PRACTICAL INFORMATION FOR QUANTITY SURVEYORS

CONTRACT MANAGERS, ARCHITECTS ENGINEERS AND BUILDERS

by

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DEDICATION

This book stands dedicated

to the loving memory of my parents

Shri T. M. Joglekar and Smt. Umabai Joglekar

Note by the Author

This book is intended and designed for day to day reference, mainly by contract managers and middle order executives of the building industry who deal with quantity surveying, estimating, analysis of rates, supervision of works, drafting of specifications, checking of interim and final bills, preparing and defending claims, disputes, etc.

The aim has been to collect within the covers of this book the wide ranging and various kinds of basic data and information which normally needs a frantic search and poring through a score of different books and publications. Much thought and discrimination had to be exercised in selecting the items of information. Too much material packed into a reference book intended for daily use can be as harmful as the omission of some vital piece of information.

Every effort has been made to achieve a high degree of reliability of the information presented. No pains have been spared in proof-reading and a meticulous correction of the text.

The sources of information are quoted at relevant places in the book to motivate the reader to refer the various Indian Standard Specifications and other authoritative publications in original whenever more detailed and complete information is needed.

Finally, I must thank the numerous users of the earlier edition of this book who kept pressing me to bring out a revised enlarged edition. Without their encouragement and a vociferous demand by the younger batch of executives, this second edition would not have been possible.

Pune,
03 April 1990
Shriramanavmi

P. T. Joglekar

CONTENTS

BASIC UNITS

Values of Prefixes of Sub-Multiples and Multiples of Metric Units

Prefix		Numerical Value	
MICROMICRO OR PICO	(μμ or p) ...	0.000 000 000 001	10^{-12}
MILLIMICRO OR NONO	(mμ or n) ...	0.000 000 001	10^{-9}
MICRO	(μ) ...	0.000 001	10^{-6}
MILLI	(m) ...	0.001	10^{-3}
CENTI	(c) ...	0.01	10^{-2}
DECI	(d) ...	0.1	10^{-1}
DEKA	(da) ...	10	10
HECTO	(h) ...	100	10^{2}
KILO	(k) ...	1 000	10^{3}
MEGA	(M) ...	1 000 000	10^{6}
KILOMEGA OR GIGA	(KM or G) ...	1 000 000 000	10^{9}
MEGAMEGA OR TERA	(MM or T) ...	1 000 000 000 000	10^{12}

Length

British Units			Metric Units		
12 inches	=	1 foot	1 micron	=	0.001 millimetre
3 feet	=	1 yard	10 millimetres	=	1 centimetre
22 yards	=	1 chain	10 centimetres	=	1 decimetre
10 chains	=	1 furlong	10 decimetres	=	1 metre
8 furlongs	=	1 mile	10 metres	=	1dekametre
5280 feet	=	1 mile	10 dekametres	=	1 hectometre
6080 feet	=	1 nautical mile (British)	10 hectometres	=	1 kilometre
6 feet	=	1 fathom	1852 metres	=	1 nautical mile (International)

Area

British Units			Metric Units		
1089 sq feet	=	1 guntha	100 sq millimetres	=	1 sq centimetre
40 gunthas	=	1 acre	100 sq centimetres	=	1 sq decimetre
43560 sq feet	=	1 acre	100 sq decimetres	=	1 sq metre
4840 sq yards	=	1 acre	100 sq metres	=	1 are or 1 sq decametre
640 acres	=	1 sq mile	100 ares	=	1 hectare or 1 sq hectometre
			100 hectares	=	1 sq kilometre

Volume

1000 cu millimetres	=	1 cu centimetre
1000 cu centimetres	=	1 cu decimetre
1000 cu decimetres	=	1 cu metre

Capacity

British Units			Metric Units		
60 minims	=	1 fluid drachm	10 millilitres	=	1 centilitre
8 fluid drachms	=	1 fluid ounce	10 centilitres	=	1 decilitre
5 fluid ounces	=	1 gill	10 decilitres	=	1 litre
4 gills	=	1 pint	10 litres	=	1 dekalitre
2 pints	=	1 quart	10 dekalitres	=	1 hectolitre
4 quarts	=	1 Imp gallon	10 hectolitres or 1000 litres	=	1 kilolitre
2 gallons	=	1 peck			
4 pecks	=	1 bushel	1 litre	=	1000.028 cu cm
8 bushels	=	1 quarter			

Weight

British Units				Metric Units		
Avoirdupois Units						
16 drams		=	1 ounce	10 milligrams	=	1 centigram
16 ounces		=	1 pound	10 centigrams	=	1 decigram
28 pounds		=	1 quarter	10 decigrams	=	1 gram
4 quarters		=	1 hundred weight	10 grams	=	1 dekagram
20 hundred weights		=	1 ton	10 dekagrams	=	1 hectogram
7000 grains		=	1 pound	10 hectograms	=	1 kilogram
14 pounds		=	1 stone	1000 kilograms	=	1 metric tonne
2000 pounds		=	1 short ton	200 milligrams	=	1 carat
100 pounds		=	1 short hundred weight			
1 ounce	= 437.5 grains	=	28.350 g	1 milligram (mg)	=	0.0154 grain
1 pound	= 16 ounces	=	0.4536 kg	1 gram (g)	=	0.0353 oz

Temperature Conversion

Fahrenheit to Celsius	Celsius to Fahrenheit
$(^{\circ}F - 32) \times \frac{5}{9} = {}^{\circ}C$	$(^{\circ}C \times \frac{9}{5}) + 32 = {}^{\circ}F$

Old Indian Weight Units				
180	grains	=	1	tola
80	tolas	=	1	seer
40	seers	=	1	maund

Miscellaneous				
1	dozen	=	12	Nos.
1	score	=	20	Nos.
1	gross	=	12	dozens (= 144 Nos.)
1	quire	=	24	sheets
1	ream	=	20	quires

International Paper Sizes

A Series		B & C Series	
Size	Millimetres	Size	Millimetres
A0	841 x 1189	C3	324 x 458
A1	594 x 841	B4	250 x 353
A2	420 x 594	C4	229 x 324
A3	297 x 420	B5	176 x 250
A4	210 x 297	C5	162 x 229
A5	148 x 210	B6/C4	125 x 324
A6	105 x 148	B6	125 x 176
A7	74 x 105	C6	114 x 162
		DL	110 x 220
		C7/6	81 x 162
		C7	81 x 114

Shipping Measure

1 shipping ton	=	40 cubic feet	
	=	1.13268 cu m	

American Measure

hundred weight	=	100	pounds
ton	=	2000	pounds
dry gallon	=	268.8	cu inch
wet gallon	=	0.83	Imp gal

Americans express road gradients in percentages. e.g. :-

20% grade = 1 in 5

General

1 radian	=	57.2958° (57° 17' 45")
π	=	3.1416
g (standard acceleration due to gravity)	=	9:80665 m per second per second
1 Imperial gallon of water weighs		10 pounds
1 cubic foot	=	6.23 Imperial gallons
1 cusec discharge	=	375 gallons per min
	=	1 cu foot per sec

Refrigeration (and Air-Conditioning) : One standard ton of refrigeration (and air-conditioning) denotes the extraction of heat at the rate of 12000 British Thermal Units per hour (equivalent of one ton of ice melting in 24 hours).

CONVERSION FACTORS

Multiply	By	To obtain
acres	0.404687	hectares
acres	0.0040469	square kilometres
centimetres	0.0328083	feet
centimetres	0.3937	inches
cubic centimetres	0.00003532	cubic feet
cubic centimetres	0.06102	cubic inches
cubic feet	28317	cubic centimetres
cubic feet	0.028317	cubic metres
cubic feet	6.22905	gallons, Imperial
cubic feet	0.2832	hectolitres
cubic feet	28.3170	litres
cubic inches	16.38716	cubic centimetres
cubic metres	35.3145	cubic feet
cubic metres	1.3079	cubic yards
degrees, angular	0.0174533	radians
degrees, F(less 32 F)	0.5556	degrees, C
degrees, C	1.8	degrees, F(less 32 F)
foot pounds	0.13826	kilogram metres
feet	30.4801	centimetres
feet	0.304801	metres
feet	304.801	millimetres
gallons, Imperial	0.160538	cubic feet
gallons, Imperial	1.20091	gallons, U.S.
gallons, Imperial	4.54596	litres
gallons, U.S.	0.832702	gallons, Imperial
gallons, U.S.	3.78543	litres
grams	0.0022046	pounds, avoirdupois
hectares	2.47104	acres
hectares	107638.7	square feet
hectares	0.00386101	square miles
horsepower, metric	0.98632	horsepower, U.S.
horsepower, U.S.	1.01387	horsepower, metric
inches	2.54001	centimetres
inches	0.0254001	metres
inches	25.4001	millimetres
kilograms	2.20462	pounds
kilograms	0.00098421	tons (= 2240 lbs)
kilogram metres	7.233	foot pounds
kilograms per metre	0.671972	pounds per foot
kilograms per sq cm	14.2234	pounds per sq inch
kilograms per sq metre	0.204817	pounds per sq foot
kilograms per cubic metre	0.0624283	pounds per cubic foot
kilometres	0.62137	miles
kilometres	3280.7	feet
litres	0.219975	gallons, Imperial
litres	0.26417	gallons, U.S.
litres	0.035	cubic feet
litres	61.022	cubic inches
metres	3.28083	feet
metres	39.37	inches
metres	1.09361	yards
miles	1.60935	kilometres
millimetres	0.00328083	feet
millimetres	0.03937	inches
ounce (oz)	28.349	grams
pounds (avoirdupois)	453.592	grams
pounds (- do -)	0.453592	kilograms
pounds (- do -)	0.0004464	tons (=2240 pounds)
pounds (- do -)	0.0004536	tonne (metric)
pounds per foot	1.48816	kilograms per metre
pounds per square foot	4.88241	kilograms per sq metre
pounds per square inch	0.07031	kilograms per sq cm
pounds per cubic foot	16.0184	kilograms per cu metre

CONVERSION FACTORS (*Contd.*)

Multiply	By	To obtain
radians	57.29578	degrees, angular
square centimetres	0.1550	square inches
square feet	0.00092903	ares
square feet	0.0929034	square metres
square inches	6.45163	square centimetres
square kilometres	247.104	square acres
square kilometres	0.3861	square miles
square metres	10.7639	square feet
square metres	1.19599	square yards
square miles	2.590	square kilometres
square yards	0.83613	square metres
tons (=2240 pounds)	1016.05	kilograms
tons (- do -)	1.01605	tonne metric
tonne (metric)	2204.62	pounds
tonne (metric)	0.98421	tons (=2240 pounds)
yards	0.914402	metres

CONVERSION OF RATES

(1)	To convert Rate per running foot into Rate per running metre	Multiply by 3.28 (For vice-versa by 0.3048).
(2)	To convert Rate per 10 running feet into Rate per running metre	Multiply by 0.328 (For vice-versa by 3.048).
(3)	To convert Rate per 100 running feet into Rate per running metre	Multiply by 0.0328 (For vice-versa by 30.48).
(4)	To convert Rate per square foot into Rate per square metre	Multiply by 10.764 (For vice-versa by 0.0929).
(5)	To convert Rate per 10 square feet into Rate per square metre	Multiply by 1.0764 (For vice-versa by 0.929).
(6)	To convert Rate per 100 square feet into Rate per square metre	Multiply by 0.1076 (For vice-versa by 9.29)
(7)	To convert Rate per cubic foot into Rate per cubic metre	Multiply by 35.315 (For vice-versa by 0.0283).
(8)	To convert Rate per 100 cubic feet into Rate per cubic metre	Multiply by 0.3532 (For vice-versa by 2.83).
(9)	To convert Rate per lb (pound) into Rate per kg	Multiply by 2.2046 (For vice-versa by 0.4536).
(10)	To convert Rate per hundredweight (cwt) into Rate per quintal	Multiply by 1.9684 (For vice-versa by 0.508).
(11)	To convert Rate per ton into Rate per tonne (Metric)	Multiply by 0.9842 (For vice-versa by 1.016).
(12)	To convert lbs/running foot into kgs/running metre	Multiply by 1.4881 (For vice-versa by 0.672)
(13)	To convert lbs/square foot into kgs/square metre	Multiply by 4.881 (For vice-versa by 0.205).
(14)	To convert lbs/cubic foot into kgs/cubic metre	Multiply by 16.0184 (For vice-versa by 0.0624).
(15)	To convert lbs/gallon into kgs/litre	Multiply by 0.0998 (For vice-versa by 1.002).
(16)	To convert Rate per gallon into Rate per litre	Multiply by 0.22 (For vice-versa by 4.546).
(17)	To convert lb/sq in. into kg/sq cm	Multiply by 0.070 (For vice-versa by 14.223).
(18)	To convert ton/sq ft into tonne/sq m	Multiply by 10.937 (For vice-versa by 0.0914).
(19)	To convert bending moment from foot-pounds to kilogram-metres	Multiply by 0.138 (For vice-versa by 7.233).
(20)	To convert Rate per acre into Rate per hectare	Multiply by 2.471 (For vice-versa by 0.4047).

WEIGHTS OF BUILDING MATERIALS

(Reference IS : 1911 - 1967)

Material	Weight in kg per cubic metre
Accoustical materials	
Cork	240
Slag wool	270
Aggregate	
Broken Stone, dry	1600 to 1870
Broken bricks :	
Fine	1450
Coarse (*surkhi*)	1010
Foam slag aggregate	700
Sand, dry, clean	1540 to 1600
Shingle, 3 mm to 38 mm	1460
Bricks	
Common burnt clay	1600 to 1920
Engineering bricks	2160
Pressed bricks	1760 to 1840
Refractory bricks	1760 to 2000
Cement (IS : 269)	
Ordinary and aluminous	1440
Rapid hardening	1280
Cement concrete, plain	
Using stone aggregate	2240 to 2400
Light weight concrete	
Cellular (*'Siporex' etc.*)	640
With foam slag aggregate	960 to 1840
Aerated	760
Chemicals	
Gypsum powder	1410 to 1760
Salt, common	960
Phenol formaldehyde	1280
Polystrene	1060
Perspex	1200 to 1350
Urea formaldehyde	1350 to 1380
Coal	
Coal	850
Coal dust	700
Coke, furnace or gas	500
Charcoal	300
Lime	
Uncalcined stone lumps	1280 to 1440
Unslaked, freshly burnt	880 to 1040
Slaked, fresh	580 to 640
Unslaked lime (*kankar*)	1180
Slaked lime (*kankar*)	1020
Stone	
Basalt	2850 to 2960
Flint	2590
Gneiss	2400 to 2690
Granite	2640 to 2800
Laterite	2080 to 2400
Limestone	2400 to 2640
Marble	2720
Quartz	2640
Sandstone	2240 to 2400
Slate	2800

Material	Weight in kg per cubic metre
Metals	
Aluminium, cast	2580 to 271(
Aluminium, wrought	2640 to 280(
Brass (Copper % : Zinc %) :-	
Muntz metal (60 : 40)	822(
Red (90 : 10)	859(
White (50 : 50)	819(
Yellow (70 : 30) :-	
Cast	844(
Drawn	868(
Rolled	855(
Bronze (copper % : Tin %) :-	
Bell metal (80 : 20)	873(
Gun metal (90 : 10)	878(
Chromium	6520 to 673(
Copper, cast	8790 to 894(
Copper, wrought	8840 to 894(
Iron, pig	720(
Iron, cast, gray	7030 to 713(
Iron, cast, white	7580 to 772(
Iron, wrought	770(
Lead, cast	1134(
Lead, wrought	1136(
Silver, wrought	10540 to 1056(
Steel, cast	785(
Steel, wrought, mild	783(
Zinc, cast	7030 to 716(
Zinc, wrought	719(
Oils, paint, bitumen etc.	
Bees wax	96(
Bitumen	104(
Creosote	107(
Diesel	96(
Glue	128(
Paint	96(
Paraffin wax	800 to 96(
Petrol	69(
Pitch (IS : 216)	101(
Red lead, dry	211(
Road tar (IS : 215)	101(
Turpentine	86:
Varnish	96(
Soils	
Clay, dry	144(
Earth, dry	1410 to 184(
Timber (IS : 399)	
Teak	64(
Benteak	67:
Bijasal	80(
Bonsum	53(
Chir	57:
Deodar	54:
Haldu	67:
Hollock	61(
Sal	86:
Water	
Fresh	100(
Salt	102:
Ice	91(

WEIGHTS OF STEEL SECTIONS ETC

HOT-ROLLED ROUND STEEL BARS
(Reference IS : 1732 - 1971)

Designation & Diameter	Weight per Metre	Designation & Diameter	Weight per Metre
mm	kg	mm	kg
ISRO 5	0.154	ISRO 45	12.5
ISRO 6	0.222	ISRO 50	15.4
ISRO 8	0.395	ISRO 56	19.3
ISRO 10	0.617	ISRO 63	24.5
ISRO 12	0.888	ISRO 71	31.1
ISRO 14	1.21	ISRO 80	39.5
ISRO 16	1.58	ISRO 90	49.9
ISRO 18	2.00	ISRO 100	61.7
ISRO 20	2.47	ISRO 110	74.6
ISRO 22	2.98	ISRO 125	96.3
ISRO 25	3.85	ISRO 140	121
ISRO 28	4.83	ISRO 160	158
ISRO 32	6.31	ISRO 180	200
ISRO 36	7.99	ISRO 200	247
ISRO 40	9.85		

HOT-ROLLED SQUARE STEEL BARS
(Reference IS : 1732 - 1971)

Designation & Side Width	Weight per Metre	Designation & Side Width	Weight per Metre
mm	kg	mm	kg
ISSQ 5	0.196	ISSQ 32	8.04
ISSQ 6	0.283	ISSQ 40	12.6
ISSQ 8	0.502	ISSQ 45	15.9
ISSQ 10	0.785	ISSQ 50	19.6
ISSQ 12	1.13	ISSQ 63	31.2
ISSQ 16	2.01	ISSQ 80	50.2
ISSQ 20	3.14	ISSQ 100	78.5
ISSQ 25	4.91		

NOTE : *Weight per metre of tor-steel/ribbed/deformed/cold twisted steel bars of any nominal diameter is taken same as given above for respective diameter in ISRO series.*

HOT-ROLLED STEEL FLATS
(Reference IS : 1731 - 1971)

Width, mm	Thickness in mm															
	3.0	4.0	5.0	6.0	8.0	10.0	12.0	16.0	18.0	20	25	32	40	45	50	60
	Weight per Metre Length in kg															
10	0.236	0.314	0.393	0.471	-	-	-	-	-	-	-	-	-	-	-	-
14	0.330	0.440	0.550	0.659	0.879	-	-	-	-	-	-	-	-	-	-	-
20	0.471	0.628	0.785	0.942	1.26	1.57	1.88	2.51	2.83	-	-	-	-	-	-	-
25	0.589	0.785	0.981	1.18	1.57	1.96	2.36	3.14	3.53	-	-	-	-	-	-	-
30	0.707	0.942	1.18	1.41	1.88	2.36	2.83	3.77	4.24	4.71	-	-	-	-	-	-
35	0.824	1.10	1.37	1.65	2.20	2.75	3.30	4.40	4.95	5.50	6.87	8.79	-	-	-	-
40	0.942	1.26	1.57	1.88	2.51	3.14	3.77	5.02	5.65	6.28	7.85	10.0	-	-	-	-
45	-	1.41	1.77	2.12	2.83	3.53	4.24	5.65	6.36	7.07	8.83	11.3	-	-	-	-
50	1.18	1.57	1.96	2.36	3.14	3.93	4.71	6.28	7.06	7.85	9.81	12.6	15.7	-	-	-
55	-	1.73	2.16	2.59	3.45	4.32	5.18	6.91	7.77	8.64	10.8	13.8	17.3	-	-	-
60	1.41	1.88	2.36	2.83	3.77	4.71	5.65	7.54	8.48	9.42	11.8	15.1	18.8	21.2	-	-
65	-	2.04	2.55	3.06	4.08	5.10	6.12	8.16	9.18	10.2	12.8	16.3	20.4	23.0	-	-
70	-	2.20	2.75	3.30	4.40	5.50	6.59	8.79	9.89	11.0	13.7	17.6	22.0	24.7	27.5	-
75	-	2.36	2.94	3.53	4.71	5.89	7.07	9.42	10.6	11.8	14.7	18.8	23.6	26.5	29.4	-
80	-	2.51	3.14	3.77	5.02	6.28	7.54	10.0	11.3	12.6	15.7	20.1	25.1	28.3	31.4	-
90	-	-	3.53	4.24	5.65	7.07	8.48	11.3	12.7	14.1	17.7	22.6	28.3	31.8	35.3	42.4
100	-	-	3.93	4.71	6.28	7.85	9.42	12.6	14.1	15.7	19.6	25.1	31.4	35.3	39.2	47.1
110	-	-	4.32	5.18	6.91	8.64	10.4	13.8	15.5	17.3	21.6	27.6	34.5	38.9	43.2	51.8
120	-	-	4.71	5.65	7.54	9.42	11.3	15.1	17.0	18.8	23.6	30.1	37.7	42.4	47.1	56.5
130	-	-	-	6.12	8.16	10.2	12.2	16.3	18.4	20.4	25.5	32.7	40.8	45.9	51.0	61.2
140	-	-	-	-	8.79	11.0	13.2	17.6	19.8	22.0	27.5	35.2	44.0	49.5	55.0	65.9
150	-	-	-	-	9.42	11.8	14.1	18.8	21.2	23.6	29.4	37.7	47.1	53.0	58.9	70.6
160	-	-	-	-	10.0	12.6	15.1	20.1	22.6	25.1	31.4	40.2	50.2	56.5	-	-
180	-	-	-	-	11.3	14.1	17.0	22.6	25.4	28.3	35.3	45.2	56.5	63.6	-	-
200	-	-	-	-	-	15.7	18.8	25.1	28.3	31.4	39.2	50.2	62.8	70.6	-	-
250	-	-	-	-	-	19.6	23.6	31.4	35.3	39.2	49.1	62.8	78.5	88.3	-	-
300	-	-	-	-	-	-	28.3	37.7	42.4	47.1	58.9	75.4	94.2	106	-	-
400	-	-	-	-	-	-	-	50.2	56.5	62.8	78.5	100	126	141	-	-

HOT-ROLLED STEEL EQUAL ANGLES

(Reference IS : 808 (Part V) 1976

Designation	Size mm x mm	Thickness mm	Weight per metre in kg
ISA 2020	20 x 20	3	0.9
		4	1.1
ISA 2525	25 x 25	3	1.1
		4	1.4
		5	1.8
ISA 3030	30 x 30	3	1.4
		4	1.8
		5	2.2
ISA 3535	35 x 35	3	1.6
		4	2.1
		5	2.6
		6	3.0
ISA 4040	40 x 40	3	1.8
		4	2.4
		5	3.0
		6	3.5
ISA 4545	45 x 45	3	2.1
		4	2.7
		5	3.4
		6	4.0
ISA 5050	50 x 50	3	2.3
		4	3.0
		5	3.8
		6	4.5
ISA 5555	55 x 55	5	4.1
		6	4.9
		8	6.4
		10	7.9
ISA 6060	60 x 60	5	4.5
		6	5.4
		8	7.0
		10	8.6
ISA 6565	65 x 65	5	4.9
		6	5.8
		8	7.7
		10	9.4
ISA 7070	70 x 70	5	5.3
		6	6.3
		8	8.3
		10	10.2
ISA 7575	75 x 75	5	5.7
		6	6.8
		8	8.9
		10	11.0
ISA 8080	80 x 80	6	7.3
		8	9.6
		10	11.8
		12	14.0
ISA 9090	90 x 90	6	8.2
		8	10.8
		10	13.4
		12	15.8
ISA100100	100 x 100	6	9.2
		8	12.1
		10	14.9
		12	17.7
ISA110110	110 x 110	8	13.4
		10	16.6
		12	19.7
		16	25.7
ISA130130	130 x 130	8	15.9
		10	19.7
		12	23.5
		16	30.7
ISA150150	150 x 150	10	22.9
		12	27.3
		16	35.8
		20	44.1
ISA200200	200 x 200	12	36.9
		16	48.5
		20	60.0
		25	73.9

Supplementary List - Equal Angles

50 x 50 x 7	50 x 50	7	5.15
x 8		8	5.82
60 x 60 x 4	60 x 60	4	3.70
70 x 70 x 7	70 x 70	7	7.38
100 x 100 x 6.5	100 x 100	6.5	9.99
x 15		15	21.90
120 x 120 x 8	120 x 120	8	14.70
x 10		10	18.20
x 12		12	21.60
x 15		15	26.60
150 x 150 x 15	150 x 150	15	33.80
x 18		18	40.10
180 x 180 x 15	180 x 180	15	40.90
x 18		18	48.60
x 20		20	53.70
200 x 200 x 24	200 x 200	24	71.10

HOT-ROLLED STEEL UNEQUAL ANGLES

(Reference IS : 808 (Part VI)-1976)

Designation	Size mm x mm	Thickness mm	Weight per metre in kg
ISA 3020	30 x 20	3	1.1
		4	1.4
		5	1.8
ISA 4025	40 x 25	3	1.5
		4	1.9
		5	2.4
		6	2.8
ISA 4530	45 x 30	3	1.7
		4	2.2
		5	2.8
		6	3.3
ISA 5030	50 x 30	3	1.8
		4	2.4
		5	3.0
		6	3.5
ISA 6040	60 x 40	5	3.7
		6	4.4
		8	5.8

HOT-ROLLED STEEL UNEQUAL ANGLES - *Contd.*

Designation	Size mm x mm	Thickness mm	Weight per metre in kg	Designation	Size mm x mm	Thickness mm	Weight per metre in kg
ISA 6545	65 x 45	5	4.1	ISA 12575	125 x 75	6	9.2
		6	4.9			8	12.1
		8	6.4			10	14.9
ISA 7045	70 x 45	5	4.3	ISA 12595	125 x 95	6	10.1
		6	5.2			8	13.4
		8	6.7			10	16.5
		10	8.3			12	19.7
ISA 7550	75 x 50	5	4.7	ISA 15075	150 x 75	8	13.7
		6	5.6			10	17.0
		8	7.4			12	20.2
		10	9.0	ISA150115	150 x 115	8	16.3
ISA 8050	80 x 50	5	4.9			10	20.1
		6	5.9			12	24.0
		8	7.7			16	31.4
		10	9.4	ISA200100	200 x 100	10	22.9
ISA 9060	90 x 60	6	6.8			12	27.3
		8	8.9			16	35.8
		10	11.0	ISA200150	200 x 150	10	26.9
		12	13.0			12	32.1
ISA 10065	100 x 65	6	7.5			16	42.2
		8	9.9			20	52.0
		10	12.2				
ISA 10075	100 x 75	6	8.0				
		8	10.5				
		10	13.0				
		12	15.4				

HOT-ROLLED STEEL TEE BARS

(Reference IS : 1173 - 1978)

Designation	Size (*h* x *b*) mm x mm	Thickness of Web mm	Thickness of Flange mm	Weight per Metre kg
Normal Tee Bars				
ISNT 20	20 x 20	4	4	1.1
ISNT 30	30 x 30	4	4	1.8
ISNT 40	40 x 40	6	6	3.5
ISNT 50	50 x 50	6	6	4.4
ISNT 60	60 x 60	6	6	5.4
ISNT 75	75 x 75	9	9	10.0
ISNT 100	100 x 100	10	10	14.9
ISNT 150	150 x 150	10	10	22.7
Deep Legged Tee Bars				
ISDT 100	100 x 50	5.8	10.0	8.1
ISDT 150	150 x 75	8.0	11.6	15.7

Designation	Size (*h* x *b*) mm x mm	Thickness of Web mm	Thickness of Flange mm	Weight per Metre kg
Slit Light Weight Tee Bars *				
ISLT 200	200 x 165	8.0	12.5	28.4
ISLT 250	250 x 180	9.2	14.1	37.5
Slit Medium Weight Tee Bars **				
ISMT 50	50 x 70	4.5	7.5	5.8
ISMT 62.5	62.5 x 70	5.0	8.0	6.7
ISMT 75	75 x 75	5.0	8.0	7.5
ISMT 87.5	87.5 x 85	5.8	9.0	9.8
ISMT100	100 x 100	5.7	10.8	12.7
Slit Tee Bars from H-Section ***				
ISHT 75	75 x 100	8.4	9.0	15.3
ISHT 100	100 x 200	7.8	9.0	20.0
ISHT 125	125 x 250	8.8	9.7	27.4
ISHT 150	150 x 250	7.6	10.6	29.4

* Slit from ISLB 200 and ISLB 500.
** Slit from MB 100, 125, 150, 175 and 200.
*** Slit from ISHB 150, 200, 250 and 300.

