

**(12) Proportion and strength of ordinary concrete**

Grade	Nominal mix by volume	Qty per 50kg of cement			Crushing strength of 15cm cubes in work test	
		Fine aggregate m <sup>3</sup>	Coarse aggregate m <sup>3</sup>	Water litres	7 days Kg/cm <sup>2</sup>	28 days Kg/cm <sup>2</sup>
M25	1:1:2	0.035	0.070	27	170	250
M20	1:1 1/2:3	0.530	0.106	30	135	200
M15	1:2:4	0.070	0.140	32	100	150

**(13) R.C.C. Slabs for Culverts**

Loading I.R.C. Class A

Concrete 1:2:4 or M15

Clear Span (m)	Overall Depth (cm)	Area of Steel/m (cm <sup>2</sup> )	Main rods		No. of rods cranked	Distributor	
			Dia (mm)	Spacing (cm)		Diameter (mm)	Spacing (cm)
0.75	18	8.00	10	10	Nil	10	22
1.00	18	10.0	12	11	Nil	10	19
1.50	20	12.40	12	10	1 in 4	12	21.50
2.00	25	18.00	14	8.50	1 in 4	12	17.50
2.50	28	20.00	16	10	1 in 4	12	16.50
3.00	32	23.80	20	13	1 in 4	14	21.50
3.50	36	26.20	20	12	1 in 2	16	27
4.00	40	29.00	20	10.50	1 in 2	16	26
4.50	43	32.00	25	15.50	1 in 2	16	25
5.00	46	34.00	25	14.50	1 in 2	16	24
5.50	49	36.50	25	13.50	1 in 2	16	24
6.00	54	40.00	25	13	1 in 2	16	23

**(14) Alternative table of R.C.C. slabs for culverts**

Loading : IRC Class A

Mild steel Gr. I

Span m	Thickness of slab (overall) cm		Longitudinal Bars				Transverse Bars					
			Bottom		Top		Bottom		Top			
	M15	M20	Dia mm	Spacing cm		Dia mm	Spacing cm	Dia mm	Spacing cm		Dia mm	Spacing cm
				M15	M20				M15	M20		
1.0	19	15	16	15.0	11.5	10	30	16	15	12.5	10	30
1.5	22	18	16	10.5	9	10	30	16	15	10	10	30
2.0	24	21.5	16	10.0	8	10	30	16	12.5	10	10	30
2.5	27	24.5	16	9.0	7.5	10	30	16	12.5	15	10	30
3.0	30.5	27.5	16	7.5	7	10	30	16	12.5	15	10	30
3.5	34	31.5	16	6.0	6.5	10	30	16	12.5	15	10	30
4.0	37	34.5	20	10.0	9	10	30	16	12.5	15	10	30
5.0	42	39.5	20	9.0	7.5	10	30	16	12.5	15	10	30
6.0	47.5	44.5	20	7.5	6.8	10	30	16	12.5	15	10	30

**(15) Requirements of cement for different works**

<b>Ref Schedule</b>	<b>Particulars</b>	<b>Quantity of cement</b>
	<b>Brick Masonry</b> (22.9cm x 11.2cm x 7.00 cm)	
153	Brick work in CM 1:4, with wire cut bricks (19cm x 9cm x 9cm)	72 kg/m <sup>3</sup>
154	Brick work in CM 1:5, with wire cut bricks (19cm x 9cm x 9cm)	58 kg/m <sup>3</sup>
158	Brick work in CM 1:5, with country burnt bricks (22.9cm x 11.2cm x 7.00 cm)	69 kg/m <sup>3</sup>
158(a)	Brick work in CM 1:5, with country burnt bricks (19cm x 9cm x 9cm)	69 kg/m <sup>3</sup>
159	Brick work in CM 1:6, with country burnt bricks (19cm x 9cm x 9cm)	58 kg/m <sup>3</sup>
159(a)	Brick work in CM 1:6, with country burnt bricks (22.9cm x 11.2cm x 7.00 cm)	58 kg/m <sup>3</sup>
171	Brick work in CM 1:8, with country burnt bricks (22.9cm x 11.2cm x 7.00 cm)	43 kg/m <sup>3</sup>
	<b>Laterite Masonry</b>	
205	Laterite masonry in CM 1:4 (44cm x 24cm x 14cm)	58 kg/m <sup>3</sup>
206	Laterite masonry in CM 1:5 (44cm x 24cm x 14cm)	46 kg/m <sup>3</sup>
206	Laterite masonry in CM 1:6 (44cm x 24cm x 14cm)	38 kg/m <sup>3</sup>
	<b>Rubble masonry</b>	
255	Cut stone work in steps 15 x 22 cm in CM 1:2	62 kg/m <sup>3</sup>
261	Coarsed Rubble work split stone in CM 1:2	101 kg/m <sup>3</sup>
264	Coarsed Rubble work split stone in CM 1:4	79 kg/m <sup>3</sup>
265	Coarsed Rubble work split stone in CM 1:5	63 kg/m <sup>3</sup>
272	Random rubble in CM 1:4	108 kg/m <sup>3</sup>
273	Random rubble in CM 1:5	86 kg/m <sup>3</sup>
274	Random rubble in CM 1:6	72 kg/m <sup>3</sup>
284	Random rubble in CM 1:8	54 kg/m <sup>3</sup>
	<b>Plastering</b>	
506	Plastering with CM 1:3, 6mm thick one coat	29 kg/10m <sup>2</sup>
506	Plastering with CM 1:3, 9mm thick one coat	43 kg/10m <sup>2</sup>
506	Plastering with CM 1:3, 12mm thick one coat	66 kg/10m <sup>2</sup>
510	Plastering with CM 1:3, 15mm thick one coat	72 kg/10m <sup>2</sup>
507	Plastering with CM 1:4, 12mm thick one coat	54 kg/10m <sup>2</sup>
511	Plastering with CM 1:4, 15mm thick one coat	59 kg/10m <sup>2</sup>
508	Plastering with CM 1:5, 12mm thick one coat	43 kg/10m <sup>2</sup>
509	Plastering with CM 1:6, 12mm thick one coat	36 kg/10m <sup>2</sup>
512	Plastering with CM 1:5, 15mm thick one coat	48 kg/10m <sup>2</sup>
513	Plastering with CM 1:6, 15mm thick one coat	40 kg/10m <sup>2</sup>
513	Plastering with CM 1:7, 12mm thick one coat	31 kg/10m <sup>2</sup>
514	Cement flushing coat, 12mm thick	22 kg/10m <sup>2</sup>
	<b>Cement concrete</b>	
110	CC 1:3:6 using 40mm (nominal size) broken stone	228 kg/m <sup>3</sup>
111	CC 1:4:8 using 40mm (nominal size) broken stone	171 kg/m <sup>3</sup>
112	CC 1:5:10 using 40mm (nominal size) broken stone	137 kg/m <sup>3</sup>
	CC 1:4:7 using 40mm (nominal size) broken stone	195.43 kg/m <sup>3</sup>

