CONVERSION OF BRITISH TO SI UNITS

Length

1 mile = 1.609 34 km
1 furlong = 0.201168 km
1 chain = 20.116 8 km
1 yd = 0.914 4 m
1 ft = 0.304 8 m
1 in = 25.4 mm
= 25.4 μm
1 milli-inch ('thou') = 25.4 μm
1 μ in (0.000 001 in) = 0.0254 μm
1 nautical mile (UK) = 1.853 18 km
1 fathom = 1.8288 m

Area

1 sq mile = 2.589 99 km^2
= 258.999 hat
1 acre = 4046.86 m^2
= 0.404 686 ha
1 rood = 1011.71 m^2
1 yd^2 (Square yard) = 0.836 127 m^2
1 ft^2 (Square foot) = 0.092 903 0 m^2
= 929.030 cm^2
1 in^2 (square inch) = 645.16 mm^2
= 6.451 6 cm^2
† 1 hectare (ha) = 10,000 m^2

Volume

1 yd^3 (cubic yard) = 0.764 555 m^3
1 ft^3 (cubic foot) = 28.316 8 dm^3
1 in^3 (cubic inch) = 16.387 1 cm^3

Capacity

1 bu (bushel) = 36.368 7 dm^3
1 pk (peck) = 9.092 18 dm^3
1 gal = 4.546 09 dm^3
1 US gal = 3.785 41 dm^3
1 qt (quart) = 1.136 52 dm^3
1 pt (pint) = 0.568 261 dm^3
1 gill = 0.142 065 dm^3
1 floz = 28.413 1 cm^3
1 fluid drachm = 3.551 63 cm^3
1 minim = 59.193 9 mm^3

Moment of section (second moment of area)

1 ft^4 = 0.008 630 97 m^4
= 86. 309 7 dm^4
1 in^4 = 41.623 1 cm^4

Velocity

1 mile/h (mph) = 1.609 34 km/h
1 ft/s = 0.304 8m/s
1 ft/min = 0.005 08 m/s
= 0.304 8 m/min
1 in = 2.54 cm/s
1 in/min = 0.042 333 cm/s
= 2.54 cm/min
1 UK knot = 1.853 18 km/h

Acceleration

1 ft/s^2 (foot per second per second) = 0.304 8 m/s^2

Mass

1 ton = 1016.05 kg
=1.016 05 t ★
1 cwt = 50.802 3 kg
1 ctl = 45.359 2 kg
1 quarter = 12.700 6 kg
1 stone = 6.350 29 kg
1 lb = 0.453 592 37 kg
1 oz = 28.349 5g
1 dr (dram) = 1.771 85 g
1 gr (grain) = 64.798 9 mg
=0.323 995 metric carat †
1 oz apoth = 1 oz tr = 31.103 5 g
1 drachm = 3.887 93 g
1 scruple = 1.295 98 g
1 dwt (penny weight) = 1.555 17 g
1 slug = 14.593 9 kg
* t = tonne (metric ton) equal to 1000 kg
† metric carat = 0.2 g

Mass rate of flow

1 ton/h = 1016.05 kg/h
= 1.016 05 t/h
1 lb/h = 0.453 592 kg/h
1 lb/s = 0.453 592 kg/s

Volume rate of flow

1 ft^3/s (1 cusec) = 0.028 316 8 m^3/s
= 28.316 8 dm^3/s
1 gal/h = 4.546 09 dm^3/h
1 gal/s = 4.546 09 dm^3/s

Fuel consumption

1 gal/mile = 2.825 l/km
= 2.824 81 dm^3/km
1 US gal/mile = 2.352 l/km
= 2.352 15 dm^3/km
1 mile/gal = 0.3540 km/l
= 0.354 006 km/dm^3
1 mile/Us gal = 0.425 1 km/l
= 0.425 144 km/dm^3

CONVERSION OF BRITISH TO SI UNITS (CONTD.)

Density

1 ton/yd^3 = 1328.94 kg/m^3
= 1.328 94 t/m^3
1 lb/ft^3 = 16.018 5 kg/m^3
1 lb/in^3 = 27.679 9 g/cm^3
=27.679 9 Mg/m^3
1 lb/gal = 0.099776 3 kg/dm^3
= 0.099 78 kg/l
1 slug/ft^3 = 515.379 kg/m^3

Moment of Inertia

1 lb ft^2 = 0.042 140 1 kg m^2
1 lb in^2 = 2.926 40 kg cm^2
1 oz in^2 = 0.182 900 kg cm^2
1 slug ft^2 = 1.355 82 kg m^2

Momentum

1 lb ft/s = 0.138 255 kg m/s

Angular Momentum

1 lb ft^2/s = 0.042 140 1 kg m^2/s

Force

1 ton f = 9.964 02 kN
1 lb f = 4.448 22 N
1 oz f = 0.278 014 N
1 pdl = 0.138 255 N

Pressure, Stress

1 tonf/ft^2 = 107.252 kN/m^2
1 tonf/in^2 = 15.444 3 MN/m^2
1 lbf/ft^2 = 47.880 3 N/m^2
1 lbf/in^2 = 6894.76 N/m^2
= 68.9476 mbar or mb
1 pdl/ft^2 = 1.488 16 N/m^2
1 ft H_2O = 298.907N/m^2
1 in Hg = 3386.39 N/m^2
= 33.8639 mbar or mb

Viscosity (dynamic Viscosity)

1 lbf h/ft^2 = 0.172 369 MN s/m^2
1 lbf s/ft^2 = 47.08803 N s/m^2
1 pdl s/ft^2 = 1488 16 N s/m^2
= 1.488 16 cP
(Centipoise)
1 slug/fts = 47.880 3 kg/ms
1 Btu in/ft^{2}s degF= 519.220 W/m degc
(Jm/m^{2}s degC)

Energy (work, heat)

1 therm = 105.506 MJ
1 hp h = 2.68452 MJ
(horsepower x hour)
1 KWh = 3.6 MJ
1 Btu (British
Thermal Unit) = 1.05506 kJ
1 ft lbf = 1.355 82 J
1 ft pdl = 0.042 140 1J

Power

1 hp (horsepower) = 745.700 W (J/s)
= 0.745 700 KW
1 ft lbf/s = 1.355 82 w

Heat flow rate

1 Btu/h = 0.293 07 1w (J/s)

Specific energy, specific latent heat

1 Btu/lb = 2326 J/kg
1 ft lbf/lb = 2.989 07 J/kg

Calorific value, volume basis

1 therm/gal = 23.2080 MJ/dm^2
= 23.2080 GJ/m^3
1 Btu/t3 = 0.037 258 J/cm^3
= 37.258 9 kJ/m^3

Thermal capacity per unit mass, specific heat capacity

1 Btu/lb degF = 4186.8 J/kg degc
1 ft lbf/lb degF = 5.380 32 J/kg degC

Specific entropy

1 Btu/lb^o R = 4186.8 J/kg^{o}k

Thermal conductance, coefficient of heat transfer

1 Btu /t^2 h degF
= 5.5678 26 W/m^2 degC
(J/m^{2}s deg C)

Thermal conductivity

1 Btu ft/ft^2 h degF
= 1.730 73 W/m deg C
(J m/m^{2}s dec C)
1 Btu in/ft^2 h deg F
= 0.144 228 W/m deg C
(J m/m^{2}s dec c)

MENSURATION

AREAS

Square

Diagonal = side x (2) 1/2 = 1.414 side
Area = side^2 = 1.2732 x area of inscribed circle
= 0.6366 x area of Circumscribing circle
Dia. of a circle equal in area to square = 1.284 x side of sq.
Dia. of circle equal periphery as square = 1.273 x side of sq.
Dia. of a circle circumscribed about square = 1.414 x side of sq.
Circumference of a circle circumscribing a square = 4.443 x side of sq.

Triangle:

Area = ½ x base x perpendicular height
$=\{ s(s-a)(s-b)(s-c) \}^{1/2}$ = (abc) 4R = rs
r = Area/s. R = (abc) / 4rs = (abc) /4 area
a,b,c are sides; s= ½ (a+b+c)
R = Radius of circumscribed of escribed circle
r = Radius of inscribed circle

Circle

Area = 1/4 x 3.14 x dia^2 = 3.14 x r^2
circumference = 3.14 x d = 3.5449 x (area)½
Side of square equal in area = 0.8862 x dia
Side of an inscribed square = 0.707 x dia. of circle
Side of an inscribed equlateral triangle = o.86 x dia.
Side of a square of equal periphery as circle = .785 x dia.
Quadrilateral inscribed in a circle
Area = { (s-a) (s-b) (s-c) (s-d) } ½
a.b.c.d. are sides s = ½ (a+b+c+d)

Semi-Circle

Centre of gravity lies at a distance of 4r/(3x3.14) from the diameter

Arc of a circle:

Length of an arc = $\frac{\theta x 2 x 3.14 x r}{360}$ x r/57.3
θ is the central angle of arc in degrees
r is the radius of the circle.

Sector of a circle :

A sector is the space included between an arc and two radius drawn to the centre.

Area = $\frac{x 3.14 x r ½}{360}$ ½ xrxl

L is the length of the arc = x3. 14xr /180 (in degrees)
r is the radius of the circle.

'centre of gravity' of the sector lies at a distance of $\frac{2 \times r \times 2a}{3L}$ from the centre on the centre line of the sector, 2a is the base or the width of segment (or chord)

Segment of circle:

A segment is that part of the circle contained between the arc and its chord.

Area = $\frac{4 \times h \times (a^2 + 2/5h^2)^{1/2}}{3}$ or $\frac{4 \times a \times h}{3}$ (approx)

'h' is the rise and 'a' is of the chord length
'Centre of gravity of a segment of circle lies at a distance of $(2^2)^3/12$xarea from the centre of the circle on the centre line of the segment.

Ellipse:

Area-0.25 x 3.14 x Dxd
D is the major long axis
d is the minor short axis
Long axis X 0.7854 = short axis
Perimeter of circumference (approx)-3.146 x $2(a^2+b^2)$ ½ a-½ D and b=½d

Parabola:

Area-base x ⅔ x height

Polycons

Area of any regular polygon - radius of inscribed circle (perpendicular drawn from the centre of the figure to the centre of side)x ½ sum of all sides.

Sum of interior angles of any polygon regular or irregular-180° x(Number of sides -2)

A regular polygon has equal sides and equal angles

a) Regular pentagon ..... Area - 1.721 x side^2

b) Regular hexagon ..... Area - 2.598 x side^2

c) Regular Octagon ..... Area - 4.828 x side^2

d) Regular Decagon ..... Area - 7.694 x side^2

e) Regular Dodecagon (12 sides) ..... Area - 11.197 x side^2

Trapezium

Area - sum of parallel Sides x ½ height

Irregular figures

" Simpson's Rule" Divide the area figure into an even number (n) of parallel strips by means of (n+1) ordinates, spaced at equal distances 'd'

Area - $\frac{d}{3}$ x first ordinate + last ordinate + 2 (sum of all intermediate odd numbered ordinates) + 4 (sum ofall intermediate even numbered ordinates

VOLUMES AND SURFACES

Diagonal of a Cube - edge of cube x $(3)^{1/2}$

Diagonal of a Rectangular solid - $(\text{length})^2 + (\text{breadth})^2 + (\text{depth})^2$

Circular Cones:

Volume = (area of basexvertical height) / 3

Convex area = ½ x perimeter of base x slant height = $3.14r\ (r^2xh^2xh^2)^{1/2}$

r is the radius and h is the vertical height centre of gravity = ¼ vertical height above base

Sphere:

Surface are a = 3.14 x dia^2

Volume = surface area x 1/6 dia

side of an equal cube = 0.806 x dia. of sphere

Side of an inscribed cube = 1.1547 x radius

Length of an equi cylinder = 0.6667 x dia. of sphere

Hemisphere Half sphere:

Total Surface area = 3 x 3.14 x rad^2

Volume = (3.14 x rad^2)

Centre of gravity 3 x rad/8 above spherical centre

Spherical sector :

Volume = 2x3.14xr^2 x h/3

Total area of conical and spherical surface = 3.14 r (2h + ¼c)

Centre of gravity above centre of sphere .... 3 (r-½h)/4

r is the radius of the sphere

C is the diameter of the segment subtended

h is the rise at the centre of the subtended segment.

Spherical segment:

Volume - 3.14 x h^2 x (r-h/3)

Area of spherical surface - 2x3.14 x r x h

Centre of gravity above the base of segment = $\frac{h(4r-h)}{4\ (3r-h)}$

r is the radius of the sphere

h is the rise at the centre of segment

Spherical zone:

A spherical zone is the part of a sphere included between two parallel planes

Volume = $\frac{3.14}{6}\ \frac{3\ C_1^2}{4} + \frac{3\ C^2}{4} + h^2 \text{ x } hr$

Area of spherical or convex surface only - 2x3.14 x r x h c_1 and c_2 are the diameters of the two circles cut by the two planes on the sphere h1 is the distance between the two planes r in the radius ofthe sphere

Spherical Wedge : (of a°)

$$\text{Volume} = \frac{a^{\circ} \times 4 \times 3.1 \times 1^3}{360 \times 3}$$ is the radius of the sphere

$$\text{Area of spherical surface} = \frac{a^{\circ}}{360} \times 4 \times 3.14 \times 1^2$$

Hollow Spheres or spherical shell

Volume = $4 \times 3.14 \times 1 \times (R^3 - r^3)/3$

R is the outer radius and r is the inner radius of the hollow spheres.

Cylindrical ring torus :

Volume = $2 \times (3.1416)^2 \times R \times r^2$

R is the radius of the ring

Area of the spherical surface = $4 \times (3.14) \times R \times r$

r is the radius of cross section of the cylinder which is to be bent to form a circular

Prismoids :

(End face are plane and parallel to each other)

Volume - $hA_1 + A_2 + 4/6$

A1 and A2 are the areas of ends, top and bottom

A is the area of the mid section parallel to ends.

h is the length between ends, or height.

Frusta of Pyramids and cones:

If a pyramid or cone is cut by a plane parallel to the base, so as to form parts, the lower part is called the Frustum of the Pyramid of cone.

R is the radius of the ring

$$\text{Volume} = \frac{h}{3}(A_1 + A_2 + \sqrt{A_1 A_2})$$

Surface area = $\frac{1}{2} \times s \times (P + p)$

A_1 and A_2 are the surface areas of the top and bottom planes:

s is the slant height

P and p are the perimeters at the two ends

$$\text{Centre of gravity above base} = \frac{hx(3A_1 + A_2 + 2(A_1 A_2)^{1/2}}{4xA_1 + A_2 + (A_1 A_2)^{1/2}}$$

ASBESTOS CEMENT SHEETS

TECHNICAL DATA OF CORRUGATED AND SEMI-CORRUGATED ROOFING SHEETS

Overall width	1.05 m	1.10 m
Cover width....	1.01 m	1.017 m
Covering efficiency:(allowing end and side laps)		
3.0 M long sheets	93%	89.6%
1.5 M long sheets	88%	84.8%
Actual cover of sheet laid (allowing end and side flaps)		
1.5 M long sheets	2.88 Sq.m	2.90 Sq.m
10 sq.M of laying area requires sheeting	1.36 sq.m	1.37 sq.m
(allowing Side and end laps)		
with sheets of 3.0 M length	10.77 sq.m	11.06 sq.m
with sheets of 1.5 M length	1.35 sq.m	11.80 sq.m
x 3mm	144 Kgs.	133 Kgs.
Average weight per 10 sq. M laid (6 mm) x 1.5mm	152 Kgs.	1412 Kgs.