HOT ROLLED STEEL CHANNELS

Designation	Depth of channel mm	Width of flange mm	Weight per metre kg
JUNIOR CHANNELS *(Reference IS : 808 - 1964 - Amendment 3 of 1968)*			
ISJC 100	100	45	5.8
ISJC 125	125	50	7.9
ISJC 150	150	55	9.9
ISJC 175	175	60	11.2
ISJC 200	200	70	14.0
LIGHT CHANNELS *(Reference IS : 808 - 1964 - Amendment 3 of 1968)*			
ISLC 75	75	40	5.7
ISLC 100	100	50	7.9
ISLC 125	125	65	10.7
ISLC 150	150	75	14.4
ISLC 175	175	75	17.6
ISLC 200	200	75	20.6
ISLC 225	225	90	24.0
ISLC 250	250	100	28.0
ISLC 300	300	100	33.1
ISLC 350	350	100	38.9
ISLC 400	400	100	45.8
MEDIUM CHANNELS (SLOPING FLANGES) *(Reference IS : 808 (PART III) - 1979)*			
MC 75	75	40	7.14
MC 100	100	50	9.56
MC 125	125	65	13.1
MC 125 *	125	66	13.7
MC 150	150	75	16.8
MC 150 *	150	76	17.7
MC 175	175	75	19.6
MC 175 *	175	77	21.7
MC 200	200	75	22.3
MC 200 *	200	76	24.3
MC 225	225	80	26.1
MC 225 *	225	83	30.7
MC 250	250	80	30.6
MC 250 *	250	82	34.2
MC 250 *	250	84	38.1
MC 300	300	90	36.3
MC 300 *	300	92	41.5
MC 300 *	300	94	46.2
MC 350	350	100	42.7
MC 400	400	100	50.1

NOTE: *Weights, dimensions etc of channels with parallel flanges (MCP series) are same as given above for MC series. The heavier sections in each size are intended for use in wagon building industry (marked *).*

HOT ROLLED STEEL BEAMS

Designation	Depth of beam mm	Width of flange mm	Weight per metre kg
JUNIOR BEAMS *(Reference IS : 808 - 1964)*			
ISJB 150	150	50	7.1
ISJB 175	175	50	8.1
ISJB 200	200	60	9.9
ISJB 225	225	80	12.8
LIGHT WEIGHT BEAMS *(Reference IS : 808 - 1964 - Amendment 3 of 1968)*			
ISLB 75	75	50	6.1
ISLB 100	100	50	8.0
ISLB 125	125	75	11.9
ISLB 150	150	80	14.2
ISLB 175	175	90	16.7
ISLB 200	200	100	19.8
ISLB 225	225	100	23.5
ISLB 250	250	125	27.9
ISLB 275	275	140	33.0
ISLB 300	300	150	37.7
ISLB 325	325	165	43.1
ISLB 350	350	165	49.5
ISLB 400	400	165	56.9
ISLB 450	450	170	65.3
ISLB 500	500	180	75.0
ISLB 550	550	190	86.3
ISLB 600	600	210	99.5
MEDIUM WEIGHT BEAMS *(Reference IS : 808 (PART I) - 1973)*			
MB 100	100	70	11.5
MB 125	125	70	13.4
MB 150	150	75	15.0
MB 175	175	85	19.5
MB 200	200	100	25.4
MB 225	225	110	31.2
MB 250	250	125	37.3
MB 300	300	140	46.1
MB 350	350	140	52.4
MB 400	400	140	61.6
MB 450	450	150	72.4
MB 500	500	180	86.9
MB 550	550	190	104
MB 600	600	210	123

HOT ROLLED STEEL BEAMS *(contd)*

Designation	Depth mm	Width of flange mm	Weight per metre kg
WIDE FLANGE BEAMS *(Reference IS : 808 - 1964)*			
ISWB 150	150	100	17.0
ISWB 175	175	125	22.1
ISWB 200	200	140	28.8
ISWB 225	225	150	33.9
ISWB 250	250	200	40.9
ISWB 300	300	200	48.1
ISWB 350	350	200	56.9
ISWB 400	400	200	66.7
ISWB 450	450	200	79.4
ISWB 500	500	250	95.2
ISWB 550	550	250	112.5
ISWB 600	600	250	133.7
ISWB 600	600	250	145.1
HOT ROLLED COLUMN SECTIONS *(Reference IS : 808 (PART II) - 1978)*			
SC 100	100	100	20.0
SC 120	120	120	26.2
SC 140	140	140	33.3
SC 160	160	160	41.9
SC 180	180	180	50.5
SC 200	200	200	60.3
SC 220	220	220	70.4
SC 250	250	250	85.6

CRANE RAIL SECTIONS

(Reference IS : 3443-1980)

Designation	Head width mm	Flange width(base) mm	Total depth mm	Weight per metre kg
ISCR 50	50	90	90	29.8
ISCR 60	60	105	105	40.0
ISCR 80	80	130	130	64.2
ISCR 100	100	150	150	89.0
ISCR 120	120	170	170	118.0
ISCR 140	140	170	170	147.0

MS PLATES

(Reference IS : 1730 (Part I) - 1974)

Thickness mm	Weight per sq m kg	Thickness mm	Weight per sq m kg
5	39.20	22	173.00
6	47.10	25	196.00
7	55.00	28	220.00
8	62.80	32	251.00
10	78.50	36	283.00
12	94.20	40	314.00
14	110.00	45	353.00
16	126.00	50	392.00
18	141.00	56	440.00
20	157.00	63	495.00

STEEL CHEQUERED PLATES

Standard Thickness mm	Weight per square metre in kg
5	39
6	47
7	55
8	63
10	78
12	94
14	110
16	126

Conform to the weights given in IS : 1730-1961 'Dimensions for steel plate, sheet and strip for structural and general engineering purposes.'

MS PLAIN BLACK SHEETS

Thickness mm	Weight per sq m kg	Thickness mm	Weight per sq m kg
0.40	3.14	1.90	14.90
0.50	3.93	2.00	15.70
0.63	4.95	2.24	17.60
0.80	6.30	2.50	19.60
0.90	7.05	2.80	22.00
1.00	7.85	3.15	24.70
1.12	8.80	3.55	27.86
1.25	9.80	4.00	31.40
1.40	11.00	4.30	33.75
1.60	12.60	4.65	36.50
1.80	14.10		

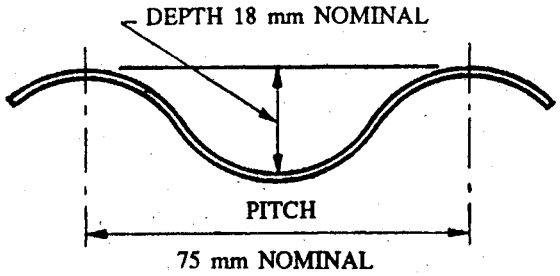
GALVANISED PLAIN STEEL SHEETS

(Reference IS : 277-1977)

Class of sheet and type of zinc coating	Weight in kg per sq m of sheet				
	Thickness of sheets in mm				
	1.60	1.25	1.00	0.80	0.63
Class 1 750 g of Zinc (Spelter) Coating per sq m Both Sides Inclusive	13.31	10.56	8.60	7.03	5.70
Class 2 600 g of Zinc (Spelter) Coating per sq m Both Sides Inclusive	13.16	10.41	8.45	6.88	5.55
Class 3 450 g of Zinc (Spelter) Coating per sq m Both Sides Inclusive	13.01	10.26	8.30	6.73	5.40
Class 4 375 g of Zinc (Spelter) Coating per sq m Both Sides Inclusive	12.94	10.19	8.22	6.66	5.32

NOTE : *Plain sheets of all classes are available in 1.8, 2.2, 2.5, 2.8, and 3 metre length. Class 4 plain sheets are also available in 3.6 metre length.*
Plain sheets of all classes are available in 0.75 and 0.90 metre widths.

CORRUGATED GALVANISED STEEL SHEETS



Weight of corrugated galvanised steel sheets is to be calculated from the area of sheet before corrugation applying the weight constants given above for plain galvanised sheets.

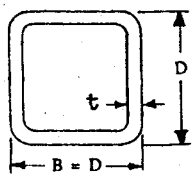
DETAILS OF CORRUGATION

Number of corrugations	Nominal overall width of sheet measured between crowns of outside corrugations	
	Before Corrugation	After Corrugation
	mm	mm
8	750	660
10	900	800
11	1000	885

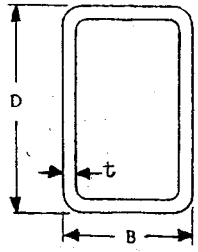
Corrugated sheets are available in lengths same as those indicated above for plain sheets.

HOLLOW MILD STEEL SECTIONS FOR STRUCTURAL USE

(Reference IS : 4923-1968)



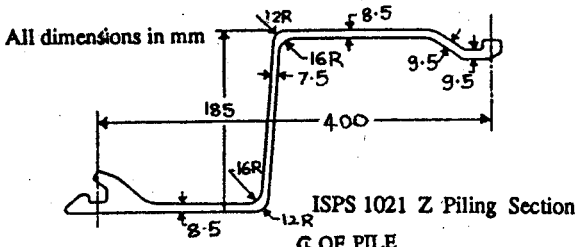
Square Hollow Sections



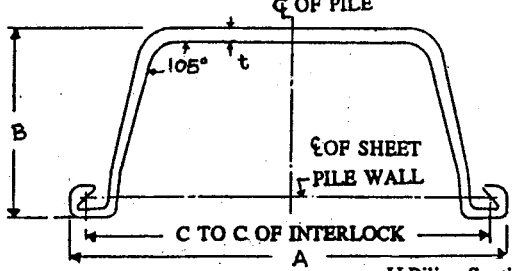
Rectangular Hollow Sections

Depth or width of Section (D) mm	Thickness (t) mm	Weight per metre kg
25.4	2.65	1.75
	3.25	2.05
	4.05	2.38
32	2.65	2.30
	3.25	2.72
	4.05	3.22
38	2.90	3.03
	3.25	3.33
	4.05	3.99
45	2.90	3.66
	3.65	4.47
	4.50	5.31
50	2.90	4.12
	3.65	5.04
	4.50	6.02
63.5	3.25	5.94
	3.65	6.59
	4.50	7.93
75	3.25	7.11
	4.05	8.69
	4.85	10.2

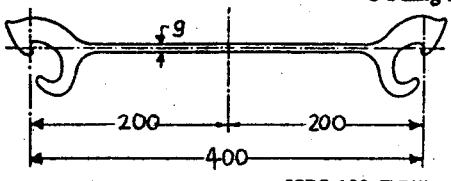
Depth of Section (D) mm	Breadth of Section (B) mm	Thickness (t) mm	Weight per metre kg
40	25	2.65	2.34
		3.25	2.77
		4.05	3.29
50.8	25.4	2.90	3.04
		3.25	3.34
		4.05	4.00
63.5	38	2.90	4.19
		3.65	5.13
		4.50	6.13
76.2	38	3.25	5.28
		3.65	5.86
		4.50	7.02
76.2	50.8	3.25	5.94
		3.65	6.59
		4.50	7.93
90	38	2.65	4.96
		3.25	5.99
		4.05	7.29
100	50	3.25	7.11
		4.05	8.69
		4.85	10.2



ISPS 1021 Z Piling Section



U Piling Section



ISPS 100 F Piling Section

SHEET PILING SECTIONS

(Reference IS : 2314-1963)

Designation	Weight per metre kg	Weight per square metre of wall kg	Perimeter per metre of wall cm	Centre to Centre distance of joints mm
ISPS 1021 Z	49.25	123.12	283	400
ISPS 1625 U	65.37	162.40	308	402.5
ISPS 2222 U	82.70	195.70	331	420.5
ISPS 100 F	55.20	138.00	104	400

U Piling Sections

Designation	Overall dimensions in mm		
	A	B	t
ISPS 1625 U	437	172	13
ISPS 2222 U	458	194.5	14

HARD-DRAWN STEEL WIRE FABRIC

(Reference IS : 1566 -1982)

Square Mesh

Sl. No.	Mesh Size (Nominal Pitch of Wires) mm	Diameter of Wire Each Way mm	Weight per sq m in kg	Sl. No.	Mesh Size (Nominal Pitch of Wires) mm	Diameter of Wire Each Way mm	Weight per sq m in kg
1	50	3.0	2.22	22	150	5.6	2.57
2	50	3.8	3.56	23	150	5.8	2.76
3	50	5.0	6.16	24	150	6.0	2.96
4	100	3.4	1.43	25	150	6.3	3.27
5	100	3.6	1.60	26	150	6.5	3.48
6	100	4.0	1.98	27	150	7.1	4.14
7	100	4.5	2.53	28	150	7.5	4.62
8	100	4.8	2.84	29	150	8.0	5.26
9	100	5.0	3.08	30	150	9.0	6.66
10	100	5.3	3.46	31	150	10.0	8.22
11	100	5.8	4.14	32	200	4.0	0.98
12	100	6.5	5.20	33	200	4.5	1.26
13	100	7.0	6.04	34	200	4.8	1.42
14	100	8.0	7.90	35	200	5.3	1.74
15	150	3.15	0.82	36	200	5.8	2.08
16	150	3.6	1.06	37	200	6.5	2.60
17	150	4.0	1.32	38	200	7.0	3.02
18	150	4.5	1.66	39	200	8.0	3.94
19	150	4.75	1.85	40	200	9.0	5.30
20	150	5.0	2.06	41	200	10.0	6.16
21	150	5.3	2.30				

Oblong Mesh

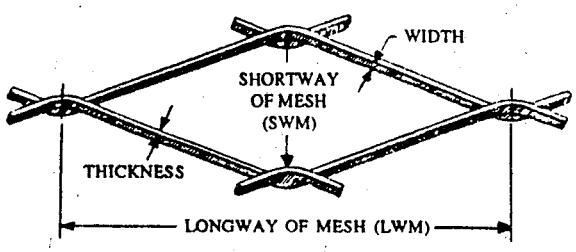
Sl. No.	Mesh Size (Pitch of Wires)		Dia. of Wires		Weight per Square metre in kg	Sl. No.	Mesh Size (Pitch of Wires)		Dia. of Wires		Weight per Square metre in kg
	Main mm	Cross mm	Main mm	Cross mm			Main mm	Cross mm	Main mm	Cross mm	
42	75	250	5.0	4.2	2.49	57	75	300	5.8	3.6	3.04
43	75	250	4.2	4.2	1.89	58	75	300	6.0	5.0	3.47
44	75	250	6.0	5.0	3.58	59	75	300	6.5	4.0	3.80
45	75	300	3.15	2.65	0.96	60	75	300	6.5	6.0	4.26
46	75	300	3.55	2.65	1.18	61	75	300	7.0	4.0	4.36
47	75	300	4.0	2.65	1.45	62	75	300	8.0	4.8	5.73
48	75	300	4.0	3.0	1.51	63	75	300	9.0	4.8	7.13
49	75	300	4.5	3.15	1.87	64	75	300	10.0	5.8	8.91
50	75	300	4.75	3.15	2.06	65	75	400	9.0	4.75	7.00
51	75	300	4.8	3.6	2.16	66	75	400	9.5	5.6	7.90
52	75	300	5.0	4.2	2.42	67	75	400	10.0	5.6	8.71
53	75	300	5.0	5.0	2.60	68	75	400	8.0	4.75	5.60
54	75	300	5.3	3.15	2.51	69	75	400	7.5	4.75	4.97
55	75	300	5.3	3.6	2.58	70	75	400	7.1	4.5	4.46
56	75	300	5.6	3.55	2.83	71	75	400	6.3	4.0	3.50

HARD DRAWN STEEL WIRE FABRIC
Oblong Mesh *(Continued)*

Sl. No.	Mesh Size (Pitch of Wires)		Dia. of Wires		Weight per sq m
	Main mm	Cross mm	Main mm	Cross mm	kg
72	100	150	4.2	3.0	1.46
73	100	150	4.5	3.0	1.62
74	100	150	4.6	3.0	1.67
75	100	150	4.8	3.6	1.95
76	100	150	5.0	3.0	1.91
77	100	150	5.3	3.6	2.26
78	100	150	5.5	3.0	2.24
79	100	150	5.8	3.6	2.60
80	100	150	6.5	4.0	3.26
81	100	150	7.0	4.0	3.68
82	100	250	4.2	4.2	1.53
83	100	250	5.0	4.2	1.96
84	100	250	5.5	4.2	2.30
85	100	250	7.0	5.0	3.64
86	100	300	4.0	3.0	1.18
87	100	300	4.2	5.0	1.64
88	100	300	4.5	3.0	1.44
89	100	300	4.2	4.2	1.45
90	100	300	4.8	3.6	1.69
91	100	300	5.0	5.0	2.10
92	100	300	5.0	4.2	1.90
93	100	300	5.0	3.0	1.73
94	100	300	5.3	3.6	2.00
95	100	300	5.8	3.6	2.34
96	100	300	6.0	5.0	2.73
97	100	300	6.5	4.0	2.93
98	100	300	7.0	4.0	3.35
99	100	300	7.0	5.0	3.53
100	100	300	7.0	5.5	3.64
101	100	300	7.5	6.0	4.21
102	100	300	8.0	4.8	4.42
103	100	300	8.0	6.0	4.69
104	100	300	8.0	6.5	4.82
105	100	300	9.0	4.8	5.46
106	100	300	10.0	5.8	6.86
107	150	250	5.0	4.2	1.44
108	150	250	6.0	5.0	3.30
109	150	250	6.5	5.5	3.90
110	150	300	6.0	5.0	2.07
111	150	300	7.0	5.0	2.52
112	150	300	8.0	6.0	3.49

EXPANDED METAL SHEETS (XPM)
(Reference IS : 412 - 1975)

Ref No.	Size of Mesh (Nominal)		Dimensions of Strands		Weight per sq m
	SWM mm	LWM mm	Width mm	Thickness mm	kg
1	100	250	6.25	3.15	3.082
2	100	250	5.00	3.15	2.470
3	100	250	3.25	3.15	1.599
4	75	200	6.50	3.15	4.282
5	75	200	5.00	3.15	3.294
6	75	200	3.25	3.15	2.141
7	40	115	6.50	3.15	8.023
8	40	115	5.00	3.15	6.172
9	40	75	5.00	3.15	6.172
10	40	75	3.25	2.24	2.854
11	40	115	3.25	3.15	4.007
12	40	75	3.25	3.15	4.007
13	40	115	3.25	1.60	2.039
14	40	75	3.25	1.60	2.039
15	25	75	3.25	3.15	5.529
16	25	75	3.25	2.24	3.931
17	25	75	3.25	1.60	2.808
18	25	75	3.25	1.25	2.194
19	20	60	3.25	3.15	7.152
20	20	50	3.25	3.15	7.152
21	20	60	3.25	2.24	5.086
22	20	50	3.25	2.24	5.086
23	20	60	3.25	1.60	3.633
24	20	50	3.25	1.60	3.633
25	20	60	2.50	1.25	2.183
26	20	50	2.50	1.25	2.183
27	12.5	50	3.25	1.60	5.037
28	12.5	40	3.25	1.60	5.037
29	12.5	50	2.50	1.60	4.000
30	12.5	50	2.50	1.25	3.125
31	12.5	40	2.50	1.25	3.125
32	12.5	50	2.50	1.00	2.500
33	12.5	40	2.50	1.00	2.500
34	10	40	3.25	1.60	5.976
35	10	40	2.50	1.25	3.591
36	10	40	2.50	1.00	2.873
37	9.5	28.5	3.25	1.60	5.19
38	9.5	28.5	2.50	1.25	2.81
39	9.5	28.5	2.50	1.00	2.09
40	6	25	3.25	1.60	7.551
41	6	25	2.50	1.25	4.887
42	6	25	2.50	1.00	3.901
43	5	20	2.50	1.00	5.008
44	3	15	1.50	1.00	4.278



HEXAGONAL WIRE NETTING
(Chicken wire mesh)
(Reference IS : 3150-1982)

Netting is made of annealed mild steel galvanised wire. The size of aperture is denoted by the distance between parallel sides of the hexagons formed.

Size of aperture	Wire dia.	Size of aperture	Wire dia.	Size of aperture	Wire dia.
mm	mm	mm	mm	mm	mm
10	0.63	31	0.90 1.12 1.40	100 (2-ply selvedge)	1.25 1.40
13	0.63 0.90	38	0.90 1.12 1.25	100 (3-ply selvedge)	1.40 1.80
19	0.63 0.80 1.12	50	0.90 1.25	75 (1 center strand 3- ply selvedge)	1.40
25	0.80 0.90 1.40	75 (2-ply selvedge)	0.90 1.25	100 (1 centre strand 3-ply selvedge)	1.40 1.60 1.80

Note :- The term 'selvedge' denotes edge so woven that the end wires do not unravel.

WIRE CLOTH FOR GENERAL PURPOSES
(Reference IS : 1568-1970)

Wire cloth is regularly woven with parallel wires in both directions to produce uniform square meshes or openings. Wire used for making the cloth can be mild steel, brass, bronze, aluminium alloy or plastics.

Average Width of Aperture	Nominal Diameter of Wire
1.70 mm	0.32, 0.4, 0.56, 0.8
1.40 mm	0.25, 0.32, 0.45, 0.63, 0.71
1.18 mm	0.25, 0.32, 0.41, 0.45, 0.56, 0.63
1.00 mm	0.22, 0.28, 0.36, 0.5, 0.56
850 microns	0.2, 0.25, 0.32, 0.45, 0.50, 0.56
710 microns	0.18, 0.25, 0.32, 0.45
600 microns	0.16, 0.22, 0.28, 0.4
500 microns	0.14, 0.2, 0.25, 0.32, 0.36
425 microns	0.14, 0.2, 0.25, 0.28
355 microns	0.125, 0.18, 0.22, 0.25
300 microns	0.112, 0.16, 0.2, 0.25
250 microns	0.1, 0.14, 0.16, 0.2
212 microns	0.1, 0.125, 0.14, 0.16, 0.18
180 microns	0.08, 0.112, 0.125, 0.14
150 microns	0.071, 0.1, 0.112, 0.125

GALVANISED STEEL BARBED WIRE
(Reference IS : 278 - 1978)

Size Designation	Diameter of Wire in mm		Weight of Barbed Wire in kg per metre		Distance Between Two Barbs
	Line Wire	Wire for barbs	MAX	MIN	mm
1	2.50	2.50	0.155	0.136	75 ±12
2	2.50	2.50	0.120	0.108	150 ±12
3	2.50	2.00	0.125	0.108	75 ±12
4	2.50	2.00	0.103	0.089	150 ±12
5	2.24	2.00	0.106	0.097	75 ±12
6	2.24	2.00	0.085	0.078	150 ±12

STEEL TUBES FOR STRUCTURAL PURPOSES

(Reference IS : 1161 - 1979)

Nominal Bore mm	Outside diameter mm	Class	Thickesss mm	Weight per metre kg	Nominal Bore mm	Outside diameter mm	Class	Thickesss mm	Weight per metre kg
15	21.3	Light	2.00	0.962	100	114.3	Light	3.65	9.97
		Medium	2.65	1.22			Medium	4.5	12.1
		Heavy	3.25	1.45			Heavy	5.4	14.5
20	26.9	Light	2.35	1.42	110	127.0	Light	4.5	13.6
		Medium	2.65	1.58			Medium	4.85	14.6
		Heavy	3.25	1.90			Heavy	5.4	16.2
25	33.7	Light	2.65	2.04	125	139.7	Light	4.5	14.9
		Medium	3.25	2.46			Medium	4.85	16.2
		Heavy	4.05	2.99			Heavy	5.4	17.9
32	42.4	Light	2.65	2.61	135	152.4	Light	4.5	16.4
		Medium	3.25	3.15			Medium	4.85	17.7
		Heavy	4.05	3.86			Heavy	5.4	19.5
40	48.3	Light	2.9	3.27	150	165.1	Light	4.5	17.8
		Medium	3.25	3.61			Medium	4.85	19.2
		Heavy	4.05	4.43			Heavy	5.4	21.2
50	60.3	Light 1	2.9	4.14	150	168.3	Light	4.5	18.1
		Light 2	3.25	4.57			Medium	4.85	19.6
		Medium	3.65	5.10			Heavy 1	5.4	21.7
		Heavy	4.5	6.17			Heavy 2	6.3	25.3
65	76.1	Light	3.25	5.84	175	193.7	Light	4.85	22.6
		Medium	3.65	6.53			Medium	5.4	25.0
		Heavy	4.5	7.92			Heavy	5.9	27.3
80	88.9	Light	3.25	6.86	200	219.1	Light	4.85	25.7
		Medium	4.05	8.48			Medium	5.6	29.4
		Heavy	4.85	10.1			Heavy	5.9	31.0
90	101.6	Light	3.65	8.82	225	244.5	Heavy	5.9	34.2
		Medium	4.05	9.75	250	273.0	-	5.9	38.8
		Heavy	4.85	11.6	300	323.9	-	6.3	49.5
					350	355.6	-	8.0	68.3

WEIGHT OF WIRE IN KILOGRAMS PER 1000 METRES

Diameter in mm	Iron	Steel	Copper	Diameter in mm	Iron	Steel	Copper
0.100	0.06	0.06	0.07	1.000	6.13	6.27	6.98
0.125	0.09	0.10	0.11	1.250	9.57	9.80	10.90
0.160	0.15	0.16	0.18	1.600	15.68	16.04	17.86
0.200	0.24	0.25	0.28	2.000	24.51	25.08	27.91
0.250	0.38	0.39	0.44	2.500	38.29	39.40	43.61
0.315	0.61	0.62	0.69	3.150	60.79	62.23	69.64
0.400	0.98	1.00	1.12	4.000	98.03	100.34	111.65
0.500	1.53	1.57	1.74	5.000	153.17	156.78	174.45
0.630	2.43	2.49	2.77	6.300	243.18	248.90	276.96
0.800	3.92	4.01	4.47	8.000	392.11	401.35	446.59

WEIGHTS OF GALVANISED IRON FITTINGS

Description of fittings	Size in mm	Weight in kg of 100 fittings	Nos per kg.
Cup-headed sheeting rivets ...	10 x 6	0.631	158
	12 x 6	0.709	141
	15 x 6	0.788	126
	18 x 6	0.867	115
Sheet bolts & nuts ...	12 x 6	1.104	91
	15 x 6	1.143	88
	18 x 6	1.182	85
	25 x 6	1.340	75
	31 x 6	1.497	67
	37 x 6	1.576	63
Roofing screws cone headed ...	50 x 6	1.261	79
	56 x 6	1.497	67
	62 x 6	1.734	58
	75 x 6	2.207	45
Hook bolts & nuts ...	87 x 7.5	5.911	17
	87 x 10	7.882	13
	100 x 7.5	6.463	15
	100 x 10	8.827	11
	112 x 7.5	7.094	14
	112 x 10	10.088	10
	125 x 7.5	7.882	13
	125 x 10	11.823	8
Limpet washers (cone or circular) ...		0.473	211
Diamond curved washers ...	30 mm or 37 mm square.	1.970	51

EQUIVALENT DIAMETERS OF STANDARD WIRE GAUGE

SWG	Millimetres	SWG	Millimetres	SWG	Millimetres
7/0	12.7	13	2.337	32	0.2743
6/0	11.785	14	2.032	33	0.2540
5/0	10.973	15	1.829	34	0.2337
4/0	10.160	16	1.626	35	0.2134
3/0	9.449	17	1.422	36	0.1930
2/0	8.839	18	1.219	37	0.1727
0	8.229	19	1.016	38	0.1524
1	7.620	20	0.914	39	0.1321
2	7.010	21	0.813	40	0.1219
3	6.401	22	0.711	41	0.1118
4	5.893	23	0.610	42	0.1016
5	5.385	24	0.559	43	0.0914
6	4.877	25	0.508	44	0.0813
7	4.470	26	0.457	45	0.0711
8	4.064	27	0.4166	46	0.0610
9	3.658	28	0.3759	47	0.0508
10	3.251	29	0.3554	48	0.0406
11	2.946	30	0.3150	49	0.0305
12	2.642	31	0.2946	50	0.0254

SHEET METAL GAUGES - BIRMINGHAM GAUGE (B. G.)