122	CC 1:2:4 using 20mm (nominal size) broken stone	33 kg/10dm <sup>3</sup>
122(a)	CC 1:11/2:3 using 20mm (nominal size) broken stone	4.32 kg/10dm <sup>3</sup>
123	CC 1:3:6 using 20mm (nominal size) broken stone	2.16 kg/10dm <sup>3</sup>
124	CC 1:4:8 using 20mm (nominal size) broken stone	1.62 kg/10dm <sup>3</sup>
	CC 1:3:6 using graded 60% 40mm & 40% 20mm bs	223.2 kg/m <sup>3</sup>
	CC 1:4:7 using graded 60% 40mm & 40% 20mm bs	191.31 kg/m <sup>3</sup>
	CC 1:3:6 using graded 50% 40mm & 50% 20mm bs	222 kg/m <sup>3</sup>
	CC 1:3:6 using graded 70% 40mm & 30% 20mm bs	224.4 kg/m <sup>3</sup>
	<b>Pointing</b>	
526	Pointing brick work with CM 1:3	13.25 kg/10m <sup>2</sup>
527	Pointing brick work with CM 1:4	10.00 kg/10m <sup>2</sup>
528	Pointing tile flooring with CM 1:3	6.62 kg/10m <sup>2</sup>
531	Pointing RR masonry with CM 1:2	18.58 kg/10m <sup>2</sup>
532	Pointing RR masonry with CM 1:3	13.25 kg/10m <sup>2</sup>
533	Pointing RR masonry with CM 1:4	10.00 kg/10m <sup>2</sup>
534	Flesh pointing ashlar masonry with CM 1:2	9.29 kg/10m <sup>2</sup>
535	Flesh pointing ashlar masonry with CM 1:3	6.62 kg/10m <sup>2</sup>

### (16) Stripping Time for formwork (I.S. 456-2000)

SI No.	Type of formwork	Min. Period
1	Vertical formwork to columns, walls and beams	16-24 hours
2	Soffit formwork to slabs (props to be refixed immediately after removal of formwork)	3 days
3	Soffit formwork to beams (props to be refixed immediately after removal of formwork)	7 days
4	Props to slabs 1. Spanning up to 4.5m 2. Spanning over 4.5m	7 days 14 days
5	Props to beams and arches 1. Spanning up to 6m 2. Spanning over 6m	14 days 21 days

In normal circumstances where ambient temperature does not fall below 15°C and where ordinary Portland cement is used and adequate curing is done

### (17) Covering capacity of paints

Lead primer on wood	9-11 m <sup>2</sup> / litre
Lead primer on metal	9-13 m <sup>2</sup> / litre
Flat undercoating	10-12 m <sup>2</sup> / litre
Gloss painting	9-13 m <sup>2</sup> / litre
Enamel	9-13 m <sup>2</sup> / litre
Varnish 1 <sup>st</sup> coat	11-13 m <sup>2</sup> / litre
Varnish 2 <sup>nd</sup> coat	13-18 m <sup>2</sup> / litre
Water paint and oil bound distemper cover approximately	6-8 m <sup>2</sup> /kg

**(18) Coefficient for measurements of painting**

S. No.	Description of work	How measured	Multiplying coefficients
1	2	3	4
<b>I. Wood work doors, windows Etc.</b>			
1.	Panelled or framed and braced doors, windows etc.	Measured flat (not girthed including)	1.30 (for each side)
2.	Ledged and battened or ledged, battened and braced doors, windows etc.	Chowkhat or frame, Edges, chocks, cleats, etc. shall be deemed to be included in the item.	- do -
3.	Flush doors etc.	-do-	1.20 (for each side)
4.	Part panelled and part glazed or gauzed doors, window etc. (Excluding painting of wire gauze portion)	-do-	1.00 (for each side)
5.	Fully glazed or gauzed doors, windows etc. (Excluding painting of wire gauze portion)	-do-	0.80 (for each side)
6.	Fully venetioned or louvered doors, windows etc.	-do-	1.80 (for each side)
7.	Trellis (or Jaffri) work one way or two way	Measured flat overall, no deduction shall be made for open spaces, supporting members shall not be measured separately	2 (for painting all over)
8.	Carved or enriched work	Measured flat	2 (for each side)
9.	Weather boarding	Measured flat (not girthed supporting frame work shall not be measured separately)	1.20 (for each side)
10.	Wood shingle roofing	Measured flat (not girthed)	1.10 (for each side)
11.	Boarding with cover fillets and match boarding	Measured flat (not girthed)	1.05 (for each side)
12.	Tile and slate battening	Measured flat overall no deductions shall be made for open spaces	0.80 (for painting all over)
<b>II. Steel work doors, windows Etc.</b>			
13.	Plain sheeted steel doors or windows	Measured flat (not girthed) including frame edges etc.	1.10 (for each side)
14.	Fully glazed or gauzed steel doors and windows (excluding painting of wire gauze portion)	-do-	0.50 (for each side)
15.	Partly panelled and partly glazed or gauzed doors and windows (excluding painting of wire gauze portion)	-do-	0.80 (for each side)
16.	Corrugated sheeted steel doors or windows	-do-	1.25 (for each side)
17.	Collapsible gates	Measured flat	1.50 (for painting all over)
18.	Rolling shutters of interlocked laths	Measured flat (size of opening) all over; jamb guides, bottom rails and locking arrangement etc. shall be included in the item (top cover shall be measured separately)	1.10 (for each side)
<b>III. General</b>			
19.	Expanded metal, hard drawn steel wire fabric of approved quality, grill works and gratings in guard bars, balustrades, railing partitions and MS Bars in windows frames.	Measured flat overall; no deduction shall be made for open spaces; supporting members shall not be measured separately	1 (for Paint all over)

20.	Open palisade fencing and gates including standards, braces, rails stays etc. in timber or steel	-do- (see note No. 12)	1 (for Paint all over)
21.	Corrugated iron sheeting in roofs, side cladding etc.	-do- Measured flat (not girthed)	1.14 (for each side)
22.	AC corrugated sheeting in roofs, side cladding etc.	-do-	1.20 (for each side)
23.	AC semi corrugated sheeting in roofs, side cladding etc. or Nainital pattern using plain sheets	-do-	1.10 (for each side)
24.	Wire gauze shutters including painting of wire gauze	-do-	1.00 (for each side)

### (19) Physical and chemical standards of drinking water (I.S. 10500:1991)

SI No.	Characteristics	Requirements (Desirable limits)	Permissible limits in the absence of alternative source	Methods of test
1	Turbidity (Units JDC Scale)	5	10	3025(Part 10) 1984
2	Colour (Units Platinum Cobalt scale)	5	25	3025(Part 4) 1983
3	Taste and odour	Unobjectionable	Unobjectionable	3025(Part 5) 1983 3025(Part 7& 8) 1984
4	PH	6.5 to 8.5	No relaxation	3025(Part 25) 1984
5	Total dissolved solids (mg/l)	500	2000	3025(Part 16) 1984
6	Total hardness (mg/l)	300	600	3025(Part 21) 1983
7	Chlorides (as mg)(mg/l)	250	1000	3025(Part 32) 1984
8	Sulphates (as SO <sub>4</sub> )	200	400	3025(Part 42) 1984
9	Fluorides (as F mg l)	1.0	1.5	
10	Nitrates (as No <sub>3</sub> )(mg/l)	45	45	3025(Part 23) 1964
11	Calcium (as Ca)(mg/l)	75	200	3025(Part 34) 1988
12	Magnesium (as mg)(mg/l) If there are 250 mg/l of Sulphates, Mg content can be increased to a maximum of 125 mg/l with the reduction of sulphates at the rate of 1 unit per every 2.5 units of Sulphates	<30	150	3025(Part 40) 1991
13	Iron (as Fe)(mg/l)	0.1	1.0	3025(Part 32) 1984
14	Manganese (as Mn)(mg/l)	0.05	0.5	3025(Part 35) 1964
15	Copper (as Cu)(mg/l)	0.05	1.5	3025(Part 36) 1964
16	Aluminium (as Al)(mg/l)	0.03	0.2	
17	Alkalinity (mg/l)	200	600	
18	Residual Chlorine (mg/l)	0.2	>1.00	
19	Zinc (as Zn)(mg/l)	5.00	15.00	3025(Part 39) 1964
20	Phenolic compounds (as Phenol)(mg/l)	0.001	0.002	3025(Part 54) 1964