Standard lengths manufactured (Metres) 1.50, 1.75, 2.00, 2.25 and 3.00

Maximum purlin spacing for roofing	1.4 m for 6mm and 1.6 m for 7 mm
Maximum overhang at eaves	0.30 m for 6mm and 0.4 m for 7 mm
Maximum rail spacing for side cladding	1.7 m for 6mm and 0.9 m for 7 mm
Horizontal lap at purlins	1.50 mm minimum
Colour available	Natural Grey

ALLOWABLE PRESSURES ON PIPES

Material	Class	Allowable Pressure				Average value of C	Available sizes (Diameter in mm)	Available lengths of pipes in m
		Test Pressure		Working Pressure				
		Kg/cm^2	Metres of water	Kg/cm^2	Metres of water			
Cast Iron	LA	12.0	120	6.0	60	100	80 to 1200	3.66, 4, 4.88, 5.0, 5.5
	A	18.0	180	9.0	90		80 to 1200	3.66, 4, 4.88, 5.5
	B	24.0	240	12.0	120		80 to 1200	3.66, 4, 4.88, 5.5
Steel	Class 1	15.0	150	7.5	75	95	200to 2000	3 to 5
	Class 2	20.0	200	10.0	100			
	Class 3	25.0	250	12.5	125			
R.C.C.	P1	2.0	20	1.33	13	120	80 to 600	2, 2.5, 3.
	P2	4.0	40	2.00	20		80 to 600	2, 2.5, 3
	P3	6.0	60	3.00	30		80 to 450	2,2.5, 3
A.C.	Class 5	5.0	50	2.5	25	130	80 to 700	3,4,5
	Class 10	10.0	100	5.0	50	to	80 to 700	3,4,5
	Class 15	15.0	150	7.5	75	140	80 to 700	3,4,5
	Class 20	20.0	200	10.0	100		80 to 700	3,4,5
	Class 25	25.0	250	12.5	125		80 to 700	3,4,5
P.V.C.	2.5 kg/cm^2	5.0	50	2.5	25	140	90 to 315	3,5,6
	4.0 kg/cm^2	8.0	80	4.0	40		50 to315	3,5,6
	6.0 kg/cm^2	12.0	120	6.0	60		40 to 315	3,5,6
	10.0 kg/cm^2	20.0	200	10.0	100		16 to 125	3,5,6

Note: 1. The sizes indicated against P.V.C. Pipes are outer dimensions.

2. Higher size of AC pipes can be manufactured on specific requirements.

CLASSFICATION OF CEMENT CONCRETE PIPES ACCORDING TO IS IS :

Class	Description	Conditions under which normally used
NP_1	Unreinforced concrete non-pressure pipes	For drainage and irrigation, use, above ground or in shallow trenches
NP_2	R.C. light duty, non-pressure pipe	For culverts carrying light traffic
NP_3	R.C. heavy duty, non-pressure pipe	For culverts carrying heavy traffic
NP_4	R.C. heavy duty, non-pressure pipe	For culverts carrying very heavy traffic, such as railway.
P_1	R.C. pressure pipes ed to a hydrostatic pressure of 2.0 kg/cm^2 20 m head	For use on gravity mains, the actual working pressure not exceeding 2/3 of the test pressure
P_2	R.C. Pressure pipes tested to a hydrostatic pressure of 4.0 kg/cm^2 (40 m head)	For use on pumping mains, actual working pressure not exceeding 1/2 of the test pressure
P_3	R.C. Pressure pipes tested to a hydrostatic pressure of 6.0 kg/cm^2 (60 m head)	For use on pumping mains, actual working pressure not exceeding 1/2 of the test pressure.

Table of painting coefficient

Sl. No.	Description of Work (Wood work, Doors, Windows etc.)	Multiplying Coefficient
1.	Panelled or framed and braced door, windows etc.	1.30 (for each side)
2.	Ledged and battened or ledged, battened and braced, doors, windows etc.	-do-
3.	Flush doors etc.	1.2(For each side)
4.	Partly panelled and partly glazed or gauged doors, windows, etc.	1.00 (for each side)
5.	Fully glazed or gauged doors, windows, etc.	0.80 (for each side)
6.	Fully venetianed or louvered doors windows etc.,	1.80 (for each side)
7.	Trellis (or jaffri) work one way or two way	2 (for painting all over)
8.	Carved or enriched work	2 (for each side)
9.	Weather boarding	1.20 (for each side)
10.	Wood single roofing	1.10 (for each side)
11.	Boarding with cover fillets and match boarding	1.05 (for each side)
12.	Tile and Slate battering	0.80 (for painting all over)
13.	Plain sheeted steel doors or windows	1.10 (for each side)
14.	Fully glazed or gauged steel doors and windows	0.50 (for each side)
15.	Partly panelled and partly glazed or steel gauged doors and windows	0.80 (for each side)
16.	Corrugated sheeted steel doors or windows	1.50 (for each side)
17.	Collapsible gates	1.50 (for painting all over)
18.	Rolling shutters of interlocked lathes	1.10 (for each side)
	GENERAL WORK	
19.	Expanded metal, hard drawn steel wire fabric of approved quality grill work and gratings, guardbars, balustrades, railings and partitions.	1 (for painting all over)
20.	Open palisade fencing and gate including standards, braces, rails stays, etc. in timber or steel.	1 (for painting all over)
21.	Corrugated iron sheeting in roofs, side cladding etc.	1.14 (for each side)
	NOTE : The height shall be taken from the bottom of the lowest rail, if the palisades do not go below it (or from the lowest rail) upto the top of palisades but to upto the top of standards, if they are higher than the palisades.	
22.	A.C. corrugated sheeting inroofs, side cladding etc.	1.20 (for each side)
23.	A.C. Semi-Corrugated sheeting in roofs, side cladding etc (or Nainital pattern using plain sheets)	1.10 (for each side)
24.	wire gauge shutters including painting of wire gauge (Tamilnadu Building Practice - Section 10)	1 (for each side)

ASBESTOS CEMENT SHEETS

TECHNICAL DATA OF CORRUGATED AND SEMI-CORRUGATED ROOFING SHEETS

Particulars	Corrugated	Semi-Corrugated
Overall width	1.05 m	1.10 m
Cover width	1.01 m	1.017 m
Covering efficiency: (allowing end and side laps)		
3.0 M long sheets	93%	89.6%
1.5 M long Sheets	88%	84.8%
Actual cover of sheet laid (allowing end and side flaps) ..		
1.5 M long Sheets	2.88 Sq m	2.90 Sq m
10 sq. M of laying area requires sheeting	1.36 Sq m	1.37 Sq m
(allowing Side and end laps)		
with sheets of 3.0 M length	10.77 Sq m	11.06 Sq m
with sheets of 1.5 M length	1.35 Sq m	11.80 Sq m
x 3mm	144 Kgs.	133 kgs.
Average weight per 10 sq. M laid (6 mm) x 1.5 mm	152 Kgs.	141 kgs.

Standard lengths manufactured (Metres) 1.50, 1.75, 2.00, 2.25, and 3.00

Maximum purlin spacing for roofing	1.4 m for 6mm and 1.6 m for 7mm
Maximum overhang at eaves	0.30 m for 6mm and 0.4 m for 7 mm
Maximum rail spacing for side cladding	1.7 m for 6mm and 0.9 m for 7mm
Horizontal lap at purlins	1.50 mm minimum
Colour available	Natural Grey

WEIGHT OF MILD STEEL FLATS

(Weight per foot in lbs.)

Width in	THICKNESS IN INCHES										
Inches	1/16	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	7/8	
6	1.23	2.55	3.38	5.13	6.38	7.65	10.20	12.75	15.30	17.85	20.40
5	1.06	2.13	3.19	4.25	5.31	6.38	8.50	10.63	12.75	14.88	17.00
4 1/2	.956	1.91	2.87	3.83	4.78	5.74	7.65	9.56	11.48	13.39	15.30
4	.850	1.70	2.55	3.40	4.35	5.10	6.80	8.50	10.20	11.90	13.60
3 1/2	.744	1.49	2.23	2.98	3.72	4.46	5.95	7.44	8.93	10.41	11.90
3	.638	1.28	1.91	2.55	3.19	3.83	5.10	6.38	7.65	8.93	10.20
2 1/4	.584	1.17	1.75	2.34	2.92	3.51	4.68	5.84	7.01	8.18	9.35
2 1/2	.531	1.06	1.59	2.13	2.66	3.19	4.25	5.31	6.38	7.44	8.50
2	.425	.850	1.28	1.70	2.13	2.55	3.40	4.25	5.10	5.95	6.80
1 1/4	.372	.744	1.12	1.49	1.86	2.23	2.98	3.72	4.46	5.21	5.95
1 1/2	.319	.638	.956	1.28	1.59	1.91	2.55	3.19	3.83	4.46	5.10
1 1/2	.266	.531	.797	1.06	1.33	1.59	2.13	2.66	3.19	-	-
3/4	.213	.425	.638	.850	1.06	1.28	1.70	2.13	2.55	-	-
1	-	.319	-	.637	-	-	-	-	-	-	-
1	-	.625	-	.570	-	-	-	-	-	-	

SQUARE AND ROUND BARS

0.7843 Kg/cm² per metre

Diameter or Width mm.	Sectional Area		Perimeter	
	Cm^2	Cm^2	Cm.	Cm.
5.0	0.25	0.20	2.0	1.57
5.5	0.30	0.24	2.2	1.73
6.0	0.36	0.28	2.4	1.88
7.0	0.49	0.38	2.8	2.20
8.0	0.64	0.50	3.2	3.51
9.0	0.81	0.64	3.6	2.83
10	1.00	0.79	4.0	3.14
11	1.21	0.95	4.4	3.46
12	1.44	1.13	4.8	3.77
14	1.96	1.54	5.6	4.40
16	2.56	2.01	6.4	5.03
18	3.24	2.54	7.2	5.65
20	4.00	3.14	8.0	6.28
22	4.84	3.80	8.8	6.91
25	6.25	4.91	10.0	7.85
28	7.84	6.16	11.2	8.80
32	10.24	8.04	12.8	10.05
36	12.96	10.18	14.4	11.31
40	16.00	12.57	16.0	12.57
45	20.25	15.90	18.0	14.14
50	25.00	19.64	20.0	15.71
56	31.36	24.63	22.4	17.59
63	39.69	31.17	25.2	19.79
71	50.41	39.59	28.4	22.31
80	64.00	50.27	32.0	25.13

ROUGH ESTIMATION OF COST OF BUILDINGS

	Name of items	Percentage of total cost
1.	Labour	30 to 35
2.	Cost of materials	70 to 65
3.	Foundation upto and including plinth	15 to 20
4.	Superstrucutre	85 to 80
5.	Second storey	75 to 85 of I storey
6.	Direct and overhead cost:-	
	a) Direct on actual work	85
	b) Overhead cost due to establishment, supervision, incidental etc.	15
7.	Sanitation and electrification:-	
	a) Sanitary and water supply	7 to 9
	b) Electric installation without fans	7
	c) Electric fans	5
8.	Cost break-up of different parts:-	
	a) Earthwork in excavation and filling	1/2 to 1
	b) Foundation concreting	4 to 6
	c) Damp proof course	1

d)	Brick work	34
e)	Roofing	20
f)	Doors and windows	16
g)	Plastering and pointing	10
h)	White and colour washing, painting	2
i)	Miscellaneous	4
9.	Cost of material and labour:-	
a)	Bricks	25
b)	Cement	10
c)	Steel bars	10
d)	Timber	15
e)	Lime	5
f)	Labour	30
g)	Miscellaneous	5
10.	Materials required on plinth area basis for single storey building:-	
a)	Brick	500 Nos. per sq.m. of plinth area
b)	Cement	1.5 bags per sq. m. of plinth area.
c)	Steel bars	12 kg. per sq.m. of plinth area.
d)	Coal for burning bricks	1.5 quintals per sq. m. of plinth area.
11.	Annual repair and maintenance	1 to 1 1/2% of capital cost of building.

MINIMUM DIMENSIONS REQUIRED IN A RESIDENTIAL BUILDING

Description	Min. Requirements
Plinth height	450 mm in general 150 mm for garages
Head Room	3.00 m for rooms
Area of living bed rooms	12.00 m^2
Area of kitchen	8.00 m^2
Area of bath room	2.52 m^2 (1.2 m x 2.1m)
Area of WC	1.2 m^2 (1.00 m x 1.20 m)
Windows	1/10 of floor area excluding doors or dry hot climate. 1/10 Of floor area excluding doors for wet hot climate
Window openings in WC and Bath Room	10% of floor area
Lighting area for staircase	1 m^2 per floor height
Staircase	Width 1 m Rise 190 mm Tread 250 mm

WORK TURNED OUT BY LABOUR

Task: The Capacity of doing work by an artisan or skilled labour in the form of quantity of work per day is known as the task work or out-turn of the labour.

The out-turn of work per artisan varies to some extent according to the nature, size, height, situation location, etc. In bigger cities where specialised and experienced labour is available, the out turn is greater than small towns and country sides. In well organised work less labour is required.

The following may be taken as the approximate quantity of work turn-out or task for an average artisan per day.