Equivalent Thicknesses

Gauge	mm	Gauge	mm	Gauge	mm	Gauge	mm
0	10.07	9	3.551	18	1.257	27	0.4432
1	8.971	10	3.175	19	1.118	28	0.3969
2	7.993	11	2.827	20	0.9957	29	0.3531
3	7.122	12	2.517	21	0.8865	30	0.3124
4	6.350	13	2.240	22	0.7938		
5	5.652	14	1.994	23	0.7066		
6	5.032	15	1.775	24	0.6289		
7	4.481	16	1.588	25	0.5598		
8	3.988	17	1.412	26	0.4981		

BOLTS AND NUTS

WEIGHT (IN KILOGRAMS) OF BLACK BOLTS WITH HEXAGON HEAD AND NUTS (ROUND NECKS)

(Including weight of one Head and one Nut)

EACH

Length in mm from underside of head to the end	Diameter of bolt in mm						
	6	10	12	16	18	20	24
25	0.019	0.048	0.101	0.171	0.278	...	...
30	0.020	0.052	0.107	0.181	0.292	0.429	...
35	0.022	0.055	0.114	0.190	0.306	0.448	0.633
40	0.024	0.059	0.120	0.200	0.321	0.467	0.657
50	0.025	0.063	0.126	0.210	0.335	0.487	0.683
55	0.027	0.066	0.132	0.220	0.349	0.506	0.709
60	0.029	0.069	0.138	0.230	0.363	0.525	0.734
65	0.030	0.073	0.145	0.240	0.377	0.544	0.759
75	0.031	0.077	0.151	0.249	0.391	0.564	0.784
90	0.034	0.084	0.164	0.269	0.420	0.602	0.834
100	0.037	0.091	0.177	0.289	0.449	0.641	0.885
110	0.040	0.098	0.189	0.309	0.477	0.680	0.936
125	0.044	0.105	0.202	0.329	0.505	0.719	0.986
140	0.047	0.112	0.214	0.348	0.533	0.757	1.036
150	0.050	0.119	0.227	0.368	0.562	0.796	1.087
160	0.053	0.127	0.240	0.388	0.590	0.834	1.138
170	0.056	0.133	0.252	0.407	0.619	0.873	1.188
190	0.059	0.141	0.265	0.427	0.647	0.912	1.239
200	0.063	0.148	0.278	0.447	0.676	0.951	1.289
220	...	0.162	0.303	0.486	0.732	1.028	1.390
240	...	...	0.316	0.506	0.761	1.066	1.441
260	...	...	...	0.546	0.818	1.144	1.542
280	...	...	...	0.565	0.846	1.183	1.592
300	...	...	...	...	0.903	1.260	1.693
Weight in kg of one round washer 3 mm thick	0.007	0.008	0.011	0.018	0.025	0.034	...
Weight in kg of one nut	0.006	0.016	0.034	0.063	0.098	0.145	0.210
Weight in kg of shank for 25 mm of length	0.006	0.014	0.025	0.039	0.057	0.077	0.101

RIVETS

WEIGHT (IN KILOGRAMS) OF CUP-HEADED STEEL RIVETS

(Including Head)

EACH

Length in mm from underside of head to the end	Diameter of rivet in mm					
	8	12	14	18	22	24
25	0.022	0.044	0.076	0.121	0.179	0.252
27	0.024	0.047	0.081	0.128	0.188	0.265
30	0.026	0.050	0.086	0.135	0.198	0.278
33	0.028	0.054	0.091	0.142	0.208	0.290
36	0.030	0.057	0.096	0.149	0.217	0.303
40	0.031	0.060	0.101	0.156	0.227	0.316
43	0.033	0.063	0.106	0.163	0.237	0.328
46	0.035	0.066	0.111	0.171	0.247	0.341
50	0.036	0.069	0.116	0.178	0.256	0.354
25mm of shank only ...	0.014	0.025	0.039	0.057	0.077	0.101
Wt in kg of one head ...	0.008	0.019	0.037	0.064	0.102	0.151

WEIGHT OF ROUND WIRE NAILS (PLAIN HEAD)

Length mm	Diameter of shank mm	Diameter of head mm	App No of nails per kg	Length mm	Diameter of shank mm	Diameter of head mm	App No of nails per kg
25	1.60	4.0	2110	60	2.80	6.3	350
25	1.80	4.5	1720	60	3.15	7.1	230
25	2.00	5.0	1430	60	3.55	8.0	180
30	1.80	4.5	1410	80	3.55	8.0	140
30	2.00	5.0	1170	80	4.00	8.0	120
40	2.00	5.0	840	90	3.55	8.0	110
40	2.24	5.6	700	90	4.50	9.0	90
40	2.50	5.6	640	100	3.55	8.0	100
50	2.00	5.0	650	100	4.00	8.0	90
50	2.24	5.6	600	100	4.50	9.0	80
50	2.50	5.6	550	100	5.00	10.0	60
50	2.80	6.3	440	125	5.00	10.0	50
50	3.15	7.1	280	125	5.60	11.2	40
60	2.24	5.6	540	150	5.60	11.2	35
60	2.50	5.6	440	150	6.30	12.6	30

HOT ROLLED STEEL SECTIONS FOR DOORS, WINDOWS & VENTILATORS

(Reference IS : 7452 - 1982)

PURPOSE OR RECOMMENDED USE OF SECTIONS

Designation & Weight per metre (in kg)	Purpose and situation of use	Designation & Weight per metre (in kg)	Purpose and situation of use
T 2 (1.036)	Horizontal glazing bars for door side-lights, doors and sashes, sub-dividing bars for fixed-lights, vertical glazing bar for windows, ventilators and doors where metal, aluminium or wooden beading is used for fixing glass.	F 4 B (2.28)	Central mullion (meeting bar for shutters) for windows using F7D as inner frames, outer frame for open-in windows in rainy areas, sub-dividing bars for openable windows and top-hung ventilators.
T3 (1.14)	Vertical glazing bar for EZ7 frames.	F 7D (1.419)	Inner and outer frames for windows and top-hung ventilators, for outer frames for centre hung ventilators, and outer frame for door side-lights.
T 6 (0.839)	Horizontal glazing bar for standard windows and ventilators.	F X8 (2.31)	Outer frames for doors.
F 2 (1.46)	Inner frames for open-in windows.	E Z7 (1.90)	Outer frame for industrial sashes.
F3 (2.28)	Outer frames for open-in windows.	K 11B (1.80)	Vertical coupling mullion for all standard windows. Can be used as horizontal coupling bar when openable windows are to be coupled above fixed ones or between two fixed windows. Can also be used as horizontal coupling mullion where windows are not exposed to weather.
F 5 (1.55) & F 8 (1.92)	Inner and midddle frames in centre-hung ventilators. F5 is used as inner frame for bottom-hung ventilators and sometimes used as inner frame for open-out windows. F 8 is also used as outer frame for bottom - hung ventilators.		
FX 6 (2.52) and FZ 5 (2.52)	Inner frames for doors.	K 12 B (2.30)	Horizontal coupling mullion, also known as weather bar. Especially used when the coupled unit is exposed to rain.

ALUMINIUM SECTIONS

ALUMINIUM EQUAL LEG ANGLES
(Ref IS : 3908 - 1966)

ISALE Series

Size mm	Weight per metre kg
10 x 10 x 1.5	0.08
10 x 10 x 2.0	0.10
15 x 15 x 1.5	0.12
15 x 15 x 2.0	0.16
15 x 15 x 3.0	0.22
20 x 20 x 2.0	0.21
20 x 20 x 3.0	0.31
25 x 25 x 2.0	0.27
25 x 25 x 3.0	0.39
25 x 25 x 4.0	0.51
30 x 30 x 3.0	0.48
30 x 30 x 4.0	0.62
30 x 30 x 5.0	0.76
35 x 35 x 3.0	0.56
35 x 35 x 4.0	0.73
35 x 35 x 5.0	0.89
40 x 40 x 3.0	0.64
40 x 40 x 4.0	0.84
40 x 40 x 5.0	1.03

ALUMINIUM TEE SECTIONS
(Ref IS : 6445 - 1971)

ISALT Series

Depth of Section mm	Width of Flange mm	Weight per metre kg
25	25	0.4
30	30	0.5
		0.7
40	50	0.8
50	50	1.2
		1.6
65	65	1.6
		2.1
		2.7
		3.3
75	75	2.4
		3.1
75	100	2.8
		3.7
100	75	2.8
		3.7
		4.5
		5.4
100	100	4.2
		5.2
		6.2
125	75	5.2
		6.2
125	100	5.9
		7.0
150	75	5.9
		7.0
150	100	7.9
		10.2
150	150	9.5
		12.4
175	175	11.2
		14.7
200	200	12.8
		16.8

ALUMINIUM BEAM SECTIONS
(Ref. IS : 5384 - 1969)

ISALB Series

Depth of Beam mm	Width of Flange mm	Weight per metre kg
40	20	0.4
40	20	0.6
50	30	0.9
50	30	1.2
60	30	1.1
60	30	1.5
60	30	1.9
60	40	1.9
60	40	2.4
80	40	2.1
80	40	2.7
80	40	3.2
100	50	3.4
100	50	3.9
100	60	3.9
100	60	4.1
100	60	4.7
120	60	4.7
120	60	5.0
120	70	5.6
120	80	6.1
120	80	7.4
150	80	6.6
150	80	8.1
150	100	7.7
150	100	9.4
150	100	12.1
200	100	10.5
200	100	13.4
200	120	12.9
200	120	16.1

ALUMINIUM UNEQUAL LEG ANGLES
(Ref IS : 3909-1966)

ISALU Series

Size mm	Weight per metre kg
20 x 10 x 1.5	0.12
20 x 10 x 2.0	0.16
20 x 15 x 1.5	0.14
20 x 15 x 2.0	0.19
20 x 15 x 3.0	0.27
30 x 15 x 2.0	0.25
30 x 15 x 3.0	0.35
30 x 20 x 2.0	0.27
30 x 20 x 3.0	0.40
30 x 20 x 4.0	0.51
40 x 20 x 2.0	0.33
40 x 20 x 3.0	0.48
40 x 20 x 4.0	0.62

ALUMINIUM UNEQUAL LEG ANGLES
(Ref IS : 3909-1966)

ISALU Series (contd)

Size mm	Weight per metre kg
40 x 25 x 2.0	0.36
40 x 25 x 3.0	0.52
40 x 25 x 4.0	0.68
50 x 25 x 3.0	0.60
50 x 25 x 4.0	0.79
50 x 25 x 5.0	0.97
50 x 30 x 3.0	0.64
50 x 30 x 4.0	0.84
50 x 30 x 5.0	1.03
60 x 30 x 3.0	0.73
60 x 30 x 4.0	0.96
60 x 30 x 5.0	1.18
60 x 40 x 4.0	1.07
60 x 40 x 5.0	1.31
60 x 40 x 6.0	1.55
80 x 40 x 4.0	1.29
80 x 40 x 6.0	1.88
80 x 40 x 8.0	2.46
100 x 50 x 6.0	2.38
100 x 50 x 8.0	3.11
100 x 50 x10.0	3.83

ALUMINIUM CHANNELS
(Ref IS : 3921-1966)

ISALC Series

Depth of Section mm	Width of Flange mm	Thick-ness of Web mm	Thick-ness of Flange mm	Weight per metre kg
40	20	2.0	2.0	0.44
40	20	3.0	3.0	0.63
50	30	3.0	3.0	0.88
50	30	4.0	4.0	1.14
60	30	3.0	4.0	1.13
60	30	4.0	6.0	1.55
60	30	5.0	8.0	1.95
60	40	4.0	6.0	1.87
60	40	5.0	8.0	2.38
80	40	4.0	6.0	2.10
80	40	5.0	8.0	2.67
80	40	6.0	10.0	3.21
100	40	5.0	8.0	2.95
100	40	6.0	10.0	3.55
100	50	5.0	8.0	3.39
100	50	6.0	10.0	4.09
100	50	8.0	12.0	4.98
120	50	5.0	8.0	3.68
120	50	6.0	10.0	4.43
120	60	6.0	10.0	4.98
120	60	8.0	12.0	6.08
150	60	6.0	10.0	5.51
150	60	8.0	12.0	6.77
150	80	6.0	10.0	6.59
150	80	8.0	12.0	8.07
150	80	10.0	16.0	10.26
200	80	8.0	12.0	9.28
200	80	10.0	16.0	11.74
200	100	10.0	16.0	13.47
200	100	12.0	18.0	15.33

METAL ROLLING SHUTTERS

(Reference IS : 6248 - 1979)

Size of rolling shutters is denoted by clear width x clear height of the opening for which shutter is intended. Maximum width without intermediate support (guide channel) is 9 metres.

Types of shutters are (a) self coiling (push-pull or manual) type upto 8 sq m clear area without ball bearings, and between 8 to 12 sq m clear area with ball bearings; (b) gear operated (mechanical)type with ball bearings. For clear areas between 12 and 25 sq m opearted by gear box and crank handle, and between 25 and 35 sq m operated by hand chain and chain wheel mounted on worm shaft; (c) electrically operated, for clear areas above 35 sq m, upto a maximum of 50 sq m.

Fixing position of hood cover and bracket can be on the inner or outer face of the wall either below or above the soffit of the opening, with the vertical guide channels fixed beyond the vertical face of the jambs. Fixing position of hood cover and bracket can also be between the jambs, with the guide channels projecting in the opening or embedded in the jambs.

Rolling curtain is built up of interlocking laths shaped out of cold rolled steel strips. The laths are made of strips not less than 0.9 mm thick for shutters upto 3.5 m width, and not less than 1.2 mm thick for shutters above 3.5 m width.

CAST IRON MANHOLE COVERS, GRATINGS, STEPS, TRAPS ETC.

Cast Iron Manhole Covers *(Ref IS : 1726 (Parts I to VII) - 1974*

HD (Heavy Duty) grade covers are designed for heavy vehicular traffic to withstand a load of 35 tonnes

MD (Medium Duty) grade covers are designed for light vehicular traffic as in footpaths/ cycle tracks to withstand a load of 5 tonnes.

LD (Light Duty) grade covers are designed for pedestrain non-vehicular traffic in domestic premises to withstand a load of 1 tonne.

HD and MD grade covers are specified to have single seal. Option for single or double seal is available in LD grade covers only. HD grade double triangular covers have a seating frame of square shape in single piece with a circular opening, and the cover is made up of two triangular pieces forming a square.

Grade / type of CI manhole cover	Size of clear opening in mm	Weight of cover in kg	Weight of seating of frame in kg
HD circular	500 (dia)	85	85
	560 (dia)	108	100
HD double triangular	500 (dia)	118	111
	560 (dia)	140	115
MD circular	500 (dia)	58	58
	560 (dia)	64	64
MD rectangular	610 x 455	80	64
LD square (single seal)	455 x 455	13	7
	610 x 610	25	13
LD square (double seal)	455 x 455	23	15
	610 x 610	37	18
LD rectangular (single seal)	455 x 610 (Pattern 1)	23	15
	455 x 610 (Pattern 2)	15	10
LD rectangular (double seal)	455 x 610	29	23

Cast Iron Gratings *(Ref IS : 5961 - 1970)* for drainage of surface water have a seating frame of size 560 x 600 mm overall, with a hinged grating of size 450 x 490 mm overall fitted in it. The minimum specified weight of grating including seating frame is 75 kg and is designed for 35 tonne load.

Cast Iron Steps for Manholes *(Ref IS : 5455 - 1969)* can be of Pattern 1 which weigh minimum 4.5 kg per step, are 150 mm wide and of overall length 375 mm of which 125 mm project from the wall. Pattern 2 steps weigh minimum 5.3 kg per step, are 165 mm wide and of overall length 385 mm of which 125 mm project from the wall. Both patterns have raised chequered nonslip tread, are 25 mm thick and have lugs for grip in the portion intended for embedding in the wall.

Cast Iron Floor / Nahni traps *(Ref IS : 3989 - 1984)* are specified to have following characteristics :-

Description	Designation / diameter / size (nominal bore of outlet)	Diameter of inlet grating	Total depth	Weight (approx.) of each trap
Cast iron floor traps	50 mm	100 mm	175 mm	2.5 kg
	75 mm	100 mm	225 mm	4.8 kg
	100 mm	200 mm	296 mm	7.5 kg
Cast iron nahni traps	50 mm	165 mm	175 mm	5.5 kg
	75 mm	165 mm	225 mm	6.5 kg

STEEL DOORS WINDOWS AND VENTILATORS

Designation

In the system of designation followed in IS for steel doors, windows and ventilators the width, type and height are indicated in succession. The width and height are indicated in the number of modules of 10 cm each. The type is indicated by letter symbols as follows :-

H = With horizontal glazing bars	S = Side hung
N = Without horizontal glazing bars	C = Centre hung
F = Non-openable fixed units intended for light only.	T = Top hung
	B = Bottom hung

Thus, the designation 10 HS 12 will indicate a window of 100 cm width, 120 cm height, of side hung type having horizontal glazing bars. As all industrial windows are provided with horizontal glazing bars, the letters H or N are not used in the designation of industrial windows.

The widths and heights indicated in the designation are nominal, ie they are inclusive of a clearance of 1 cm all around. The actual dimensions of 10 HS 12 will therefore be 98 cm wide and 118 cm high.

Glazing

The total area of glazing panes required for each type of door, window and ventilator, (separately in panes upto 0.5 sq m in each pane and in panes exceeding 0.5 sq m in each pane) are indicated in the tables given below, and on the next page as a time saver device for taking off (estimating) glazing quantities of steel doors windows and ventilators. Dimensions of glazing panes have been measured to the nearest 5 mm, and the area of glazing, for each size of pane/per window etc., has been calculated to the nearest 0.01 sq m

Requirement of fixing lugs

The number of steel adjustable lugs to be provided for fixing the doors/windows/ventilators of different sizes, as specified in the relevant IS are as follows :-

Dimensions of steel doors, windows and ventilators in metres		*Ref IS : 1038 - 1983*			*Ref IS : 1361 - 1978* (Industrial windows)			Note
Width	Height	Top	Bottom	Each side	Top	Bottom	Each side	
0.60, 0.80, 1.20		2	2					Fixing lugs made out of 3.15 mm thick 14 mm wide flats, bent at right angle, having one leg 70 mm long provided with a slot, and other leg 100 mm long, fixed through slot with csk galvanised machine screw 6 mm dia, 12 mm long and nut.
1.50 and 1.80		3	3					
	0.60 and 0.90			2				
	1.20 and 1.50			3				
	2.00 and 2.10			4				
1.00					2	2		
1.60 and 2.20					4	4		
	1.00						2	
	1.50						3	
	2.00						4	

Table of Sizes, Types, Glazing Areas and Glazing Clips

Industrial Windows *(Ref IS : 1361 - 1978)*
All industrial windows are with horizontal glazing bars.
None of the glazing panes exceed 0.5 sq m area per pane.

Designation of steel window	Total area in sq m of glazing in panes not excdg 0.5 sq m in each pane	Number of glazing clips required per window	Designation of steel window	Total area in sq m of glazing in panes not excdg 0.5 sq m in each pane	Number of glazing clips required per window
10 C 10/10 T 10/10 B 10	0.72	12	16 F 15 (Non-openable)	2.11	30
10 F 10 (Non-openable)	0.84	12	16 C 20/16 T 20 / 16 B 20	2.72	40
10 C 15/10 T 15 / 10 B 15	1.17	18	16 F 20 (Non-openable)	2.84	40
10 F 15 (Non-openable)	1.29	18	22 C 10/22 T 10/22 B 10	1.79	28
10 C 20/10 T 20/10 B 20	1.61	24	22 F 10 (Non-openable)	1.91	28
10 F 20 (Non-openable)	1.74	24	22 C 15/22 T 15/22 B 15	2.80	42
16 C 10/16 T 10/16 B 10	1.25	20	22 F 15 (Non-openable)	2.93	42
16 F 10 (Non-openable)	1.38	20	22 C 20/22 T 20/22 B 20	3.82	56
16 C 15/16 T 15/16 B 15	1.98	30	22 F 20 (Non-openable)	3.94	56

Note : *In all industrial windows of C, T, or B designation the openable portion is 98 x 98 cm and rest of the area, if any, is made up of fixed non-openable glazed portions.*

Table of Sizes, Types and Glazing Areas
For Doors, Windows, Ventilators and Fixed Lights, *(Ref IS : 1038 - 1983)*

Designation of steel door window ventilator or fixed light	Area of glazing in panes not excdg. 0.5 sq m in each pane	Area of glazing in panes excdg. 0.5 sq m in each pane
	sq m	sq m
Doors, Side Hung Type With Horizontal Glazing Bars		
6 HS 20	0.75	-
8 HS 20	1.03	-
10 HS 20	1.32	-
12 HS 20	1.67	-
6 HS 21	0.75	-
8 HS 21	1.03	-
10 HS 21	1.33	-
12 HS 21	1.67	-
Doors, Side Hung Type Without Horizontal Glazing Bars		
6 NS 20 #	0.76	-
8 NS 20 #	1.10	-
10 NS 20 @	1.36	-
12 NS 20 @	1.68	-
6 NS 21 #	0.76	-
8 NS 21 #	0.54	0.56
10 NS 21 @	1.36	-
12 NS 21 @	1.68	-
Windows, Side Hung Type Without Horizontal Glazing Bars		
5 NS 9 !	0.33	-
6 NS 9 !	0.41	-
10 NS 9 $	0.68	-
12 NS 9 $	0.85	-
15 NS 9 @	1.08	-
18 NS 9 @	1.31	-
5 NS 12 #	0.45	-
6 NS 12 #	-	0.56
10 NS 12 @	0.94	-
12 NS 12 @	-	1.16
15 NS 12 ¢	0.94	0.54
18 NS 12 ¢	-	1.81
5 NS 15 #	0.57	-
6 NS 15 #	0.15	0.56
10 NS 15 @	1.19	-
12 NS 15 @	0.31	1.16
15 NS 15 ¢	1.32	0.54
18 NS 15 ¢	0.47	1.81
Fixed Lights - (Window Height) Without Horizontal Glazing Bars		
5 NF 9 !	0.36	-
6 NF 9 !	0.47	-
10 NF 9 $	0.78	-
12 NF 9 $	0.94	-
15 NF 9 @	1.19	-
18 NF 9 @	1.43	-
5 NF 12 #	0.49	-
6 NF 12 #	-	0.61
10 NF 12 @	-	1.06
12 NF 12 @	-	1.28
15 NF 12 ¢	-	1.62
18 NF 12 ¢	-	1.95
5 NF 15 #	0.62	-
6 NF 15 #	0.16	0.61
10 NF 15 @	0.27	1.06
12 NF 15 @	0.33	1.28
15 NF 15 ¢	0.41	1.62
18 NF 15 ¢	0.50	1.95

Designation of steel window, ventilator or fixed light	Area of glazing in panes not excdg. 0.5 sq m in each pane	Designation of steel window, ventilator or fixed light	Area of glazing in panes not excdg. 0.5 sq m in each pane
	sq m		sq m

Note : *Units in this part of the table do not require any glazing in panes exceeding 0.5 sq m per pane.*

Windows, Side Hung Type With Horizontal Glazing Bars		**Fixed Lights, Window Height With Horizontal Glazing Bars**	
5 HS 9	0.32	5 HF 9	0.36
6 HS 9	0.40	6 HF 9	0.44
10 HS 9	0.67	10 HF 9	0.77
12 HS 9	0.84	12 HF 9	0.93
15 HS 9	1.06	15 HF 9	1.17
18 HS 9	1.31	18 HF 9	1.42
5 HS 12	0.43	5 HF 12	0.48
6 HS 12	0.55	6 HF 12	0.59
10 HS 12	0.92	10 HF 12	1.02
12 HS 12	1.14	12 HF 12	1.24
15 HS 12	1.44	15 HF 12	1.56
18 HS 12	1.77	18 HF 12	1.89
5 HS 15	0.55	5 HF 15	0.61
6 HS 15	0.70	6 HF 15	0.75
10 HS 15	1.17	10 HF 15	1.29
12 HS 15	1.45	12 HF 15	1.57
15 HS 15	1.82	15 HF 15	1.97
18 HS 15	2.24	18 HF 15	2.39
Ventilators, Top Hung Type With Horizontal Glazing Bars		**Ventilators, Top Hung Type Without Horizontal Glazing Bars**	
5 HT 6	0.20	5 NT 6 *	0.20
6 HT 6	0.25	6 NT 6 *	0.26
10 HT 6	0.45	10 NT 6 !	0.45
12 HT 6	0.55	12 NT 6 !	0.56
15 HT 6	0.71	15 NT 6 #	0.72
18 HT 6	0.87	18 NT 6 #	0.87
5 HT 9	0.33	5 NT 9 *	0.34
6 HT 9	0.41	6 NT 9 *	0.42
Ventilators, Centre Hung Type With Horizontal Glazing Bars		**Fixed Lights, Ventilator Height With Horizontal Glazing Bars**	
5 HC 6	0.16	5 HF 6	0.23
6 HC 6	0.21	6 HF 6	0.28
10 HC 6	0.38	10 HF 6	0.49
12 HC 6	0.47	12 HF 6	0.60
15 HC 6	0.68	15 HF 6	0.75
18 HC 6	0.83	18 HF 6	0.91
Ventilators, Centre Hung Type Without Horizontal Glazing Bars		**Fixed Lights, Ventilator Height Without Horizontal Glazing Bars**	
5 NC 6 *	0.17	5 NF 6 *	0.25
6 NC 6 *	0.21	6 NF 6 *	0.29
10 NC 6 !	0.39	10 NF 6 !	0.50
12 NC 6 !	0.48	12 NF 6 !	0.60
15 NC 6 #	0.70	15 NF 6 #	0.76
18 NC 6 #	0.89	18 NF 6 #	0.92
Fixed Lights, Door Height With Horizontal Glazing Bars		**Fixed Lights, Door Height Without Horizontal Glazing Bars**	
6 HF 20	0.91	6 NF 20 #	0.92
6 HF 21	0.91	6 NF 21 #	0.92

No. of glazing clips required per unit designated in this table

Sign used	*Clips required*	*Sign used*	*Clips required*
*	2	$	8
!	4	@	12
#	6	¢	18

COMMERCIAL ABBREVIATIONS

@	At or to
a.a.r.	Against all risks.
A/C	Account current.
Acc.	Account.
a/o	Account of.
a/d	After date.
A/S	Account sale.
B/E	Bill of exchange.
B/L	Bill of lading.
b/s	Bill of sale.
c & f	Cost and freight included in price.
c.i.f.	Cost, insurance and freight included in price.
C.O.D.	Collect (or cash) on delivery.
Cr	Creditor.
c/o	Care of.
c/s	Cases.
C.W.O.	Cash with order.
d.d.	Days after date.
Dr.	Debtor.
d.s.	Days after sight.
d/y	Delivery.
ea.	Each.
E.E.	Errors excepted.
E. & O. E.	Errors and omissions excepted.
f.a.q.	Fair average quality.
f.a.s.	Free alongside ship : buyer puts them on board and pays dues and charges.
f.o.b.	Free on board; the price quoted to include all the expenses of putting goods on board ship.
f.o.r.	Free on rail, i.e. loaded into wagons.
f.o.v.	Free on van, i.e. loaded into vans.
f.o.w.	Free on wharf alongside ship.
G.M.B.	Good marketable brands.
G.O.B.	Good ordinary brands.
I.O.U.	I owe you.
inst.	Instant (present month).
Ltd.	Limited.
m.d.	Months after date.
m.s.	Months after sight.
M/s.	Messers.
M.O.	Money order.
n.a.	No advice.
No.	Numero (number).
o/a	On account.
%	Per cent.
0/00	Per thousand.
p.n.	Promissory note.
P.O.	Postal order.
P.T.O.	Please turn over.
Percent	By the hundred (centum).
pro rata	In proportion.
pro tem.	Pro tempore (for the time being).
Prox.	Proximo (next month).
Re	As regards.
Shri	Shreeyut.
S'Shri	Sarvashreeyut.
R.S.V.P.	Please reply.
S.O.	Supplied only, i.e. not fixed.
SS	Steamship.
Ult.	Ultimo (last month).
viz.	Videlicet (namely, to wit).
Xd	Ex-dividend.
Xi	Ex-interest.
Ex. div.	Ex dividend.
£.p.	Librae, pence (pounds, pence).
–Do– or -do-	Dittto or ditto.
cum. div.	With dividend.