21	Anionic detergents (mg/l) (MBAS)	0.02	1.0	Methylene – blue extraction method
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22	Mineral oil (mg/l)	0.01	0.03	Gas chromatographic method
	<b>Toxic materials</b>			
23	Arsenic (as As)(mg/l)	0.01	0.05	3025(Part 37) 1988
24	Cadmium (as Cd)(mg/l)	0.01	0.01	Atomic absorption spectrophotometric method
25	Chromium (as Hexavalent Cr)(m/l)	0.05	0.05	3025(Part 38) 1964
26	Cyanides (as Cd)(mg/l)	0.05	0.05	3025(Part 27) 1986
27	Lead (as Pb)(mg/l)	0.05	0.05	Atomic absorption spectrophotometric method
28	Selenium (as Se)(mg/l)	0.01	0.01	3025(Part 28) 1964
29	Mercury (Total as Hg)(mg/l)	0.001	0.001	Mercury ion analyser
30	Poly nuclear aromatic hydrocarbons (PAH)	0.2 µg/l	0.2 µg/l	
	<b>Radio activity</b>			
31	Gross Alpha activity (Bq/l)	0.1	0.1	
32	Gross Beta Activity (Bq/l)	1.0	1.0	

**(20) Recommended per capita water supply levels for design of schemes**

SI No	Classification of Towns / Cities	Recommended maximum water supply levels
1	Towns provided with piped water supply but without sewerage system	70
2	Cities provided with piped water supply where sewerage system is existing/contemplated	135
3	Metropolitan and mega cities provided with piped water supply where sewerage system is existing/contemplated	150

**(21) Recommended water supply levels for institutions**

SI No	Institutions	Litres per head per day
1	Hospitals (including laundry) a) No. of beds exceeding 100 b) No. of beds not exceeding 100	450 (per bed) 340 (per bed)
2	Hotels	180 (per bed)
3	Hostels	135
4	Nurse's homes and medical quarters	135
5	Boarding Schools/ Colleges	135

6	Restaurants	70 (per bed)
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7	Airports and seaports	70
8	Junction stations and intermediate stations where mail or express stoppage (both railways and bus stations) is provided	70
9	Terminal stations	45
10	Intermediate stations (Excluding mail and express stops)	45 (could be reduced to 25 where bathing facilities are not provided)
11	Day Schools/ Colleges	45
12	Offices	45
13	Factories	45 (could be reduced to 30 where no bathrooms are provided)
14	Cinema, concert halls and theatre	15

**(22) Recommended water requirements for Domestic & Non-Domestic needs**

SI No	Description	Amount of water (lpcd)
1	For communities with population upto 20,000 a) Water supply through stand post b) Water supply through house supply connection	40 (min) 70 to 100
2	For communities with population 20,000 to 1,00,000	100 to 150
3	For communities with population above 1,00,000	150 to 200

**(23) Design period for the components in water supply schemes**

SI No	Items	Design Period ( in years)
1	Storage by dams	50
2	Infiltration works	30
3	Pumping 1. Pump house (Civil Works) 2. Electric Motors and Pumps	30 15
4	Water Treatment units	15
5	Pipe connection to several treatment units and other small appurtenances	30
6	Raw water and clear water conveying mains	30
7	Clear water reservoirs at the head works, balancing tanks and service reservoirs (overhead or ground level)	15
8	Distribution system	30

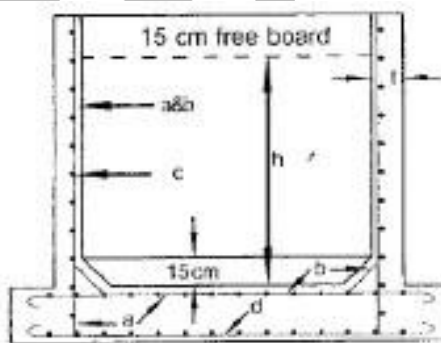
**(24) Design data for small RCC square water tank**

Capacity in litres	Length x Breadth inside in m	Depth including free board in cm	Thickness of walls and floor in cm	Reinforcements					
				Walls				Floor	
				Hori. steel		Vert. steel		Bars each way	
				Bars c		Bars a&b		Bars d	
				Dia (mm)	Sacing (cm)	Dia (mm)	Sacing (cm)	Dia (mm)	Sacing (cm)
2000	1.5x1.	1.00	10	6	15	6	15	6	20
3500	5	1.25	10	6	15	6	15	6	20
5000	1.8x1.	1.40	10	6	15	6	15	6	20
7000	8	1.50	11.5	10	22	10	22	6	20
9000	2.0x2.	1.60	11.5	10	20	10	15	6	20
14000	0	2.00	13	10	18	12	18	6	14
23000	2.3x2.	2.10	15	10	16	16	20	6	12
	3								
	2.5x2.								
	5								
	2.8x2.								
	8								
	3.5x3.								
	5								

Note: Horizontal reinforcement can be reduced towards the top to about 2/3 of the bottom reinforcement, and thickness of walls can also be diminished towards the top.

Light reinforcement should be provided at the top in the floor slab

Bars (a) & (b) are alternate and the distance between each bars will be half of the spacing given.



Small RCC square water tank

### **(25) Location and requirements of wells (National Building code 2005)**

#### **The well shall be located**

1. Not less than 15m from any ash pit, refuse pit, earth closet or privy and shall be located on a site upward from the earth closet or privy.
2. Not less than 18m from any cess pit soakway or borehole latrine.
3. That contamination by the movement of subsoil or other water is unlikely .

**The well shall**

1. Have a minimum internal diameter of not less than 1m
2. Be constructed to a height not less than 1m above the surrounding ground level to form a parapet or kerb to and to prevent surface water from flowing into a well
3. Be of sound and permanent construction throughout. Temporary or exposed wells shall be permitted only in fields or gardens for purposes of irrigation
4. Have the interior surface of the lining or walls of the well be rendered impervious for a depth of not less than 1.8m measured from the level of the ground immediately adjoining the well-head.

**(26) Location and requirements of septic tanks  
(National building code 2005)**

1. Septic tanks shall have a minimum width of 75cm, minimum depth of 1m below the water level and a minimum liquid capacity of 1m<sup>3</sup>. The length of the tanks shall be 2 to 4 times the width.
2. Septic tanks may be constructed of brickwork, stone masonry, concrete or other suitable materials as approved by the authority.
3. The minimum nominal diameter of the pipe shall be 100mm.
4. The gradient of land drains, under drainage as well as the bottom of the dispersion trenches and soak ways shall be between 1:300 and 1:400.
5. Every septic tank shall be provided with ventilating pipe of at least 50mm diameter.