	Particulars of item	Quantity M^2	M^3	$Foot^2$	Per day $Foot^3$	
1.	Brick work in lime or cement mortar in foundation and plinth		1.25		45	per mason
2.	do in superstructure		1.00		35	"
3.	Brickwork in mud mortar in mortar in arches		1.50		55	"
4.	do in superstructure		1.25		45	"
5.	Brickwork in cement or lime mørtar in arches		0.55		20	"

6.	do in jack arches		0.55		20	"
7.	Half brick wall in partition	5.00		50		"
8.	Coursed rubble stone masonry in lime or cement mortar including dressing		0.80		30	
9.	Random rubble stone masonry in lime or cement mortar		1.00		35	"
10.	Ashlar masonry in lime or cement mortar		0.40		15	"
11.	Stone arch work		0.40		15	"
12.	Lime concrete in foundation		8.50		300	"
13.	Lime concrete in roof terracing		6.00		200	"
14.	Cement concrete 1.2.4.		5.00		175	"
15.	R.B. Work		1.00		35	"
16.	R.C.C. work		3.00		125	"
17.	12 mm (1/2) plastering with cement or lime mortar	8.00		80		"
18.	Pointing with cement or lime mortar	10.00		100		"
19.	White washing or colour washing - 3 coats	70.00		700		Per whitewasher
20.	White washing or colour washing - 1 coat	200.00		2000		"
21.	Painting or varnishing doors or windows - 1 coat	25.00		250		per painter
22.	Coal tarring or solignum painting - 1 coat	35.00		350		"
23.	Painting large surface 1 coat	35.00		350		"
24.	Distempering - 1 coat	35.00		350		"
25.	2.5 cm (1") C.C. floor	7.50		75		per mason
26.	Flag stone floor laying with lime or cement mortar excluding L.C.	10.00		100		"
27.	Brick-on-edge floor in lime or cement mortar excluding L.C.	7.00		70		"
28.	Brick flat floor as in above	8.00		80		"
29.	Timber framing sal or teak wood		0.07		2.5	per carpenter
30.	-do- country wood		0.15		5	"
31.	Door and window shutters Parelled or glazed	0.70		7		"
32.	-do- battened	0.80		8		"
33.	Sawing hard wood	4.00		40		per pair of sawer
34.	Sawing of softwood	6.00				
35.	Single Allahabad tilling or Mangalore tilling	6.00		60		per tile layer
36.	Double Allahabad tilling	4.00		40		per tile layer
37.	Breaking of brick ballast - 40 mm (1.1/2") guage		0.75		25	per labourer or braker
38.	Breaking of brick ballast - 25 mm (1") gauge		0.55		20	"
39.	Breaking of stone ballast - 40 mm (1.1/2") gauge		0.40		15	"
40.	Breaking of stone ballast - 25 mm (1") gauge		0.25		10	"
41.	Ashlar stone dresing		0.70		25	per stone cutter
42.	Flang stone dresing	1.50		15		per stone cutter
43.	Earthwork in excavation ordinary soil		3.00		100	perbiladar mazdoor
44.	Earthwork in excavation in hard soil		2.00		75	"
45.	Excavation in rock		1.00		35	"
46.	Number of bricks laid by a mason	600 bricks per mason				
47.	Amount of work done by a mazdoor (helper) per day.					
	i. Mix	3 cu.M. (100 Cft) mortar				
	ii. Deliver bricks	4000 Nos. to a distance of 15m (50")				
	iii. Deliver mortar	5.5 cu. M. (200 Cft)				
48.	Scaffolding cost for single building	Re 0.50 per Cu. M. (Rs. 1.50 % Cft.) of brick work.				

M.S. FLATS
WEIGHT PER METRE IN K.G.

Thickness MM Size MM	3	5	6	8	10	12	16	18	20	22	25
12	0.3	0.5	0.6	0.8	0.9	1.1	1.5	1.7	1.9	2.1	2.4
16	-	0.6	0.8	1.0	1.3	1.5	2.0	2.3	2.5	2.8	3.1
20	0.6	0.8	0.9	1.3	1.6	1.9	2.5	2.8	3.1	3.5	3.9
25	0.8	1.0	1.2	1.6	2.0	2.4	3.1	3.5	3.9	4.3	4.9
32	1.1	1.3	1.5	2.0	2.4	3.0	4.0	4.5	6.9	5.5	6.3
35	-	-	1.6	-	2.8	-	-	-	-	-	-
40	1.4	1.6	1.9	2.5	3.1	3.8	5.0	5.7	6.3	6.9	7.8
45	-	-	2.1	-	3.5	4.2	-	-	-	-	-
50	1.7	2.0	2.4	3.1	3.9	4.7	6.3	7.1	7.8	8.6	9.8
53		-	-	-	-	-	6.6	-	-	-	-
56		-	-	-	-	-	7.0	-	-	-	-
63		2.5	3.0	4.0	4.9	5.9	7.9	8.9	9.9	10.9	12.4
65		-	-	4.1	5.1	6.1	-	-	10.2	-	-
75		-	-	4.7	5.9	7.1	-	-	11.8	-	14.7
80		3.1	3.8	5.0	6.3	7.5	10.0	11.3	12.6	13.8	15.7
100		3.9	4.7	6.3	7.8	9.4	12.6	14.0	15.7	17.5	19.6
110		-	-	-	-	-	-	-	17.3	-	-
125		4.9	5.9	7.8	9.8	11.8	15.7	17.7	19.6	21.6	25.5
150		-	-	-	-	14.1	-	18.8	23.6	-	29.4
160		6.3	7.5	10.0	12.6	15.1	20.1	22.6	25.1	27.6	31.4
180		-	-	-	-	17.0	22.6	25.4	28.3	-	-
200		7.8	9.4	12.6	15.7	18.8	25.1	28.3	31.4	34.5	39.2
220		-	-	-	-	-	-	-	34.5	-	-
250		9.8	11.3	15.7	19.6	23.6	31.4	35.3	39.2	43.2	49.1

ROLLED STEEL EQUAL ANGLES (INDIAN STANDARD) Dimensions and Properties

Designation	Size (h x b)	Thick-ness t	Sectional area a	Weight per Metre w	Moments of Inertia			Modulus of Section	Centre of Gravity
					$I_{xx} = I_{yy}$	I_{uu}	I_{vv}	$Z_{xx} = Z_{yy}$	$C_{xx} = C_{yy}$
(mm x mm)	(mm x mm)	(mm)	(cm^2)	(kg)	(cm^4)	(cm^4)	(cm^4)	(cm^3)	(cm)
1	2	3	4	5	6	7	8	9	10
ISA 2020	20 x 20	3.0	1.12	0.9	0.4	0.6	0.2	0.3	0.59
		4.0	1.45	1.1	0.5	0.8	0.2	0.4	0.63
ISA 2525	25 x 25	3.0	1.41	1.1	0.8	1.2	0.3	0.4	0.71
		4.0	1.84	1.4	1.0	1.6	0.4	0.6	0.75
		5.0	2.25	1.8	1.2	1.8	0.5	0.7	0.79
ISA 3030	30 x 30	3.0	1.73	1.4	1.4	2.2	0.6	0.6	0.83
		4.0	2.26	1.8	1.8	2.8	0.7	0.8	0.87
		5.0	2.77	2.2	2.1	3.4	0.9	1.0	0.92
ISA 3535	35 x 35	3.0	2.03	1.6	2.3	3.6	0.9	0.9	0.95
		4.0	2.66	2.1	2.9	4.7	1.2	1.2	1.00
		5.0	3.27	2.6	3.5	5.6	1.5	1.4	1.04
		6.0	3.86	3.0	4.1	6.5	1.7	1.7	1.08
ISA 4040	40 x 40	3.0	2.34	1.8	3.4	5.5	1.4	1.2	1.08
		4.0	3.07	2.4	4.5	7.1	1.8	1.6	1.12
		5.0	3.78	3.0	5.4	8.6	2.2	1.9	1.16
		6.0	4.47	3.5	6.3	10.0	2.6	2.3	1.20
ISA 5045	45 x 45	3.0	2.64	2.1	5.0	8.0	2.0	1.5	1.20
		4.0	3.47	2.7	6.5	10.4	2.6	2.0	1.25
		5.0	4.28	3.4	7.9	12.6	3.2	2.5	1.29
		6.0	5.07	4.0	9.2	14.6	3.8	2.9	1.33
ISA 5050	50 x 50	3.0	2.95	2.3	6.9	11.1	2.6	1.9	1.32
		4.0	3.88	3.0	9.1	14.5	3.6	2.5	1.37
		5.0	4.79	3.8	11.0	17.5	4.6	3.1	1.41
		6.0	5.68	4.5	12.9	20.6	5.3	3.6	1.45
ISA 5555	55 x 55	5.0	5.27	4.1	14.7	23.5	5.9	3.7	1.53
		6.0	6.26	4.9	17.3	27.5	7.0	4.4	1.57
		8.0	8.18	6.4	22.0	34.9	9.1	5.7	1.65
		10.0	10.02	7.9	26.3	41.5	11.2	7.0	1.72
ISA 6060	60 x 60	5.0	5.75	4.5	19.2	30.6	7.7	4.4	1.65
		6.0	6.84	5.4	22.6	38.0	9.1	5.2	1.69
		8.0	8.96	7.0	29.0	46.0	11.9	6.8	1.77
		10.0	11.00	8.6	34.8	54.9	14.6	8.4	1.85
ISA 6565	65 x 65	5.5	6.25	4.9	21.7	39.4	9.9	5.2	1.77
		6.0	7.44	5.8	29.1	46.5	11.7	6.2	1.81
		8.0	9.70	7.7	37.4	59.45	15.3	8.1	1.89
		10.0	12.00	9.4	45.0	71.3	18.8	9.9	1.97
ISA 7070	70 x 70	5.0	6.77	5.3	31.1	49.8	12.5	6.1	1.89
		6.0	8.06	6.3	36.8	58.8	14.8	7.3	1.94
		8.0	10.58	8.3	47.4	75.5	19.3	9.5	2.02
		10.0	13.02	10.2	57.2	90.7	23.7	11.7	2.10
ISA 7575	75 x 75	5.0	7.27	5.7	38.7	61.9	15.5	7.2	2.02
		6.0	8.66	6.8	45.7	73.1	18.4	8.4	2.06
		8.0	11.38	8.9	59.0	94.1	24.0	11.0	2.14
		10.0	14.02	11.0	71.4	113.3	29.4	13.5	2.22
ISA 8080	80 x 80	6.0	9.29	7.3	56.0	89.6	22.5	9.6	2.18
		8.0	12.21	9.6	72.5	115.6	29.4	12.6	2.27
		10.0	15.05	11.8	87.7	139.5	36.0	15.5	2.34
		12.0	17.81	14.0	101.9	161.4	42.4	18.3	2.42
ISA 9090	90 x 90	6.0	10.47	8.2	80.1	128.1	32.0	12.2	2.42
		8.0	13.79	10.8	104.2	166.4	42.0	16.0	2.51
		10.0	17.03	13.4	126.7	201.9	51.5	19.8	2.59
		12.0	20.19	15.8	147.9	234.9	60.9	23.3	2.68
ISA 100100	100 x 100	6.0	11.67	9.2	111.3	178.1	44.5	15.2	2.67
		8.0	15.39	12.1	145.1	231.8	58.4	20.0	2.76
		10.0	19.03	14.9	177.0	282.2	71.8	24.7	2.84
		12.0	22.59	17.7	207.0	329.3	84.7	29.2	2.92
ISA 110110	110 x 110	8.0	17.2	13.4	195.0	311.7	78.2	24.4	3.00
		10.0	21.06	16.5	238.4	380.5	96.3	30.1	3.08
		12.0	25.02	19.6	279.6	445.3	113.8	35.7	3.16
		15.0	30.81	24.2	337.4	535.4	139.3	43.7	3.27
ISA 130130	130 x 130	8.0	20.22	15.9	328.3	525.1	131.4	34.5	3.50
		10.0	25.06	19.7	402.7	634.4	162.1	42.7	3.58
		12.0	29.82	23.4	473.8	755.9	191.8	50.7	3..66
		15.0	36.81	28.9	574.6	914.2	235.0	62.0	3.78
ISA 150150	150 x 150	10.0	29.03	22.8	622.4	995.4	249.4	56.9	4.06
		12.0	34.59	27.2	735.4	1174.8	296.0	67.7	4.14
		15.0	42.78	33.6	896.8	1429.7	363.8	83.5	4.26
		18.0	50.79	39.9	1048.9	1668.2	429.5	98.7	4.38
ISA 200200	200 x 200	12.0	46.61	36.6	1788.9	2862.0	719.9	122.2	5.35
		15.0	57.80	45.4	2197.7	3511.8	883.7	151.4	5.49
		18.0	68.81	54.0	2588.7	4130.8	1046.5	179.9	5.61
		25.0	93.80	73.6	3436.3	5460.0	1411.6	243.3	5.88

TECHNICAL DATA OF

SIZE N 6		APPROX O. D.		WALL THICKNESS			WEIGHT OF BLACK PIPE PLAIN END			
MM	IN.	MM	IN.	MM	IN.	SWS	KG/M (IS 1239)	LB/FT (BS 1387)	MTS/ TONNE	FT/ TONNE
15 L	1/2 L	21.3	27/32	2.00	0.080	14	0.952	0.640	1050	3445
15 M	1/2 M	"	"	2.65	0.104	12	1.220	0.820	820	2690
15 H	1/2 H	"	"	3.25	0.128	10	1.450	0.977	690	2264
20 L	3/4 L	26.9	1-1/16	2.35	0.092	13	1.410	0.944	709	2326
20 M	3/4 M	"	"	2.65	0.104	12	1.580	1.060	633	2077
20 H	3/4 H	"	"	3.25	0.128	10	1.900	1.270	526	1726
25 L	1 L	33.7	1-11/32	2.65	0.104	12	2.010	1.350	498	1534
25 M	1 M	"	"	3.25	0.128	10	2.440	1.640	410	1345
25 H	1 H	"	"	4.05	0.160	8	2.970	2.000	337	1102
32 L	1-1/4 L	42.4	1-11/16	2.65	0.104	12	2.580	1.730	388	1273
32 M	1-1/4 M	"	"	3.25	0.128	10	3.140	2.110	318	1043
32 H	1-1/4 H	"	"	4.05	0.160	8	3.840	2.580	260	853
40 L	1-1/2 L	48.3	1-29/32	2.90	0.116	11	3.250	2.190	308	1010
40 M	1-1/2 M	"	"	3.25	0.128	10	3.610	2.430	277	909
40 H	1-1/2 H	"	"	4.05	0.160	8	4.430	2.980	228	741
50 L	2 L	60.3	2-3/8	2.90	0.116	11	4.110	2.760	243	797
50 M	2 M	"	"	3.65	0.144	9	5.100	3.420	196	643
50 H	2 H	"	"	4.50	0.176	7	6.170	4.140	162	531
65 L	2-1/2 L	76.1	3	3.25	0.128	10	5.800	3.900	172	564
65 M	2-1/2 M	"	"	3.65	0.144	9	6.510	4.380	154	505
60 H	2-1/2 H	"	"	4.50	0.176	7	7.900	5.310	127	417
80 L	3 L	88.9	3-1/2	3.25	0.128	10	6.810	4.580	147	482
80 M	3 M	"	"	4.05	0.160	8	8.470	5.690	118	387
80 H	3 H	"	"	4.85	0.192	6	10.100	6.760	99	325
100 L	4 L	114.3	4-1/2	3.65	0.144	9	9.890	6.640	101	331
100 M	4 M	"	"	4.50	0.176	7	12.100	8.140	83	272
100 H	4 H	"	"	5.40	0.212	5	14.400	9.710	69	226
125 M	5 M	139.7	5 1/2	4.85	0.192	6	16.200	10.900	62	203
125 H	5 H	"	"	5.40	0.212	6	17.800	12.000	56	184
150 M	6 M	165.1	6 1/2	4.85	0.192	6	19.200	12.900	52	171
150 H	6 H	"	"	6.40	0.212	6	21.200	14.300	47	154