COMMON LATIN AND FRENCH TERMS USED IN CORRESPONDENCE ETC.

Anno Domini	In the year of our Lord.
Ab initio	From the begining.
Ab origine	From the origin.
Addenda	List of additions; things to be added.
Ad hominem	Personal.
Ad hoc	For this special purpose.
Ad infinitum	To infinity.
Ad interim	In the meanwhile.
Ad nauseum	To the point of disgust or satiety.
Ad referendum	For further consideration.
Ad rem	To the point; to the purpose.
Ad valorem	According to the value.
Ad verbum	To a word, or word for word.
Alter idem	Another exactly similar.
Ante meridiem	Before noon.
A priori	From cause to effect.
A posteriori	From effect to cause.
Argumentum ad ignorantiam	Argument founded on ignorance of the person addressed.
Bona fide	Good faith (in good faith), genuine.
Coeteries paribus	Other things being equal.
Caveat emptor	Let the buyer beware (look after his own interests).
Corrigenda	Things to be corrected; a list of errors.
De facto	In the point of fact; actual or actually.
De jure	From the law; by right.
De novo	Anew.
De rigueur	Indispensable; obligatory.
Errata	List of errors.
Et cetera	And the rest.
Et sequentes; Et sequentia	And those that follow.
Exempli gratia	By way of example.
Ex gratia	As an act of grace.
Ex officio	In virtue of his office.
Ex parte	From one party or side.
Experto crede	Trust one who has had experience.
Ex post facto	After the deed is done; retrospective.
Expressis verbis	In express terms.
Flagrante delicto	In the very act.
Fons et origio	The source and origin.
Force majeure	Greater force or strength; overwhelming force, act of God.
Humanem est errare	To err is human.
Ibidem (or ibid)	At the same place, (in the book).
Id est (i.e.)	That is, often is.
In extenso	At full length.
Infra dig	Beneath one's dignity.
In re	In the matter of.
In situ	In its original situation.
In statu quo	In former state.
Inter alia	Among other things.
In terrorem	As a warning.
Inter se	Among themselves.
In toto	Entirely.
In transitu	In the course of passage or transit.
Ipsissima verba	By the very words.
Ipso facto	By that very fact.
Jure humano	By human law.
Juste milieu	The golden mean.
Lacuna	A gap, A vacant space.
Lapsus calami	A slip of the pen.
Lapsus linguoe	Slip of the tongue.
Lex loci	Law or custom of the place.
Lex non scripta	Unwritten law.
Lite pendente	During the trial.

Locum tenens	... ...	A substitute.
Locus standi	... ...	A place of standing; A right to appear and be heard before a court in a particular case.
Mal a propos	... ...	Ill timed.
Mala fide	... ...	In bad faith; treacherously.
Mandamus	... ...	Writ issued by higher court to lower court.
Me judice	... ...	I being judge; in my opinion.
Modus operandi	... ...	Manner of working.
Modus vivendi	... ...	Manner of living; used as a temporary working arrangment.
Mutatis mutandis	... ...	With the necessary changes.
Nil admirari	... ...	To be astonished at nothing.
Nolens volens	... ...	Willing or non-willing.
Non liquet	... ...	The case is not clear.
Non sequitur	... ...	It does not follow.
Nota bene (N.B.)	... ...	Mark well, take notice.
Nudis verbis	... ...	In plain words.
Obiter dictum	... ...	A word said by the way; a passing comment made by a judge.
Obscurium per obscurius	... ...	An obscurity explained by another obscurity.
Onus probandi	... ...	The burden of proof.
Pari passu	... ...	With equal pace; side by side.
Per	... ...	For, through.
Per diem	... ...	Per day.
Per mensem	... ...	Per month.
Per se	... ...	By itself.
Persona grata	... ...	An acceptable person.
Petito principii	... ...	A begging of the question.
Post meridiem	... ...	After noon.
Poste restante	... ...	To remain in post office until call for.
Prima fascie	... ...	At first view or consideration.
Pro et contra (Pros and cons)	... ...	For and against.
Pro forma	... ...	For the sake of form.
Pro rata	... ...	According to rate or proportion.
Pro tempore	... ...	For the time being.
Quantum meruit	... ...	As much as he deserved.
Quantum sufficit	... ...	As much as suffices.
Quid pro quo	... ...	Something in return; as equivalent.
Raison d'etre	... ...	Justification for existence.
Re	... ...	In the matter of.
Reductio ad absurdum	... ...	A reducing to the absurd (A method of proof).
Res judicata	... ...	A case or suit already settled.
Resume	... ...	A summary or abstract.
Seriatum	... ...	In a series, one by one.
Sine cura	... ...	Without a charge or care.
Sine die	... ...	Without a day being appointed.
Sine qua non	... ...	Without which not; something indispensable.
Status quo	... ...	The state in which.
Stet	... ...	Let it stand; do not delete.
Sub judice	... ...	Under consideration.
Sub poena	... ...	Under a penalty.
Sub poena ad testificandum	... ...	Call to a witness for verbal evidence.
Sub poena duces tecum	... ...	Summons to witness for producing certain documents.
Suggestio falsi	... ...	Suggesting soemthing which is false.
Supressio veri	... ...	A supression of truth.
Ultra vires	... ...	Beyond powers conferred by law.
Ut infra	... ...	As below.
Ut supra	... ...	As above.
Verbatim et literatim	... ...	Word for word and letter for letter.
Vexato questio	... ...	A disputed question.
Via media	... ...	A middle course.
Vice versa	... ...	The terms of the case being interchanged or reversed.
Viva voce	... ...	Orally.

MEASUREMENT OF PLINTH AND CARPET AREAS OF BUILDINGS

(Reference IS : 3861- 1975)

Plinth Area shall mean the covered built up area measured at the floor level of any storey or at the floor level of the basement.

Carpet Area shall mean the covered area of the usable rooms at any floor level.

A Balcony is a horizontal projection with a handrail/parapet, serving as passage or sitting out place.

Mezzanine Floor - An intermediate floor in between two main floors having minimum height of 2.2 m (or minimum 1.8 m where rules of the local bodies permit) from the floor and having proper access to it.

Stair Cover (mumty) is the roofed space over a staircase and its landing, built to enclose only the stairs for the purpose of providing protection from weather and not used for human habitation.

Loft is an intermediate storage area in between two main floors.

Porch is a covered surface (with roof supported on pillars or otherwise), used for the purpose of pedestrian or vehicular approach to a building.

Measurement - Measure lengths to the nearest 0.01 m. Work out areas to the nearest 0.01 sq m.

The areas of each of the following categories shall be measured separately :-
(a) Basement (b) Floor without cladding (stilted floor) (c) Floors including top floor which may be partly covered (d) Mezzanine floor, and (e) Garrage.

Measurement of Plinth Area - Following areas shall be included where occuring in each category of plinth area :-
(a) Area of the wall at the floor level excluding plinth offsets it any. When the building consists of columns projecting beyond the cladding, the plinth area shall be measured upto the external face of the cladding (In case of corrugated sheet cladding outer edge of corrugation shall be considered) (b) Internal shaft for sanitary installations and garbage chute, provided these do not exceed 2 sq m in area, vertical duct for airconditioning, and lift well including landing (c) Stair cover (mumty) (d) Machine room, and (e) Porch

The following shall not be included in the plinth area :-
(a) Additional floor for seating in assembly buildings/theatres and auditoriums (b) Cantilevered porch (c) Balcony (d) Area of loft (e) Internal sanitary shaft and garbage chute provided these are more than 2 sq m in area (f) Area of architectural band, cornice., etc., (g) Area of vertical sun breaker or box louver projecting out and other architectural features, for example slab projection for keeping flower pots (h) Open platform (j) Terrace at floor one (k) Spiral Staircase including landing, and (m) Towers, turrets domes projecting above the terrace level at terrace.

Wall Area means the area *on plan* occupied by walls (including thickness of finishing/dado if the height of such finish is more than 1 m from floor finish) on any particular floor and qualifying for inclusion in the plinth area.

The following shall be included in the wall area :-
(a) Area on plan occupied by door and other openings (b) Intermediate pillars, supports and other such obstructions within the plinth area irrespective of their locations (c) Pillasters along wall if exceeding 300 sq cm in area (d) Flues within the wall (e) Built-in cupboards/ almirahs/ shelves appearing within a height of 2.20 m from floor (f) Fire place projecting beyond the face of wall in living or bed room

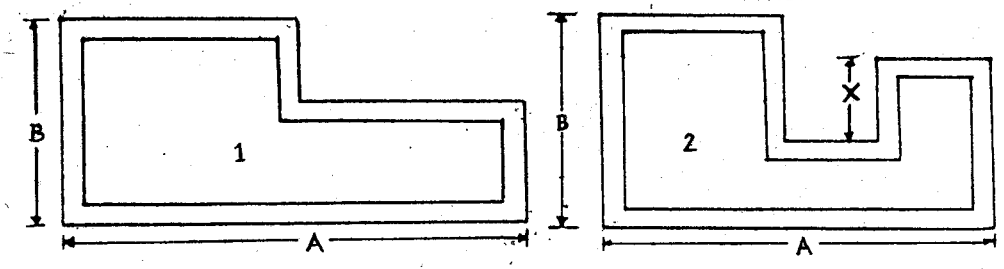
The following shall be excluded from the wall area :-
(a) Pillaster along wall not exceeding 300 sq cm in area, and (b) Chullah platform projecting beyong the face of the wall.

Carpet Area shall mean the plinth area less the area of following portions :-
(a) Wall area (b) Verandah (c) Corridor and passage (d) Entrance hall and porch (e) Staircase and stair-cover i.e. mumty (In a hall or basement the area of portion upto 1 m beyond the last step of staircase shall be treated as part of the staircase) (f) Lift shaft and machine room for lift (g) Bathroom and lavatory (h) Kitchen and pantry (j) Store (k) Canteen (m) Airconditioning duct and plant room (n) Shaft for sanitary piping (p) Stilted floor and garage.

Note :- *(1) IS : 3861 - 1975 also lays down the method of measurement of 'Rentable area' of residential and non-residential buildings.*

(2) The sum (addition) of the built up area of all floors (including basement) is usually termed as the plinth area of that particular building when calculating the approximate estimated cost of the building on the basis of 'plinth area rates'.

CENTRE LINE METHOD FOR WORKING OUT QUANTITIES



1. **Buildings *without* Re-entrant Portion** (Figure marked 1)
   - i) Length of centre line of external walls = $2 (A+B) - 8 (\frac{t}{2})$
   - ii) External perimeter = $2 (A+B)$
   - iii) Internal perimeter of external walls = $2 (A+B) - 8 (t)$

2. **Buildings *with* Re-entrant Portion** (Figure marked 2 showing one re-entrant portion)
   - i) Length of centre line of external walls = $2 (A+B) + 2 (X) - 8 (\frac{t}{2})$
   - ii) External Perimeter = $2 (A+B) + 2 (X)$
   - iii) Internal perimeter of external walls = $2 (A+B) + 2 (X) - 8 (t)$

The set of three equations in sl. No. 2 should be suitably modified if more than one re-entrant portion occurs in the building plan.

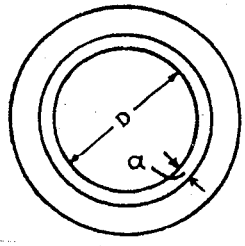
Where 'A' and 'B' are the *extreme dimensions of length and width* of the *building in which all offsets and corners are at 90 °* , uniform thickness of external walls is 't' , and 'X' is the length of the re-entrant portion where applicable.

It is much simpler to remember that in the above kind of buildings, to work out (a) length of centre line of external walls, or (b) internal perimeter of external walls, or (c) length along centre line of plinth protection of uniform width running all around the building, or (d) length of the edge of roof slab having uniform projection beyond outer walls, or (e) lengths along the centre line of successive offsets shown only on one side of the external wall, or (f) similar situations :-

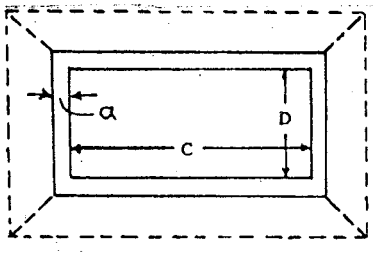
the required length = Length along external perimeter of external wall (+) or (-) 8 times the *shift* from the external face of the external wall to the point at which the length is to be worked out.
Use (+) sign in the above equation when the centre line which is being calculated falls outside the external perimeter of the external walls (as in the case of (c), (d) or (e) above, and use (-) sign for vice versa (as in the case of (a) or (b) above).

It will be worthwhile to note that the calculation of centre line does not get affected by any increase in the number of right angle offsets in the building, as each external corner formed by an additional offset will be compensated for by a corrresponding internal corner formed by the offset.

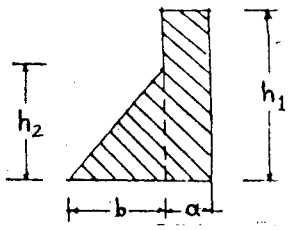
Tanks Having Wall Built to a Batter



Plan (Circular Tank)



Plan (Rectangular Tank)



Section of wall

Circular Tank

$$\text{Cubic contents of wall} = \pi (D+a) \times (h_1\ a) + \pi \left(D + 2a + \frac{2b}{3} \right) \times \frac{(bh_2)}{2}$$

Rectangular Tank

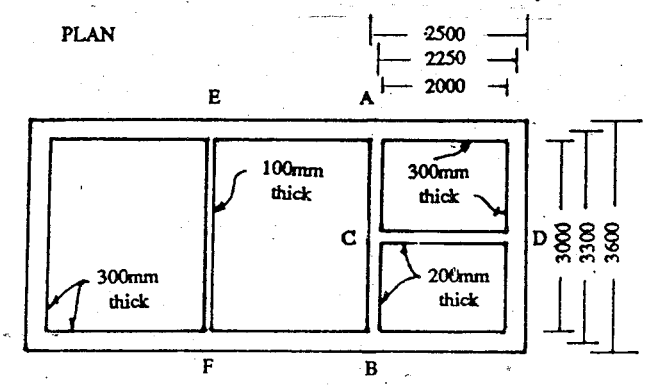
$$\text{Cubic contents of wall} = ah_1 \left[2(C+D) + 4a \right] + 2 \left(C + 2a + \frac{2b}{3} + D + 2a + \frac{2b}{3} \right) \left(\frac{1}{2} bh_2 \right)$$

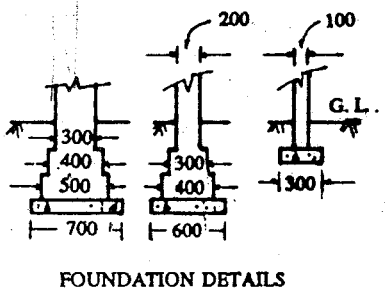
(Note :- Centre line taken at the centre of gravity)

CENTRE LINE METHOD *(continued)*

Quantities in Foundations of Cross Walls

In calculating quantities of excavation/ earthwork, foundation concrete, brickwork/ stone masonry etc., for cross walls (ie internal walls), any possible confusion can be avoided by following the method explained below :





FOUNDATION DETAILS

For the building in the above sketch, quantities of work in foundations of the external walls will be calculated on the basis of length of centre line of the external walls. For quantities of work in foundations of cross walls the effective lengths of excavation /earthwork, concrete in foundations, brick offsets etc. (duly allowing for work already measured for external walls), are worked out as follows :-

Cross Wall Marked AB

The centre to centre length of cross wall AB is 3300 mm. At both ends it meets the external wall. The width of foundation of external wall is 700 mm and width of foundation of cross wall is 600 mm.

3300 (-) 700	= 2600 mm	=	Length of excavation in trenches and length of concrete in foundation for cross wall AB clear of the excavation/ foundation concrete of the external walls.
3300 (-) 500	= 2800 mm	=	Length of bottom offset of brickwork , clear of the bottom brick offset of external walls.
3300 (-) 400	= 2900 mm	=	Length of middle offset of brickwork, clear of the middle brick offset of external walls.
3300 (-) 300	= 3000 mm	=	Length of top offset of brickwork, which tallies with the length given on plan.

Cross Wall Marked CD

The centre to centre length of cross wall CD is 2250 mm. At one end the cross wall CD joins the external wall which is 300 mm thick and at the other end it joins the cross wall AB 200 mm thick. The widths of foundation of external wall and cross wall AB are 700 mm and 600 mm respectively.

$2250 (-) \frac{700+600}{2}$	= 1600 mm	=	Length of excavation in trenches and length of concrete in foundation for the cross wall CD clear of the excavation/ foundation concrete of the external wall and the cross wall AB.
$2250 (-) \frac{500+400}{2}$	= 1800 mm	=	Length of bottom offset of brickwork.
$2250 (-) \frac{400+300}{2}$	= 1900 mm	=	Length of middle offset of brickwork.
$2250 (-) \frac{300+200}{2}$	= 2000 mm	=	Length of top of brickwork, which tallies with the length given on plan.

Cross Wall Marked EF (*A case of varying depth of foundations*)

The centre to centre length of cross wall EF is 3300 mm. At both ends it joings the 300 mm thick external wall. The depth of foundation of cross wall EF is less than that of the external wall. Here it should be remembered that length of excavation in trenches and length of concrete in foundation will not be the same, as the concrete in foundation for the cross wall EF will have to extend into the excavation in trench for external wall upto the edge of the 400 mm wide brick offset of the external wall at both the ends of the cross wall EF.

3300 (-) 700	= 2600 mm	=	Length of excavation in trenches for cross wall EF clear of the excavation in trenches for the external walls.
3300 (-) 400	= 2900 mm	=	Length of concrete in foundation for cross wall EF, clear of the middle offset of brickwork of the external walls.
3300 (-) 300	= 3000 mm	=	Length of brickwork for cross wall EF.

Once the correct lengths of all offsets are properly worked out, following the normal procedure of measuring the quantities of excavation, returning filling and ramming (RF & R) *initially* same as the quantity of excavation, concrete and brick offsets below ground along with *deduction of RF & R* and *addition of removal of spoil* (equal to the quantity of concrete and brick offsets below ground) can be followed mechanically. The very small quantity of RF & R *below* the concrete of cross wall EF (in the above example) for the 150 mm portion at each end extending into the excavation for external walls also gets automatically accounted for.

CALCULATION OF REINFORCEMENT

Cover to Reinforcement

Para 25.4 of *IS :456-1978- Code of practice for plain and reinforced concrete* lays down that reinforcement bars shall have concrete cover (exclusive of plaster or other finish) as follows :-

(a) At each end of reinforcing bar not less than 25 mm, nor less than twice the diameter of such bar;
(b) For a longitudinal reinforcing bar in a column, not less than 40 mm, nor less than diameter of such bar. In the case of columns of minimum dimension of 200 mm or under, whose reinforcing bars do not exceed 12 mm, a cover of 25 mm may be used;
(c) For longitudinal reinforcing bar in a beam, not less than 25 mm, nor less than diameter of bar;
(d) For tensile, compressive, shear or other reinforcement in a slab, not less than 15 mm, nor less than the diameter of such bar; and
(e) For any other reinforcement, not less than 15 mm, nor less than the diameter of such bar.

The cover may be increased by the RCC designer by inserting notes in the structrual drawings or by making stipulations in the specifications to cater for special considerations like proximity of saline water, harmful chemicals etc.

For articles with thin cross section like precast RCC fencing posts, certain government departments like the MES specify concrete cover of 20 mm or twice the diameter of main bars, whichever is greater.

Lap Splices

Length of bars supplied by manufacturers is usually in the range of 8 to 13 m. When length of bars in stock is shorter than the required length the bars are extended by providing lap splices. Allowance to be made for lap splices in the calculation of quantity of reinforcement should be :-

(a) 24 times the bar diameter, for bars in compression.
(b) 30 times the bar diameter, for bars in tension.

When the estimator is in doubt as to whether a particular bar is in compression or tension he should allow for 30 times the bar diameter.

Normally, bars larger than 36 mm diameter are to be extended by butt welding, but if lap splices are permitted for such bars additional spirals of 6 mm diameter are provided around the lapped portion.

When bars of different diameters are spliced (as in curtailing of reinforcement) the lap length is to be calculated on the basis of the smaller diameter of bar.

Cranked Bars

For cranked bars add 0.4 t to allow for extra length due to cranking when bars are bent to an inclination of 45^0 , and add 0.3 t to allow for extra length due to cranking when bars are bent to an inclination of 30^0. The values of 0.4 t and 0.3 t are for each crank and thus if the bar is cranked at both ends twice these values will have to be added. (t = vertical distance through which bar is cranked.)

Allowance for hooks

For the purpose of anchorage, ends of all plain round mild steel reinforcing bars including the spliced ends are provided with hooks. Such hooks are not obligatory when using torsteel/ ribbed/deformed/cold twisted bars unless particularly shown or stipulated in drawings or specifications.

When using plain round mild steel bars conforming to *IS: 432-1960*, or deformed mild steel bars conforming to *IS: 1139-1959* the minimum allowance for each hook is 9 times the diameter of bar (but in no case less than 75 mm) rounded off to the nearest 5 mm, and works out as follows :-

Diameter of bar	Minimum allowance for each hook	Diameter of bar	Minimum allowance for each hook	Diameter of bar	Minimum allowance for each hook
mm	mm	mm	mm	mm	mm
5	75	16	145	32	290
6	75	20	180	36	325
8	75	22	200	40	360
10	90	25	225	45	405
12	110	28	250	50	450

The same allowance as given above is required for each of the two hooks provided for the purposes of forming binders, stirrups, links and the like.

CALCULATION OF REINFORCEMENT *(contd.)*

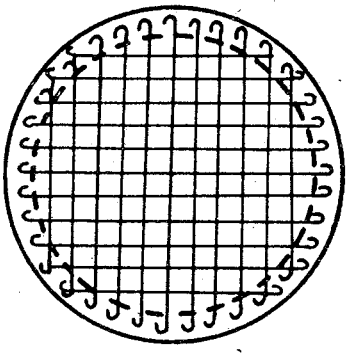
Allowance for Hooks *(contd)*

The minimum allowance for each hook (which in no case shall be less than 75 mm) when using the following categories of steel bars is given below :-

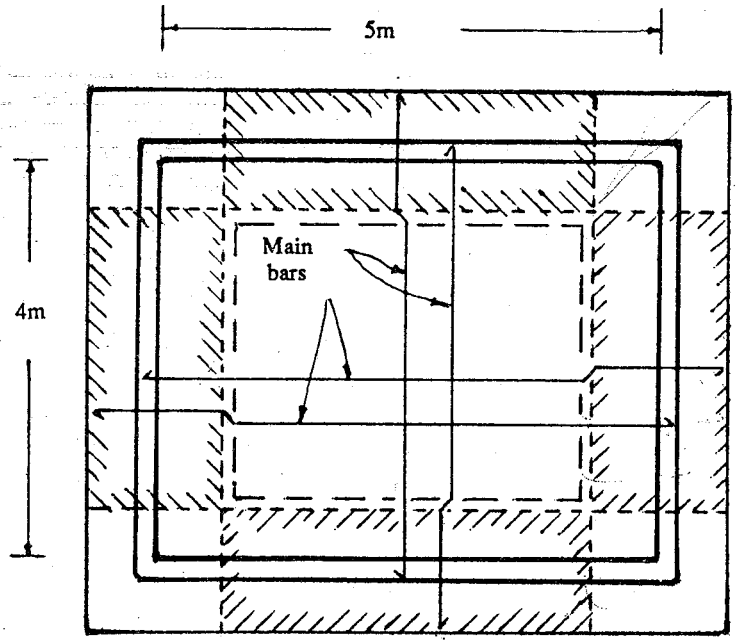
Medium tensile steel (IS:432-1960) or (IS:1139-1959) - 11 times diameter of bar.

Cold twisted steel bars (IS:1786-1961) ... ... - 13 times diameter of bar.

(Reference IS:2502-1963 - Code of practice for bending and fixing of bars for concrete reinforcement)



PLAN - Circular Slab



Two way Reinforced slab

Reinforcement for Circular Slabs

For finding length of bars required (excluding hooks and laps) in a circular flat slab, find out a square of the same area as the circlular slab using formula 59 on page 126 of this book. Total length of bars required for such a square slab (calculated with the same reinforcement and spacing as that of the circular slab) will be same as total length required for the circular slab. Allowance for hooks and laps can be added later on.

The same principle as above can be applied for finding reinforcement required in flat walls and slabs of curved or irregular shapes.

Two Way Reinforced Slabs

In a two way reinforced slab, distribution or temperature bars that may be indicated in the structural drawings are required only for the portion of the main bars taken to the top of the slab after cranking.

In the sketch shown, main reinforcement bars, in the innermost central rectangle (shown by dotted lines) are at bottom in both the directions. No distribution/ temperature/tying bars are needed in this area as the main bars in one direction can be tied to the main bars running at right angle to them.

Similarly, in the four rectangles formed at corners of the slab, main reinforcement bars in both the directions will be available at top as well as at bottom for tying to each other at intersections.

Temperature/distribution/tying bars indicated in the schedule of reinforcement of a two way reinforced slab are therefore required to be calculated only for the four rectangles shown shaded in the sketch, at top, as the bent up portion of main bars need lateral support which is provided by tying up with the temperature/distribution/ tying bars.

In a two-way reinforced slab, depending on the design requirements, other reinforcement like extra bars over support at top, corner bars etc., may be required. These are not shown in the accompanying sketch.

When working out the number of main reinforcement bars required in a slab, at the given centre to centre spacing, it should be remembered that :-

(a) No bars are required to be provided over the support (wall or beam) in the direction parallel to the support. The first bar in the direction parallel to the support is placed at a distance of half the specified centre to centre spacing of the bars.

(b) The number of bars required are calculated by working out the number of spaces and adding one for the end bar.

Binders/Stirrups/Links

(a) Except where otherwise clearly indicated in the drawings, calculation for the number of binders/stirrups/ links in columns should cater for the complete vertical length of the main reinforcement of the column including the portion in footing/pedestal/base and junction with beams.

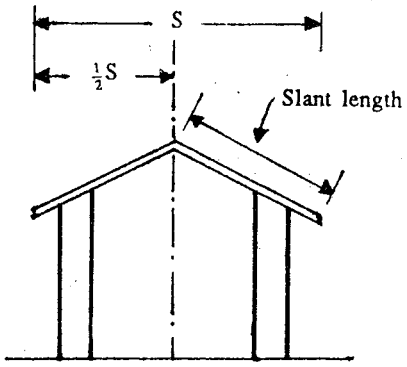
(b) Where a beam is supported on columns, either terminating at, or continuous beyond the column, no stirrups are needed for the portion of main reinforcement of the beam entering or passing through the column.

ESTIMATING DATA FOR ROOF SLOPES, ROAD GRADIENTS ETC.