**(27) Design of drainage system**

1. Allow for a flow of liquid waste from the buildings at the rate of 0.03 m<sup>3</sup>/min/100 persons
2. The minimum velocity in drain pipes shall be 0.75 m/sec. The drain pipes shall be half full at peak flow. Velocity shall not exceed 2.4 m/sec.
3. Pipe diameter shall not be less than 100mm.
4. Gradients of various pipe sizes and discharges are as follows:-

Velocity	Pipe dia	Gradient
0.75 m/s	100	1 in 35
0.75 m/s	150	1 in 65
0.75 m/s	230	1 in 120
0.75 m/s	300	1 in 200

**(28) Standards for sanitary arrangements (National Building Code)**

	For males	For females
<b>Office buildings</b>		
Water closet	1 for every 25 persons	1 for every 15 persons or part thereof
Urinals	Nil up to 6 persons 1 for 7-20 persons 2 for 21-45 persons 3 for 46-70 persons 4 for 71-100 persons	
Wash basins	1 for every 25 persons or part thereof	
<b>Hospitals</b>		

Water closet	For males and females 1 for every 8 beds or part thereof
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	2 up to 30 beds, add 1 for every additional 30 beds	
<b>Theatres</b>		
Water closets	1 for every 100, above 400 add 1 for every 250	2 for every 100, above 400 add 1 for every 100
Urinals	1 for every 50	
Wash basins	1 for every 200	1 for every 20
<b>Schools</b>		
Water closets	1 for every 4 pupils or part thereof	1 for every 25 pupils or part thereof
Urinals	1 for every 40 pupils or part thereof	
Wash basins	1 for every 40 pupils or part thereof	1 for every 40 pupils or part thereof

### (29) Size of septic tanks (IS: 2470)

No. of users	Length (m)	Width (m)	Liquid Depth for cleaning in	
			1 year interval	2 year interval
<b>Domestic Tanks</b>				
5	1.50	0.75	1.00	1.05
10	2.00	0.90	1.00	1.40
15	2.00	0.90	1.30	1.80
20	2.30	1.10	1.30	1.80
50	4.00	1.40	1.30	2.00
<b>Tanks for Hostels and Boarding School</b>				
50	5.00	1.60	1.30	1.40
100	5.70	2.10	1.40	1.70
150	7.70	2.40	1.40	1.70
200	8.90	2.70	1.40	1.70
300	10.70	3.30	1.40	1.70

Air space of 30cm above storage level to be provided

Floor should be of cement concrete of grade M15 and sloped towards sludge cleaning end

The capacity designed is inclusive of waste water from bath room, sink etc.

Certain authorities recommend not to let in waste water to the septic tank and to limit the size to obtain a capacity of 0.092 m<sup>3</sup>/users (KESA)

### (30) Depreciated Value per rupee of Capital Cost of Building

No. of Years	Depreciation Constant					
	A 1.0%	B 1.5%	C 2.0%	D 4.0%	E 4 ½%	F 6%
1	0.9000	0.9000	0.9000	0.9000	0.9000	0.9000
2	0.9000	0.9000	0.9000	0.9000	0.9000	0.8835
3	0.9000	0.9000	0.9000	0.8849	0.8710	0.8305
4	0.9000	0.9000	0.9000	0.8496	0.8318	0.7805
5	0.9000	0.9000	0.9000	0.8156	0.7943	0.7336
6	0.9000	0.9000	0.8855	0.7830	0.7586	0.6896
7	0.9000	0.8991	0.8678	0.7518	0.7244	0.6482
8	0.9000	0.8853	0.8504	0.7218	0.6918	0.6092

9	0.9000	0.8722	0.8333	0.6929	0.6607	0.5727
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10	0.9000	0.8590	0.8166	0.6653	0.6310	0.5383
11	0.8945	0.8461	0.8002	0.6387	0.6026	0.5052
12	0.8855	0.8333	0.7841	0.6132	0.5754	0.4755
13	0.8766	0.8208	0.7685	0.5887	0.5495	0.4410
14	0.8678	0.8083	0.7530	0.5652	0.5243	0.4202
15	0.8590	0.7962	0.7379	0.5426	0.5012	0.3950
16	0.8504	0.7841	0.7231	0.5210	0.4786	0.3712
17	0.8418	0.7728	0.7086	0.5001	0.4571	0.3481
18	0.8333	0.7607	0.6944	0.4801	0.4365	0.3279
19	0.8249	0.7492	0.6805	0.4610	0.4169	0.3082
20	0.8166	0.7379	0.6668	0.4426	0.3981	0.2897
21	0.8083	0.7267	0.6534	0.4249	0.3802	0.2724
22	0.8002	0.7158	0.6403	0.4080	0.3631	0.2560
23	0.7921	0.7950	0.6275	0.3916	0.3467	0.2406
24	0.7841	0.6944	0.6149	0.3760	0.3311	0.2261
25	0.7762	0.6839	0.6026	0.3610	0.3162	0.2125
26	0.7685	0.6736	0.5905	0.3465	0.3020	0.1998
27	0.7607	0.6634	0.5786	0.3328	0.2884	0.1878
28	0.7530	0.6534	0.5670	0.3195	0.2754	0.1767
29	0.7454	0.6436	0.5556	0.3067	0.2630	0.1009
30	0.7379	0.6339	0.5445	0.2944	0.2512	0.1560
31	0.7305	0.6243	0.5335	0.2821	0.2399	0.1465
32	0.7231	0.6149	0.5229	0.2714	0.2291	0.1378
33	0.7158	0.6056	0.5124	0.2605	0.2188	0.1295
34	0.7086	0.5965	0.5021	0.2501	0.2089	0.1217
35	0.7015	0.5875	0.4920	0.2401	0.1995	0.1144
36	0.6944	0.5786	0.4821	0.2305	0.1905	0.1075
37	0.6874	0.5699	0.4725	0.2214	0.1820	0.1011
38	0.6805	0.5613	0.4630	0.2125	0.1738	0.0950
39	0.6737	0.5529	0.4537	0.2040	0.1660	0.0893
40	0.6668	0.5445	0.4446	0.1959	0.1585	0.0833
41	0.6601	0.5362	0.4357	0.1880	0.1514	0.0789
42	0.6534	0.5282	0.4270	0.1805	0.1445	0.0742
43	0.6403	0.5202	0.4184	0.1734	0.1380	0.0697
44	0.6339	0.5124	0.4101	0.1664	0.1318	0.0665
45	0.6275	0.5047	0.4018	0.1598	0.1259	0.0616
46	0.6212	0.4971	0.3938	0.1534	0.1202	0.0579
47	0.6212	0.4896	0.3854	0.1472	0.1148	0.0544
48	0.6149	0.4821	0.3781	0.1414	0.1096	0.0511
49	0.6087	0.4749	0.3705	0.1357	0.1047	0.0481
50	0.6026	0.4677	0.3631	0.1303	0.1000	0.0452
51	0.5965	0.4607	0.3558	0.1251	0.0955	0.0425
52	0.5905	0.4537	0.3586	0.1201	0.0912	0.0399
53	0.5945	0.4469	0.3417	0.1153	0.0871	0.0375
54	0.5786	0.4401	0.3348	0.1108	0.0832	0.0355
55	0.5728	0.4335	0.3281	0.1063	0.0794	0.0331

56	0.5670	0.4270	0.3215	0.1021	0.0759	0.0312
57	0.5613	0.4206	0.3151	0.0979	0.0724	0.0293
58	0.5556	0.4142	0.3087	0.0940	0.0692	0.0275
59	0.5500	0.4080	0.3021	0.0903	0.0661	0.0259
60	0.5445	0.4018	0.2965	0.0867	0.0631	0.0243

**Note: A type – Brick in lime mortar, Teak wood only, B type – Both lime and mud mortar, Teak only, C type – Brick in mud mortar and country wood used, D type – Inferior to class C like police lines, E type – electrification, F type – Water supply and sanitary works**

### (31) Classification of Roads

**Express Ways:** They shall be suitable for all-weather use and should have atleast four lanes modern type surface with controlled access and grade separation at all road and rail crossings. The bridge shall be designed for the highest I.R.C. loading prescribed.

**National and State Highways:** They should be suitable for all weather use and have modern type surface. Access to these roads shall be limited and where necessary parallel service roads shall be provided for local traffic. As regards culverts and bridges all existing structures shall be designed for the highest I.R.C. loading.

**Major District Roads:** They shall be suitable for all weather use and have atleast a metalled single lane carriage way. The type of surface will depend upon the needs of the traffic. All new bridges shall be designed for I.R.C. Class A loading.