BLACK & GLAVANISED PIPES

WEIGHT OF BLACK PIPE SCREWED & SOCKETED				WEIGHT OF GALVANISED PIPE PLAIN END				WEIGHT OF GALVANISED PIPE SCREWED & SOCKETED				
KG/M (IS 1239)	LB/FT (BS 1387)	MTS/ TONNE	FT/ TONNE	KG/M	LB/FT	MTS/ TONNE	FT/ TONNE	KG/M	LB/FT	MTS/ TONNE	FT/ TONNE	WIDTH OF THE STRIP
0.961	0.046	1040	3412	1.004	0.675	996	3268	1.013	0.678	987	3238	64
1.230	0.828	813	2667	1.274	0.856	785	2575	1.284	0.860	779	2556	63
1.460	0.983	685	2247	1.504	1.011	665	2182	1.513	1.015	661	2169	---
1.420	0.954	704	2310	1.471	0.987	680	2230	1.486	1.001	673	2208	82
1.590	1.070	629	2064	1.642	1.103	609	1998	1.658	1.115	603	1978	81
1.910	1.280	524	1719	1.953	1.312	512	1680	1.969	1.324	508	1667	---
2.030	1.360	493	1617	2.092	1.345	478	1568	2.110	1.418	474	1551	102
2.460	1.650	407	1335	2.525	1.697	396	1299	2.538	1.707	394	1293	101
2.990	2.010	334	1096	3.058	2.065	327	1078	3.077	2.070	325	1066	---
2.610	1.750	383	1257	2.681	1.802	373	1224	2.710	1.821	369	1211	129
3.170	2.130	315	1033	3.247	2.182	308	1010	3.279	2.204	305	1011	128
3.870	2.600	258	846	3.937	2.646	254	834	3.968	2.668	252	827	---
3.290	2.220	304	997	3.378	2.270	296	971	3.425	2.298	292	958	147
3.650	2.460	274	899	3.731	2.507	268	872	3.788	2.547	264	866	146
4.470	3.010	224	735	4.545	3.054	220	722	4.587	3.084	218	715	---
4.180	2.810	239	784	4.255	2.859	235	771	4.384	2.923	230	755	184
5.170	3.470	193	633	5.236	3.519	191	627	5.319	3.075	168	617	182
6.240	4.190	160	525	6.329	4.253	158	518	6.369	4.280	157	515	---
5.920	3.980	169	554	5.988	4.024	187	548	6.135	4.119	163	535	234
6.630	4.460	151	495	6.711	4.510	149	489	6.849	4.603	146	479	232
8.020	5.390	125	410	8.065	5.420	124	407	8.187	5.510	122	400	---
6.980	4.690	143	468	7.042	4.732	142	466	7.194	4.832	139	456	273
8.640	5.800	116	380	3.696	5.844	115	377	3.850	5.947	113	371	272
10.300	6.870	97	318	10.309	6.928	97	318	10.417	6.985	96	315	---
10.200	6.840	98	321	10.416	6.998	96	315	10.750	7.224	93	304	355
12.400	8 340	81	265	12.658	8.511	79	259	12.980	8.729	77	252	354
14.700	9.910	68	222	15.152	10.159	66	217	15.152	10.353	66	213	---
18.700	11.200	60	196	16.849	11.546	59	194	17.241	11.789	58	190	434
18.300	12.300	55	180	18.519	12.655	54	177	18.868	12.948	53	173	436
19.800	13.300	51	167	20.000	13.659	50	164	20.408	14.000	49	160	515
21.800	14.700	46	150	22.222	15.135	45	148	22.727	15.556	44	144	517

ROLLED STEEL UNEQUAL ANGLES (INDIAN STANDARD) Dimensions and Properties

Designation	Size	Thick-ness	Sec-tional area	Weight per Metre	Moments of Inertia				Modulus of Section		Centre of Gravity	
	(h x b)	t	a	w	I_{xx}	I_{yy}	I_{uu}	I_{vv}	Z_{xx}	Z_{yy}	C_{xx}	C_{yy}
1	2	3	4	5	6	7	8	9	10	11	12	13
	(mm x mm)	(mm)	(cm^2)	(kg)	(cm^4)	(cm^4)	(cm^4)	(cm^4)	(cm^3)	(cm^3)	(cm)	(cm)
ISA 3020	30 x 20	3.0	1.41	1.1	1.2	0.4	1.4	0.2	0.6	0.3	0.98	0.49
		4.0	1.84	1.4	1.5	0.5	1.8	0.3	0.8	0.4	1.02	0.53
		5.0	2.25	1.8	1.9	0.6	2.1	0.4	1.0	0.4	1.06	0.57
ISA 4025	40 x 25	3.0	1.88	1.5	3.0	0.9	3.3	0.5	1.1	0.5	1.30	0.57
		4.0	2.46	1.9	3.8	1.1	4.3	0.7	1.4	0.6	1.35	0.62
		5.0	3.02	2.4	4.6	1.4	5.1	0.8	1.8	0.7	1.39	0.66
		6.0	3.56	2.8	5.4	1.6	5.9	1.0	2.1	0.9	1.43	0.69
ISA 4530	45 x 30	3.0	2.18	1.7	4.4	1.5	5.0	0.9	1.4	0.7	1.42	0.69
		4.0	2.86	2.2	5.7	2.0	6.5	1.1	1.9	0.9	1.47	0.73
		5.0	3.52	2.8	6.9	2.4	7.9	1.4	2.3	1.1	1.51	0.77
		6.0	4.16	3.3	8.0	2.8	9.2	1.7	2.7	1.3	1.55	0.81
ISA 5030	50 x 30	3.0	2.34	1.8	5.9	1.6	6.5	1.0	1.7	0.7	1.63	0.65
		4.0	3.07	2.4	7.7	2.1	8.5	1.2	2.3	0.9	1.68	0.70
		5.0	3.78	3.0	9.3	2.5	10.3	1.5	2.8	1.1	1.72	0.74
		6.0	4.47	3.5	10.9	2.9	11.9	1.8	3.4	1.3	1.76	0.78
ISA 6040	60 x 40	5.0	4.76	3.7	16.9	6.0	19.5	3.4	4.2	2.0	1.95	0.96
		6.0	5.65	4.4	19.9	7.0	22.8	4.0	5.0	2.3	1.99	1.00
		8.0	7.37	5.8	25.4	8.0	29.0	5.2	6.5	3.0	2.07	1.08
ISA 6545	65 x 45	5.0	5.26	4.1	22.1	8.6	25.9	4.8	5.0	2.5	2.07	1.08
		6.0	6.25	4.9	26.0	10.1	30.4	5.7	5.9	3.0	2.11	1.12
		8.0	8.17	6.4	33.2	12.8	38.7	7.4	7.7	3.9	2.19	1.20
ISA 7045	70 x 45	5.0	5.52	4.3	27.2	8.8	30.9	5.1	5.7	2.5	2.27	1.04
		6.0	6.56	5.2	32.0	10.3	38.3	6.0	6.8	3.0	2.32	1.09
		8.0	8.58	6.7	41.0	13.1	48.3	7.8	8.9	3.9	2.40	1.16
		10.0	10.52	8.3	49.3	15.6	55.4	9.5	10.9	4.8	2.48	1.24
ISA 7550	75 X 50	5.0	6.02	4.7	34.1	12.2	39.4	6.9	6.7	3.2	2.39	1.16
		6.0	7.16	5.6	40.3	14.3	45.4	8.2	8.0	3.8	2.44	1.20
		8.0	9.38	7.4	51.6	18.3	59.4	10.0	10.4	4.9	2.52	1.28
		10.0	11.52	9.0	62.3	21.8	71.2	12.9	12.7	6.0	2.60	1.36
ISA 8050	80 x 50	5.0	6.27	4.9	40.6	12.3	45.7	7.2	7.5	3.2	2.60	1.12
		6.0	7.46	5.9	48.0	14.4	53.9	8.5	9.0	3.8	2.64	1.16
		8.0	9.78	7.7	61.9	18.5	69.3	11.0	11.7	4.9	2.73	1.24
		10.0	12.02	9.4	74.7	22.1	83.3	13.5	14.4	6.0	2.81	1.32
ISA 9060	90 x 60	6.0	8.65	6.8	70.6	25.2	81.5	14.3	11.5	5.5	2.87	1.39
		8.0	11.37	8.9	91.6	32.4	105.3	18.5	15.1	7.2	2.96	1.48
		10.0	14.01	11.0	110.9	39.1	127.3	22.8	18.6	8.8	3.04	1.55
		12.0	16.57	16.57	129.1	45.2	147.5	26.8	22.0	10.3	3.12	1.63
ISA 10065	100 x 65	6.0	9.55	7.5	96.7	32.4	110.6	18.6	14.2	6.4	3.19	1.47
		8.0	12.57	9.9	125.9	41.9	143.6	24.2	18.7	8.5	3.28	1.55
		10.0	15.51	12.2	153.2	50.7	174.2	29.7	23.1	10.4	3.37	1.63
ISA 10075	100 x 75	6.0	10.14	8.0	100.9	48.7	124.0	25.6	14.4	8.5	3.01	1.78
		8.0	13.36	10.5	131.6	63.3	166.3	33.6	19.1	11.2	3.10	1.87
		10.0	16.50	13.0	160.4	7.9	191.1	41.2	23.6	13.8	3.19	1.95
		12.0	19.58	15.4	187.5	89.5	228.5	48.6	27.9	16.3	3.27	2.03
ISA 12575	125 x 75	6.0	11.66	9.2	187.8	51.6	208.9	30.5	22.2	8.7	4.05	1.59
		8.0	15.38	12.1	245.5	67.2	272.8	40.0	29.4	11.5	4.15	1.68
		10.0	19.02	14.9	300.3	81.6	332.9	49.1	36.3	14.2	4.24	1.76
ISA 12595	125 x 95	6.0	12.86	10.1	203.2	102.1	252.3	52.9	23.1	14.0	3.70	2.22
		8.0	16.98	13.3	266.0	133.3	329.7	69.6	30.6	18.3	3.80	2.31
		10.0	21.02	16.5	325.8	162.7	402.9	85.6	37.8	22.9	3.88	2.39
		12.0	24.98	19.6	382.6	190.4	472.0	101.0	44.8	27.1	3.96	2.47
ISA 15075	150 x 75	8.0	17.42	13.7	407.2	70.2	432.8	44.5	41.7	11.8	5.23	1.53
		10.0	21.56	16.9	499.1	85.3	529.8	54.6	51.6	14.5	5.32	1.61
		12.0	25.62	20.1	587.0	99.5	622.2	64.3	61.2	17.1	5.41	1.69
ISA 150115	150 x 115	8.0	20.56	16.2	465.7	238.9	581.2	123.3	44.2	27.2	4.46	2.73
		10.0	25.52	20.0	573.3	293.4	714.3	152.4	54.9	33.8	4.55	2.82
		12.0	30.38	23.8	676.5	345.3	841.4	180.4	65.3	40.2	4.64	2.90
		15.0	37.52	29.5	823.5	418.6	1020.9	221.2	80.4	49.4	4.76	3.02
ISA 200100	200 x 100	10.0	29.03	22.8	1210.0	209.2	1286.7	132.5	92.8	26.2	6.96	2.01
		12.0	34.59	27.2	1431.7	246.2	1521.0	156.8	110.6	31.1	7.05	2.10
		15.0	42.78	33.6	1750.5	296.1	1856.7	191.9	136.5	38.3	7.18	2.22
ISA 200150	200 x 150	10.0	34.00	26.7	1377.9	669.6	1696.6	350.8	96.3	58.3	5.99	3.51
		12.0	40.56	31.8	1634.9	793.2	2010.8	417.0	117.4	69.6	6.06	3.60
		15.0	50.25	39.4	2005.6	969.9	2461.9	513.6	145.4	86.0	6.20	3.72
		18.0	59.76	46.9	2359.4	1136.9	2889.5	606.9	172.5	101.9	6.33	3.84

INDIAN STANDARD ROLLED STEEL BEAMS (Dimension and Properties)

Section h x b	Weight per Metre w (kg)	Sectional Area (sq. cm) a	Thickness of		Moments of Inertia		Moduli of Section	
			Flange tf (mm)	WEB tw (mm)	I_{xx} (cm^4)	I_{yy} (cm^4)	Z_{xx} (cm^3)	Z_{yy} (cm^3)
1	2	3	4	5	6	7	8	9
Designation ISLB								
75 x 50	6.1	7.71	5.0	3.7	72.7	10.0	19.4	4.0
100 x 50	8.0	10.21	6.4	4.0	168.0	12.7	33.6	5.1
125 x 75	11.9	15.12	6.5	4.4	406.8	43.4	65.1	11.6
150 x 80	14.2	18.08	6.8	4.8	688.2	55.2	91.8	13.8
175 x 90	16.7	21.30	6.9	5.1	1096.2	79.6	125.3	17.7
200 x 100	19.8	25.27	7.3	5.4	1696.6	115.4	169.7	23.1
225 x 100	23.5	29.92	8.6	5.8	2501.9	112.7	222.4	22.5
250 x 125	27.9	35.53	8.2	6.1	3717.8	193.4	297.4	30.9
275 x 140	33.0	42.02	8.8	6.4	5375.3	287.0	392.4	41.0
300 x 150	37.7	48.08	9.4	6.7	7332.9	376.2	488.9	50.2
325 x 165	43.1	54.90	9.8	7.0	9874.6	510.8	607.7	61.9
350 x 165	49.5	63.01	11.4	7.4	13158.3	631.9	751.9	76.6
400 x 165	56.9	72.43	12.5	8.0	19306.3	716.4	965.3	86.8
450 x 170	65.3	83.14	13.4	8.6	27536.1	853.0	1223.8	100.4
500 x 180	75.3	95.50	14.1	9.2	38579.0	1063.9	1543.2	118.2
550 x 190	86.3	109.97	15.0	9.9	53161.6	1335.1	1933.2	140.5
600 x 210	99.5	126.69	15.5	10.5	72867.6	1821.9	2428.9	173.5
Designation ISMB								
100 x 75	11.5	14.60	7.2	4.0	257.5	40.8	51.5	10.9
125 x 75	13.0	16.60	7.6	4.4	449.0	43.7	71.8	11.7
150 x 80	14.9	19.00	7.6	4.8	726.4	52.6	96.9	13.1
175 x 90	19.3	24.62	8.6	5.5	1272.0	85.0	145.4	18.9
200 x 100	25.4	32.33	10.8	5.7	2235.4	150.0	223.5	30.0
225 x 110	31.2	39.72	11.8	6.5	3441.8	218.3	305.9	39.7
250 x 125	37.3	47.55	12.5	6.9	5121.6	334.5	410.5	53.5
300 x 140	44.2	56.26	12.4	7.5	8603.6	453.9	573.6	64.8
350 x 140	52.4	66.71	14.2	8.1	13630.3	537.7	778.0	76.8
400 x 140	61.6	78.46	16.0	8.9	20458.4	622.1	1022.9	88.9
450 x 150	72.4	92.27	17.4	9.4	30390.8	834.0	1350.7	111.2
500 x 180	86.9	110.74	17.2	10.2	45218.3	1369.1	1808.7	152.2
550 x 190	103.7	132.11	19.3	11.2	64893.6	1833.8	2359.8	193.0
600 x 210	122.6	156.21	20.8	12.0	91813.0	2651.0	3060.4	252.5
Designation ISWB								
150 x 100	17.0	21.67	7.0	5.4	839.1	94.0	111.0	19.0
175 x 125	22.1	28.11	7.4	5.8	1509.4	188.6	172.5	30.2
200 x 140	28.8	36.71	9.0	6.1	2624.5	328.8	262.5	47.0
225 x 150	33.9	43.24	9.9	6.4	3920.5	448.6	348.5	58.8
250 x 200	40.9	52.05	9.9	6.7	5943.1	857.5	475.4	85.7
300 x 200	48.1	61.33	10.0	7.4	9821.6	990.1	654.1	99.0
350 x 200	56.9	72.50	11.4	8.0	15521.7	1175.9	887.0	117.6
400 x 200	66.7	85.01	13.0	8.6	23426.7	1388.0	1171.3	138.8
450 x 200	79.4	101.15	15.4	9.0	35057.6	1706.7	1558.1	170.7
500 x 250	95.2	121.22	14.7	9.9	52290.9	2987.8	2091.7	239.0
550 x 250	112.5	143.34	17.6	10.5	74906.1	3740.6	2723.9	299.2
600 x 250	113.7	170.38	21.3	11.2	106198.5	4702.5	3540.0	376.2
600 x 250	145.1	184.88	23.6	11.8	115626.6	5298.3	3854.2	423.9
Designation ISHB								
150 x 150	27.1	34.48	9.0	5.4	1455.6	431.7	194.1	57.6
150 x 150	30.6	38.98	9.0	8.4	1540.0	460.3	205.3	60.2
150 x 150	34.6	44.08	9.0	11.8	1635.6	494.3	218.1	63.2
200 x 200	37.3	47.54	9.0	6.1	3608.4	967.1	360.8	96.7
200 x 200	40.0	50.94	9.0	7.8	3721.8	994.6	372.2	98.6
225 x 225	43.1	54.94	9.1	6.5	5279.5	1353.8	469.3	120.3
225 x 225	46.8	59.66	9.1	8.6	5478.8	1396.6	487.0	123.0
250 x 250	51.0	64.96	9.7	6.9	7736.5	1961.3	618.9	156.9
250 x 250	54.7	69.71	9.7	8.8	7983.9	2011.7	638.7	159.7
300 x 250	58.8	74.85	10.6	7.6	12545.2	2193.6	836.3	175.5
300 x 250	63.0	80.25	10.6	9.4	12950.2	2246.7	863.3	178.4
350 x 250	67.4	85.91	11.6	8.3	19159.7	2451.4	1094.8	196.1
350 x 250	72.4	92.21	11.6	10.1	19802.8	2510.5	1131.6	199.4
400 x 250	77.4	98.66	12.7	9.1	28083.5	2728.3	1404.2	218.3
400 x 250	82.2	104.66	12.7	10.6	28123.5	2783.0	1444.2	221.3
450 x 250	87.2	111.14	13.7	9.8	39210.8	2985.2	1742.7	238.8
450 x 250	92.5	117.89	13.7	11.3	40349.9	3045.0	1793.3	242.1