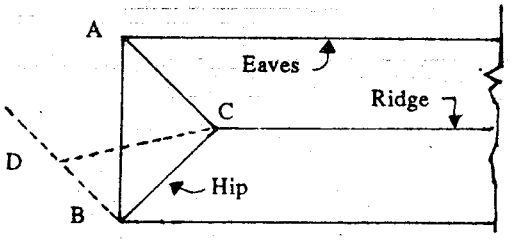
Slope 1 = Height	Angle of inclination = Ø	Value of Natural Sec Ø	Value of Natural Sin Ø	Value of Natural Tan Ø
1 : 1	45° - 00'	1.4142	0.7071	1.0000
1 : $1\frac{1}{2}$	33° - 40'	1.2015	0.5544	0.6661
1 : 2	26° - 34'	1.1181	0.4472	0.5000
1 : $2\frac{1}{4}$	23° - 58'	1.0944	0.4062	0.4444
1 : $2\frac{1}{2}$	21° - 48'	1.0770	0.3714	0.4000
1 : 3	18° - 26'	1.0541	0.3162	0.3333
1 : 4	14° - 02'	1.0307	0.2425	0.2500
1 : 5	11° - 19'	1.0198	0.1962	0.2001
1 : 6	09° - 28'	1.0138	0.1645	0.1667
1 : 7	08° - 08'	1.0102	0.1415	0.1429
1 : 8	07° - 08'	1.0078	0.1242	0.1252
1 : 9	06° - 21'	1.0062	0.1106	0.1113
1 : 10	05° - 43'	1.0050	0.0996	0.1000
1 : 12	04° - 46'	1.0035	0.0831	0.0833
1 : 14	04° - 05'	1.0025	0.0712	0.0714
1 : 15	03° - 49'	1.0022	0.0666'	0.0667
1 : 16	03° - 35'	1.0020	0.0625	0.0627
1 : 18	03° - 11'	1.0015	0.0555	0.0556
1 : 20	02° - 52'	1.0013	0.0500	0.0500
1 : 25	02° - 17'	1.0008	0.0398	0.0400
1 : 30	01° - 55'	1.0006	0.0334	0.0335
1 : 40	01° - 26'	1.0003	0.0250	0.0250
1 : 50	01° - 09'	1.0002	0.0201	0.0200

Remarks

When using the equations given below, take the span of roof equal to clear span between walls (+) thickness of outer walls (+) roof projections on either side.



S = Span



PLAN - Hipped end of roof

If BD is vertical distance between the eaves and the ridge level, then graphically CD represents actual length of the hip rafter CB.

NOTES

Sloping length of Roof

To find the sloping length (slant length) of roof, (for common rafters, barge boards, sheeting, tiling etc) :

Sloping length = Span of roof x Sec Ø

Hip/Valley rafters

To find the actual length of hip/valley rafters (also for ridge tiling over hip or for valley gutters):

Actual length of Hip or Valley = 0.7071 x Span of roof x Sec Ø

Height of Roof, or Rise due to road gradients etc.

To find rise of roof at a given distance from the edge of eaves (or from the inner or outer edge of wall parallel to eaves), OR to find the rise of road of a given gradient at a given distance from starting point :

Rise = Tan Ø x distance.

Sloping Area (or Actual Area) of Roof

Acual Area = Area of Roof on plan x Sec Ø

QUICK METHODS FOR ESTIMATING MATERIAL AND LABOUR REQUIREMENT IN DIFFERENT TYPES OF BUILDINGS

CBRI Roorkee in their Building Research Notes No. 31, 43 and 44 have projected simple statistical relations for quick approximate estimation of the requirement of material and labour for various kinds of buildings for purposes such as budgeting, advance procurement of materials, justification of tenders and computation of cost indices. This information in a slightly concise form is reproduced here, with grateful acknowledgements to CBRI Roorkee.

Statistical Relationships for Residential Buildings (Building Portion Only)

(A = Plinth area of one dwelling in sq m)

Material/Labour	Unit	Statistical Relationships		
		Single Storey	Double Storey	Four Storey
		Load bearing Construction (Including foundation)		RCC Framed Construction (Including foundation)
MATERIAL				
Bricks	100 Nos	2.26A + 66.8	2.15A + 63	$2.56A - 0.0096A^2 - 26.2$
Cement	tonne	0.153A + 0.57	0.145A + 0.54	0.2024A - 0.364
Steel	kg	21.3A - 314	21.97A - 305	$102.46A - 0.401A^2 - 1662$
Sand	cu m	0.47A - 7	0.43A - 5.6	0.397A - 0.38
Coarse Aggregate :-				
(i) 20 mm and down	cu m	0.176A - 0.21	0.178A - 0.21	0.366A - 0.76
(ii) 40 mm and down	cu m	0.145A + 1.5	0.075A + 0.78	$0.0027A + 0.0001A^2 + 0.45$
Brick Aggregate	cu m	0.113A - 0.83	0.056A - 0.42	0.021A + 0.01
Timber for :-				
(i) frames and shutters	cu m	0.019A + 0.23	0.019A + 0.23	0.02A + 0.11
(ii) shuttering	cu m	0.0042A	0.0042A	0.0097A - 0.03
Ballies for formwork	m	0.504A	0.504A	0.936A - 2.35
Lime	q	0.145A - 0.35	0.083A - 0.17	0.063A - 0.08
Surkhi	cu m	0.052A - 0.37	0.026A - 0.18	0.01A
Bitumen	kg	1.836A - 9	0.918A - 4	0.357A + 0.14
Glass panes	sq m	0.047A	0.047A	0.047A
Primer for oil paint	litre	0.048A	0.048A	0.045A + 0.56
Oil paint	litre	0.08A + 0.27	0.08A + 0.27	0.075A + 0.93
Stone rubble	cu m	-	-	0.032A
LABOUR				
Mason	day	1.335A + 28	1.355A + 6	1.593A - 2
Carpenter	day	1.184A - 9	1.194A - 9	1.66A
Painter	day	0.19A	0.19A	0.19A
Blacksmith	day	0.269A - 4	0.274A - 1.4	$1.11A - 0.0043A^2 - 17.6$
Mazdoor	day	4.769A + 32	4.91A + 13	5.833A - 9.2

NOTE : The above relationships are applicable for plinth areas ranging from 30 to 300 sq m in the case of single and double storeyed buildings, and upto 100 sq m for four storeyed framed buildings. Builder's hardware and rainwater goods will have to be added extra, on as required basis.

Services like water supply, plumbing, drains and electrical wiring etc., will have to be added extra. Specifications common for the above three types of buildings are given below, followed by portion of specifications which are not common for the three types.

Common Specifications

Excavation in ordinary soil. Brickwork (traditional) in cement mortar 1:6. Half brick thick walls in cement mortar 1:3 reinforced with hoop iron. Sand filling in plinth. All RCC work in cement concrete 1:2:4, finished on exposed faces with 6 mm thick plaster in cement mortar 1:3. 38 mm thick cement concrete 1:2:4 floor finish, laid on cement concrete 1:5:10 bed in ground floor, but laid directly on RCC slab in upper floors. Timber joinery having 100 x 75 mm frames fixed with m.s. holdfasts, and 38 mm thick shutters, panelled for doors and fully glazed for windows. Wall plaster white washed internally and colourwashed externally. Painting to woodwork and exposed steelwork. Precast RCC in shelves and raised cooking platform. Round steel guard bars for windows. RCC staircase for double storeyed and four storeyed buildings.

Differing Specifications

Specifications which are not common for the three types of residential buildings for which statistical relationships are given on page 33 are indicated below :-

Load bearing single and double storeyed buildings	Four storeyed (RCC famed) buildings
Ordinary strip foundations, with PCC 1:5:10.	RCC coloumn footings on PCC 1:4:8 levelling course.
Waterproofing to roof slab consisting 6 mm thick plaster, bitumen tack coat and 100 mm thick lime concrete terracing.	Same as single/double storeyed buildings, but finished with 40 mm thick concrete topping after laying lime terracing.
Plaster in cement morar 1:6, 12 mm thick on the smooth side of brick walls and 20 mm thick on rough side of wall.	Plaster 12 mm thick in cement mortar 1:4 internally and 20 mm thick externally including neeru finish.
---	Timber cupboard provided.

Statistical Relationships for Office Buildings (Building Portion Only)

(A = Plinth area of all storeys added up, in sq m)

Material/Labour	Unit	Statistical Relationship	Material/Labour	Unit	Statistical Relationship
Cement	tonne	0.1925A + 18.52	Steel windows	sq m	0.1117A + 93.26
Fine sand	cu m	0.03A + 105.50	Glass (for glazing)	sq m	0.1407A + 55.99
Coarse sand	cu m	0.2592A - 80.94	Primer for painting	litre	0.0256A + 9.70
Coarse aggregate :			Oil paint	litre	0.0322A + 7.24
(i) 20 mm size	cu m	0.2728A - 48.50	Lime	q	0.0754A - 51.21
(ii) 10 mm size	cu m	0.1164A - 20.74	Surkhi	cu m	0.0204A - 18.39
(iii) 40 mm size	cu m	0.0151A - 73.91	Marble chips	q	0.1338A - 48.52
Brick ballast	cu m	0.0426A - 38.37	Marble powder	cu m	0.0012A - 0.36
Timber for :					
(i) formwork	cu m	0.0050A + 11.19	**LABOUR**		
(ii) joinery	cu m	0.0024A - 0.53	Mason	day	1.1314A - 407.40
			Carpenter	day	0.7094A + 449.09
Ballies (centering)	m	0.5507A + 797.75	Glazier	day	0.0122A + 10.31
Bricks	100 Nos	1.1829A - 524.23	Painter	day	0.0905A + 37.26
Steel	tonne	0.0479A	Blacksmith	day	0.479A
Flush doors	sq m	0.0636A - 17.07	Mazdoor	day	6.055 A - 2024.37

NOTE : The above relationships are applicable for plinth areas ranging from 1600 to 2600 sq m spread over 4 to 10 storey high office buildings, having average storey height of 3.10 m. The relationships do not include for builder's hardware, waterproofing to top of roof slab, rainwater pipes, and services like water supply, plumbing, drains, sanitary fittings, and electrical wiring. Materials required for scaffolding are excluded. Quantity of steel consists of about 80% deformed reinforcement bars, the rest being round mild steel bars for reinforcement and a small negligible quantity of flat iron holdfasts.

Specifications for the various office buildings considered in working out the above relations are substantially same as those given for four storeyed residential buildings on pages 33 and 34 except that :-

Lean concrete (under RCC cloumn footings) is PCC 1:5:10.

Flooring all over is 40 mm thick marble chips flooring cast-in-situ, consisting 31 mm thick underlayer of PCC 1:2:4, and top layer of 9 mm thick marble chips mixed with marble powder and cement (terrazo cast-in-situ). The marble chips flooring is laid on 100 mm thick PCC 1:5:10 subgrade in ground floor, and on 50 mm thick lime concrete (using brick aggregate) cushioning layer on upper floors.

Dado/skirting consists of 6 mm thick marble chips (terrazo) layer cast-in-situ, on 15 mm thick cement plaster 1:3 backing.

35 mm thick flush door shutters fixed to 100 x 60 mm wooden frames. Holdfasts embedded in PCC 1:3:6 blocks. Windows are standard steel glazed windows. Door/windows finished with oil-paint.

Walls plastered in cement mortar 1:6, 12 mm thick on fair face of brick walls and 20 mm thick on rough face, and given white/colour wash both internally and externally.

Material/Labour for Internal Water Supply and Sanitary Services

(Accomodation built for Government employees considered)

Material/Labour Required per Tenement	Unit	Double Storeyed Residential					Four Storeyed Residential			
		Average Plinth Area per Tenement								
		25 m²	37 m²	55 m²	84 m²	122 m²	42 m²	60 m²	70 m²	112 m²
W.C	Set	1	1	1	2	2	1	1	1	2
Wash basin	Set	-	-	1	1	2	-	-	1	2
Sink	Set	-	-	-	1	1	-	-	1	1
Soil/waste pipe :										
(i) 100 mm dia	m	3.20	4.70	5.80	7.20	8.90	8.10	8.30	8.90	10.40
(ii) 75 mm dia	m	-	-	-	-	-	3.90	4.30	4.40	4.50
(iii) 50 mm dia	m	2.40	3.90	8.20	8.60	18.00	2.80	3.10	3.50	3.90
Cement	tonne	0.21	0.28	0.37	0.37	0.51	0.19	0.24	0.25	0.33
Sand	cu m	0.61	0.84	1.08	1.08	1.41	0.55	0.67	0.74	0.95
Coarse aggregate	cu m	1.03	1.41	1.78	1.78	2.24	0.79	1.12	1.13	1.16
Primer (paint)	litre	0.08	0.14	0.21	0.25	0.43	0.30	0.30	0.32	0.44
Oil paint	litre	2.00	2.70	3.70	4.90	6.90	4.17	4.36	4.94	5.96
Bricks	No.	100	135	215	215	350	130	135	150	180
Holder bats	No.	3.5	5	8.5	9.5	16.5	9	10	11	12
Floor/nahni trap	No.	1	2	3	4	5	2	2	3	5
G.I. Pipes :										
(i) 15 mm dia	m	11.44	10.70	14.00	18.65	38.50	22.40	26.20	30.00	57.00
(ii) 20 mm dia (and above)	m	-	10.43	18.65	21.53	40.00	17.60	23.40	25.00	41.00
Bibcock, 15 mm size	No.	2	3	3	5	6	3	3	4	5
Stopcock, 15 mm size	No.	-	3	3	5	8	2	3	4	5
Stopcock, 20 mm size	No.	-	-	-	-	-	1	1	1	1
PVC connector	No.	-	-	-	1	1	1	1	1	2
Shower rose	No.	1	1	1	2	2	1	1	1	2
Tank 270 litres	No.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	1	1	1	1
SWG pipe 100 mm dia	m	6.71	8.95	9.57	9.68	10.45	4.10	6.60	6.60	10.20
Gully trap	No.	1	1	1.5	1.5	2	0.50	0.50	1	1
Mirror	No.	-	-	-	1	2	-	-	1	2
Towel rail	No.	-	-	-	1	2	-	-	1	2
Labour										
Fitter	day	3.71	5.68	8.63	11.51	18.85	9.90	11.50	13.80	20.60
Mason	day	2.29	3.27	4.87	6.45	8.83	3.60	4.20	6.00	7.80
Painter	day	0.44	0.62	0.79	1.15	1.70	1	1	1	1.80
Mazdoor	day	8.11	11.38	16.34	20.63	30.35	17.60	22.00	24.00	34.60

Material/Labour for Internal Water Supply and Sanitary Services

(Per 100 sq m plinth area of multistoreyed office buildings)

Material	Unit	Qty	Material	Unit	Qty	Material/Labour	Unit	Qty
W.C. Seat/pan	Set	0.33	C.I.bend/junction	No.	1.80	G.I. pipe 32/50 mm size	m	1.50
Wash basin	Set	0.33	SWG pipe 150 mm	m	0.70	Bib cock, 15 mm size	No.	0.50
Mirror, towel rail & soap dish	Set	0.33	Cement	tonne	0.03	Stop cock, 15 mm size	No.	1.20
Urinal	Set	0.33	Sand	cu m	0.08	PVC connector	No.	1.20
100 mm dia soil pipe	m	3.30	Coarse aggregate	cu m	0.14	Fitter	day	3.30
50 mm dia waste pipe	m	2.40	Spun yarn	kg	1.10	Mason	day	1.60
Lead for joints	kg	9.10	G.I. pipe, 15 mm size	m	2.30	Painter	day	0.45
Floor/nahni traps	No.	0.70	G.I. pipe 20/25 mm size	m	2.00	Mazdoor	day	5.00

NOTE : Round up quantities to whole articles where appropriate.

THUMB RULES FOR

CROSS CHECKING ACCURACY OF DETAILED ESTIMATES

Some times it becomes necessary to quickly check the accuracy of a detailed estimate in which some major mistake is suspected. Before they can be rectified, such major mistakes have first to be located, which can be done by applying the following cross checks/thumb rules :-

Excavation and Earthwork

(a) Total quantity excavated must tally with the total quantity of spoil disposed off.

(b) If quantity of earth required for refilling in foundations plus earth for filling under floors exceeds quantity excavated, check whether winning extra earth or murrum has been measured.

Concrete

Ratio of depth of the concrete bed in foundations to the depth of foundation trench should work our nearly same as the ratio of cubic contents of concrete in foundations to the cubic contents of excavation in trenches for foundations.

Reinforced Concrete

The ratio of total cubic contents of reinforced concrete to the total weight of reinforcement should be worked out, and checked with the following data :-

(i) In residential buildings *without* full-length verandahs and so involving only occasional verandah columns/ bressumur beams, and with load-bearing walls, where the cubic contents of concrete consists mainly of slabs, the ratio works out to 0.70 to 0.85 quintals per cu m of concrete.

(ii) In buildings with load-bearing walls roofed over with RCC slabs, with full-length verandahs roofed over with RCC slabs and supporting RCC verandah bressumur beams and RCC verandah columns (usually as in office/technical accommodation/Admin blocks/single men's hostels or barracks etc.) the ratio usually works out to 0.90 to 1.10 quintals of reinforcement for every cu m of concrete. (The proportion of steel increases on account of the more number of beams and columns involved).

(iii) In framed structures the ratio will be about 1.15 to 1.40 quintals of reinforcement for every cu m of concrete. The lesser proportion of reinforcement will be obtained where sheer wall method is adopted in the design.

If it can be checked, the ratio of reinforcement : concrete, separately for beams, lintels, columns, slabs etc. should be worked out. These ratios can be checked with those given for reinforcement in various situations and structural members on page 97 of this book.

Formwork

Reinforced concrete in various situations, on an average requires the following quantities of formwork. (Requirement of formwork varies widely with the sections of concrete, and hence the following should be taken as a rough indication only) :-

Columns

Footings only	:	$\frac{3}{4}$ to 2 sq m per cu m of concrete.
20 x 20 cm column shafts	:	20 sq m per cu m of concrete.
20 x 38 cm column shafts	:	15 sq m per cu m of concrete.
Overall (For single storey construction)	:	4 to 6 sq m per cu m of concrete

Beams	**In brick construction**	
(Sides and soffits)	(Average 20 x 20 cm beams, with occasional large beams)	
Rectangular beams	:	14 to 16 sq m per cu m of concrete.
Tee beams	:	18 to 20 sq m per cu m of concrete.

Beams		**In stone construction**
		(Average 25 cm deep 38 cm wide beams with occasional large beams)
Rectangular beams	:	9 to 11 sq m per cu m of concrete.
Tee beams	:	10 to 12 sq m per cu m of concrete.
Lintels		**In brick construction**
Average 20 x 15 cm section	:	15 sq m per cu m of concrete.
Average 20 x 10 cm section	:	18 sq m per cu m of concrete.
		In stone construction
Average 38 x 15 cm section	:	10 sq m per cu m of concrete.

Slabs
Varies from 8 sq m per cu m to 9 sq m per cu m for 11 cm thick slab. With larger thickness of slab lesser form work per cu m of concrete will be required. Also with more thickness of walls or more number of cross-walls lesser quantity of formwork will be required per cu m of concrete in slab.

Staircases		
Anchor beam	:	10 sq m per cu m of concrete.
Flight (with 13 cm waist), including soffit, edge of waist, ends of steps and faces of risers	:	9 sq m per cu m of concrete.
Parapet (10 cm thick)	:	20 to 21 sq m per cu m of concrete.
Landing beam	:	9 to 10 sq m per cu m of concrete.
Landing slab (11 cm thick)	:	8 sq m per cu m of concrete.
Overall for staircase	:	11 to 12 sq m per cu m of concrete.
Chajjas		
(9 cm average thickness)	:	14 to 15 sq m per cu m of concrete.
RCC boxes		
(45 cm projecting, 5 cm thick)	:	26 sq m per cu m of concrete for stone walling, and 30 sq m per cu m of concrete for brick walling.

In a complete residential building of traditional design, with load bearing walls, the total form work required varies from 9 to 11 sq m per cu m of concrete for stone construction, and from 10 to 12 sq m per cu m of concrete for brick construction.

A mistake most commonly liable to be committed is that in the measurement of formwork and concrete for Tee beams. Depth of Tee beams indicated in drawings is (usually) inclusive of thickness of slabs. As slabs are measured overall, depth of Tee beams should be measured exclusive of the thickness of slabs, both for concrete and formwork.

Brickwork / stone masonry

A rough estimate of brickwork / masonry required in a building can be made from the following information :-

In Residential Buildings

With 20 cm thick brick walls throughout	Area covered by walls is about 16 to 17% of the plinth area.
With 30 cm thick external brick walls and 20 cm thick internal walls.	Area covered by walls is about 20% of the plinth area.
With 38 cm thick external stone walls and 20 cm thick internal cross walls.	Area covered by walls is about 22 to 24% of the plinth area.
With 38 cm thick stone walls throughout.	Area covered by walls is about 26 to 30% of the plinth area.

In two buildings of identical design, with sizes, location and disposition of rooms same, (i.e. floor area of rooms is same), but one with stone construction and the other with brick construction, then, the plinth area of the building with stone construction will be larger by 16% as compared to that with brick construction.

Flooring

Rough check on the accuracy of floor area can be exercised by using the details given under brickwork/stone masonry above. For this purpose areas of the different types of floor finishes should be added up.

Where flooring in different storeys has been separately measured/abstracted, this may provide another useful cross check. Total floor areas in different storeys will tend to be nearly same if overall dimensions of the upper storeys are not changed.

Plastering etc.

For checking quantity of internal plaster add up lengths of internal cross walls and external walls separately, after which area of internal plaster can be found as follows :-

(Length of external walls + twice the total length of internal cross walls) x room height.

From the above quantity the major deductions for doors, windows, dados (terrazo, glazed tiling etc.) should be made for comparing with quantity of plaster worked out in the detailed estimate.

Areas of costlier varieties of dados and skirtings (terrazo, glazed tiling etc.) should be measured in detail.

Roof covering

For pitched roofs, area of roof covering can be checked by applying constants given on page 32 of this book.

In the case of water proofing to top of roof, check up whether area of water proofing required for upturns and tucking in at parapet walls (if any) has been measured. Quantity required on this account may sometimes turn out to be quite large.

External painting/plastering/finishing

Add up length of external wall faces and multiply by the height, from which deduct openings etc.

White/colourwashing

Area will be same as internal/external plaster.

Also check up whether whitewash to soffits has been measured, the quantity for which should approximately be equal to formwork to soffits. Whitewash to sides of roof beams and soffits of beams and staircases and chajjas should be added.

Spot items

A list of some of the spot items and situations most likely to be forgotton by the taker-off of a detailed estimate are given below :-

Ramps, plinth protection, open platforms and steps.

Drop walls in verandahs and above large openings including lintels for the same, also internal gable walls.

Parapet walls above roof level, and chimney flues etc.

Loft slabs and shelves.

Plaster/pointing to inner faces of walls enclosing lofts; internal gable walls above ceiling level; inner faces of sanitary shafts; and parapets above roof level.

Hip and valley rafters, valley gutters, aprons and flashings to chimney flues and other abutments such as parapets etc., in roof.

Bed blocks for fixing purlins and hip/valley rafters.

Pelmet boxes.

Water storage tank above lavatories.

NOTE :— *The list of crosschecks given above is by no means complete, and the suggestions may appear rather simple and obvious. These crosschecks are given here with the intention of suggesting as to how a detailed estimate may be checked in limited time available. Further crosschecks may be thought up and added to this list.*

ANALYSIS OF PRICES

Elements of builder's costs

Rates quoted by a builder have to cater for the following :-

Basic costs	Indirect costs
Materials,	Overheads,
Labour,	Establishment charges,
Tools and plant.	Profit.

Materials

Cost of materials will include the price charged by suppliers, transportation/haulage to site of work, unloading and storing. Allowance has also to be made for waste, pilferage, breakages, offcuts due to nonstandard sizes specified, depreciaton due to bad storage, returning empty cases, compaction/loss in bulk, and for cash/trade discounts available. Another important consideration will be payments on account of state/interstate sales tax, octroi, custom duty, royalty and the like.

Labour

Requirement of labour can be met with by the builder either by entering into agreements with labour sub-contractors by negotiating net rates payable per unit of each different item of work or getting work executed by directly employed labour, or by a judicious mixture of the two methods.

The system of labour subcontractors is usually found to be cost-time effective, but may tend to compromise on the aspect of quality. Reputed builders usually opt to execute important activities like curing of concrete etc., and 'finishing items' of work through directly employed labourers and the remaining bulk of work through labour subcontractors.

Due allowance as applicable has to be made for idle/travelling time, overtime, holidays with pay, attendance on Regional Labour Commissioner, compliance with provisions of labour compensation act and other labour regulations, minimum fair wages, irrecoverable advance payments to labourers, and the like.

In situations where labour has to be imported, aspects like fares, paid leave, increments in scales, medical attention, free messing/living accomodation, visa, passport, airport fees etc., may also come into play.

The element of labour in the basic rate therefore, is not calculated on the actual wages paid but on a previously worked out 'all-in' rate for each category of labourer/artisan or item of work giving judicious weightage to all the factors mentioned above.

Tools plant and machinery

Plant used on site is subdevided into :-

(a) Plant used for specific items of work which enables charging cost of its use to the basic rates of a particular item of work like brickwork, concrete etc.

(b) Plant like cranes, hoists, scaffolding etc., the cost of which cannot be broken down and allocated to individual items of work, and therefore has to be accounted for in the overheads.

Cost of plant has to include for **'standing charges'** consisting of interest on capital outlay and depreciation to cater for replacement cost, maintenance and repairs, **'running costs'** consisting of fuel, oil, lubricants and the operator's pay, and **'variable costs'** consisting of setting up the plant, temporary site work required in connection with use of the plant, shifting locations etc.

Overheads

Overhead charges denote expenses incurred for a particular job/site by the builder but which cannot be conveniently included in the basic cost of specific items of work such as brickwork etc.

Overhead charges are subdivided into **'fixed'** or **'one-time'** overheads and **'variable'** or **'time related'** overheads.

Fixed or one-time overhead charges should include for all costs incurred in the initial setting up of an efficiently operating work site, such as providing temporary site-offices, storage sheds, labour camp, canteen, ablution places, fencing, approach roads, mixing/casting platforms, water tanks, curing tanks, obtaining telephone/electrical/water connections and for demolishing and clearing all these temporary site works on completion. All expenses in connection with shifting tools, plant, machinery, and fares paid to employees for shifting to the new site are also treated as fixed one-time overhead charges.

Overheads (continued)

Variable or time related overhead charges should include for finance charges on the rolling capital employed (or loans/overdrafts from Banks) which will remain locked up during the period of construction and the amount of security deposit until the end of defects liability period, site office expenses like salaries of engineers, supervisors, timekeepers, clerk, cashier, watchmen, storekeepers, drivers of jeeps/staff bus, stationery, postage, telephone/electricity/water bills, tea and refreshments served at site, maintenance of site offices including furniture/equipment put up for builder's employees as well as for supervising agencies working on behalf of the employer, repair and upkeep of all temporary works like mixing/casting platforms, storage sheds, water/curing tanks, approach roads, fencing, labour camp, canteen, ablution places, petrol/oil/ lubricants for jeeps, staff-bus, and pumps for pumping construction water, rents for hired accomodation if any, and similar other expenses.

Owning and using costs or hire charges on general plant like cranes/hoists/scaffolding, pump for pumping construction water and the like will also figure in the variable or time related overheads.

Maintaining a skeleton team of workers and supervisor for attending to defects cropping up during the defects liability period, may, depending on preference of the builder, be included either as a time related overhead or assessed on lump sum basis and included in the fixed or one-time overhead charges.

The following items should not be lost sight of when toting up the overhead expenses :-

(a) Turnover tax, Income tax, and Sales tax (if the law requires the work to be treated as a finished article sold by builder to the employer) as applicable.