**Other District Roads:** They shall be suitable for all-weather use except at major river crossing where low level structures or ferries may be provided. The carriage way shall have a single lane width. The surface need be gravel or stabilized soil except where the consideration of climate and traffic necessitates a higher type of pavement. All bridge and culverts shall be designed for Class A loading.

**Village Roads:** These roads may have single lane carriage way with low cost surface of gravel or stabilized soil. They shall be provided with culverts at small streams, cause ways over minor river crossings and level structures or ferries at major river crossings. Village roads and other district roads are together known as rural roads.

### (32) Component layers of the pavement

**Sub Grade:** Sub grades shall be well compacted to utilize their full strength and to economise thereby on the overall thickness of pavement required. 95-100 percent of the Standard Proctor Density is to be ensured in the top 50cm of the subgrade. If the subgrade consists of bad clay or other unsuitable materials, the top 150mm or other specified depth of subgrade shall be removed and the excavation filled with earth accepted for other portions of the road, leveled, shaped, watered and compacted.

**Sub Base:** where there is the possibility of the sub grade working into the base, a layer of soling stones or suitably designed admixture of soils may be laid. The thickness of the sub base shall be determined from the CBR values of the sub grade; but should not be less than 10cm

**Base:** base material shall be of good quality to stand the high stress concentration which develop immediately under the wearing surface. The minimum thickness recommended for base is 15 cms even in minor roads. Water bound macadam is usually adopted as a base course material for our roads.

**Surfacing:** thin surface dressings and open graded premix carpets would be sufficient for medium to heavy traffic. For very heavy traffic and at locations like bus stops and roundabouts dense asphaltic concrete in single or multiple courses is suggested.



**(33) Minimum Standards of Roads in Kerala**  
(Vide K.S.S. 1974 and IRC:73-1980)

Sl. No.	Description	National Highways	State Highways	District roads MDRS & ODRS	Village Roads
1	Land width or right of way				
	(a) Open agricultural area on in built up areas	30m	30m	15	8m
	(b) By passes	45m	45m		-
2	Width of formation				
	(a) In plains and rolling terrain	12m	12m	7m	6m
	(b) In filling section				
	(i) In hard rock for two lanes	9m	9m	7m	4m
	In hard rock for single lanes	7m	7m	7m	4m
(ii) In other than hard rock for two lanes	10m	10m	7m	4m	
	In other than hard rock for single lanes	7.5m	7.5m	7m	4m
3	(a) Clear width of pavement				
	In straight reaches single lanes	3.75m	3.75	3.75m	3m
	In straight reaches two lanes without kerbs	7m	7m	7m	3m
	In straight reaches two lanes with kerbs	7.5m	7.5m	7.5m	3m
	In straight reaches for every additional lane to add	3m	3.5m	3.5m	3m
	(b) Extra widening of formation and pavements in curved sections				
	(i) For radius above 300m	-	-	-	-
	(ii) Radius 300 to 150m	0.3m	0.3m	-	-
(iii) Radius 150 to 60m	0.6m	0.6m	0.3m	0.3m	
(iv) Radius below 60m	0.9m	0.9m	0.6m	0.6m	
4	Cross fall or camber				
	(a) Earth, gravel or stabilized soil	-	-	-	1 in 25
	(b) Water-bound macadam	1 in 33	1 in 33	1 in 33	1 in 33
	(c) Black topped surface	1 in 50	1 in 50	1 in 50	1 in 50
	(d) Cement concrete pavement	1 in 72	1 in 72	1 in 72	1 in 72
(e) For shoulders or berms	1 in 33	1 in 33	1 in 33	1 in 33	

5	Gradient				
	(a) In planes and rolling terrain				
	(i) Ruling gradient	1 in 30	1 in 30	1 in 30	1 in 20
	(ii) Limiting or maximum Allowable gradient	1 in 20	1 in 20	1 in 15	1 in 15
	(iii) Exceptional or absolute maximum gdt to be adopted for short distances not exceeding 60m in a km	1 in 15	1 in 15	1 in 12	1 in 12
	(a) In hills				

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	(i) Ruling gradient (ii) Limiting gradient (iii) Exceptional gradient	1 in 20 1 in 15 1 in 12	1 in 20 1 in 15 1 in 12	1 in 15 1 in 12 1 in 12	1 in 15 1 in 12 1 in 12
6	Horizontal Curves (Radius) (a) Flat or Rolling (i) In planes ruling min Absolute min (ii) In rolling country ruling min Absolute min (b) In hills ruling min Absolute e min	370m 250m 250m 155m 80m 50m	370m 250m 250m 155m 80m 50m	240m 150m 250m 100m 80m 50m	90m 45m 80m 45m 80m 50m
7	Vertical Curves (a) Summit curves (b) Valley curves	Square Parabola Cubic Parabola	Square Parabola Cubic Parabola	- - - -	- - - -
8	Design speed for calculating Super elevation (a) In rolling terrain (b) In hilly areas	80 km/hr 50 km/hr	80 km/hr 50 km/hr	85 km/hr 40 km/hr	35 km/hr 25 km/hr
9	Structures (a) Culverts- width outside of parapet (b) Bridges- Clear width inside	12m 7.5m	12m 7.5m	7m 7.5m	126m 3.75m

### (34) Specification for temperature in bituminous works

Type of construction	Temperature at application/ mixing bitumen & aggregate		Temperature of mix at laying
	Bitumen	Mix	
Tack coat surface dressing 80/100 penetration	163-177	Dry	-
Penetration macadam 80/100 penetration	163-177	Dry	-
Penetration macadam 30/40 penetration	177-190	Dry	-
BUSG 80/100 penetration	163-177	Dry	-
Open graded mixes 80/100 penetration	150-165	125-150	110-135
Open graded mixes 60/70 penetration	165-180	125-150	110-135
Dense- semi dense mixes 80/100 penetration	165-180	150-177	155-163
Dense- semi dense mixes 60/70 penetration	165-177	150-177	155-163
Dense- semi dense mixes 30/40 penetration	175-190	150-177	155-163

**(35) Tentative Output of Road Machinery**

<b>Sl.No.</b>	<b>Machine/ Tool</b>	<b>Output</b>
1	Scraper(motorised) towed	160 cum/day
2	Dozer	200 cum/day
3	Motor Grader	600 cum/day
4	Excavator 1 m3 capacity	400 cum/day
5	Three smooth wheeled road roller	
5.1	Earth work	450 cum/day
5.2	Moorum/Gravel	450 cum/day
5.3	Pavement	
	1. WBM Stone base course	45 cum/day
	2. WBM/ WMM wearing course	40 cum/day
	3. DBM	40 cum/day
5.4	Surface Dressing	
	1. First Coat	2500 Sqm/ day
	2. Second Coat	3500 Sqm/ day
5.5	Premix Carpet	
	1. 25 mm Thick	2000 Sqm/ day
	2. 20 mm Thick	2000 Sqm/ day
6	Earthwork compaction by sheep foot road roller	600 cum/day
7	Vibratory Road Roller earth-work (Depends on layer thickness and type)	600 cum/day
8	Other Machinery	
8.1	Mini-Hot Mix Plant 6-10 TPH	8 Ton/Hr
8.2	Hot Mix Plant 40-60 TPH	50 Ton/Hr
8.3	Paver Finisher 75-160 TPH	75 Ton/Hr
8.4	Bitumen Boiler	2000 Litr/hr
8.5	Water Tankers	10,000 litres
8.6	Bitumen Pressure Distributors	10,000 litres
8.7	Wet Mix Macadam Plant 60 TPH	50 Ton/Hr
8.8	Stone crusher less than 100 ton/ hr	Depends on requirement