ROLLED STEEL CHANNELS (INDIAN STANDARD) Dimensions and Properties

	Section	Thickness of Flange	Thickness of Web	Sectional area	Weight per Metre	Moments of Inertia		Moduli of Section		Centre of Gravity
	h x b	t_f	t_w	a	w	I_{xx}	I_{yy}	Z_{xx}	Z_{yy}	C_{yy}
	(mm x mm)	(mm)	(mm)	(cm^2)	(kg)	(cm^4)	(cm^4)	(cm^3)	(cm^3)	(cm)
ISLC	75 x 40	6.0	3.7	7.26	5.7	66.1	11.5	17.6	4.3	1.35
	100 x 50	6.4	4.0	10.02	7.9	164.7	24.8	32.9	7.3	1.62
	125 x 65	6.6	4.4	13.67	10.7	356.8	57.2	57.1	12.8	2.04
	150 x 75	7.8	4.8	18.36	14.4	697.2	103.2	93.0	20.2	2.38
	175 x 75	9.5	5.1	22.40	17.6	1148.4	126.5	131.3	24.8	2.40
	200 x 75	10.8	5.5	26.22	20.6	1725.5	146.9	172.6	28.5	2.35
	225 x 90	10.2	5.8	30.53	24.0	2547.9	209.5	226.5	32.0	2.46
	250 x 100	10.7	6.1	35.65	28.0	3687.9	298.4	295.0	40.9	2.70
	300 x 100	11.6	6.7	42.11	33.1	6047.9	346.0	403.2	46.4	2.55
	350 x 100	12.5	7.4	49.47	38.8	9312.6	394.6	532.1	52.6	2.41
	400 x 100	14.0	8.0	58.25	45.7	13989.5	460.4	699.5	60.2	2.36
ISML	75 x 40	7.3	4.4	8.67	6.8	76.0	12.6	20.3	4.7	1.31
	100 x 50	7.5	4.7	11.70	9.2	186.7	25.9	37.3	7.5	1.53
	125 x 65	8.1	5.0	16.19	12.7	416.4	59.9	66.6	13.1	1.94
	150 x 75	9.0	5.4	20.88	16.4	779.4	102.3	103.9	19.4	2.22
	175 x 75	10.2	5.7	24.38	19.1	1223.3	121.0	139.8	22.8	2.20
	200 x 75	11.4	6.1	28.21	22.1	1819.3	140.4	181.9	26.3	2.17
	225 x 80	12.4	6.4	33.01	25.9	2694.6	187.2	239.5	32.8	2.30
	250 x 80	14.1	7.1	38.67	30.4	3816.8	219.1	305.3	38.4	2.30
	300 x 90	13.6	7.6	45.64	35.8	6362.6	310.8	424.2	46.8	2.36
	350 x 100	13.5	8.1	53.66	42.1	10008.0	430.6	571.9	57.0	2.44
	400 x 100	15.3	8.6	62.93	49.4	5082.8	504.8	754.1	66.6	2.42

ROLLED STEEL TEE BARS (INDIAN STANDARD) : Dimensions and Properties

ISNT	20 x 20	3.0	3.0	1.13	0.9	0.4	0.2	0.3	0.2	0.60
	30 x 30	3.0	3.0	1.75	1.4	1.4	0.6	0.6	0.4	0.83
	40 x 40	6.0	6.0	4.48	3.5	6.3	3.0	2.2	1.5	1.20
	50 x 50	6.0	6.0	5.70	4.5	12.7	5.9	3.6	2.4	1.44
	60 x 60	6.0	6.0	6.90	5.4	22.5	10.1	5.2	3.4	1.67
	80 x 80	8.0	8.0	12.25	9.6	71.2	32.3	12.3	8.1	2.23
	100 x 100	10.0	10.0	19.10	15.0	173.8	79.9	24.1	16.0	2.79
	150 x 150	10.0	10.0	29.08	22.8	603.8	267.5	54.6	35.7	3.95

THE THEORETICAL WEIGHT OF CHEQUERE PLATES

Thickness (mm)	Weight kg/m2	Thickness (mm)	Weight kg/m2
5	45.30	8	68.90
6	53.20	10	84.60
7	61.10	12	100.30

WEIGHT OF M.S. RODS PER METER IN KG.

d. mm	Round	Square	Hexa-gonal	Octa-gonal	d. mm	Round	Square	Hexa-gonal	Octa-gonal
5	0.154	0.196	0.170	0.163	53	17.319	22.051	19.098	18.267
6	0.222	0.283	0.245	0.234	54	17.978	22.891	19.824	18.963
7	0.302	0.385	0.336	0.319	55	18.650	23.746	20.565	19.672
8	0.395	0.502	0.435	0.416	56	19.335	24.618	21.319	20.394
9	0.499	0.636	0.551	0.527	57	20.031	25.505	22.088	21.129
10	0.617	0.785	0.680	0.650	58	20.740	26.407	22.869	21.877
11	0.746	0.950	0.823	0.787	59	21.462	27.326	23.665	22.638
12	0.888	1.130	0.979	0.936	60	22.195	28.260	24.474	23.412
13	1.042	1.327	1.140	1.09	61	22.941	29.210	25.296	24.198
14	1.208	1.539	1.330	1.275	62	23.700	30.175	26.133	24.998
15	1.387	1.766	1.530	1.463	63	24.470	31.157	26.982	25.811
16	1.578	2.010	1.740	1.665	64	25.253	32.154	27.846	26.637
17	1.782	2.269	1.965	1.879	65	26.05	33.17	28.72	27.48
18	1.998	2.543	2.203	2.107	66	26.86	34.20	29.61	28.33
19	2.226	2.834	2.454	2.348	67	27.68	35.24	30.52	29.19
20	2.466	3.140	2.719	2.601	68	28.51	36.30	31.44	30.07
21	2.719	3.462	2.998	2.868	69	29.35	37.37	32.37	30.96
22	2.984	3.799	3.290	3.148	70	30.21	38.46	33.31	31.87
23	3.261	4.153	3.596	3.440	71	31.08	39.57	34.27	32.78
24	3.551	4.522	3.916	3.746	72	31.96	40.69	35.24	33.71
25	3.853	4.906	4.249	4.065	73	32.86	41.83	36.23	34.66
26	4.163	5.307	4.596	4.396	74	33.76	42.99	37.23	35.61
27	4.495	5.723	4.956	4.741	75	34.68	44.16	38.23	36.58
28	4.84	6.154	5.330	5.299	76	35.61	45.34	39.27	37.56
29	5.18	6.602	5.717	5.469	77	36.56	46.54	40.31	38.56
30	5.49	7.065	6.118	5.853	78	37.51	47.76	41.38	39.56
31	5.925	7.544	6.503	6.250	79	38.48	48.99	42.43	40.59
32	6.313	8.038	6.961	6.659	80	39.49	50.24	43.51	41.62
33	6.714	8.549	7.403	7.082	81	40.45	51.50	44.60	42.67
34	7.127	9.075	7.859	7.518	82	41.15	52.78	45.71	43.73
35	7.553	9.616	8.328	7.966	83	42.47	54.08	46.83	44.80
36	7.990	10.200	8.811	8.428	84	43.50	55.39	47.97	45.89
37	8.440	10.747	9.307	8.903	85	44.55	56.72	49.12	46.99
38	8.903	11.335	9.817	9.391	86	45.60	58.06	50.28	48.10
39	9.378	11.940	10.340	9.891	87	46.67	59.42	51.46	49.22
40	9.865	12.560	10.877	10.405	88	47.75	60.79	52.65	50.36
41	10.364	13.196	11.428	10.932	89	48.84	62.18	53.85	51.51
42	10.876	13.847	11.992	11.472	90	49.94	63.58	55.07	52.68
43	11.400	14.515	12.570	12.024	91	51.06	65.01	56.30	53.85
44	11.936	15.198	13.162	12.590	92	52.18	66.44	57.54	55.04
45	12.485	16.896	13.707	13.196	93	53.32	67.90	58.80	56.25
46	13.046	16.611	14.385	13.761	94	54.48	69.36	60.07	57.46
47	13.619	17.341	15.017	14.263	95	55.64	70.85	61.36	58.69
48	14.205	18.086	15.663	14.986	96	56.82	72.35	62.65	59.93
49	14.803	18.848	16.323	15.614	97	58.01	73.86	63.96	61.19
50	15.414	19.625	16.996	16.258	98	59.21	75.39	65.29	62.46
51	16.036	20.418	17.682	16.915	99	60.43	76.94	66.63	63.74
52	16.617	21.226	18.383	17.585	100	61.65	78.50	67.98	65.02

ESTIMATED QUANTITIES OF MATERIALS REQUIRED PER CUBIC METER OF COMPACTED MORTAR OR CONCRETE

Cement	Nominal mix fine aggregate	Coarse aggregate	Water Cement Ratio	Water litres per 50 kg bag of cement	Cement by wt kg.	by No. of Bags	Sand litres	Crushed stone litres
1	1	-	0.25	12.5	1,015	20.3	710	-
1	1-½	-	0.28	14.0	815	16.3	855	-
1	2	-	0.30	15.0	687	13.75	963	-
1	2-½	-	0.35	17.5	585	11.7	1,023	-
1	3	-	0.40	20.0	505	10.1	1,060	-
1	4	-	0.53	26.5	395	7.9	1,106	-
1	6	-	0.70	35.0	285	5.7	1,197	-
1	8	-	0.90	45.0	220	4.4	1,232	-
1	1	2	0.30	15.0	560	11.2	392	784
1	2	2	0.42	21.0	430	8.6	602	602
1	1-½	3	0.42	21.0	395	7.9	414	828
1	1-½	3.-½	0.48	24.0	363	7.25	419	838
1	2	3	0.50	25.0	385	7.7	539	808
1	2	3-½	0.53	26.5	330	6.6	462	808
1	2	4	0.55	27.5	310	6.2	434	868
1	2-½	3-½	0.57	28.5	305	6.1	534	748
1	2-½	4	0.60	30.0	285	5.7	499	798
1	3	4	0.65	32.5	265	5.3	556	742
1	2-½	5	0.65	32.5	265	5.1	446	892
1	3	5	0.69	34.5	240	4.8	504	840
1	3	6	0.75	37.5	215	4.3	452	904
1	4	8	0.95	47.5	165	3.3	462	924

MATERIALS REQUIRED FOR VARIOUS THICKNESSES OF PLASTER

Mix	Material	Thickness mm					
		5	10	20	30	40	50
1 : 1	C	5.1	10.1	20.3	30.5	40.6	50.8
	FA	3.5	7.1	14.2	21.3	28.4	35.5
1: 1-½	C	4.1	8.2	16.3	24.5	32.6	40.8
	FA	4.3	8.6	17.1	25.6	34.2	42.7
1 : 2	C	3.4	6.9	13.7	20.6	27.5	34.3
	FA	4.8	9.6	19.3	28.9	88.5	48.1
1:2-2/2	C	2.9	5.9	11.7	17.5	23.4	29.2
	FA	5.1	10.2	20.5	30.7	41.0	51.2
1:3	C	2.5	5.1	10.1	15.2	20.2	25.3
	FA	5.3	10.6	21.2	31.8	42.4	53.0
1:4	C	2.0	4.0	7.9	11.9	15.8	19.7
	FA	5.5	11.1	22.1	33.2	44.2	55.3
1:6	C	1.4	2.9	5.7	8.6	11.4	14.3
	FA	6.0	12.0	23.9	35.9	47.9	59.9
1:8	C	1.1	2.2	4.4	6.8	8.8	11.0
	FA	6.2	12.3	24.6	37.0	49.3	61.6