(b) In tendering for works for which an impossibly short period of completion coupled with penalty or preassessed liquidated damages are stipulated, the builder may have to reluctantly work out the likely penalty/damages in advance and include them in the overheads.

(c) Builders being a pragmatic community may also have to accept facts of life and allow for the likely expenses on entertaining and any inevitable extent of 'greasing' of officials in the employer's organisation.

Establishment Charges

Expenses incurred on running the permanent head office of the builder's firm (as distinct from the site office meant for a particular job) are termed as establishment charges.

Establishment charges include salaries of head office clerical staff like clerks, secretary and cashier, low grade employees like peons, messengers, drivers of office cars, attendants, cleaners etc., specialist staff like accountant, estimator/ quantity surveyor for working out tenders, and administrative staff like Directors (fee/salary as applicable) or working partners (their salary being distinct from share in net profit). Other incidental expenses incurred by the head office establishment are telex/telephone/electricity/water bills/stationery, postage, depreciation of office furniture and equipment like computers/telex machines/typerwriters etc., rent/repairs of office premises, theft/fire insurance, legal fees to lawyers and professional fees paid to chartered accountants and consultants.

The percentage addition for establishment charges to be made in each tender submitted by the firm is decided by comparing the annual turnover of the firm during the previous year with the total expenses of the head office during the previous year.

Profit

Simply stated, profit to a builder, similar to any other commercial transaction, is the difference between the all-inclusive construction cost and the contract amount paid by the employer.

Building contracts provide for interim or on-account payments at fixed intervals of a month (or less). The rolling capital required by the builder on a particular job therefore is only a fraction of the total contract amount. The net profit in a building contract may be (say) only 10% but the return on the rolling capital employed can turn out to be as large as 120% per annum, or even more. (As an example consider a contract for Rs. 60 Lacs to be completed in 12 months, with stipulation for monthly on-account payments. If the tender allows for 10% profit, the yield on the initial rolling capital of about 5 Lacs inclusive of the cost of site mobilisation will be Rs.6 Lacs or 120% per annum.)

Any extent of care exercised in working out the legitimate costs involved in a work cannot neutralize risk elements like meeting unfavourable strata in foundations, inclement weather, strikes, labour and political unrest, or for that matter the gravest risk of the owner (employer) going bankrupt half way through. The percentage mark-up for profit by the builder is therefore considered as inclusive of the risk elements.

Competition

Keen competition by a builder for a particular tender may consist of allowing for a lesser percentage of profit, which however has obvious limitations. Keen competition is therefore synonymous with extra care and meticulous working out of the costs involved so as to reduce the element of risk margin required to be built up in the tendered amount.

WORKING UP AND SUBMISSION OF TENDERS

To survive and succeed in his profession a builder has to compete with others in getting works awarded to him at a reasonable margin of profit. Time allowed for submission of tenders is usually so short that to meet the tender deadline a well laid out drill and considerable effort and planning is required.

On an average, a well established builder may have to compete and quote for about 6 to 10 jobs before he 'lands' one. The 'success ratio' ranging from 1 in 6 to 1 in 10 may go down to as low as 1 in 20 during difficult times and recession.

The tendering team of a builder's organisation has to keep a lot of information, references, standard catalogues and prices, ' where to buy what' lists etc., ready at hand and also a few dependable subcontractors of each discipline prepared to work for the builder, from whom quotations can be obtained at short notice. Feedbacks from supervisors of on-going jobs on actual costs of various items of work are obtained, carefully monitored/compared and kept on record for reference.

STEPS IN WORKING OUT A TENDER

Assuming that 42 days (6 weeks) are available for preparing the quotation, the various steps leading to submission of a tender by the builder would consist of :-

Days/Chronology	Event
0	Enquiries/application for and receipt of blank tender documents.
Day No 1 to 3	Initial reading through of documents, perusal of drawings and decision to compete.
Day No 4 to 31	Working out detailed quantities in the case of lump sum tenders (bill of quantities being usually not supplied in Indian tendering practice) either 'in-house' or as a 'farmed out' job. This activity is always critical when quoting for lump sum tenders.
Day No 4 to 20	Careful reading through of documents, despatch of inquiries and receipt of quotations from subcontractors for electrical/water supply/plumbing items etc., and from suppliers of building materials/ proprietory articles.
Day No 6 to 10	Prepare check-list of items of information to be collected. Visit to the site of work and to the agency supervising the work on behalf of the owner/employer. Assessing the nature/extent and cost of all site mobilisation work like approach roads, fencing, site offices etc., that will be needed. Assessing extent of competition that will be encountered. Discrete enquiry about the soundness of the owner/employer and his capacity to pay ensuring regular interim payments and cash flow.
Day No 10 to 20	Decision on construction methods, programming of work and relating these to the time allowed in the tender for completion of the work on ground. Drawing up of network if required to be submitted along with the tender.
Day No 21 to 25	Assessing cost of overheads of fixed as well as time related nature.
Day No 26 to 31	Work out basic unit rates (exclusive of overheads/establishment charges/profit) for all items of work in readiness for pricing the detailed quantities. It is a good policy to work out basic unit rates independantly for each job.
Day No 32 to 38	Pricing the worked out quantities at the basic unit rates and striking a total. This total when compared with the total cost of overheads for the job in question yields the percentage mark-up of the basic unit rates to cater for overheads.
Day No 39 to 40	Establishment charges (or head office charges) expressed as a percentage for a particular builder usually remain constant for all jobs. A policy decision about the percentage of profit is made for each job depending on the size/type/nature of job, risk factors involved and the extent of urgency to secure work. Rate to be quoted for each item of work in the bill of quantities will be :- Basic unit rate + overheads, establishment charges and profit together expressed as a percentage.*
Day No 41	The blank tender documents are neatly filled up, signed and stamped. Accompanying documents like forwarding letter, instruments of earnest money, programme of work, cash flow requirements/stage payment schedules etc., typed and kept ready.
Day No 42	Submission of tender.

* **NOTE** : Most Government departments consider 5% overheads, 2.5% establishment charges and 10% profits totalling up to a mark-up of 17.5% on basic costs as reasonable. Builders however have their own opinion about these mark-ups and these vary from one builder to another. Establishment charges, for example, could be as low as 0.5% for single entreprenuers. When quoting for jobs in the vicinity of a work-in-hand with the builder the overheads would be lower than jobs in new stations. The percentage of profit allowed for could be lower for jobs of large magnitude. Overheads and establishment charges are highest in the case of a public limited concern, followed by private limited companies, multi-partnership concerns and single proprietorship concerns in a descending order.

WORKING OUT UNIT RATES

Working out unit rates for various items of work for the purpose of submitting tenders and for assessing the reasonability of rates quoted by others, at all levels i.e. the employer/owner's supervising agency, consultants, architects, builders, subcontractors etc., needs to be done with due care in a systematic and methodical manner. Adhocism, guesswork or reliance on rates projected by others may lead to grave consequences. Unit rates should be based on well established and tested constants compiled from actual observations at site duly co-related and checked by theoretical calculations.

Average constants for requirement of materials per unit of various items of work and for output of labour/machinery/plant/transport etc., are given in this book. Example illustrating the method of working out rate is given below using market rates prevailing in Pune urban area for work in private sector, during January 1990.

Item of work : **Cement concrete 1:2:4 using 20 mm graded coarse aggregate in reinforced suspended floor slabs (excluding formwork and reinforcement).**

Unit : **Per cubic metre.**

Note : Rate for concrete work is usually calculated in two stages. The basic rate for concrete mixed and delivered on banker is first worked out. The cost of conveying, pouring, vibrating/consolidating, finishing and curing the concrete in the particular situation (i.e. slab, column, beam, chajja, lintel, foundations etc.,) is then added to it.

I CONCRETE DELIVERED ON BANKER

Materials (at market rates inclusive of delivery to site of work)			**Rs.**	**Rs.**
Cement	: 308.53 kg i/c wastage	@ Rs. 1.60 per kg		= 493.65
Coarse aggregate	: 0.88 cu m	@ Rs.150.00 per cu m	= 132.00	
Sand	: 0.44 cu m	@ Rs.140.00 per cu m	= 61.60	
		Cost of coarse aggregate and sand	= 193.60	
		Add for 2.5% wastage on coarse aggregate and sand	= 4.84	
		Cost of coarse aggregate and sand	= 198.44	198.44
		Cost of materials		= 692.09
Labour and plant (at calculated 'all-in' wages)				
Mazdoor	: 0.50 day	@ Rs. 30.00 per day	= 15.00	
Bhisti	: 0.10 day	@ Rs. 35.00 per day	= 3.50	
Hire of mixer machine including operator's pay and diesel etc.,	: 0.07 day	@ Rs.425.00 per day	= 29.75	
Daily allowance payable to mixer operator	: 0.07 day	@ Rs. 25.00 per day	= 1.75	
		Cost of labour and plant	= 50.00	50.00
		Cost of concrete delivered on banker	=	742.09

II CONVEYING, POURING, VIBRATING, FINISHING AND CURING CONCRETE IN SLABS

Labour and plant (at calculated 'all-in' wages)				
Mason	: 0.24 day	@ Rs. 80.00 per day	= 19.20	
Mazdoor	: 2.00 days	@ Rs. 30.00 per day	= 60.00	
Bhisti	: 0.80 day	@ Rs. 35.00 per day	= 28.00	
Hire of vibrator including operator's pay etc.,	: 0.07 day	@ Rs.100.00 per day	= 7.00	
Daily allowance payable to operator of vibrator m/c	: 0.07 day	@ Rs. 20.00 per day	= 1.40	
		Add lump sum for scaffold/ramp for conveying concrete	= 5.00	
		Cost of conveying/pouring/vibrating/finishing and curing	= 120.60	120.60
		Total basic rate		= 862.69
		Add for overhead expenses (@ 5% of basic rate)		= 43.13
		Add for establishment charges (@ 2.5% of basic rate)		= 21.56
		Total costs		= 927.38
		Add for 10% profit		= 92.74
		Rate to be quoted		=1020.12

Rounded off to Rs.1020/- per cubic metre.

WORKING-COSTS OF TOOLS AND PLANT

Working cost of plant is made up of :-

(a) Standing cost (This may also be termed as 'owning cost')
(b) Operating cost

STANDING COST

For working out the standing cost of plant it is best to use the simplest method available, this being the 'straight line method', which is illustrated by an example given below :-

Capital cost (or purchase price) of a ten tonne truck	=	Rs. 5 lacs
Expected efficient running life is 5 years		
Credit for estimated residual (resale) value at the end of 5 years	=	Rs. 2 lacs
		Rs. 3 lacs
Standing (or owning) cost per annum Rs. 3 lacs ÷ 5 years	=	Rs. 60,000 per annum.
Allowing for 52 weekly holidays, 12 other holidays and 25 days for maintenance, the number of average working days may be taken as 275 per year.		
Standing cost per working day, Rs. 60,000 ÷ 275	=	Say Rs. 220 per day.

The straight line method assumes that profits from use of the plant pay for the interest on the capital costs.

OPERATING COST

The operating cost of plant will have to include for cost of fuel, lubricating oil and grease; maintenance, repair, spares, and renewal of tyres; insurance and licence fees in connection with use of the plant, if any; and the operator's (and/or attendant's) pay. The total operating costs (on the basis of the working days) per year are worked out, and these devided by the number of working days yield the operating cost of the plant per day.

Operating cost should be worked out from records maintained for each different type of plant. Information in the table below may be taken as indicative. The average plant working days per year are worked out on the assumption that the plant works for 8 hours per working day, and also take into account that some types of plant usually remain idle during certain part of the year.

Type of plant	Fuel used	Cost of repairs and renewals per year as a percentage of capital cost of plant	Estimated		Consumption per working day of eight hours		
			Average working days per year	Years of life of the plant (for efficient economical running)	Fuel Diesel/ Petrol as applicable (litres)	Lubricating oil (litres)	Grease in kg
Angledozers and bulldozers (D4)	Diesel	10 %	200	5	66	1.40	0.18
Concrete mixer (10/7 capacity)	Diesel	7.5%	225	7	15	0.55	0.14
Concrete mixer (10/7 capacity)	Petrol	10 %	225	6	26	0.55	0.14
Compressor, 60 cu m per minute	Diesel	10 %	200	5	26	0.65	0.14
Compressor, 60 cu m per minute	Petrol	15 %	200	3	46	0.65	0.14
Crane, 0.6 to 0.7 tonne	Petrol	12 %	185	6	50	1.10	0.14
Dumpers and trucks	Diesel	17 % *	275	5	Varies with size etc.		
Dumpers and trucks	Petrol	20 % *	275	4	Varies with size etc.		
Hoist	Petrol	10 %	185	6	26	0.70	0.14
Mechanical trenching plant	Diesel	10 %	225	7	Varies with size etc.		
Pumps, 75 mm	Petrol	12 %	150	6	18	0.70	0.03
Pumps, 100 mm	Petrol	12 %	150	6	24	1.10	0.07
Rollers, 6 to 8 tonnes	Diesel	7.5%	225	8	32	1.10	0.20
Rollers, 10 tonne	Diesel	7.5%	225	8	47	1.45	0.25

* Includes renewal of tyres.

HIRE CHARGES

If the plant is considered for hiring out to third parties, the build-up for hire charges should be worked out as follows :-

(a) Standing cost per year worked out as explained above + (b) Interest on capital outlay at bank rate + (c) Cost of repairs and renewals per year + (d) Salary of operator (and/or attendant) per year.

The sum of (a) to (d) devided by the number of average working days per year will yeild the basic hire charge per day. To this, depending on the terms of the hire agreement the cost of fuel/oil/lubricants will have to be added. On the net figure so arrived at, a further addition of 10% for profits would seem reasonable. On the above basis the hire charges per day for a 10 tonne truck work out in the region of Rs. 1600 per day, inclusive of fuel, oil and lubricants; and driver/attendant's pay, etc.

OUTPUT OF TOOLS AND PLANT

TRANSPORTATION

Output of vehicles for transportation of materials depends on :-

(a) Carrying capacity of vehicles by weight or volume, whichever is critical.
(b) Distance to be travelled.
(c) Time taken in loading and in unloading.
(d) Idle time in waiting for turn at loading and unloading point, where applicable.
(e) Time lost in payment, documentation and checking at loading and unloading points and at octroi and check posts, if any.
(f) Average speed of vehicle depending on the condition of road, vehicle and traffic.

The carrying space in a ten tonne truck measures approximately 14' - 7" x 7' - 3" x 1' - 10" (height of tailboard), which for all practical purposes of calculations is taken as 185 cft or 5.3 cu m.

Average speed of trucks may be taken as 25 kmph. The speed will work out lesser for short trips and may go up to about 35 to 40 kmph for long distances to be travelled on open roads.

Time required for loading and unloading of various building materials using manual labour is given in the table below.

LOADING / UNLOADING TIME

Capacity of a ten tonner truck	Materials handled	Unit	Time to be allowed (per unit) in minutes			
			Loading		Unloading	
			Ideal strength of labour gang to be employed	Time in minutes	Ideal Strength of labour gang to be employed	Time in minutes
5.3 cu m	Earth, murrum, sand, coarse aggregate etc.	per cu m	5	9	2	3
5.3 cu m	Random rubble stones and boulders	per cu m	5	8	3	3
3000 Nos	Bricks	1000 Nos	6	30	6	15
10 tonne	Reinforcement bars, loose.	per tonne	6	12	6	9
10 tonne	-Ditto- in coils or in bundles	per tonne	6	6	4	4
10 tonne	Cement in bags	per tonne	3	4	3	4
3000 Nos	Flooring tiles, of 20 x 20 cm size	1000 Nos	6	30	6	20
14 cu m	Timber in cut sizes	per cu m	6	10	6	7
5.5 cu m	Miscellaneous stores	per cu m	6	10	6	10

Time required per round trip of truck in *minutes* $= t + \frac{120\,D}{S}$

Number of trips to be done by a truck per day $= \frac{H}{\frac{2\,D}{S} + \frac{t}{60}}$

Where :-

t = Time taken in minutes for loading + time taken in minutes for unloading + average time lost in minutes per trip for payment, documentation, checking, octroi, toll posts etc., as applicable.
D = One way distance in km.
H = Number of hours of work per day.
S = Speed of truck in km per hour.

Efficient loading using chutes or machine operated shovels for loading, and unloading by tipper trucks/dumpers for materials like earth, sand, shingle, aggregate, boulders, stones etc., requires about 4 minutes per vehicle for loading and 3 minutes per vehicle for unloading, inclusive of manouvring the vehicle in position.

Regional transport authorities allow 6 labourers to travel along with the truck for loading and unloading purposes. Where a very large quantity of materials is to be moved employing several trucks, separate stationery gangs at the loading and unloading points can be employed, leading to economy.

When checking back on the number of kilometres done suitable allowance should be made for the movement of vehicle from its place of parking to duty and back, (say 6 km/day on an average).

Carrying capacity of a two-bullock cart may be taken as 1.25 cu m or 1 tonne travelling at a speed of about 3 to 4 km per hour.

DRILLING HOLES IN ROCK FOR BLASTING

Hand (manual) Drilling

Hand drilling is suitable when total quantity of rock to be removed is small. Where the depth of cut requires holes not more than 35 cm deep, single hand drilling is suitable. For deeper vertically bored holes in fairly homogeneous rocks churn drilling is considered more economical. For seamy rocks and conglomorates, and for horizontal or inclined bores a three-man jumper drill is used.

Information set out in the table below should be taken as indicative, and any corrections to it required by actual observations at site recorded for future use.

Type of rock etc.	Manual hand-drilling		
	Requirement of man-days per metre depth		Days of forging unit with a blacksmith and helper for sharpening and pointing drills per metre depth
	Single hand drill (19 to 20 mm dia hole) OR Churn drill for 40 to 45 mm dia hole	3 man jumper drill	
1. Lime stone	0.50	0.75	0.011
2. Granite or Gneiss	0.55	0.80	0.012
3. Hornblende	0.70	1.00	0.016
4. Trap and Basalt	0.75	1.00	0.017
5. Sandstone (and hard old cement concrete)	0.80	1.25	0.019
6. Quartz	1.00	1.60	0.023

Machine Drilling

The average output per drilling machine and drill operator depends on the depth to be drilled per hole. More time per metre depth is required for lesser depths of holes due to time taken in moving and resetting the machine, pumping out hole, changing the drills etc. Air compressor time required will depend on the number of drilling machines operated from a single compressor unit. It is rarely that full capacity of the compressor unit can be fully utilised unless cutting trenches is involved.

Allowance for time of forging unit with blacksmith and helper for pointing and sharpening drills will be required at the same scale as indicated above for manual drilling, when using information set out below for machine drilling.

Type of rock etc.	Machine drilling						
	Days of drilling machine and operator per metre of hole						
	Average depth of each individual hole in centimetres						
	30	60	90	150	300	450	600
1. Lime stone	0.08	0.05	0.05	0.04	0.03	0.03	0.02
2. Granite or Gneiss	0.09	0.06	0.05	0.05	0.04	0.03	0.03
3. Hornblende	0.09	0.07	0.05	0.05	0.04	0.04	0.03
4. Trap and Basalt	0.09	0.07	0.06	0.05	0.05	0.04	0.04
5. Sandstone (and hard old cement concrete)	0.10	0.07	0.06	0.05	0.05	0.05	0.04
6. Quartz	0.12	0.10	0.09	0.07	0.06	0.06	0.05

The number of holes required to be drilled in blasting operations depends on the depth of rock that needs to be taken out or permissible considering safety aspects. Generally holes are drilled at a distance behind the face of ledge not more than three-fourths of the height of face to be taken out. Holes are spaced at a uniform distance apart. Spacing of holes for estimating purposes may be assumed as1.33 m for Gneiss, 1.66 m for Trap, Basalt or Granite, and 2.66 m for Limestone. To allow for any undulations in ground the actual depth of holes should be assumed as about 0.20 m more than estimated depth of each hole.

Breaking out Brickwork, Concrete, Hard Road Surface etc., Using Pneumatic Tools

Description of surface	Unit	Time in days of :-		Remarks
		Compressor with two pneumatic tools	Operator	
Breaking out brickwork	cu m	0.04	0.08	Operator time does not include for any removal of debris.
Breaking out concrete	cu m	0.35	0.70	
Tar-road crust 150 m	10 sq m	0.15	0.30	

CONCRETE MIXERS

Machine mixing is better qualitywise and cheaper than handmixing when concrete is required in quantities in excess of 20 cubic metres in one stretch.

Capacity of a concrete mixing machine is indicated by a system of double numbers, such as 7/5 (or 10/7, 14/10, 21/14 etc.,) denoting capacity per batch in cubic feet of dry and wet mix, eg. a mixer capacity of 10/7 signifies that per batch it will accept 10 cubic feet of dry ingredients of concrete which when mixed with appropriate quantity of water will produce 7 cubic feet of wet concrete ready for placing in position.

With the advent of metric system, Indian manufacturers of construction machinery have started expressing dry/wet mix capacity of concrete mixers in litres such as 400/300 (in place of 14/10), 300/210 or 280/200 (in place of 10/7) etc. When the capacity of concrete mixer is expressed by a single number such as 300 it denotes volume of wet mix produced per batch in litres. Some manufacturers have also started expressing capacity of concrete mixers in cubic metres such as .20/.14 (in place of 7/5) which seems to be more appropriate and preferable as concrete is measured in cubic metres and not in litres.

Concrete mixers normally cater for an overload of about 10% over their rated capacity when needed to allow for use of full (ie. avoiding fractions) number of 50 kg cement bags to be used per batch.

Suffixes using alphabets appended to the stated capacity denote the type of mixer, eg. HF for hand fed, BL for batch loading type, T for tilting, NT for non-tilting, RD for reversible drum, etc.

Concrete mixers are mostly diesel driven or electrically driven, petrol driven kind having slowly gone out of vogue. Builders who restrict their operations to particular urban areas would prefer the electrically driven varieties, while others will opt for the diesel driven kind.

Information set out in the table below for various sizes of concrete mixing machines will be of use if facility for weighing cement required for each batch is available, enabling use of full rated capacity of the machine.

Particulars	Capacity of Concrete Mixing Machine					
	5/3.5	7/5	10/7	14/10	18/12	21/14
Batch output in cu m (yield)	0.10	0.14	0.20	0.28	0.34	0.40
No. of batches per cubic metre	10	7.14	5	3.57	2.94	2.50
Time in minutes/cubic metre (based on 3 minutes/cycle)	30	21.42	15	10.71	8.82	7.50
Output in cu m per hour	2.00	2.80	4.00	5.60	6.80	8.00

Where batching is done by volume, the capacity of the concrete mixer chosen should be such that it will consume one or more *whole* bags of 50 kg cement per batch. The table given below should be referred to for output of concrete mixers, quantities of sand and coarse aggregate per batch etc., where batching is done by volume. It will be noted that where batching is done by volume the requirement of using whole bags of cement per batch precludes full use of the rated capacity of the mixer. As major quantity of concrete work is of 1:2:4 proportion the most preferred size of concrete mixer is of 10/7 capacity (using one bag per batch) for normal building operations, and of 21/14 capacity (using two bags of cement per batch) for comparatively larger quantities of concrete.

Nominal mix mix by volume	Minimum size of mixer to use-up one 50 kg bag of cement	Yield of wet concrete per batch using one cement bag of 50 kg	Aggregate per batch using one 50 kg bag of cement		No. of batches per cu m	Time in minutes per cu m based on 3 min per cycle	Output in cu m per hour
			Coarse aggregate	Fine aggregate (sand)			
			cu m	cu m			
1 : 1.5 : 3	7/5	0.1273	0.1056	0.0528	7.86	23.58	2.55
1 : 2 : 4	10/7	0.1662	0.1463	0.0731	6.02	18.06	3.32
1 : 3 : 6	14/10	0.2405	0.2165	0.1082	4.16	12.48	4.81
1 : 4 : 8	21/14	0.3167	0.3009	0.1504	3.16	9.48	6.33
1 : 5 : 10	21/14	0.3970	0.3772	0.1886	2.52	7.56	7.94

MORTAR MIXERS

For mixing lime-sand/cement-sand/cement-lime-sand mortars, lime-soil mixes for soil stabilisation,plastering materials etc., roller pan mortar mixers with mixed-mortar output of 150 litres (5 cft) and 225 litres (8 cft) capacity per charge are available, operated on 5 HP diesel engine or 3.7 kilowats electric motor. These are fitted with two heavy duty revolving cast iron rollers capable of crushing small pebbles in sand and lumps in lime for producing smooth mortar of required consistency. The output will depend on the desired mixing time per cycle. The output however rarely becomes a critical factor due to the relatively slow offtake of mortar as compared to concreting operations.

CONCRETE VIBRATORS

Needle type vibrators are suitable for proper compaction of reinforced concrete in columns, beams slabs etc.

Indian made, high frequncy immersion-needle type concrete vibrators are driven by motors operating on petrol/diesel/ kerosene engine of 2 to 5 HP capacity or on electric mains supply using 3.5 kilowatts energy or on compressed air supplied from compressors supplied through air hose. The poker (needle) may be out-of-balance rotor type or pendulam type made to IS 2505 of 1968, available in standard sizes of 25, 30, 40, 50, 60 and 80 mm dia driven by 4 to 6 mm long flexible shaft encased in rubber sheathing.

Built-in-head needle vibrators operating on 400 volts electric mains supply, with high frequency-low voltage convertors which eliminate the bulky flexible shaft are also available with vibrator heads of 34, 66 and 85 mm dia (of 300, 410 and 470 mm length respectively) using 3.5 kilowatts energy.

Plate and screed vibrators are suitable for compacting concrete (and also other loose aggregates such as gravel, sand, crushed stone etc.,) in roads, airfields, heavy duty floors, footpaths etc. The usual compacting surface of the plate vibrator is of 560 x 500 mm size and claims to achieve compaction in layers upto 300 mm thick with an output of about 500 sq m per hour. Plate vibrators may be petrol/kerosene engine (3 HP) driven or operating on electric mains.

For compacting concrete in roads, vibrators mounted on screed-beams laid across the road width and moved manually are used.

CONCRETE BLOCK MAKING MACHINES

Machines of Indian make for producing precast concrete blocks of various sizes and kinds like solid blocks, closed and open cavity blocks, corner column blocks, U channel blocks etc. are available. These have provision for loading concrete ingredients with tipping barrows or machine operated hoppers. Concrete is mixed in machine mixers. Consolidation is achieved through vibrations induced in the moulding area, and tamping done either manually or through hydraulic filling draws and hydraulic tampers. After laying and tamping the blocks the plant is moved to a predetermined direction and distance on the casting platform manually or by motorised action, ready for the next operation.

The number of operations vary from 30 to 40, 45 to 55, 75 to 85 etc. per hour and the output varies from 150, 200, 400 (or more) blocks per hour depending on size of the plant.

The motors for mixing, vibrating, tamping and travel of the plant (for subsequent operation) vary from 0.5 to 5 HP, electrically operated, depending on the capacity of the plant and the various motorised functions provided with it.

HOISTS, CRANES AND FORKLIFTS

In construction projects of some magnitude use of lifting and handling equipment like hoists, cranes, forklifts etc., have become almost mandatory from cost and time efficiency considerations.

Even small firms of builders engaged in putting up a block of flats in urban areas find it advantageous to hire a hoist for concreting slabs, beams etc., and for conveying building materials, precast units etc. to upper floors (as opposed to the age old custom of ramps and headloads). Hoists are of various sizes and capacities, a typical one being a single or double platform builder's hoist capable of lifting 500 to 700 kg load to a height of 50 metres, powered by a 10 HP electric motor or diesel engine.

Forklifts are versatile self propelled diesel operated compact machines suitable for lifting up and moving fabricated building components like precast concrete units etc. from the fabricating or precasting yards to the location of their use within the work site area. Forklifts have weight carrying capacity in the range of 1.5 to 5 tonnes and can travel at a speed of about 15 km per hour adequate for building site purpose. Forklifts can negotiate gradients upto 13 degrees in laden state. Apart from moving the load, forklifts can also lift the loads to a height of about 3 to 5 metres for placing in position. Forklifts are available in the front-loading as well as side loading versions, and can be fitted with additional attachments like extension of the fork or fixed/adjustable crane boom for handling irregular size/shape of materials (eg. reinforcement bars in coils etc.,) by hooking or slinging.