8.9	Multistage Stone crusher more than 100ton/hr	Depends on requirement
8.10	Concrete Batch mixing Plant upto 50 cum/Hr	40 cum/hr
8.11	Concrete Batching Mix more than 50 cum/Hr	Depends on requirement
9	Haulage by trucks/Tippers	
9.1	When lead = 2 km	8 Trips per day
9.2	When lead = 8 km	6 Trips per day
9.3	When Lead = 16 km	5 trips per day
9.4	When lead = 30 km	4 trips per day

### (36) Floor- Area ratio (F.A.R)

Sl No.	Building use/ Occupancy	Max. permissible coverage	Max permissible FAR (without additional fee)	Max. permissible FAR (with additional fee)
1	Residential A1	65	3	4
2	Spl. Residential A2	65	2.5	4
3	Educational B	35	2.5	3
4	Medical/ Hospital C	40	2	3
5	Assembly D	40	1.5	2.5
6	Office/ Business D	40	2	3
7	Mercantile/ Commercial F	65	2.5	4
8	Industrial G1	40	1.5	0
9	Small Industrial G2	60	2.5	3
10	Storage H	60	2.5	3
11	Hazardous I1	30	1	0
12	Hazardous I2	25	0.7	0

### (37) Requirements of parts of buildings

#### 1. Plinth

Main buildings- The plinth or any part of a building shall be so located with respect to the surrounding ground level that adequate drainage of the site is assured. The height of plinth shall not be less than 45cm from the surrounding ground level.

Interior courtyard- Every interior courtyard shall be raised atleast 15cm above the level of the centre of the nearest street and shall be satisfactorily drained.

#### 2. Habitable rooms

Residential, business & mercantile buildings- The height of all rooms for human habitation shall not be less than 2.75m measured from the surface of the floor to the lowest point of the ceiling.

Educational buildings- Ceiling height 3.6m for all regions; in cold regions, 3m

Industrial buildings- Ceiling height 3.6m, except when air conditioned, 3m

#### 3. Bathrooms & Water closets

The height of the bathroom/ WC measured from the surface of the floor to the lowest point in the ceiling shall not be less than 2m.

#### 4. Ledge or Tand/ Loft

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It shall have a minimum head room of 2.2m. The maximum height of loft shall be 1.5m.

#### 5. Garage

The height of the garage shall not be less than 2.4m. The size of the garage shall be as;

Private garage	2.5 x 5.0 m (min)
Public garage	Based on the number of vehicles parked

#### 6. Chimneys

The chimneys shall be built atleast 0.9m above the flat roofs. In the case of sloping roofs, the chimney top shall not be less than 0.6m above the ridge of the roof in which the chimney penetrates.

#### 7. Parapet

Parapet walls and handrails provided on the edges of the roof terraces, balcony, verandah etc shall not be less than 1.05m and not more than 1.2m in height from the finished floor level.

### (38) Standards of space allotment for various types of buildings

#### 1. School Buildings

1. For primary Schools	
Class Room:	Minimum of 1 sq. m per student
2. For Secondary Schools:	Minimum of 1 sq. m per student
3. For Colleges(Arts & Science)	
Lecture Hall:	Minimum of 1.2 sq. m per student
Laboratory:	Minimum of 2.5 sq. m per student

The requirement for Professional Colleges will be suggested by the authorities concerned.

#### 2. Student Hostels

1. For Dormitories:	Minimum of 4.5 sq. m per student
For triple occupancy:	Minimum of 6.5 sq. m per student
For Double Occupancy:	Minimum of 7.5 sq. m per student
For Single Occupancy:	Minimum of 9.0 sq. m per student

#### 2. Standards for Sanitary Requirements

Relevant rules in KMBR shall be followed.

For office buildings, officers with basic pay 36140 and above are eligible for separate toilet.

#### 3. Tourist Bungalows

1. Economic Class:	
Area for Single Room:	12 sq.m excluding toilets
Area for Double Room:	18 sq.m excluding toilets
2. Upper Class:	
Area for Single Room:	15 sq.m excluding toilets
Area for Single Room:	20 sq.m excluding toilets

#### 4. Government Officials

1. For Gazetted Officer	15 sq.m.
2. For Non-gazetted Officer	3.75 sq.m.
3. For records	10% of the item no.2 above

**(39) Dimensions of play ground**

<b>1</b>	<b>Football Field</b>	Length-90 m to 120m ;Breadth-45m to 90m For international matches L=100m to 110m; B= 64m to 75m. Goal posts are 7.32m apart (inside measurement) and cross bar (lower edge) 2.4m from ground.
<b>2</b>	<b>Hockey Field</b>	Length- 100 yds/ 91.44m; Breadth-60 yds/ 54.86m. Goal posts are 4 yds/ 3.66m apart and cross bar 7 ft/ 2.13m from ground (inside measurement)
<b>3</b>	<b>Basketball Court</b>	Length- 28m; Width-15m. Radius of centre circle- 1.8m. Size of back board- 1.8m x 1.2m. Diameter of basket- 0.45m (inside). Height of the basket from floor- 3.05m.
<b>4</b>	<b>Volleyball Court</b>	Length- 18m; Width- 9m. Net shall be 1.0m wide and 9.5m long. The height of the net (top edge) from the ground shall be 2.43m for men and 2.24m for women.
<b>5</b>	<b>Lawn Tennis Court</b>	Length- 78ft/ 23.77m; Breadth- 36ft/ 10.97m (27ft/ 8.23m for singles). Height of net at the centre – 3ft/ 0.915m
<b>6</b>	<b>Badminton (Ball) Court</b>	Length- 80ft/ 24.38m; Breadth- 40ft/ 12.19m. Height of net (Top edge) from ground- 6ft/ 1.83m at centre and 6ft lin/ 1.855m at posts.
<b>7</b>	<b>Mini Basketball Court</b>	Length- 26m; Width-14m. Radius of centre circle- 1.8m. Size of back board- 1.2m x 0.9m. Diameter of basket- 0.45m (inside). Height of the basket from floor- 2.6m.
<b>8</b>	<b>Handball Court</b>	Length- 40m; Width- 20m. Goal posts are 3.0m apart and 2.0m high.
<b>9</b>	<b>Badminton (Shuttle) Court</b>	Length- 44ft/ 13.4m; Breadth-20ft/ 6.10m. Height of net(tp edge) from ground- 5ft/ 1.524m at centre and 5ft/ 1.55m at posts
<b>10</b>	<b>Table Tennis</b>	Size of table- 9ft/ 2.74m x 5 ft/ 1.52m. Height of playing surface from floor- 2.5ft/ 0.76m; Height of net from playing surface- 15.25cm. Diameter of ball- 38mm; Weight of ball- 2.5gm.
<b>11</b>	<b>Cricket</b>	Ball- Weight 5 ½ to 5 ¾ Oz. Circumference 8 ½ to 9 inch Bat- Max width 4 ¼ inch. Max length- 38 inch Wickets- 22 yards from stump pitch- 5 ft on each side Top of stump- 28 inch from ground Ground- Minimum 60 yards from centre of pitch



**(41) Dimensions and Nominal Mass of Steel Tubes****IS 1239 (PART 1) : 2004**

Nominal Bore mm (1)	Outside Diameter		Thickness mm (4)	Mass of Tube	
	Maximum mm (2)	Minimum mm (3)		Plain End kg/m (5)	Screwed and Socketed kg/m (6)
6	10.1	9.7	1.8	0.360	0.363
8	13.6	13.2	1.8	0.515	0.519
10	17.1	16.7	1.8	0.670	0.676
15	21.4	21.0	2.0	0.947	0.956
20	26.9	26.4	2.3	1.38	1.39
25	33.8	33.2	2.6	1.98	2.00
32	42.5	41.9	2.6	2.54	2.57
40	48.4	47.8	2.9	3.23	3.27
50	60.2	59.6	2.9	4.08	4.15
65	76.0	75.2	3.2	5.71	5.83
80	88.7	87.9	3.2	6.72	6.89
100	113.9	113.0	3.6	9.75	10.0