C = Cement in Kilogrames FA : Fine aggregate (sand) in litres

Note : No allowance has been made in table for bulking and wastage

DATA FOR PLAIN M.S.SHEETS IN TERMS OF GAUGE & THICKNESS IN mm
STANDARD WIDTHS

Standard Thickness		Theoretical weight in kg. per sq metre	600 mm (23.62")	750 mm (29.53")	900 mm (35.43")	1000 mm (39.37")	1100 mm (47.31")	1200 mm (47.24")	1250 mm (49.21")
G	MM		Maximum widths in meters						
10	3.15	24.75	3.00	3.00	3.00	3.00	3.00	3.00	3.00
11	2.80	22.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
12	2.50	19.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60
13	2.24	17.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60
14	2.00	15.70	3.60	3.60	3.60	3.60	3.60	3.60	3.60
15	1.80	14.15	3.60	3.60	3.60	3.60	3.60	3.60	3.60
16	1.60	12.55	3.60	3.60	3.60	3.60	3.60	3.60	3.60
17	1.40	11.00	3.60	3.60	3.60	3.60	3.00	-	-
18	1.25	9.80	3.60	3.60	3.60	3.60	3.00	-	-
19	1.12	8.80	3.60	3.60	3.60	3.00	-	-	-
20	1.00	7.85	3.60	3.60	3.60	3.00	-	-	-
21	0.90	7.05	3.60	3.60	3.00	3.60	-	-	-
22	0.80	6.30	3.60	3.60	3.60	3.00	-	-	-
24	0.63	4.95	3.60	3.60	3.60	3.00	-	-	-

MS PLATES (PLAIN)

Thickness in mm	weight in kg. per sq m.	Thickness. in m.m	weight in kg. per sq m.
5	39.25	16	125.60
6	47.10	18	141.30
8	62.80	20	157.00
10	78.50	22	172.70
12	94.20	25	196.25
14	109.90		

RAILS

Desig nation	lb/yd	Kg/m	Desig nation	lb/yd	Kg/m	Desig nation	lb/yd	Kg/m	Desig nation	lb/yd	Kg/m
HEAVY RAILS			LIGHT RAILS			BRIDGE RAILS			BULL HEAD RAILS		
IRS	105	52.09	BS	30	14.88		70	34.72	BS	100	49.90
BS	90	44.61	BS	24	11.91		56	27.78	BS	90	44.61
BS	75	37.13	BS	20	9.92	CR	CRANE RAILS				
BS	60	29.76					100	88.78			
BS	50	24.80					80	63.52			

GALVANISED STEEL SHEETS (PLAIN SHEETS)

Weight in KILOGRAMS square metre of Sheets

Description and class of sheet		Thickness of sheets in mm				
		1.60	1.25	1.00	0.80	0.63
		16G	18G	20G	22G	24G
Class 1	(750 g of Zinc (Spelter) coating / sq m.both sides inclusive)	13.31	10.56	8.60	7.03	5.70
Class 2	(600 g of Zinc (Spelter) coating / sq m.both sides inclusive)	13.36	10.41	8.55	6.88	5.55
Class 3	(450 g of Zinc (Spelter) coating / sq m.both sides inclusive)	13.01	10.26	8.30	6.73	5.40
Class 4	(375 g of Zinc (Spelter) coating / sq m.both sides inclusive)	12.94	10.19	8.22	6.66	5.32

WEIGHT OF WIRE IN KILOGRAMS PER 1000 MTRS

Diameter in mm	iron	Steel	Coper
0.100	0.06	0.06	0.07
0.125	0.09	0.10	0.11
0.160	0.15	0.16	0.18
0.200	0.24	0.25	0.28
0.250	0.38	0.39	0.44
0.315	0.61	0.62	0.69
0.400	0.98	1.00	0.12
0.500	1.53	1.57	1.74
0.630	2.43	2.49	2.77
0.800	3.92	4.01	4.47
1.00	6.13	6.27	9.98
1.250	9.57	9.80	10.90
1.600	15.68	16.04	17.86
2.000	24.51	25.08	27.91
2.500	38.29	39.40	43.61
3.150	60.79	62.23	69.64
4.000	98.03	100.34	111.65
5.000	153.17	156.78	174.45
6.300	243.18	249.90	276.96
8.000	392.11	401.35	446.59

FIELD TESTS FOR SAND
(Based on IS 1542 - 1960)

To check the suitability of sand for being used in mortor or concrete it may be put to the following tests in the field:-

(i) Taste of sand shall Provide check for the presence of salts.

(ii) Rub a little sand between the fingers. Stains left on fingers will indicate the presence of clayey impurities.

(iii) Vigorously stir a sample of sand in a glass of water and allow it to rest. Amount of clay or slit present in it would settle on the Sand.

(iv) Stir a sample of stand in a 3% solution of caustic soda and keep the bottle corked for 24 hours. If the colour of the liquid turns brown, then the present of orgonic matter is indicated.

REMOVAL OF FORM WORK FOR CONCRETE STRUCTURES

a)	Walls, columns and vertical sides of beams	24 to 48 hr as may be decided by the engineer-in-charge
b)	Slabs sides [props left under]	3 days
c)	Beam soffits [props left under]	7 days
d)	Removal of props to slabs:	
	1. Spanning up to 4.5m	7 days
	2. Spanning over 4.5m	14 days
e)	Removal of props to beams and arches	
	1. Spanning up to 6m	14 days
	2. Spanning over 6m	21 days

LOADS

Structures are designed for the worst combination of dead and live loads; wherever applicable, wind loads, seismis forces and secondary effects such as shrinkage, the rise or fall in temperature, etc. must also be considered.

Dead Loads:

The dead Weight of a number of materials and structural item is given in the Table No. 1. In using these figures it should be noted that the density of most materials varies within certain well defined limits and this variation can, therefore, effect the imposed loading. The figure in the table are however, sufficiently accurate for normal design purpose.

Live Loads:

The live load to be used for the design of floors and roofs in building are given in table 2 & 3 respectively. They are considered as uniformly distributed static loads on the plan are and include the effects of normal impact. They, however do not take into consideration special concentrated loads nor do they cater for loads incidential to construction and special cases of vibration such as moving machinery, heavy acceleration from cranes hosits and the like, such loads should be dealt with individually in each case.

The figure given in Table No. 2 & 3 are conversions from the loading specified in the Indian standard Code of Practice; No. 875-1957 and their application should, therefore be read in conjuction with the provisions of this code.

Wind Pressure:

The basic pressure induced by wind loads for various heights of exposed surface are given in Table No. 4. The figures are based on table III of the I.S. Code of Practice No. 875. 1957 and their application should confirm to the provision contained in clause 4 of the code.

Earth Pressure

The value of the horizontal pressure exerted by a retained material is obtained from the normal Rankin's formula, which for a level fill retained against in vertical surface is expressed as:

$$P = wh \quad \frac{1-\sin \varnothing}{1x\sin \varnothing}$$

where p = the pressure in kg/m^3
w = the unit weight of earth kg/m^3
h = the height of fill in Meter.
$\varnothing$ = the angle of repose of the fill in degrees.

The unit weight of earth and the angle of repose, will of course vary depending upon the degree of saturation of the retained material.

The pressures exerted on inclined surfaces and due to the effect of sloping files are also derived from the normal formulae, for which reference may be made to text-book on the subject.

Seismic Effects

The forces exerted as a result of seismic effects can be calculated directly from the formulate given in clause 7 of the I.S. Code of Practice No. 875 = 1957.

DEAD WEIGHT OF MATERIALS

Item	Weight	
Bituminous Substances		
Anthracite coal	1550	kg/m^3
Pear	750	kg/m3
Heavy Charcoal	530	kg/m^3
Coke	1200	kg/m^3
Graphite	500	kg/m^3
Crude oil	880	kg/m^3
Pitch	1100	kg/m^3
Coaltar	1200	kg/m^3
Excavated Materials		
Clay (dry)	1600	kg/m^3
Clay (damp, plastic)	1760	kg/m^3
Earth (dry, loose)	1200	kg/m^3
Earth (Packed)	1520	kg/m^2
Sand (dry, loose)	1440-1700	kg/m^3
Sand (dry, packed)	1600-1900	kg/m^3
Liquids		
Alcohol	780	kg/m^3
Gasoline	670	kg/m^3
Ice	913	kg/m^3
Nitric acid	1500	kg/m^3
Sulphuric acid	1800	kg/m^3
Vegetable oil	930	kg/m^3
Water	1000	kg/m^3
Building Materials		
Bricks	1600	kg/m^3
Cement	1400	kg/m^3
Chalk	2200	kg/m^3
Glass	2560	kg/m^3
Limestone	2650	kg/m^3
Sandstone	2800	kg/m^3
Steel	7800	kg/m^3
Timber	570-720	kg/m^2
Structural Items. Ceilings Finishes, etc.		
A.C. Sheets	17	kg/m^2
Brick masonry	1920	kg/m^2
Brick Wall, 6 in. thick	295	kg/m^2
Brick Wall, 9 in. thick	440	kg/m^2
Cement Plaster, 2.5 cm. thick	44	kg/m^2
Concrete	2306	kg/m^2
G.I. sheet, 24 gauge	5	kg/m^2
G.I. sheet, 16 gauge	10	kg/m^2
Mangalore tiles with battons	69	kg/m^2
Rubble masonry	2100	kg/m^2

LIVE LOADS ON FLOORS

Loading class No.	Types of floors	Minimum live load kg/m^2 of floor area
200	Floors in houses, hospital, wards, bed rooms and sitting rooms, hostel, etc.	200
250	Office floors, other than entrance halls	250 to 400
300	Floors of banking halls, entrance halls and reading rooms	300
400	Shop floors used for the display and sale of merchandise, work rooms	400
500	Floors of warehouses, workshops, factories, office floor for storage, etc.	500
750	Floors of warehouses, workshop and factories for medium weight loads	750
1000	Floors of warehouses, workshops, factories etc., for heavy weight loads, floors of book stores and libraries, roofs and pavement, etc.	1000
Garage	Floors used for garages for vehicles not exceeding (light) 2.5 tonnes gross weight:	
	Slabs	400
	Beams	250
Garage	Floors used for garages for vehicles not exceeding (heavy) 4 tonnes gross weight	750

LIVE LOADS ON ROOFS

Sl. No.	Type of Roof	Live load Measured on Plan	Minimum Live load measured on Plan
1.	Flat, Sloping of Curved roof with slopes and including 10°		
	(a) Access Provided	150 kg/m^2	375 kg Uniformly distributed over any span of one metre width if the roof slab and 900 kg/uniformly distributed over the span in the case of all beams;
	(b) Access not provided except for maintenance	75 kg/m^2	190kg uniformly distributed over any span of one metre width if the roof slab and 450 kg. uniformly distributed over the span in the case of all beams;
2.	Sloping roof with slope greater than 10°	75 kg/m^2	Less than one kg/m^2 for every degree increase in slope over 10° upto and including 20° and 2 kg/m^2 for every degree, increase in slope over 20° (subject to a min. of 40 kg/m^2
3.	Curved roofs with slop at springing greater than 10°	(75-345r^2) (kg/m^2)	Where r = h/l h = the height of the highest point of the structure measured from its springing: l = chord width of the roof if signly curved and shorter of the two sides if doubly curved (Subject a min. of 40 kg/m^2

Note: For special types of roofs with highly permeable and absorbent material, the contingency of roof material increasing in Weight due to absorption of moisture shall be provided for.

USUAL RANGE OF SAFE BEARING CAPACITY VALUES

Types of rocks/soils	Safe bearing capacity Kg/cm^2
(a) Rocks:	
(i) Rocks hard without lamination and defects, e.g. - granite and dionite	33
(ii) Laminated rocks - e.g., sandstone and limestone	16.5
(iii) Resitual deposits of shattered and broken bedrock	9
(iv) Soft rock	4.5
(b) Non-Cohesive Soils:	
(i) Gravel, sand offering high resistance to penetration when excavated by tools	4.5
(ii) Coarse sand, compact and dry	4.5
(iii) Medium sand, compact and dry	4.5
(iv) Fine sand, silt	2.5
(v) Loose gravel or sand gravel mixture dry	1.0
(vi) Fine sand, loose and dry	1.0
(c) Cochesive Soils:	
(i) Soft Shale, hard clay in deep bed dry	4.6
(ii) Medium clay, readily indented with a thumb nail	2.5
(iii) Moist clay and sand clay mixture with strong thumb pressure	1.5
(iv) Soft dry with moderate thumb pressure	1.0
(v) Very soft clay which can be penetrated	0.5
(vi) Balck cotton soil or expensive clay in dry condition	No generalised value
(vii) Peat	-do-
(viii) Fills or made up ground	-do-

USEFUL DATA FOR RETAINING WALLS

Sl. No.	Description of backing meterial filled in the back of retaining wall	Weight kg/m^3	Angle of repose 'O' indegree
1.	Dry sand clean	1550 - 1600	30° - 35°
2.	Moist sand	1600 - 1750	35°
3.	Wet sand	1750 - 2000	25° - 26°
4.	Consolidated dry sand	1920	35°
5.	Dry earth (vegetable)	1600	20° - 30°
6.	Moist earth (vegetable)	1600 - 1750	45° - 50°
7.	Wet earth (vegetable)	1750 - 1920	15° - 17°
8.	Dry consolidated earth (vegetable)	1600	50°
9.	Gravel (clean)	1440	40°
10.	Sand mixed gravel	1600 - 1750	26° - 30°
11.	Rubble stone	1600 - 1750	45°
12.	Dry clay	1920 - 2240	30°
13.	Damp clay	2000 - 2550	45°
14.	Wet clay	2000 - 2550	15°
15.	Mud	1600 - 1920	0°
16.	Coal ashes	640	40° - 45°

PERMISSIBLE STRESSES IN STEEL REINFORCEMENT

Permissible stresses in N/mm^2

Sl. No.	Type of stress in steel reinforcement	Mild steel bars conforming to IS : 432 Part 1-1966 or Deformed mild steel bars conforming to IS:1139-1966	Medium Tensile steel conforming to IS:432 Part 1-1966 or Deformed Medium Tensile steel bars conforming to IS : 1139-1966.	High yield strength Deformed bars conforming to IS:1139-1966 or IS:1986-1979 (Grade Fe 415)
(1)	(2)	(3)	(4)	(5)
(i)	Tension			
	(a) Upto and including 20 mm	140	Half the guaranteed yield stress subject to a maximum of 190	230
	(b) Over 20 mm	130		230
(ii)	Compression in	130	130	190
(iii)	Compression in bars in a beam or slab when the compressive resistance of the concrete is taken into account	The calculated compressive stress in the surrounding concrete multiplied by 1-5 times the modular ratio.		
(iv)	Compression in bars in a beam or slab where the compressive resistance of the concrete is not taken into account			
	(a) Upto and including 20 mm	140	Half the guaranteed yield stress subject to a maximum of 190	190
	(b) Over 20 mm	130		190

PERMISSIBLE STRESSES IN CONCRETE

(in Newton Per mm^2)
(IS : 456 - 1978)

Grade of concrete	Permissible stress in compression		Permissible stress in bond (average) For Plain bars in tension
	Bending	Direct	
(1)	(2)	(3)	(4)
M 10	3.0	2.5	
M 15	5.0	4.0	0.6
M 20	7.0	5.0	0.8
M 25	8.5	6.0	0.9
M 30	10.0	8.0	1.0
M 35	11.5	9.0	1.1
M 40	13.0	10.0	1.2