Stationary cranes with hydraulically telescoping boom extendible and retractable under load, of various sizes, weight lifting capacities and heights are available from Indian manufacturers. These are a common sight in locations where high rise buildings are being constructed. Mobile truck mounted cranes of various capacities and capabilities are also available, giving more details of which is beyond the scope of this book.

AIR COMPRESSORS AND PNEUMATIC TOOLS

Reliable, stationary or portable, wheel or skid mounted compressors powered by diesel engine (30 to 250 HP) or electric mains supply (motor ratings 22 to 150 kilowatts), of capacities ranging from 0.062 to 125 cu m per minute of compressed air at a pressure range from 2 to 10 kg per sq cm produced by reputed Indian manufacturers are available.

Consumption of compressed air by various pneumatic tools used in the building industry varies from about 0.5 to 3.5 cu m per minute per tool at a pressure range of about 6 kg per sq cm. Choice of compressor will depend on the scale of building operations and the number of tools desired (or practicable) to be operated simultaneously from a single compressor. For a 'two tool compressor' a capacity of 7 cu m per minute at a pressure range of 7 kg per sq cm may be considered as adequate.

Compressed air has various applications in the building industry like drilling in steel, rock, timber etc., pneumatic hammers and rock/concrete breakers, rivetting hammers and rivet busters, grinders, concrete immersion vibrators, submersible pumps, guiniting/shotcreting operations, cleaning road surfaces preparatory to tack-coats of bitumen etc.

The typical air consumption of some pneumatic tools along with their output claimed by Indian manufacturers is given below :-

Type of tool	Size, capacity, output and other details	Air consumption per minute	
		cu m	Pressure kg/sq cm
Hand hammer rock drill	Percussive rotary motion. Flushing device using air or water. Hand-held or mounted on drill-leg. Weight 18 to 23 kg. Dia of bits upto 63 mm. 1900 to 2300 blows per minute. One man operation. Bores upto 66 mm dia holes in rocks for blasting, fitting bolts for rock stabilisation etc. Bores of length 3 to 4 m (light duty), 8 to 11 m (medium), 12 to 15 m (heavy).	1.7, 2.1 and 3 for light, medium and heavy duty respectively	5.60
Heavy duty breakers	Operates a hammer of about 30 to 35 kg weight. One man operation. Used for breaking soft rock, concrete, demolition work etc. Delivers about 1100 blows per minute.	1.85	5.60
Light duty pick	Operates a picking tool with percussive motion. Weighs about 10 kg. One man operation. Used for excavating and trench digging in hard soil and soft rock, or breaking lean concrete.	1.13	5.60
Concrete vibrator needle type	Vibrates and consolidates concrete delivering about 8000 vibrations per minute. Weight 14 kg. One man operation.	0.70	5.60
Grinder and die grinders	Smooth rotary motion. Used for finishing metal patterns, burrs from gas cut metal, trimming welded joints, fettling etc. 3000 to 15000 revolutions per minute depending on chosen model.	Varies from 0.4 to 1.2	5.60
Light/heavy duty drills for metal, timber etc.	Rotary motion. Drills holes in plates/rolled steel sections for rivetting/bolting etc. Heavy duty drill can be adapted for drilling, tapping threads, reaming etc. Holes upto 50 mm dia can be made depending on chosen model.	Varies from 0.4 to 1.7	5.60
Rivetting hammer	Used for cold and hot rivetting in steel structures. Capacity for hot rivetting : Flush = 28.5 mm, cupped 22.2 mm. Delivers 1300 blows per minute. Weighs about 10 kg.	0.90	5.60
Rivet buster	Used for cutting and punching out rivets upto 19 mm dia in demolition/ dismantling or repair work.	1.00	5.60
Submersible sump pump	Uses compressed air for imparting rotary motion to the pump device, for dewatering of excavations. Performance 640 litres at 1.5 m head to 95 litres at 30 m head per minute.	2.30	5.60

ASPHALT/BITUMEN MIXING PLANTS

A cold-mix asphalt plant uses sundried aggregates at ambient temperature and bitumen heated to required temperature separately in a tar boiler.

A hot-mix asphalt plant has capabilities for drying and heating of aggregates to required temperature and mixing them with hot bitumen pumped from a separate tar boiler (some plants have a small integral tar boiler of limited capacity). For heating of aggegates a separate revolving oil fired drum may be used which after heating are discharged into a paddle mixer. Some plants employ the same enclosure in the plant for drying/heating of aggregates and later mixing with hot bitumen. A hot mix plant can serve as a cold-mix plant by shutting off the function of heating aggregates, in which case the output increases by about 30%.

Sizes of plant are denoted by the output per batch of aggregate mixed with bitumen, in litres or in cubic feet. Typical models have the following characteristics :-

Type of plant	Batch capacity - litres (cft)	Output - tonnes per hour	Diesel Engine (HP)	Remarks
Cold-mix	200 litres (7 cft)	5 to 8	12	-
	300 litres (10 cft)	15 to 20	18	-
Hot mix	300 litres (10 cft)	6 to 8 (at 180°C)	12	Combined drying and mixing.
	300 litres (10 cft)	10 to 12 (at 180°C)	25	Separate drying and mixing.

For small scale operations hand operated bitumen drum mixers (cold-mix) with a batch capacity of about 140 to 200 litres may be used in conjuction with a small tar boiler or bitumen heated in open drums.

TAR BOILERS

Tar boilers can have capacities of 900, 1080, 1360 (etc.,) litres per feed. These are usually oil fired but old models may use conventional fuels like coal, firewood etc. For tack coats etc., pressure pumps with spraying attachment fed from the boilers through pipes can be used.

ROAD ROLLERS

Road rollers upto 6 tonne capacity are termed as light rollers and those of 8 to 12 tonne capacity termed as heavy.

The system of dual numbers employed for indicating the capacity of a roller (such as 8-10, 10-12 etc.,) indicates weight of roller with and without sand/water ballast.

Conventional three wheel power driven rollers have one front wheel (steering roll) and two rear wheels (drive rolls). The driving power is applied to the rear wheels, but the function of effective consolidation is considered to be carried out by the front wheel which is considerably wider but of smaller diameter than the rear wheels.

A tandem road roller is one having only two wide wheels, one at front (of more width and larger diameter) functioning as driving and consolidating roll and the other at rear as steering roll.

Vibration rollers are usually similar to a tandem roller but have a provision of vibration generating system incorporated in the driving/consolidating wheel. In single wide-wheel vibrating roller the vibrations are induced by a diesel engine but motion is imparted by towing by tractor.

Sheep-foot rollers have blunt spikes on the wheels and may be power-driven or towed. These are used for consolidation of soil in earthen dams, formation surfaces of roads and in soil-stabilisation.

A variable pressure device in road rollers consists of a heavy weight which can be slided and locked in place so as to exert more pressure on the front or rear rolls as desired.

Output of road rollers depending on the type of surface consolidated, for the purpose of estimating and analysing rates is given below :-

Output per day of 8 hours work with 8 to 12 tonne road roller

Type of surface rolled	output	Type of surface rolled	output
(a) **Formation surfaces**		(d) Single coat surface treatment	800 sq m
(i) Road work	2000 sq m	(e) Double coat surface treatment	400 sq m
(ii) Airfield work	2500 sq m		
(b) **Stone soling (15 cm spread thickness)**		(f) **Permix carpet 2.5 cm thick including seal coat**	
(i) Road work	500 sq m	(i) Road work	600 sq m
(ii) Airfield work	600 sq m	(ii) Airfield work	750 sq m
(c) **Waterbound macadam**			
(i) Road work (11 cm spread thickness)	30 cu m	(g) Premix macadam 8 cm thick with seal coat- Airfield work	300 sq m
(ii) Airfield work ... ... (12.5 to 15 cm spread thickness)	35 cu m		

A conventional 8 to 10 tonne road roller employs a diesel engineof about 35 HP and can travel at four different speeds of about 1.3, 1.9, 8 and 8.85 kmph. It has a rolling width of 1675 mm for 8 to 10 tonne roller and 1880 mm for a 10 to 12 tonne roller.

MANUFACTURERS OF CONSTRUCTION MACHINERY

A brief list of major manufacturers of construction machinery in India, which though not exhaustive will enable intending purchasers to make a start in their search of plant adequate for their needs, is given below with their addresses and brief indication of product range.

1.	Kirloskar Pneumatic Co Ltd, Pune 13.	Air compressors and various kinds of pneumatic tools.
2.	Atlas Copco (I) private Ltd, Gandhi Memorial bldg., Netaji Subhash Road, Bombay- 2.	Air compressors and rock drills.
3.	Acme Mfg Co Ltd, Antop hill, Wadala, Bombay.	'Millars' brand hot/cold-mix asphlat mixers, mortar/concrete mixers, concrete batching plants.
4.	Garlick & Co (P) Ltd, Jacob circle, Bombay 11.	Builder's hoists, concrete mixers, stone crushers, asphalt plants, tar boilers, tandem and vibrating rollers.
5.	Shirke construction equipments (P) Ltd. 72-76 Mundhwa, Pune 411036.	Concrete block making machines, concrete machines, cranes, etc.
6.	Voltas Ltd, 19 J. N. Heredia marg Bombay 38.	Fork lifts
7.	Jessop & Co, 63 Netaji Subhas Road, Calcutta 1.	Road rollers

LABOUR OUTPUT CONSTANTS FOR BUILDING WORK

In compiling the labour constants given below *IS : 7272 (Part I) - 1982 - Recommendations for labour output constants for building work*, which gives constants for only about 60 items of work has been relied upon as a basis. Labour constants from other sources like standard books on estimating by British and Indian authors and schedules of rates of NBO, CPWD, MES, state PWDs etc., have also been taken after comparing and rationalising them.

Labour constants can at best be only indicative. Actual labour outputs differ in a fairly wide range depending on conditions of work like weather, climate, continuity, incentive, fatigue and resting time, incidental holdups, preparatory work, organisation, efficiency of labour / supervision and quality.

The categories bhisti, mate and helper are not shown separately in some of the items for the sake of convenience, but their time has been added to the constants for the category of mazdoor.

Sl. No.	Description of work	Unit of work	Category of labour	Labour constant in days (of 8 hours) per unit of work			
				Soil		Rock	
				Soft/loose	Hard/dense	Soft	Hard
	EXCAVATION AND EARTHWORK						
1.	Surface excavation not exceeding 30 cm deep, average 15 cm deep, and getting out.	sq m	Mazdoor	0.08	0.15	0.31	0.65
2.	Add to (or deduct from) item 1 above for every 3 cm above or below 15 cm average depth.	sq m	Mazdoor	0.01	0.014	0.034	0.069
3.	Rough excavation not exceeding 1.5 m deep and getting out.	cu m	Mazdoor	0.30	0.52	1.18	2.84
4.	Excavation over areas not exceeding 1.5 m deep and getting out.	cu m	Mazdoor	0.40	0.68	1.59	3.94
5.	Excavation not exceeding 1.5 m deep and getting out, in trenches not exceeding 1.5 m wide or for shafts, wells, cesspits, manholes and the like, not exceeding 10 sq m on plan.	cu m	Mazdoor	0.55	0.96	2.19	4.90
6.	Extra over items 3 and 4 above for each additional 1.5 m depth (or part thereof) beyond the first stage of 1.5 m depth.	cu m	Mazdoor	0.12	0.12	0.18	0.18
7.	Extra over item 5 above for each additional 1.5 m depth (or part thereof) beyond the first stage of 1.5 m depth.	cu m	Mazdoor	0.09	0.09	0.15	0.15
8.	Excavating small post holes each not exceeding 0.5 cu m, including returning filling and ramming around posts etc., and removing surplus soil to a distance not exceeding 50 m spread and levelled.	Each	Mazdoor	0.41	0.61	1.23	1.88
9.	Taking up excavated material from spoil heaps, filling borrows / baskets and wheeling / removing and depositing :-						
	at 25 m distance	cu m	Mazdoor	0.25	0.25	0.28	0.28
	at 50 m distance	cu m	Mazdoor	0.30	0.30	0.37	0.37
	at 100 m distance	cu m	Mazdoor	0.36	0.36	0.50	0.50
	at 200 m distance	cu m	Mazdoor	0.56	0.56	0.78	0.78
10.	Taking up excavated materials from spoil heaps and loading manually into dumpers or lorries.	cu m	Mazdoor	0.25	0.25	0.28	0.28

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Category of labour	Labour constants in days (of 8 hours) per unit of work			
				Soil		Rock	
				Soft/loose	Hard/dense	Soft	Hard
11.	Returning, filling and ramming excavated spoil around foundations (no lead involved)	cu m	Mazdoor	0.21	0.21	0.27	0.27
12.	Fillings, spreading/levelling in layers of 25 cm thickness, watering and well ramming under floors, including lead upto 50 metres.	cu m	Mazdoor	0.35	0.35	-	-
13.	Bore holes in clay, soft/loose or black cotton soils for single under-reamed piles 2 m deep and disposing off soil to a distance not exceeding 50 m away, for bore of :-						
	200 mm dia	Each	Mazdoor	1.14	-	-	-
	250 mm dia	Each	Mazdoor	1.37	-	-	-
	300 mm dia	Each	Mazdoor	1.60	-	-	-
14.	Extra over item 13 above for each additional under-reaming :-						
	200 mm dia	Each	Mazdoor	0.45	-	-	-
	250 mm dia	Each	Mazdoor	0.60	-	-	-
	300 mm dia	Each	Mazdoor	0.70	-	-	-
15.	Extra over item 13 above for each additional metre depth (intermediate depths pro-rata)						
	200 mm dia	Each	Mazdoor	0.31	-	-	-
	250 mm dia	Each	Mazdoor	0.40	-	-	-
	300 mm dia	Each	Mazdoor	0.45	-	-	-
16.	Surface dressing or trimming of natural ground to remove small unequalities not exceeding 15 cm deep (including removing vegetation/shrubs/brushwood/undergrowth and carrying away rubbish to a distance of 50 m.	sq m	Mazdoor	0.04	0.06	-	-

Sundry Labours - Excavator

				Type of rock	
				Granite/Trap/Gneiss	Sedimentary
17.	Drilling holes (for blasting) in rock manually with boring bars and drill bits for :-				
	20 to 25 mm dia holes	m	Mazdoor	0.51	0.39
	50 mm dia holes	m	Mazdoor	2.05	1.53
	75 mm dia holes	m	Mazdoor	4.90	3.52

(Note :- In item 17 above allow 0.02 days per m for pointing/sharpening of tools by one smith and one helper)

				Labour constant in days (of 8 hours) per unit of work
18.	Hardcore laid, spread, levelled, watered and consolidated to required levels in layers of :-			
	75 mm consolidated thickness	sq m	Mazdoor	0.05
	150 mm consolidated thickness	sq m	Mazdoor	0.09
	225 mm consolidated thickness	sq m	Mazdoor	0.14
	250 mm consolidated thickness and above	cu m	Mazdoor	0.50
19.	Stone pitching 150 mm thick.	sq m	Mazdoor	0.12
20.	Stone pitching 250 mm thick.	sq m	Mazdoor	0.15
21.	Cut up or lift existing turf into suitable sods, roll up and set aside for reuse.	sq m	Mazdoor	0.06
22.	Relaying turf, including preparing surface, watering and light rolling.	sq m	Mazdoor	0.04

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Category of labour	Labour constants in days (of 8 hours) per unit of work
23.	Preparing surfaces and sowing grass seeds (0.05 kg/sq m) and watering	sq m	Mazdoor	0.04
24.	Trimming sides of excavation.	sq m	Mazdoor	0.013
25.	Levelling, grading and compacting bottom of excavation	sq m	Mazdoor	0.026
26.	Ditto, but to falls or gradients.	sq m	Mazdoor	0.028
27.	Ditto but to falls and currents or crossfalls	sq m	Mazdoor	0.03
28.	Ditto but to falls and cambers	sq m	Mazdoor	0.032
29.	Trimming sloping faces of embankments and cuttings.	sq m	Mazdoor	0.035
30.	Clear site of all rubbish, cut down shrubs, undergrowth and small trees not exceeding 600 mm girth, grub up roots and burn or remove from site.	sq m	Mazdoor	0.05
31.	Cutting down hedge, grubbing up roots, filling excavation with earth and consolidate.	sq m	Mazdoor	0.09
32.	Treating bottom and sides of excavation with chemical mixed with water at specified rate for antitermite treatment (Also applicable for treating top of filling).	sq m	Mazdoor	0.03
33.	Treating soil for backfill with chemical mixed with water (Area of substructure faces in contact with backfill measured)	sq m	Mazdoor	0.15
34.	Cutting down trees, digging out roots, filling holes and consolidating surface, lopping branches and clearing off rubbish, and stacking timber neatly at a distance of 50 metres :-			
	Trees of 100 cm grith at 1 m height	Each	Mazdoor	5.75
	Ditto, but 150 cm girth	Each	Mazdoor	8.60
	Ditto, but 200 cm girth	Each	Mazdoor	11.50
	Ditto, but 250 cm girth	Each	Mazdoor	14.20
	Ditto, but 300 cm girth	Each	Mazdoor	17.30
	(Intermediate girths prorata)			
35.	Rolling surfaces with light hand roller	sq m	Mazdoor	0.013
36.	Prepare small pits, fill up with earth mixed with manure and plant small shrubs (live) upto 1 m high.	Each	Mazdoor	0.05
37	Ditto for planting small trees, and providing tree guards.	Each	Mazdoor	0.25

38. Providing timbering to uphold faces of excavation for basement in dry ground :-			Nature of ground soil		
			Firm	Moderately Firm	Loose
Upto 1.5 m depth	sq m	Carpenter	0.03	0.11	0.22
		Mazdoor	0.03	0.11	0.22
Between 1.5 and 3 m depth	sq m	Carpenter	0.04	0.15	0.30
		Mazdoor	0.04	0.15	0.30
Between 3 and 4.5 m depth	sq m	Carpenter	0.05	0.19	0.38
		Mazdoor	0.05	0.19	0.38

Note : For timbering to shafts reduce labour constants in item 38 by 50%. The constants are applicable for first use, and will be negligibly less for each reuse.

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Category of labour	Labour constant in days (of 8 hours) per unit of work

CONCRETE

Note :*Labour constants given in items 39 and 40 below are for isolated structures upto 10 m height without using lifts/ hoists, and with small size mixing plants, applicable to average work site conditions in India. For large jobs using lifts/hoists/cranes, large and sophisticated mixing plants, and better management, it should be possible to reduce the constants by as much as 35 to 50%.*

				Machine mixed ct. concr.	Hand mixed ct. concr.	Hand mixed lime concr.
39.	Mixed concrete delivered on banker.	cu m	Mazdoor	0.50	1.00	1.60
			Bhisti	0.10	0.10	0.20
			Mixer operator	0.07	-	-
			Mixer (machine)	0.07	-	-
			Bullock (with driver)	-	-	0.15

Note : *Item 40 below does not include for mixing time given in item 39. Lead from the mixing platform to the place of pouring concrete is assumed upto 30 m.*

				Labour days (of 8 hours) per unit
40.	Conveying, pouring, consolidating and curing concrete (excluding mixing time) in the following :-			
	Unreinforced foundations	cu m	Mason	0.10
			Mazdoor	1.13
			Bhisti	0.60
			Vibrator (m/c & operator time)	0.07
	Unreinforced subases of floors.	cu m	Mason	0.17
			Mazdoor	1.33
			Bhisti	0.70 (0.20)
			Vibrator (- do -)	0.07
	Reinforced foundations, footings, bases of columns, basement ground slabs, under-reamed piles and plinth beams (excluding reinforcement/formwork).	cu m	Mason	0.17
			Mazdoor	1.50 (2)
			Bhisti	0.80 (0.90)
			Vibrator (- do -) carpenter	0.07 3.0
	Reinforced suspended floor, roof, landing and canopy slabs (ditto)	cu m	Mason	0.24
			Mazdoor	2.00
			Bhisti	0.80
			Vibrator (- do -)	0.07
	Reinforced chajjas upto 15 cm in thickness (ditto)	cu m	Mason	0.30
			Mazdoor	3.00
			Bhisti	0.08
			Vibrator (- do -)	0.10
	Reinforced beams, lintels and cantilevers (other than plinth beams) (ditto).	cu m	Mason	0.20
			Mazdoor	2.50 (3.0)
			Bhisti	0.80 (0.90)
			Vibrator (- do -)	0.07
	Reinforced pillars and columns (ditto).	cu m	Mason	0.23
			Mazdoor	3.00
			Bhisti	0.80
			Vibrator (- do -)	0.10
	Reinforced staircases, fins, water tanks (upto 1200 litres), chullah hoods, fascias, parapets and railings, domes, vaults, shell roofs, folded plates and the like (ditto).	cu m	Mason	0.30
			Mazdoor	3.80
			Bhisti	0.80
			Vibrator (- do -)	0.07

LABOUR CONSTANTS

Constants for Sundry Labours on Concrete

Sl. No.	Description of work	Labour hours (Mazdoor) per sq m
41.	Hack faces for key.	0.90
42.	-Ditto- extensively.	1.40
43.	Remove burrs/excrescenses.	0.25
44.	Rubbing down with fine sand and flat stone (exposed concrete work).	0.90
		Labour hours (semiskilled) per sq m
45.	Wire brushing green concrete to expose aggregate.	0.60
46.	Stopping small holes and honeycombing.	0.60
47.	Broomed finish (highways).	0.50

Sl. No.	Description of work	Labour hours per sq m	
		Mason	Mazdoor
48.	Applying cement slurry @ 2.75 kg per sq m.	-	0.30
49.	Wood float finish to freshly laid concrete surfaces.	0.25	-
50.	Steel float finish to -do-	0.30	-
51.	Making smooth top of floors, landings, stairs etc., with cement mortar 1:2 and applying floating coat of neat cement, and preparing for curing.	0.35	0.25
52.	Grouting 25 mm thick under steel stanchion bases or grillages.	0.40	0.80
53.	Lay polythene film or building paper under foundations.	0.02	0.07

Sl. No.	Description of work	Labour Hours Per m	
		Mason	Mazdoor
54.	Plaster drip for chajjas or roof projections.	0.25	0.35
55.	Fixing bituminous expansion strips in floors :-		
	75 mm high	0.11	0.11
	150 mm high	0.14	0.14
	225 mm high	0.17	0.17
	300 mm high	0.19	0.19

Sl. No.	Description of work	Labour hours Per No.	
		Mason	Mazdoor
56.	Forming mortice holes upto 50 cu cm each for balusters, ragbolts etc., and grouting after fixing balusters etc.	0.60	0.60
57.	-Ditto- but between 50 and 100 cu cm each -do-	1.20	0.60
58.	Grouting anchor bolt 300 mm long.	0.30	0.30
59.	-Ditto- 450 mm long.	0.40	0.40

Note : *For working out labour constants for concrete cast in situ inclusive of the labour for providing formwork (and any centering as the case may be) in following situations, allow labour time for formwork (see items 66 to 79) as per area of formwork per unit given below.*

Item	Size in cm (cross section) (w) x (d) or thickness	sq m of formwork required per cu m of concrete.
Kerbs	30 x 20	6.67
Kerbs	20 x 30	10.00
Lintels	23 x 15	13.80
Lintels	23 x 20	12.76
Siesmic bands, bed plates, anchor blocks and copings/window cills which are flush with walls.	23 x 15 23 x 10	8.70 8.70
Window cills and copings projecting 5 cm on each side of wall.	33 x 10 33 x 15	9.09 8.08
Concrete topping to tops of brick steps.	30 x 5	5.33
DPC/plinth courses.	23 x 4	2.48
Parapets 10 cm thick.		20.00
Vertical fins at windows (in 23 cm wall) projecting out by 30 cm	5 cm th.	35.10
-Ditto- (-do-) but projecting out by 45 cm.	5 cm th.	36.18
Cills in RCC boxes at windows, or shelves (in 23 cm walls) projecting out by 30 cm.	5 cm th.	15.09
-Ditto- (-do-) but projecting out by 45 cm.	5 cm th.	16.17
Column shafts, 20 x 20 cm		20.00
Column shafts, 20 x 30 cm		16.67
Column shafts, 20 x 40 cm		15.00
Sides and soffits of beams	20 x 20 23 x 20 23 x 30 23 x 40	15.00 13.70 12.03 11.20
Soffits of slabs in average residential buildings :-		
for 80 mm thick slabs		10.50
for 100 mm thick slabs		8.40

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Category of labour	Labour constants in days (of 8 hours) per unit of work
	PRECAST CONCRETE ARTICLES			
	Note : *In precasting operations the concrete mixing machine, stacks of sand/aggregate, cement store, water for mixing, casting platform and curing tank etc., are so located as to ensure maximum economy in the labour time. Curing effort (bhisti) is negligible. The precasting gang works on the same job over and over again resulting in better efficiency.*			
	When adding for labour in making moulds to the constants given below, due note should be taken of the nature of moulds and that they need not have bottoms (soffits). It is usual to allow for 25 to 30 uses of the mould.			
60.	Mixing by hand and conveying concrete to moulds, preparing moulds (oiling) etc., placing ready fabricated reinforcement cage in position, pouring/consolidating/vibrating concrete, working up exposed surfaces in moulds, marking tops with casting date, stopping holes/ honeycombing after striking moulds, curing by keeping immersed in curing tank, and stacking finished precast concrete articles ready for use in work, (labour for fabricating moulds and reinforcement cage not included).	cu m	Mason Mazdoor Bhisti Vibrator (machine)	0.50 1.75 0.10 0.10
61.	Handling, hoisting and fixing precast lintels upto 3 m height, including bedding in mortar.	cu m	Mason Mazdoor	1.00 1.60
62.	-Ditto- window cills -ditto-	cu m	Mason Mazdoor	1.15 1.60
63.	-Ditto- bedplates, copings and kerbs in roof including jointing and pointing as necessary.	cu m	Mason Mazdoor	1.35 1.75
64.	Handling and placing in position duct covers 75 mm thick.	cu m	Mason Mazdoor	0.25 1.40
65.	Handling and fixing roadside kerbs and concrete bonders in stone masonry.	cu m	Mason Mazdoor	0.70 1.00

FORMWORK AND CENTERING

Note : *Formwork after initial fabrication can be used between 6 to 16 times again where repetitive operations are possible. The labour (and material) constants vary widely with the number of repetitive operations possible in the same or other sites of work. Very often, for non-repetitive odd shapes/sizes the constants will have to be worked out for single use.*

Three operations are involved, i.e. initial fabrication for first use, fixing in place for the first and each subsequent reuse, and stripping/cleaning/preparing for each reuse. On an average the labour time for fixing is about 40% more than the time for intial fabrication, and labour time for stripping/cleaning/preparing for reuse is about 30% less than the time for initial fabrication.

Where readymade steel forms and props are used as in the case of soffits of slabs, very negligible time will be required in initial fabrication for the marginal/odd areas, and the number of reuses will be several times more than the possible reuses of timber/plywood formwork.

When using a combination of plywood, timber scantlings, ballies and steel clamps/bolts the labour constants expressed in terms of the materials used can be taken as follows for a labour team of one carpenter and 4/5 th mazdoor (representing 5 carpenters and 4 helpers).