**(42) Dimensions and Nominal Mass of Steel Tubes – Medium****IS 1239 (PART 1) : 2004**

Nominal Bore mm (1)	Outside Diameter		Thickness mm (4)	Mass of Tube	
	Maximum mm (2)	Minimum mm (3)		Plain End kg/m (5)	Screwed and Socketed kg/m (6)
6	10.6	9.8	2.0	0.404	0.407
8	14.0	13.2	2.3	0.641	0.645
10	17.5	16.7	2.3	0.839	0.845
15	21.8	21.0	2.6	1.21	1.22
20	27.3	26.5	2.6	1.56	1.57
25	34.2	33.3	3.2	2.41	2.43
32	42.9	42.0	3.2	3.10	3.13
40	48.8	47.9	3.2	3.56	3.60
50	60.8	59.7	3.6	5.03	5.10
65	76.6	75.3	3.6	6.42	6.54
80	89.5	88.0	4.0	8.36	8.53
100	115.0	113.1	4.5	12.2	12.5
125	140.8	138.5	4.8	15.9	16.4
150	166.5	163.9	4.8	18.9	19.5

**(43) Dimensions and Nominal Mass of Steel Tubes – Heavy****IS 1239 (PART 1) : 2004**

Nominal Bore	Outside Diameter		Thickness	Mass of Tube	
	Maximum	Minimum		Plain End	Screwed and Socketed
	mm	mm		kg/m	kg/m
(1)	(2)	(3)	(4)	(5)	(6)
6	10.5	9.8	2.6	0.487	0.490
8	14.0	13.2	2.9	0.765	0.769
10	17.5	16.7	2.9	1.02	1.03
15	21.8	21.0	3.2	1.44	1.45
20	27.3	26.5	3.2	1.87	1.88
25	34.2	33.3	4.0	2.93	2.95
32	42.9	42.0	4.0	3.79	3.82
40	48.8	47.9	4.0	4.37	4.41
50	60.8	59.7	4.5	6.19	6.26
65	76.6	75.3	4.5	7.93	8.05
80	89.5	88.0	4.8	9.90	10.10
100	115.0	113.1	5.4	14.50	14.80
125	140.8	138.5	5.4	17.90	18.40
150	166.5	163.9	5.4	21.30	21.90

**MARKING**

Each tube shall be marked with manufacturer's name or trade-mark, IS No. that is, IS 1239 (Part 1) and class of tubes, that is, L, M, and H, for light, medium and heavy class. The different classes of tubes shall be distinguished by colour bands, which shall be applied as follows before the tubes leave the manufacturer's works:

- Light tubes—Yellow
- Medium tubes— Blue
- Heavy tubes —Red

NOTE — For export purpose the colour band on the light tubes may be painted yellow or brown.

### (44) Hollow Steel Sections for Structural Use – Specification IS 4923 : 1997

#### Dimensions and properties of square hollow section (IS:4923)

Designation	Depth or Width <i>D</i>	Thick-ness	Weight	Area of Section	Moment of Inertia	Radius of Gyration	Elastic Modulus	Plastic Modulus
mm	mm	mm	kg/m	cm <sup>2</sup>	cm <sup>4</sup>	cm	cm <sup>3</sup>	cm <sup>3</sup>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
25.0 × 25.0 × 2.6	25.0	2.6	1.69	2.16	1.72	0.89	1.38	1.76
25.0 × 25.0 × 3.2	25.0	3.2	1.98	2.53	1.89	0.86	1.51	1.98
30.0 × 30.0 × 2.6	30.0	2.6	2.10	2.68	3.23	1.10	2.15	2.68
30.0 × 30.0 × 3.2	30.0	3.2	2.49	3.17	3.62	1.07	2.41	3.08
30.0 × 30.0 × 4.0	30.0	4.0	2.94	3.75	3.97	1.03	2.64	3.50
32.0 × 32.0 × 2.6	32.0	2.6	2.26	2.88	4.02	1.18	2.51	3.11
32.0 × 32.0 × 3.2	32.0	3.2	2.69	3.42	4.54	1.15	2.84	3.59
32.0 × 32.0 × 4.0	32.0	4.0	3.19	4.07	5.02	1.11	3.14	4.11
35.0 × 35.0 × 2.6	35.0	2.6	2.51	3.20	5.43	1.30	3.10	3.81
35.0 × 35.0 × 3.2	35.0	3.2	2.99	3.81	6.18	1.27	3.53	4.42
35.0 × 35.0 × 4.0	35.0	4.0	3.57	4.55	6.93	1.23	3.96	5.11

38.0 × 38.0 × 2.6	38.0	2.6	2.75	3.51	7.14	1.43	3.76	4.57
38.0 × 38.0 × 2.9	38.0	2.9	3.03	3.86	7.68	1.41	4.04	4.97
38.0 × 38.0 × 3.2	38.0	3.2	3.29	4.19	8.18	1.40	4.30	5.34
38.0 × 38.0 × 3.6	38.0	3.6	3.63	4.62	8.76	1.38	4.61	5.80
38.0 × 38.0 × 4.0	38.0	4.0	3.95	5.03	9.26	1.36	4.87	6.22
40.0 × 40.0 × 2.6	40.0	2.6	2.92	3.72	8.45	1.51	4.22	5.12
40.0 × 40.0 × 3.2	40.0	3.2	3.49	4.45	9.72	1.48	4.86	6.01
40.0 × 40.0 × 3.6	40.0	3.6	3.85	4.91	10.45	1.46	5.22	6.53
40.0 × 40.0 × 4.0	40.0	4.0	4.20	5.35	11.07	1.44	5.54	7.01
45.0 × 45.0 × 2.6	45.0	2.6	3.32	4.24	12.47	1.71	5.52	6.64
45.0 × 45.0 × 2.9	45.0	2.9	3.66	4.67	13.45	1.70	5.98	7.25
45.0 × 45.0 × 3.2	45.0	3.2	3.99	5.09	14.41	1.68	6.40	7.83
45.0 × 45.0 × 3.6	45.0	3.6	4.42	5.63	15.57	1.66	6.92	8.55
45.0 × 45.0 × 4.5	45.0	4.5	5.31	6.77	17.74	1.62	7.88	9.99
49.5 × 49.5 × 2.9	49.5	2.9	4.07	5.19	18.37	1.88	7.42	8.93
49.5 × 49.5 × 3.6	49.5	3.6	4.93	6.28	21.42	1.85	8.66	10.60
49.5 × 49.5 × 4.5	49.5	4.5	5.95	7.58	24.64	1.80	9.96	12.47
63.5 × 63.5 × 3.2	63.5	3.2	5.85	7.45	44.35	2.44	13.97	16.65
63.5 × 63.5 × 3.6	63.5	3.6	6.51	8.29	48.55	2.42	15.29	18.36
63.5 × 63.5 × 4.5	63.5	4.5	7.93	10.10	57.00	2.38	17.95	21.93
72.0 × 72.0 × 3.2	72.0	3.2	6.71	8.54	66.32	2.79	18.42	21.80
72.0 × 72.0 × 4.0	72.0	4.0	8.22	10.47	79.03	2.75	21.95	26.32
72.0 × 72.0 × 4.8	72.0	4.8	9.66	12.31	90.31	2.71	25.09	30.49
75.0 × 75.0 × 3.2	75.0	3.2	7.01	8.93	75.53	2.91	20.41	23.79
75.0 × 75.0 × 4.0	75.0	4.0	8.59	10.95	90.19	2.87	24.05	28.76
75.0 × 75.0 × 4.9	75.0	4.9	10.30	13.12	104.82	2.83	27.95	33.92
88.9 × 88.9 × 3.6	88.9	3.6	9.38	11.95	142.83	3.46	32.13	37.85
88.9 × 88.9 × 4.5	88.9	4.5	11.52	14.67	170.97	3.41	38.46	45.85
88.9 × 88.9 × 4.9	88.9	4.9	12.44	15.85	182.57	3.39	41.07	49.23
91.5 × 91.5 × 3.6	91.5	3.6	9.67	12.32	156.49	3.56	34.21	40.24
91.5 × 91.5 × 4.5	91.5	4.5	11.88	15.14	187.57	3.52	41.00	48.79
91.5 × 91.5 × 5.4	91.5	5.4	14.01	17.85	215.68	3.48	47.14	56.77
100.0 × 100.0 × 4.0	100.0	4.0	11.73	14.95	226.35	3.89	45.27	53.30
100.0 × 100.0 × 5.0	100.0	5.0	14.41	18.36	271.10	3.84	54.22	64.59
100.0 × 100.0 × 6.0	100.0	6.0	16.98	21.63	311.47	3.79	62.29	75.10
113.5 × 113.5 × 4.5	113.5	4.5	14.99	19.10	372.88	4.42	65.71	77.33
113.5 × 113.5 × 4.8	113.5	4.8	15.92	20.28	393.31	4.40	69.30	81.81
113.5 × 113.5 × 5.4	113.5	5.4	17.74	22.60	432.58	4.38	76.23	90.55
113.5 × 113.5 × 6.0	113.5	6.0	19.53	24.87	469.81	4.35	82.79	98.96
125.0 × 125.0 × 4.5	125.0	4.5	16.62	21.17	505.83	4.89	80.93	94.84
125.0 × 125.0 × 5.0	125.0	5.0	18.33	23.36	552.62	4.86	88.42	104.10
125.0 × 125.0 × 6.0	125.0	6.0	21.69	27.63	640.89	4.82	102.54	121.87
132.0 × 132.0 × 4.8	132.0	4.8	18.71	23.83	634.39	5.16	96.12	112.69
132.0 × 132.0 × 5.4	132.0	5.4	20.88	26.59	700.11	5.13	106.08	125.02
132.0 × 132.0 × 6.0	132.0	6.0	23.01	29.31	762.98	5.10	115.60	136.98
150.0 × 150.0 × 5.0	150.0	5.0	22.26	28.36	982.12	5.89	130.95	152.98
150.0 × 150.0 × 6.0	150.0	6.0	26.40	33.63	1145.91	5.84	152.79	179.88