MINIMUM DIMENSIONS REQUIRED IN A RESIDENTIAL BUILDING

Description	Min. Requirements
Plinth height	450 mm in general 150 mm for garages
Head room	3.00 m for rooms
Area of living bed rooms	12.00 m^2
Area of kitchen	8.00 m^2
Area of bath room	2.52 m^2 (1.2 m x 2.1 m)
Area of WC	1.2 m^2 (1.00 m x 1.20 m)
Windows	1/10 of floor area excluding doors or dry hot climate 1/10 of floor area excluding doors for wet hot climate
Window openings in WC and Bath room	10% of floor area
Lighting area for staircase	1 m^2 per floor height
Staircase	Width 1 m Rise 190 mm Tread 250 mm

THICKNESS OF STEEL SHEETS

No. S.W.G.	Thickness mm	No. S.W.G.	Thickness mm	No. S.W.G.	Thickness mm
1	7.62	14	2.03	27	0.42
2	7.01	15	1.83	28	0.38
3	6.40	16	1.63	29	0.35
4	5.89	17	1.42	30	0.31
5	5.38	18	1.22	40	0.12
6	4.88	19	1.02	50	0.02
7	4.47	20	0.91	7/0	12.7
8	4.06	21	0.81	6/0	11.78
9	3.66	22	0.71	5/0	10.97
10	3.25	23	0.61	4/0	10.16
11	2.95	24	0.50	3/0	9.45
12	2.64	25	0.51	2/0	8.84
13	2.34	26	0.48	0	8.23

RECOMMENDED MIXTURES FOR SEVERAL CLASSES FOR CONSTRUCTION INTENDED PRIMARILY FOR USE OF SMALL JOBS

Kind of Work	Gallons of water to add to each one sack batch			Trial Mixture for first batch			
	Dry Sand	Moist sand and broken stones	Wet sand and broken stones	Cement	Sand	Broken Stones	Maximum aggregate size
				Sacks	C.ft	C.ft	Ins
Foundations, wall, which need not be watertight, mass concrete for footings retaining walls, compound walls machine Foundations etc.	7 1/2	6	5	1	3.6	6	2
Watertight basement walls and pits walls above ground, dams, monsoon protections walls and sundry small block articles.	6 1/2	5	4 1/2	1	3	2.4	1 1/2
Storage tanks, Bins and troughs, Well curbs and plate-forms. Septic tanks and cisterns. Watertight floors sidewalks and roadways. Flagstones and slabs, pool-linings, steps, stairs beams, lintels corner posts, gateposts. columns and piers.	5 1/2	4 1/2	3 3/4	1	2.4	3.6	1
Posts and poles for fencing, telegraphs and signals, Garden furniture, benches, boxes and flower pots. One work of very [illegible] section.	4 1/2	3 3/4	3 1/2	1	2.4	2.4	3/4

RECOMMENDED MIXES FOR VARIOUS TYPES OF CONSTRUCTION

Depends on whether concrets is to be tamped, rubbed or vibrated and on absorption of water by aggregate.

Nature of Work	Mixture Recommended Vol. proport.	Maximum size of aggregate to use	Water in gallons per bag of C.	Bast Consistency
Long Span R.C. Arches High Load R.C. Columns	1:1:2	1/2" to 3/4"	3.5 to 4.0	Medium
Heavily stressed members of structures, small precast work such as Posts and Poles for Fencing, Telegraphs, Signals, Garden; furniture and decoratives and other work of very thin sections, watertight constructions for high heads, long piles.	1:2:2	1/2" to 3/4"	4.5 to 5.0	Medium or soft.
R.C. Columns and members subjected to medium loads, wall and floors of resirvoir and tanks, cisterns, sewers, well kerbs and platforms and other watertight constructions, for moderate heads, non-surfaced roof slabs, concrete deposited under water.	1:3:2 to 1:2:2:4	3/4"	5.5	Medium.

RECOMMENDED MIXES FOR VARIOUS TYPES OF CONSTRUCTION

Depends on whether concrets is to be tamped, rodded or vibrated and on absorption of water by aggregate.

General R.C. Building work Subjected to ordinary stressed such as beams, slabs, columns, panel walls basements and retaining, walls, stairs, lintels, sills, roads, pavements, driveways, side walls, floor steps, bunkers and silos, bridge construction dams and piers etc. exposed to action of water and frost, machine foundations subjected to vibrations, R.C. footings, R.C. piles.	1:2:4	1/2" to 1 1/2" as required	6.0 to 6 1/2	Stiff for Roads Medium for others
Mass concrete work in colverts, retaining walls, compound walls and ordinary machine bases, foundation walls which need not be water-tight.	1:3:5	1" to 2"	7.5	Stiff for Meedium
Mass concrete for heavy walls foundations under column footings and under heavy duty floors, concrete blocks, hollow block construction (1/2" AGG).	1:4:8	1 1/2" to 2 1/2	1.00 to 10.05	Medium

DRINKING WATER STANDARDS

Substance or property	Acceptable	Cause for Rejection
PHYSICAL QUALITY		
Turbidity (Units on J.T.U. Scale)	2.5	10
Colour (Units on Platinum Cabalt Scale)	5.0	25
Taste and odour	Unobjectionable	Unobjectionable
CHEMICALA QUALITY		
pH	7.0 to 8.5	<6.5>9.2
Total dissolved solids (mg/l)	500	1500
Total hardness (as $CaCO_3$) (Mg/1)	200	600
Calcium (as Ca) (mg/1)	75	200
Magnesium (as Mg) (Mg/1)*	<30	150
Chlorides (as Cl) (mg/l)	200	1000
Sulphates (as SO_4) (mg/l)	200	400
Iron (as Fe) (mg/l)	0.1	1.0
Manganese (as Mn) (mg/l)	0.05	0.5
Copper (as Cu) (mg/l)_	0.05	1.5
Zinc (as Zn) (mg/l)	5.0	15.0
Phenolic Compounds (as phenols) (mg/l)	0.001	0.002
Anionic detergents (as MBAS) (mg/l)	0.2	1.0
Fluorides (as F) (mg/l)	1.0	1.5
Nitrates (as NO_3) (mg/l)	45	45
Toxic Materials:		
Arsenic (as As) (mg/l)	0.05	>0.05
Barium (as Ba) (mg/l)	—	>1.00
Cadmium (as Cd) (mg/l)	0.01	>0.01
Chromium (as hexavalent Cr) (mg/l)	0.05	>0.05
Cyanides (as CN) (mg/l)	0.05	>0.05
Lead (as Pb) (mg/l)	0.1	>0.1
Mercury (total as Hg) (mg/l)	0.001	>0.001
Selenium (as Se) (mg/l)	0.01	0.05
Silver (as Ag) (mg/l)	—	0.05
Poly nuclear Aromatic Hydrocarbon (PAH)	0.2 ug	>0.2ug
Radio activity	3 PCi/1	3 PCi/1
Gross Alpha activity	30 PCi/1	30 PCi/1

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.

DIMENSIONS AND PROPERTIES OF A.C. PRESSURE PIPES

These pipes are classified according to the test presssure as under:

Class of pipe	Class 1	Class 2	Class 3	Class 4	Class 5
Test pressure	5 kg/cm^2	10 kg/cm^2	15 kg/cm^2	15 kg/cm^2	25 kg/cm^2

The nominal diameters of pipe shall be 50, 80, 100, 125, 150, 200, 250, 300, 450, 600, 900, 1000 mm. The nominal effective length, (length between extremities for pipes with plain end and effective length of pipes with sockets) shall not be less than (i) 3 m for pipes of nominal diameter of 100 mm or less and (ii) 4 m for pipes of nominal diameter greater than 100 mm. The maximum working pressure, under which each class of this pipe shall be used, shall not exceed half the test pressure for that class of pipe given above.

DIMENSIONS AND PROPERTIES OF VERTICALLY CAST IRON PRESSURE PIPES FOR WATER, GASS AND SEWAGE

Vertically cast pipes tested to the pressure in kg/cm^2 as under.

Sl.No.	Nominal diameter	Socket and spigot pipes		Flanged pipes	
		Class A Kg/cm^2	Class B Kg/cm^2	Class A Kg/cm^2	Class B Kg/cm^2
1.	Upto and including 300 mm	20	25	20	15
2.	Over 300 mm and including 600 mm	20	25	15	20
3.	Over 600 mm and upto and including 1000 mm	15	20	10	15
4.	Over 1000 mm to 1500 mm	10	10	10	10

DIMENSIONS AND PROPERTIES OF CENTRIFUGALLY CAST (SPUN) IRON PRESSURE PIPES FOR WATER, GAS AND SEWAGE

These pipes have been classified as Class LA. Class A and Class B. Class LA pipes have been taken as the basis for evolving the series of pipes. Class A allows 10% increase in thickness over Class LA and Class B allows a 20% increase in thickness over LA.

Standard lengths for socket and spigot pipes are 3.66., 4.88 and 5.5 m. For flanged pipes with screwed flanged lengths are 2.0, 2.8, 3.0, 4.88, 5.0 and 5.5 m. Hydraulic test pressures in kg/cm^2 for socket and spigot pipes are as follows:

Nominal diameter	Class LA	Class A	Class B
Upto and including 600 mm	20 kg/cm^2	25 kg/cm^2	30 kg/cm^2
Over 600 mm	15 kg/cm^2	20 kg/cm^2	25 kg/cm^2

CLASSIFICATION OF C.C. PIPES ACCORDING TO IS : 458-1971

Class	Description	Conditions under which normally used
NP_1	Unreinforced concrete non-pressure pipes	For drainage and irrigation, use, above ground or in shallow trenches
NP_2	R.C. light duty, non-pressure pipe	For culverts carrying light traffic
NP_3	R.C. heavy duty, non-pressure pipe	For culverts carrying heavy traffic
NP_4	R.C. heavy duty, non-pressure pipe	For culverts carrying very heavy traffic, such as railway
P_1	R.C. pressure pipes tested to a hydrostatic pressure of 2.0 kg/cm^2 20 m head	For use on gravity mains, the actual working pressure not exceeding $^2/_3$ of the test pressure
P_2	R.C. pressure pipes tested to a hydrostatic pressure of 4.0 kg/cm^2 (40 m head)	For use on pumping mains, actual working pressure not exceeding $^1/_2$ of the test pressure
P_3	R.C. pressure pipes tested to a hydrostatic pressure of 6.0 kg/cm^2 (60 m head)	For use on pumping maing, actual working pressure not exceeding $^1/_2$ of the test pressure

CENTRE OF GRAVITY FOR GEOMETRIC SHAPES

Straight line :— At the middle point of the line.

Semi circumference :— On the middle radius, at a distance of 0.6366 x radius above the diameter.

Quadrant of a circle :— On the middle radius, at a distance of.90028 x radius from the centre.

Cycloid :— On a perpendicular to the base at its middle point, at a distance of 2/3 the diameter of the generating circle above the base.

Triangle :— On a line drawn from any angle to the middle of the opposite side, at a distance of one-third of the line from the side or at the intersection of such lines drawn from any two angles.

Parallelogram :— At the intersection of the diagonals.

Quadrilateral :— Draw a diagonal, dividing it into two triangles. Draw a line joining their centres of gravity. Draw the other diagonal and again draw a line joining the centres of gravity of the two triangles. The intersection of the two lines is the centre of gravity.

Sector of a circle :— On the radius which bisects the arc Z = 2cr - 3l from the centre. c = chord, r = radius, l = arc.

Semicircle :— On the middle radius Z = 0.4244 x r from centre.

Segment of a circle :— Z = C3 + 12a from centre. a = area, c = chord.

Parabola :— In the axis 3/5 of its length from the vertex.

Prism of cylinder :— At the middle point of the line joining the centres of gravity of the bases.

Cone or Pyramid :— In the axis $^1/_4$ of its length from the base.

Paraboloid :— In the axis $^2/_3$ of its length from the vertex.

IMPORTANT STANDARD DATA

for civil works

(As adopted in Tamil Nadu State P.W.D)

(i) Mortar - Per Cu.m.

S.No.	Description of work	Materials required			Remarks
		Lime in cu.m.	Cement in kg.	Sand in cu.m.	
1.	Lime Mortar 1:1.5	0.67	-	1.00	Special grinding charges to be added.
2.	Lime Mortar 1:2 for Concrete and Masonry	0.50	-	1.00	-do-
3.	Cement Mortar 1:2	-	720	1.00	Mixing charges to be added
4.	Cement Mortar 1:3	-	480	1.00	,,
5.	Cement Mortar 1:4	-	360	1.00	,,
6.	Cement Mortar 1:5	-	288	1.00	,,
7.	Cement Mortar 1:6	-	240	1.00	,,
8.	Cement Mortar 1:8	-	180	1.00	,,

(ii) Wood work wrought and putup- per cu.m.

S.No.	Description	Required					Remarks
		Wood cu.m.	Iron work kg.	Labour in Numbers.			
				Carpenter Class		Mazdoor	
				I	II	I	
1.	Large scantling over 3m for Joist & Rafters	1.00	-	4.5	13.2	35.3	L.S. may be added for nails, screws etc.,
2.	Scantling below 3m.	1.00	-	4.5	13.2	8.8	
3.	For Trusses	1.00	112.0 (average)	6.7	19.8	8.8	

(iii) Concrete for 1 Cu.m.

S.No.	Description of work	Required						Remarks
		Material	Mortar in Cu.m	Labour in Nos.				
				Mason	Class	Mazdoor	Catagary	
				I	II	I	II	
(a)	Concrete with brocken stone using 40% Mortar	Metal 0.95 Cu.m	0.38	-	0.18	1.77	1.41	-
(b)	Concrete with brocken stone using 50% Mortar	Metal 0.90 Cu.m	0.45	-	0.18	1.77	1.41	-
(c)	Concrete 1:2:4 R.C.C. Work	20 m.m. Metal 0.90 Cu.m	Cement 323.1 Kg. Sand 0.45 Cu.m	-	0.35	2.12	3.53	-
(iv)	Steel grill work for R.C.C. work 1. Quintal M.S. ROD/ R.T.S. ROD	Steel 1 Quintal Binding wire 0.01 Quintal		-	-	-	-	Fitter I Class 3 Nos.

(v) Scaffolding, Centering etc.,

(a) SCAFFOLDING

Providing two legged scaffolding using 15cm dia. blue-gum posts or casuarina posts or best quality bamboo posts of 4m. Overall length (3m. height +0.5m projection +5m. into the ground) the distance between the two rows being 1.26m. and the spacing of posts being 2m. in both the rows with two horizontal posts with 0.5m overlap on either side and braces at 2m. C/c including longitudinal and transverse middle braces to step up and providing a platform with country wood planks of 40mm thick and 1m width, etc., in a complete form using coir and nails -1 m run.

