.mt. plinth area
 - f) Functional Buildings of Railway Stations and Air Ports like waiting rooms, retiring rooms, rest rooms, inspection bungalows and catering units
 - g) Community Centres, Banquet Halls, Barat Ghars, Kalyan Mandaps and buildings for similar use.”

i) *Definitions*

i)	“Solar Assisted Water Heating System	A device to heat water using solar energy as heat source.
ii)	“Auxiliary back up”	Electricity operated or fuel fired boilers/systems to heat water coming out from solar water heating system to meet continuous requirement of hot water.
iii)	“New Building”	Such buildings of above said categories for which construction plans have been submitted to competent authority for clearance.
iv)	“Existing building”	Such buildings, which are licensed to perform their respective business.

ii) *Installation of Solar Water Heating System*

- a) *New Buildings:* Clearance of plan for the construction of new buildings of the aforesaid categories shall only be given if they have a provision in the building design itself for an insulated pipeline from the rooftop in the building to various distribution points where hot water is required. The building must have a provision for continuous water supply to the solar water heating system. The building should also have open space on the roof top, which receives direct sun light. The load bearing capacity of the roof should at least be 50 kg. per sq.mt. All new buildings of above said categories must complete installation of solar water heating systems before obtaining necessary license to commence their business.
- b) *Existing Buildings:* Installation of Solar Assisted Water Heating Systems in the existing building shall be made mandatory at the time of change of use to above said category provided there is a system or installation for supplying hot water.
- iii) *Capacity:* The capacity of solar water heating system to be installed on the building of different categories shall be decided in consultation with the local bodies. The recommended minimum capacity shall not be less than 25 litres per day for each bathroom and kitchen subject to the condition that maximum of 50% of the total roof area is provided with the system.

- iv) *Specifications:* Installation of Solar Assisted Water Heating Systems shall conform to BIS (Bureau of Indian Standards) specification IS 12933. The solar collectors used in the system shall have the BIS certification mark.
- v) *Auxiliary System:* Wherever hot water requirement is continuous, auxiliary heating arrangement either with electric elements or oil of adequate capacity can be provided..