## (45) Dimensions and properties of Rectangular hollow steel sections (IS:4923)

Designation	Depth of Section <i>D</i>	Width of Section <i>B</i>	Thick- ness	Weight	Area of Section	Moment of Inertia About		Radius of Gyration About		Elastic Modulus About		Plastic Modulus About	
						X-X	Y-Y	X-X	Y-Y	X-X	Y-Y	X-X	Y-Y
						$\text{cm}^4$	$\text{cm}^4$	cm	cm	$\text{cm}^3$	$\text{cm}^3$	$\text{cm}^3$	$\text{cm}^3$
mm (1)	mm (2)	mm (3)	mm (4)	Kg/m (5)	$\text{cm}^2$ (6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
50.0 × 25.0 × 2.9	50.0	25.0	2.9	2.98	3.80	10.93	3.60	1.70	0.97	4.37	2.88	5.72	3.48
50.0 × 25.0 × 3.2	50.0	25.0	3.2	3.24	4.13	11.63	3.80	1.68	0.96	4.65	3.04	6.14	3.73
60.0 × 40.0 × 2.9	60.0	40.0	2.9	4.12	5.25	24.74	13.11	2.17	1.58	8.25	6.56	10.25	7.73
66.0 × 33.0 × 2.9	66.0	33.0	2.9	4.07	5.19	27.33	9.12	2.29	1.33	8.28	5.53	10.59	6.49
66.0 × 33.0 × 3.6	66.0	33.0	3.6	4.93	6.28	31.87	10.52	2.25	1.29	9.66	6.37	12.56	7.66
66.0 × 33.0 × 4.5	66.0	33.0	4.5	5.95	7.58	36.64	11.93	2.20	1.25	11.10	7.23	14.77	8.94
70.0 × 30.0 × 2.9	70.0	30.0	2.9	4.12	5.25	29.82	7.72	2.38	1.21	8.52	5.14	11.07	6.04
70.0 × 30.0 × 3.2	70.0	30.0	3.2	4.50	5.73	32.04	8.24	2.37	1.20	9.15	5.49	11.98	6.51
70.0 × 30.0 × 4.0	70.0	30.0	4.0	5.45	6.95	37.23	9.42	2.31	1.16	10.64	6.28	14.20	7.66
80.0 × 40.0 × 2.9	80.0	40.0	2.9	5.03	6.41	50.87	17.11	2.82	1.63	12.72	8.56	16.07	9.88
80.0 × 40.0 × 3.2	80.0	40.0	3.2	5.50	7.01	54.94	18.41	2.80	1.62	13.74	9.21	17.46	10.72
80.0 × 40.0 × 4.0	80.0	40.0	4.0	6.71	8.55	64.79	21.49	2.75	1.59	16.20	10.74	20.91	12.77
96.0 × 48.0 × 3.2	96.0	48.0	3.2	6.71	8.54	98.61	33.28	3.40	1.97	20.54	13.87	25.85	15.91
96.0 × 48.0 × 4.0	96.0	48.0	4.0	8.22	10.47	117.54	39.32	3.55	1.94	24.49	16.30	31.21	19.14
96.0 × 48.0 × 4.8	96.0	48.0	4.8	9.66	12.31	134.35	44.55	3.30	1.90	27.99	18.56	36.13	22.08
100.0 × 50.0 × 3.2	100.0	50.0	3.2	7.01	8.93	112.29	37.95	3.55	2.06	22.46	15.18	28.20	17.37
100.0 × 50.0 × 4.0	100.0	50.0	4.0	8.59	10.95	134.14	44.95	3.50	2.03	26.83	17.98	34.10	20.93
122.0 × 61.0 × 3.6	122.0	61.0	3.6	9.67	12.32	232.61	78.83	4.34	2.35	38.13	25.84	47.71	29.42
122.0 × 61.0 × 4.5	122.0	61.0	4.5	11.88	15.14	278.94	93.78	4.29	2.49	45.73	30.75	57.85	35.56
122.0 × 61.0 × 5.4	122.0	61.0	5.4	14.01	17.85	320.83	107.03	4.24	2.45	52.60	35.09	67.29	41.22
127.0 × 50.0 × 3.6	127.0	50.0	3.6	9.34	11.89	227.08	52.05	4.37	2.09	35.76	20.82	45.95	23.70
127.0 × 50.0 × 4.6	127.0	50.0	4.6	11.69	14.89	276.33	62.46	4.31	2.05	43.52	24.98	56.66	29.04
145.0 × 82.0 × 4.8	145.0	82.0	4.8	15.92	20.28	555.16	228.50	5.23	3.36	76.57	55.73	94.93	63.93
145.0 × 82.0 × 5.4	145.0	82.0	5.4	17.74	22.60	610.85	250.59	5.20	3.33	84.26	61.12	105.07	70.66
172.0 × 92.0 × 4.8	172.0	92.0	4.8	18.71	23.83	917.13	346.91	6.20	3.82	106.64	75.41	132.08	85.61
172.0 × 92.0 × 5.4	172.0	92.0	5.4	20.88	26.59	1012.47	381.74	6.17	3.79	117.73	82.99	146.55	94.86