RATE FOR 6m RUN:

15cm dia. posts (blue gum posts or casuarina or bamboo posts)	70m run	
Country wood planks	0.3 cu.m	
Total cost of material		(A)
Material can be used for 10 times		(A) / 10 : (B)
DETAILED DATA:		
Cost of materials for one operation		(B)
Mazdoor Catagory - (I) 2 Nos.		-
Coir-nails etc.	L.S.	-
Total for 6m run		(C)
Rate for 1m run C/6		(D)
For every additional height of 2.5m taking 6m run- extra materials required:		
Vertical post 1m run.		
Country wood planks 0.01 Cu.m.		
Total		(E)
Cost of one operation (E)/10		= (F)
Mazdoor category (I)	2 Nos.	
Coir nails etc. L.S.		-
Total		(G)
Cost for 1m. run and every additional height of 2.5m (G)/6		= (H)

(b) Centering

(i) WOOD CENTERING:

Centering for soffits of reinforced cement concrete slabs or plane surface including strutting 3m high for 10 sq.m.

Country wood boarding 40mm thick	0.40 Cu.m.	
Country wood joists (average 10cm X 6.5cm at about 90cm centre)	0.12 Cu.m.	
Casuarina props 10 to 13cm dia. at 75cm centres	98.50 m	
Total		(P)
Materials can be used for 5 times		
Cost of materials for one operator (P) / 5		
Carpenter I Class 3.8 Nos		
Mazdoor catagory-(I) 5.4 Nos.		
Wedges 21.5 Nos.		
coir, Nails etc. L.s.		
Total for 10 sq.m.		(Q)

(C) STRUTTING:

(I) Strutting to centerings of reinforced cement concrete slabs or plane surfaces upto 3m height - 1 sq.m.

Cost of casuarina props 10 to 13 cm dia. at 75 cm C/c and braces 9.85m run		=	(R)
Cost of materials for one operation: (R) / 5		=	S
Carpenter I Class	0.03 Nos.	=	
Mazdoor category - I	0.03 Nos.	=	
Nails, Coirs etc.	L.S.	=	
Total for 1 Sq.m.			(T)

(ii) Strutting to centering of reinforced cement concrete slabs or plane surfaces for every additional 1m height or part there of but not less than 30cm over the initial 3m height T/3

Note:- Rates for centering and strutting for several types of R.C. works. (i.e.) slabs, walls, columns etc., are derived as follows:

1) Centering to soffits of R.C. Slabs and plane surfaces including strutting 3m high	Q -
2) Strutting and providing supports for R.C. walls upto 3m high (Both sides to be measured)	Qx110/100
3) Centering to soffits of R.C. slabs and plane surface including strutting 3m high in small quantities (i.e. sun shades)	Qx120/100
4) Centering to sides and soffits of lintel and beams	Q -
5) Strutting and providing supports to columns	Qx120/100

NOTE:

1) Rate Q include charges for strutting 3m high
2) For every additional 1m height of strutting above 3m or part thereof but not less than 30cm.
3) Additional rate (T) will be adopted.
   The centering charges will be calculated taking into account the following considerations:
4) For curved surfaces, 1.5 times the rate for plane surfaces and for round columns twice the rate for square columns shall be allowed.
5) In case of "Tee" beam, floors and bridge slabs, to allow for the extra cost of bevels, etc., the whole area of the slab shall be considered (i.e.) without deducting for the thickness of the beams.
6) Where the beams are so closely spaced that the joints below the centering planks may be supported from the flanges or sides of the beams (i.e.) without strutting from below, the rate for centering (Q) shall be less by the amount of strutting 3m high. But in the case of contilever slabs, in similar cases, no deduction need be made.
7) For special precast, ornamental works the rate for centering may be worked out with reference to the particular type of work required.

(vi) Masonry Work for 1 Cu.m.

S.No	Description of work	Required							Remarks
		Stone in Cu.m.	Bricks in Numbers	Mortar in Cu.m	Labour Nos. Mason (I)	Class (II)	Mazdoor (I)	Categary (II)	
	(a) Stone Masonry								
1.	Cut Stone Work	1.05(1)	-	0.16	1.06	2.47	3.53	2.82	(1) Roughly dressed to shape at quarry
2.	Coursed rubble First Sort	1.10(2)	-	0.28	1.06	2.47	1.41	1.41	(2) Including bond stone 0.10 Cu.m.
3.	Randam rubble	1+0.1	-	0.34	0.71	1.06	1.41	1.41	
4.	Randam rubble in clay	1+0.1	-	0.4	0.35	1.06	1.06	1.06	
5.	Dry stone masonry	1.2	-	-	0.35	0.71	0.71	0.35	
6.	Rough stone dry packing	1.10	-	-	0.35	-	1.06	0.71	Including spolls for filling and wedging
7.	Jetty stone dry packing	1.10	-	-	0.35	-	1.41	0.71	Including small stones for wedging
8.	Gravel backing for revetment for 1 Cu.m.	-	-	1.16 Gravel	-	-	0.71	0.35	
	(b) BRICK MASONRY WORK USING THE BRICKS SIZES OF - FOR 1 Cu.m.								
9.	9"x4 3/8"x2 3/4"	-	460	0.25	1.41	-	0.71	2.12	I class bricks,
10.	8 3/4"x4 1/4"x2 1/4"	-	601	0.28	0.35	0.71	0.71	1.41	country bricks,
11.	8 3/4"x4 3/8"x2 3/4"	-	459	0.25	0.35	1.06	0.71	2.12	Stock bricks
12.	8 3/4"x4 1/4"x2"	-	657	0.30	0.35	0.71	0.71	1.41	Country bricks,
	For partion wall 8 3/4"x4 1/4"x2"	-	657	0.19	0.50	0.56	0.71	1.41	Extra one I Class Mason may be added for 10m² of partition wall (Country bricks)
13.	Damp proof course in cm.1:4 with 2% impermo by weight of cement used. 20mm TK for 10 Sq.m.	-	-	0.21	1.1	1.1	2.2	1.1	1.51 kg. of impermo.

NOTE: For well steining in stone masonry add 1.4 mason II Class for 1 Cu.m of finished work.

S.No.	Description of work	Unit	Materials	Mortar in Cu.m.	Mason I Class in Nos.	Mason II Class in Nos.	Mazdoor Category I in Nos.	Mazdoor Category II in Nos.		
1	2	3	4	5	6	7	8	9	10	11
vii	**WEATHERING COURSE:** Concrete broken brick jelly 20m.m. size in pure slaked lime over R.C.C. roof slab, the proportion (being 32:12.5) for required depth of 80 mm for giving required slope and thickness to roof as required, well beaten with wooden beaters etc., Complete	10 Cu.m.	Brick Jelly 20mm size 12.8 Cu.m. slaked lime 5 Cu.m.		1.8	-	17.7	14.1	-	-
viii	Terrace flooring with one course of pressed tiles 20 cm x 20cm x 20mm using cement mortar(1:3) mixed with crude oil 10 percent by weight of cement and (Instead of crude oil any approved water proofing compound may also be used) Pointed with same oiled mortar.	10 sq.m	Pressed tiles 20cm x 20cm x 20mm-250 Nos Crude Oil 5.8 kg.	0.12 Cu.m.	1.1	2.1	2.2	1.1	-	- Pointing with c.m. 1.3 $10\ m^2$ may be added

(ix) Plastering for 10 Sq.m.

S.No.	Thickness of plastering	Required					Remarks
		Motars in Cu.m.	Labour				
			Mason	Class	Mazdoor	Catagory	
			(I)	(II)	(I)	(II)	
1.	12 mm	0.14	1.1	-	0.5	1.1	Same rate applies to brick work and stone work
2.	20 mm	0.22	2.2	-	0.5	3.2	
3.	10 mm	0.10	1.1	-	1.1	1.1	Special plastering for R.C.C. works in Cm 1:3
4.	15 mm	0.17	1.51	-	0.5	1.89	
1.	Flush pointing - Brick work	0.06	-	1.6	0.5	1.1	
2.	For Marble slabs, pressed tiles, ornamental tiles full depth.	0.04	-	2.2	0.5	1.1	Colouring matter L.S. may be added.
3.	Flush pointing - R.R.	0.09	-	1.6	0.5	1.1	

NOTE: 1) Data for pointing coursed rubble work will be the same as brick work.
2) "Raised or lined pointing" add 1.1 No. Masons to the rate for flush pointing.

(xi) Roofing with asbestos sheets 7 mm thick for 10 sq.m.

S.No.	Description	Required						Remarks
		materials			labour Nos.			
		A.C. Sheet in sq.m	u or j bolts and nuts Nos.	Bitumen washers Nos.	Fitter II class	Carpenter I class	Mazdoor category I	
1.	A.C.Corrugated sheets	11.00	20	20	2.2	1.1	3.2	Sundries for adjustable ridges
2.	A.C.Semi corrugated sheets	11.50	20	20	2.2	1.1	3.2	white lead etc., may be added

(xii) (a) Painting, wood-Oiling, Tarring, Varnishing, BEE's waxing Etc., Painting with ready mixed paints:

NOTE: 1. For painting new and old plastered surfaces adopt data for new and old wood work, respectively- except for priming coat.

2. The weight of ready mixed paint may be taken as 1.1 kg per litre. Painting with ready mixed paint of approved quality and colour over a priming coat.

Description of work	Quantity for									
	One Coat				Two Coats				Three Coats	
	New wood work	Old wood work	New Iron work	Old Iron work	New Wood work	Old Wood work	New Iron work	Old Iron work	New Wood work	New Iron work
Ready mixed paint (Litre)	1.44	1.33	1.33	1.11	2.55	2.22	2.22	1.89	3.55	3.11
Painter (Nos.) I Class	0.7	0.7	0.7	0.7	1.2	1.2	1.1	1.1	1.6	1.5
Sundries including brushes, soap putty etc.,	L.S	L.S	L.S	L.S	L.S	L.S	L.S	L.S	L.S	L.S
Total for 10 sq.m.										

(b) PAINTING PRIMING COAT 10 Sq.m. :

S.No.	Description of work	whiting	Material Required						
		kg.	White lead kg.	Red lead kg.	Patent drier	Linseed oil litre	Painter I Class	Mazdoor category I class	Remarks
1.	Painting priming coat on new wood work	1.00	0.61	-	-	(Twice boiled) 0.61	0.7	-	Sundries including brushes soap,putty etc. may to added
2.	Painting priming coat on new Iron work	-	-	1.00	15.3 gms.	0.46	0.7	-	-do-
3.	Painting priming coat on new plastered surface.	0.55	-	0.55	-	0.6	0.7	-	-do-

(c) VARNISHING 10 Sq.m.:

Item	Description of work	Varnish in litres	Plastic emulsion paint litres	Paint primer Litres	Cement paint kg.	Mazdoor Cat I Nos	Mazdoor Cat II Nos	Painter I Class Nos	Linseed Oil Litre	Remarks
1.	Best Varnishing - Wood work one coat	0.77	-	-	-	0.7	-	0.7	0.6	Sundries including brushes soap,
2.	-do- two coats	1.20	-	-	-	1.1	-	1.1	0.90	putty etc. may be to added.
3.	Plastic emulsion painting two coats	-	1.40	0.98	-	-	-	2.2	-	Brushes, Sand paper putty, plaster of Paris etc- L.S may be added.
4.	Cement paint two coats	-	-	-	3.23	0.50	0.80	0.50	-	Sundries for
5.	Cement Paint Three coats (Including printing coat)	-	-	-	4.80	0.75	1.20	0.75	-	brushes may be added.

(xiii) White washing 100 Sq.m.

S.No.	Description of work	Required					Remarks
		Fine screened Shell lime in Cu.m.	Mason	Class	Mazdoor	Category	
			(I)	(II)	(I)	(II)	
1	2	3	4	5	6	7	8
1.	White washing one coat	0.05	-	1.1	0.3	1.9	Gum, Conjee Water, prickly pear juice including necessary fire wood-L.S. Sundries including brushes etc. L.S.
2.	White washing two coat	0.07	-	1.6	0.5	2.7	
3.	Distempering Two Coats	Distemper 1.34 kg.	Painter I class 0.5	-	0.5	0.80	Painter I Class - 0.5 Nos.

(xiv) COLOUR WASHING 10 Sq.m.:

4. Colour washing one coat / two coats — Rate for white washing one coat / two coats plus 50% of the white washing one coat / two coats rate for colouring pigments.

Note for white washing & Distempering.

1. Same rate shall apply for walls and ceilings.
2. If thorough and complete scrapping off old surface coating is to be done add L.S. Rs. /10m^2
3. Cleaning & Brushing walls and preparing surface in accordance with the standard specification is included in the labour data for white washing.
4. The data is to be altered to suit the class of distemper to be applied in accordance with the makers instructions.

Theoritical cement requirement for various items of work:

Item No.	Description of Work		Cement requirement for I cum of work or 10 sq. m. of finished surface. Kg.
1.	Cement Concrete 1:2:4	0.45 x 720	324
	Cement Concrete 1:3:6	0.45 x 480	216
	Cement Concrete 1:4:8	0.45 x 360	162
	Cement Concrete 1:4:10	0.38 x 360	137
	Cement Concrete 1:5:10	0.45 x 288	130
	Cement Concrete 1:5:12½	0.38 x 288	110
2.	Special plastering for R.C. slabs & beams with cement mortar 1:3, 10mm. thick.	0.10 x 480	48
3.	Brick work in cm.1:5 country bricks 8¼"x4¼"x2"	0.30 x 288	86
4.	Cutstone in cement mortar 1:2	0.16 x 720	115
5.	Cutstone in cement mortar 1:4	0.16 x 360	58
6.	Coursed Rubble masonry in cm. 1:2, I Sort	0.28 x 720	202
7.	Coursed Rubble masonry in cm. 1:5 - I Sort	0.28 x 288	81
8.	Coursed Rubble masonry in cm. 1:2 - II Sort	0.32 x 720	230
9.	Coursed Rubble masonry in cm. 1:5 - II Sort	0.32 x 288	92
10.	Random Rubble masonry in c.m. 1:3	0.34 x 480	163
11.	Random Rubble masonry in c.m. 1:6	0.34 x 240	82
12.	Damp proof course in c.m. 1:3, 20mm, thick	0.21 x 480	101
13.	Finishing the floor with 20mm. cement concrete (Ellis pattern I sort- No sand to be used)		117
14.	Paving Hydraullic pressed cement mosaic tiles of size 20cmx20cmx20mm. With C.M. 1:3 and pointed with oiledmortor	0.21 x480	101
15.	Terrace flooring with one course of pressed tiles of size 20cm x 20cm x 20mm using c.m. 1:3	0.16 x 480	77
16.	Plastering with c.m. 1:3, 12mm thick	0.14 x 480	67
17.	Plastering with c.m. 1:5, 12mm thick	0.14 x 288	40
18.	Plastering with c.m. 1:3, 20mm thick	0.22 x 480	106
19.	Stucco plastering 12mm. thick using blue granite chips of size 10mm. and below over a base plastering in c.m. 1:5 12mm. thick.		126.50
20.	Pointing with c.m. 1:3, flush pointing brick work	0.06 x 480	29
21.	Pointing with c.m. 1:3 flush pointing Random Rubble masonry	0.09 x 480	43
22.	Pointing with c.m. 1:3 to full depth of tiles (marble slabs, pressed tiles, ornamental tiles)	0.04 x 480	19