Material	First use	Subsequent use
Plywood	0.33 hours per sq m	0.16 hours per sq m
Timber scantlings	20 hours per cu m	10 hours per cu m
Props	0.15 hours each	0.10 hours each

LABOUR CONSTANTS

FORMWORK AND CENTERING (contd)

Note : *The labour constants given below are for each sq m of area of formwork in contact with concrete and include for fabricating, erecting, propping, stripping, cleaning and reusing, and take into consideration 16 uses after initial fabrication. They are not applicable for readymade steel forms.*

Sl. No.	Item	Category of labour	Labour constant in days (of 8 hours) per sq m of formwork
66.	Foundations, footings, bases of columns, plinth beams and mass concrete.	Carpenter Mazdoor	0.13 0.13
67.	Column shafts, other than circular or curved on plan.	Carpenter Mazdoor	0.25 0.20
68.	-Ditto- but circular or curved on plan.	Carpenter Mazdoor	0.38 0.25
69.	Walls/partitions and square/ rectangular shafts and chimneys.	Carpenter Mazdoor	0.25 0.20
70.	Sides and soffits of beams/ lintels.	Carpenter Mazdoor	0.30 0.20
71.	Soffits of slabs for floor/roof/ landings.	Carpenter Mazdoor	0.23 0.20
72.	Soffits of slabs and folding plates upto 30° inclination.	Carpenter Mazdoor	0.34 0.25
73.	Slabs/folding plates cast at an inclination of more than 30° (area of soffit measured).	Carpenter Mazdoor	0.57 0.50
74.	Edges of slabs and breaks in floor (upto 20 cm depth)	Carpenter Mazdoor	0.07 0.05
75.	-Ditto- above 20 cm in depth	Carpenter Mazdoor	0.06 0.05
76.	Staircases (soffits/edges/risers of steps and waist slab).	Carpenter Mazdoor	0.30 0.17
77.	Vertical fins/sun breakers, louvres etc.	Carpenter Mazdoor	0.56 0.50
78.	Chullah hoods, weather shades, chajjas, corbel and the like.	Carpenter Mazdoor	0.45 0.40
79.	Cornices/mouldings, 20 cm depth, 40 cm girth upto 10 cm projection.	Carpenter Mazdoor	0.16 0.16

REINFORCEMENT FOR CONCRETE

The labour for providing reinforcement in following locations consists of two main operations and the labour time required for them is in the following proportion :-

Operation	Foundations, bases of columns, plinth beams machine bases and the like	Suspended slabs	Walls	Beams, lintels, columns staircases, fins, chajjas and the like	Links stirrups, & spacers.
Cut to required size & bend to shape.	50 %	49 %	42 %	44 %	47 %
Place in position & tie with m.s. wire	50 %	51 %	58 %	56 %	53 %

Following labour constants are applicable for cutting, bending, fabricating, placing in position and tying with m.s. wire at each intersection, reinforcement using plain round/deformed/torsteel bars.

Sl. No.	Diameter of bars used	Labour constant in days (of 8 hours) per quintal for team of one Blacksmith and one Mazdoor Foundations, column/ machine bases, plinth beams	Casings to steel beams & columns	Suspended slabs	Walls and parapets	Beams, lintels, columns, stairs, fins, chajjas and the like	Links, stirrups, & spacers
80	6 mm dia	1.00	1.14	1.09	1.13	1.15	1.19
81	8 mm dia	0.94	1.08	1.03	1.06	1.09	1.13
82	10 mm dia	0.75	0.79	0.78	0.81	0.84	0.88
83	12 mm dia	0.63	0.66	0.65	0.69	0.71	0.75
84	16 mm dia	0.50	0.60	0.59	0.63	0.65	0.69
85	18 mm dia	0.47	0.57	0.56	0.60	0.62	0.66
86	20 mm dia	0.44	0.54	0.53	0.56	0.59	0.63
87	22 mm dia & above	0.39	0.49	0.46	0.50	0.53	0.56

Note : *Most surveyors adopt a constant of 1 day per quintal irrespective of diameter of bar, and location.*

LABOUR CONSTANTS

Reinforcement Using Hard Drawn Steel Wire Fabric

Sl. No.	Using steel fabric of weight :-	Labour constant in hours per sq m for a team consisting of one Blacksmith and one Mazdoor for reinforcement using hard drawn steel wire fabric in following situations.					
		Foundations and bases of columns	Machine foundations	Beds, roads & footpaths	Suspended floors and roofs	Walls	Casings to steelwork
88.	Not exceeding 2 kg per sq m	0.09	0.11	0.10	0.13	0.15	0.17
89.	2 to 4 kg per sq m	0.10	0.12	0.11	0.14	0.16	-
90.	4 to 8 kg per sq m	0.11	0.13	0.12	0.15	0.17	-

91. For raking cutting and circular cutting on hard drawn steel wire fabric used as reinforcement, extra labour time of 0.09 and 0.11 hours per running metre respectively should be added over and above the constants given at sl No. 88 to 90 above.

MIXING OF MORTAR

Sl. No.	Description of work	Unit of work	Category of labour	Labour days (of 8 hours) per unit		
				Cement mortar	Lime mortar or cement lime mortor	Mud mortar
92.	Mixing mortar by hand, any proportion	cu m	Mazdoor	1.00	1.33	0.70
			Bhisti	0.10	0.10	0.35
			Bullock (with driver)	-	0.33	-
93.	Mixing cement mortar by machine, in any proportion.	cu m	Mazdoor	0.36	-	-
			Bhisti	0.10	-	-
			Mixer machine	0.07	-	-
			Mixer operator	0.07	-	-

BRICKWORK

Sl. No.	Description of work	Unit of work	Labour constant in days (of 8 hours) per unit of work		
			Mason	Mazdoor	Bhisti
	Note :- *Labour constants given below for mason's time may be reduced by 6% when using modular bricks.*				
94.	Brickwork in mud mortar (excluding labour in mixing mud mortar) in :-				
	(a) foundations and plinth	cu m	0.66	1.60	-
	(b) superstructure upto 3 m height above plinth ...	cu m	0.82	1.93	-
95.	Brickwork, one brick or more in thickness, in cement, or lime or cement-lime mortar (excluding labour in mixing the mortar), in :-				
	(a) foundations and plinth	cu m	0.82	1.60	0.20
	(b) superstructure	cu m	0.98	1.93	0.20
96.	Add to constants in item 95(b) for brickwork in :-				
	(i) square / rectangular pillars	cu m	0.54	0.27	-
	(ii) circular pillars (including cutting/dressing bricks) ...	cu m	1.42	0.35	-
	(iii) wall, curved on plan to less than 6 m radius (-do)	cu m	0.26	0.53	-
	(iv) plain arches upto 6 m span (allow carpenter's time @ 2.25 sq m per cu m for 40 cm thick arch) ...	cu m	0.26	0.36	-
	(v) gauged arches using special arch bricks (allow -do-)	cu m	1.68	2.49	-
	(vi) Walls with faces tapered to a slope more than 1 in 4 (i/c cutting/ dressing bricks) - Area of tapered face to be measured.	sq m	0.27	0.22	-

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Labour constant in days (of 8 hours) per unit of work		
			Mason	Mazdoor	Bhisti
97.	Brick-tile masonry work in superstructure, one brick-tile and over in thickness (excluding labour in mixing mortar) ...	cu m	1.80	1.80	0.20
98.	Brick-tile masonry work in 5 cm thick walls (excluding -do-) ...	sq m	0.19	0.19	0.04
99.	Brickwork in half brick thick walls using old size bricks (-do-) ...	sq m	0.13	0.21	0.04
100.	Brick walls with bricks laid on edge using old size bricks (-do-) ...	sq m	0.17	0.19	0.04
101.	Honeycombed half brick thick walls using old size bricks (-do) ...	sq m	0.20	0.17	0.04
102.	Forming brick band, 5 cm projection, depth equal to one layer of brickwork,(excluding labour in mixing mortar.)	m	0.02	0.01	-
103.	Closing end of cavity wall with half brick wall (-do-) ...	m	0.02	0.02	-
104.	Forming 50 to 75 mm cavity for cavity walls including providing m.s. ties (3 ties per sq m) and painting ties with bitumen.	sq m	0.08	0.09	-
105.	Cutting toothing and bonding new brick wall to existing. ...	sq m	0.20	0.10	-
106.	Bedding door/window frames in mortor (excluding labour in mixing mortar.	10 m	0.05	0.05	-
107.	Pointing door/window frames in mortar (-do) - Each side measured.	10 m	0.06	0.03	-
108.	-Ditto- but in mastic - Each side measured.	10 m	0.08	0.03	-
109.	Parging and coring to flues (cowdung - mud - cement mixture) ...	10 m	0.40	0.40	0.02
110.	Raking out joints and flush pointing simultaneously with brickwork. ...	sq m	0.02	0.02	-
111.	Fixing only holdfasts.	10 No.	0.15	-	-
112.	Tarring and sanding to holdfasts.	10 No.	-	0.08	-
113.	Forming fair finished channels in concrete, 30 cm girth. ...	10 m	0.75	0.07	-
114.	Add or deduct to item 113 for each 2.5 cm girth more or less. ...	10 m	0.08	-	-
115.	Laying DPC 15 to 20 mm thick with cement mortar (excluding labour in mixing of mortar).	sq m	0.01	0.01	0.01
116.	Treating surface of concrete, DPC or plaster with water proofing liquid as specified by manufacturer :-				
	(a) one coat work	10 sq m	0.06	0.05	
	(b) two coat work	10 sq m	0.12	0.05	
117.	Fixing, jointing and embedding AC flue pipe 150 mm dia, in brickwork.	m	0.06	0.06	
118.	Cutting/champhering/rubbing bricks to shape, and fixing as projecting drip courses at junction of roof with wall, plinth courses and the like (excluding labour in mixing mortar).	m	0.02	0.01	
			Skilled workman	Mazdoor	
119.	Prime surfaces, fix in position 12 mm thick impregnated fibre board in expansion joint and finish with sealing compound (constant is for 10 cm deep joint. Other depths pro-rata).	100 m	0.30	0.25	
120.	Heating and filling blown grade bitumen into expansion joint 2.5 cm wide, 15 cm deep.	100 m	1.55	1.50	
121.	-Ditto- but using mixture of bitumen cement and sand. ...	100 m	1.75	2.00	
122.	Fabricate to shape and fix in position metal sheet in expansion joint, 250 mm girth.	m	0.09	-	
123.	Cut to required width and fix AC sheet as cover to expansion joint. ...	m	0.09	-	
124.	Heat and apply bitumen with brushes to DPC, and blind with sand.	10 sq m	0.32	0.07	
125.	3 course damp proofing treatment to basements/reservoirs etc. ...	10 sq m	1.18	1.55	
126.	5 course damp proofing treatment to basements/reservoirs etc. ...	10 sq m	1.72	2.32	
127.	7 courses -ditto-	10 sq m	2.20	3.00	

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Labour constant in days (of 8 hours) per unit of work	
			Mason	Mazdoor
128.	Cutting chases in brickwork (per 10 cm girth) ...	m	0.15	0.15
129.	Cutting holes in brickwork (upto 50 sq cm on face)	per 10 cm depth	0.15	0.15
130.	Add for each additional 50 sq cm on face. ...		0.06	0.06
131.	Bedding wall-plates 115 mm wide	m	0.04	0.04
132.	Beam filling	m	0.05	0.05
	PRECAST CONCRETE BLOCK MASONRY			
133.	Precast concrete block (solid or hollow) masonry work in foundations and plinth, built in any mortar (excluding labour in mixing mortar and in manufacturing the precast blocks).	cu m	1.32	1.85
134.	-Ditto- but in superstructure (excluding -do-) for walls and partitions of :-			
	(a) 20 cm nominal thickness	cu m	1.48	2.18
		sq m	0.30	0.44
	(b) 15 cm nominal thickness	sq m	0.26	0.38
	(c) 10 cm nominal thickness	sq m	0.22	0.32
135.	Extra labour over item 134(a) for square/rectangular columns ...	cu m	0.54	0.27
136.	Extra labour over item 133 for filling hollow blocks with sand. ...	cu m	-	0.12
137.	7.5 cm (nominal) thick walls using gypsum partition solid blocks built in any mortar (excluding labour in mixing mortar and in manufacturing blocks)	sq m	0.19	0.27
	STONE MASONRY			
138.	Random rubble (RR) masonry, uncoursed, laid dry in retaining walls, abutments etc.	cu m	0.47	0.94
139.	RR masonry in foundations and plinth (excluding labour in mixing mortar) for :-			
	(a) foundations/plinth in any kind of mortar	cu m	0.60	1.62
	(b) superstructure in any kind of mortar	cu m	0.75	2..00
140.	Extra labour over item 139 (a) or (b) for :-			
	(a) work brought up to courses	cu m	0.20	-
	(b) walls curved on plan to a radius less than 6 metres ...	cu m	0.20	0.40
	(c) work in square or rectangular columns	cu m	0.58	0.27
	(d) work in uncoursed polygonal masonry	cu m	0.08	-
	(e) work in uncoursed squared rubble masonry ...	cu m	0.43	0.13
	(f) work in regular coursed, squared rubble masonry ...	cu m	0.85	0.20
	(g) work in block-in-course masonry	cu m	1.26	0.38
	(h) work in ashlar masonry	cu m	2.99	0.80
	Note :- *Labour for facework given in items below is to be allowed for each finished face of stone walling.*			
141.	Facework to RR masonry (uncoursed or brought up to courses) for hammer dressing to face/beds/joints of face stones, in :-			
	(a) limestone or sandstone	cu m	0.05	0.02
	(b) granite or trap stone	cu m	0.10	0.05
142.	Facework to polygonal rubble walling (uncoursed or brought up to course) for hammer dressing to face/beds/joints of face stones, in			
	(a) limestone or sandstone	cu m	0.06	0.02
	(b) granite or trap stone	cu m	0.12	0.05

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Labour constant in days (of 8 hours) per unit of work	
			Mason	Mazdoor
143.	Facework to squared rubble walling (uncoursed or brought up to courses) for hammer dressing to face/beds/joints of face stones in :-			
	(a) limestone or sandstone ...	sq m	0.15	0.08
	(b) granite or trap stone ...	sq m	0.30	0.15
144.	Facework to regular coursed squared rubble masonry for dressing to face/ beds/joints of face stones in :-			
	(a) limestone or sandstone ...	sq m	0.27	0.14
	(b) granite or trap stone ...	sq m	0.54	0.25
145.	Facework to block-in-course masonry, regular coursed for dressing to face/bed/joints of face stones in :-			
	(a) limestone or sandstone	sq m	0.54	0.25
	(b) granite or trap stone	sq m	1.10	1.45
146.	Facework to ashlar masonry in			
	(a) limestone or sandstone	sq m	0.54	0.25
	(b) granite or trap stone	sq m	1.10	0.50
147.	Extra over items of facework for external angles (for quoins and jambs) in :-			
	(a) RR/polygonal rubble uncoursed or brought up to courses	m	0.08	0.02
	(b) squared rubble masonry uncoursed/brought up to course	m	0.10	0.02
	(c) squared rubble regular coursed masonry	m	0.11	0.02
	(d) block-in-course masonry	m	0.22	0.03
	(e) ashlar masonry	m	0.50	0.06
148.	40 to 50 mm thick red or white self-faced lime/sandstone lining (veneer work) to faces of walls, including dressing to edges and cutting to size, backing and jointing in mortar and pointing in cement. ...	sq m	1.80	3.00
149.	Fixing gunmetal cramps or copper pins (including making chases) for anchoring stone slabs in wall lining to backing or for securing to adjacent slabs of wall lining.	Each	0.06	0.03
150.	Cutting opening through stone walls for doors, windows etc., or for enlarging existing openings, converting existing windows to doors and the like, including shoring/underpinning as required and removing debris off the premises	cu m	0.35	0.70
151.	Forming jambs (in coursed/uncoursed masonry) to newly cut opening in existing walls, including cutting toothing and bonding to old work, facing and pointing to match existing (each face of jamb).	sq m	0.40	0.65
152.	Making good under cills or over lintels including all pinning as necessary for newly cut openings in stone walls (measured for top or bottom of lintel/ cill in contact with wall)	sq m	0.30	0.30
153.	Cutting toothing and bonding new brick or stone walls to existing wall built in lime or cement mortar (measured for vertical face of new wall in contact with old)	sq m	0.23	0.12
154.	Marble work, dressed, table rubbed and polished, in steps, window cills, jambs, pillars and wall linings etc., 25 to 50 mm thick, set jointed and pointed, in cement mortar.	sq m	2.38	4.10
155.	Stone kerb of roughly squared stones of size 20 cm x 30 cm in cross-section, finely hammerdressed at top and roughly hammer-dressed at sides and ends, set jointed and pointed in cement and sand mortar (using stones roughly squared to size at quarry)	m	0.30	0.20
156.	-Ditto- but of size 15 cm x 30 cm in cross-section.	m	0.22	0.17

Sl. No.	Description of work	Unit of work	Category of labour	Labour constants in days (of eight hours) per unit of work

WOODWORK (Carpenter's Work)

Notes :*Labour constants for carpenter's work vary considerably with the species, grains and workability of timber, thinner and thicker sections used, location, quality of work etc. Constants given below are for the likely average output.*

All constants given are applicable to work done on hardwood. For work on softwood reduce the constants by 33%.

The category 'helper' given in the constants for carpenter's work denotes an apprentice carpenter.

Sl. No.	Description of work	Unit of work	Category of labour	Clean sawn	Wrought
157.	Timber in scantlings (ie exceeding 5 cm thick and not exceeding 20 cm thick in both directions) in unframed work as in floor/ceiling joists, common/jack/valley/hip rafters and purlins in roof and the like.	cu m	Carpenter	3.30	6.60
			Helper	3.30	6.60
158.	-Ditto- but in framed work as in roof trusses, trimmer and trimming joists, frames for partitions etc., which require mortice and tenon/tusk tenon/devetailed joints.	cu m	Carpenter	7.60	10.90
			Helper	5.00	8.30

Sl. No.	Description of work	Unit of work	Category of labour	Cross section in sq cm: Upto 3	Excdg 3 & upto 6	Excdg 6 & upto 13	Excdg 13 & upto 25
159.	Timber in clean sawn fillets fixed with nails (for work using fillets cut to required cross section at sawmill).	10 m	Carpenter	0.13	0.16	0.26	0.40
			Helper	0.06	0.08	0.13	0.20
160.	-Ditto- but wrought	10 m	Carpenter	0.24	0.27	0.40	0.56
			Helper	0.11	0.13	0.19	0.27
161.	Extra over item 160 if fillets are fixed with countersunk wood screws	10 m	Carpenter	0.06	0.06	0.07	0.15
			Helper	0.03	0.03	0.03	0.06

Sl. No.	Description of work	Unit of work	Category of labour	
162.	Nailing clean sawn roof battens to common rafters for tiling in roof (Allow 0.01 day per sq m for items (a) to (e) below for helper)			
	(a) battens nailed 15 cm c/c	sq m	Carpenter	0.07
	(b) battens nailed 20 cm c/c	sq m	Carpenter	0.06
	(c) battens nailed 25 cm c/c	sq m	Carpenter	0.05
	(d) battens nailed 30 cm c/c	sq m	Carpenter	0.04
	(e) battens nailed 35 cm c/c	sq m	Carpenter	0.03

Sl. No.	Description of work	Unit of work	Category of labour	Clean sawn	Planed on one side	Planed on both sides
163.	Timber boarding with butt joints for sides and ends, edges shot not requiring any framing, fixed with nails, For thickness of boarding :-					
	(a) 15 mm	sq m	Carpenter	0.09	0.19	0.27
			Helper	0.05	0.09	0.13
	(b) 20 mm	sq m	Carpenter	0.10	0.20	0.28
			Helper	0.05	0.09	0.13
	(c) 25 mm	sq m	Carpenter	0.12	0.22	0.29
			Helper	0.06	0.11	0.14
	(d) 30 mm	sq m	Carpenter	0.16	0.26	0.34
			Helper	0.06	0.11	0.14
	(e) 40 mm	sq m	Carpenter	0.21	0.31	0.39
			Helper	0.08	0.14	0.17
164.	Extra over item 163, if boarding is jointed with tongue and grooved joints (In item 164 (a)and (b) below add helper's time at the rate of half the constants given for carpenter)					
	(a) 15 to 25 mm ...	sq m	Carpenter	-	0.22	0.22
	(b) 30 to 40 mm ...	sq m	Carpenter	-	0.25	0.25

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Category of labour	Labour constants in days Thickness of boarding in mm 15	20	25	30	40
165.	Extra ove item 163 if boarding is fixed with countersunk screws.	sq m	Carpenter	0.04	0.07	0.09	0.11	0.15
			Helper	0.03	0.05	0.06	0.07	0.09
166.	Extra over item 163 if boarding is fixed to ceilings from below, or if fixed in shelves/built-in-cupboards/pelmets and the like not involving framed work.	sq m	Carpenter	0.02	0.02	0.02	0.02	0.03
			Helper	0.01	0.01	0.01	0.01	0.01
167.	Extra over item 163 if boarding is framed with dovetailed or similar joints before fixing.	sq m	Carpenter	0.21	0.21	0.22	0.22	0.24

WOODWORK (Joinery)

Note : *Constants are for work done on hardwood. For work on softwood reduce constants by 33%. The category 'Helper' in joinery constants denotes semi-skilled carpenter. Joinery constants include for planing surfaces all over.*

Sl. No.	Description of work	Unit of work	Category of labour	Labour constant in days
168.	Plain, solid, straight door/window chowkats (frames) including any transomes and mullions, wrought, framed, rebated on the solid, rounded/champhered, grooved for plaster key where required, joints put together with glue and pinned, including fixing/erecting.	cu m	Carpenter	17.00
			Helper	5.00
	Note : *In item 168 the proportion of labour required in fabrication to the labour required in fixing may be taken as 4:1.*			
169.	Extra over item 168 for making additional rebate for second shutter.	cu m	Carpenter	5.40
170.	Cutting notches in hardwood chowkats for housing fixed glass louvers (each vertical length of chowkat measured).	per m	Carpenter	0.16
171.	Fabricating and fitting in place skeleton shutters, without sash bars, open rebated and prepared to receive glass, wire gauze etc., fitted with shaped, cut and mitred timber beads for securing glass, wire gauze etc., :-			
	(a) 25 to 35 mm thick	sq m	Carpenter	1.30
			Helper	0.40
	(b) 40 to 50 mm thick	sq m	Carpenter	1.50
			Helper	0.40
172.	All as in item 171 above but devided into squares with sash bars :-			
	(a) 25 to 35 mm thick	sq m	Carpenter	1.75
			Helper	0.50
	(b) 40 to 50 mm thick	sq m	Carpenter	2.00
			Helper	0.50
173.	Deduct from item 171 if cut and mitred beads are not required.	sq m	Carpenter	0.20
174.	Deduct from item 172 if cut and mitred beads are not required.	sq m	Carpenter	0.40
175.	Fabricating and fitting in place ledged and battened shutters using 15 to 25 mm thick battens.	sq m	Carpenter	0.60
			Helper	0.15
176.	Fabricating and fitting in place ledged, braced and battened shutters using 15 to 25 mm thick battens.	sq m	Carpenter	0.75
			Helper	0.18
177.	Fabricating and fitting in place framed, ledged, braced and battened shutters using 15 to 25 mm thick battens.	sq m	Carpenter	2.30
			Helper	0.40
178.	Fabricating and fitting in place, plain, framed panelled shutters, with panels flat on both sides:- (a) having styles and rails 25 to 35 mm thick	sq m	Carpenter	1.80
			Helper	0.50
	(b) having styles and rails 40 to 50 mm thick	sq m	Carpenter	2.00
			Helper	0.50
179.	Add to items 178 (a) and (b) for raised timber panels with bevelled or champhered margins on one side of the shutter	sq m	Carpenter	0.25
180.	-Ditto- on both sides of the shutter	sq m	Carpenter	0.50

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Category of labour	Labour constants in days
181.	Marginal planing to edges of shutters to fit them within rebates of chowkats including hanging shutters and easing, (for any type of flush, panelled, battened or skeleton shutter of any thickness made of hard or softwood. Fixing hinges paid separately).	sq m	Carpenter Helper	0.20 0.20
182.	Fixing only readymade floor level kitchen storage units of size 0.5 m long, 0.90 to 1.25 m high, and 0.5 to 0.75 m deep, including plugging and securing to walls.	Each	Carpenter Helper	0.13 0.03
183.	-Ditto- but for wall units 0.50 m long, 0.80 m high and 0.30 to 0.40 m deep, including -ditto-	Each	Carpenter Helper	0.12 0.03
184.	Making and fixing hardwood draining boards to design	sq m	Carpenter	1.85
185.	Turner's work on hardwood in making balusters, newel posts, table legs and the like, including fixing in position :-			
	(a) for sections upto 15 mm dia	per m	Turner Carpenter	0.03 0.01
	(b) for sections exceeding 15 and not exceeding 25 mm dia	per m	Turner Carpenter	0.08 0.03
	(c) for sections exceeding 25 and not exceeding 50 mm dia	per m	Turner Carpenter	0.30 0.06
	(d) for sections larger than 50 mm dia (maximum girth x length) ...	sq m	Turner Carpenter	1.00 0.09
186.	Making and fixing timber stairs, 1 m wide and 3 m rise per flight consisting of one wall string, one outer string, risers and treads housed into strings, handrail on balusters, and newel post as necessary, all timber wrought and framed and fixed complete. ...	per flight	Carpenter Helper	15.00 4.00
187.	Making and fixing newel posts to design (not requiring turning) upto 100 sq cm in cross section.	per m	Carpenter Helper	0.22 0.05
188.	-Ditto- but exceeding 100 and upto 160 sq cm in cross section.	per m	Carpenter Helper	0.30 0.06
189.	Wall handrail to shape, made out of 50 mm x 50 mm overall cross section, hollowed for handgrip, screwed to hardwood plugs or m.s. brackets embedded in wall. ...	per m	Carpenter Helper	0.18 0.04
190.	Handrails, rounded or shaped, with splayed faces in straight length and fixed, upto 50 sq cm in cross-section.	per m	Carpenter Helper	0.14 0.04
191.	-Ditto- but upto 75 sq cm in cross-section.	per m	Carpenter Helper	0.26 0.04
192.	Extra over items 190 and 191 for sinking at bottom for flat iron core.	per m	Carpenter	0.10
193.	Carving and fixing 90° ramps or knees in handrails.	Each	Carpenter	1.00
194.	Carving and fixing 180° ramps or kness in handrails (as in doglegged stairs) ...	Each	Carpenter	3.00

' Sundry Labours - Joiner's Work '

Sl. No.	Description of work	Unit of work	Carpenter days	Sl. No.	Description of work	Unit of work	Carpenter days
195.	Planing by hand and truing up to scantlings and fillets.	sq m	0.14	201.	Champhers / rounded edges (upto 25 mm girth)	m	0.02
196.	Raking cutting (per 25 mm of thickness)	m	0.06	202.	Moulding, plain (ditto-).	m	0.04
197.	Circular cutting (-ditto-)	m	0.12	203.	Wrought ends of timber (per 50 mm girth of end cross-section).	Each	0.04
198.	Tongue and grooved joints (-ditto-)	m	0.06	204.	Boring holes for bolts upto 20 mm dia (per 15 mm thickness of timber bored).	Each	0.01
199.	Rebated joints (-ditto-)	m	0.05	205.	Countersinking for heads of bolts or for nuts.	Each	0.02
200.	Forming rebates or grooves (per 25 mm girth)	m	0.03	206.	Notching for cross timbers.	Each	0.02

LABOUR CONSTANTS

Sl. No.	Description of item fixed	Labour constants in days	Sl. No.	Description of item fixed	Labour constants in days

BUILDER'S HARDWARE

Notes : *Labour constants are in days of work by skilled carpenter, and are for fixing one article of builder's hardware to hardwood, with screws. For work in fixing to softwood the constants may be reduced by 33%.*

207.	Barrel tower bolt or skeleton tower bolt of :		218.	Tee hinge upto 200 mm length ...	0.05
	(a) 75 to 100 mm size ...	0.03	219.	-Ditto- 300 to 400 mm length ...	0.06
	(b) 125 to 300 mm size ...	0.05	220.	Double action spring hinge of any size ...	0.07
	(c) 375 to 450 mm size ...	0.06	221.	Bow handle of any size ...	0.01
	(d) 600 mm size ...	0.07	222.	Mortice latch or rim latch ...	0.18
208.	Sliding (aldrop) door bolt upto 300 mm size with hasp and staple (suitable for use with pad-locks) fixed partly with nuts and bolts and partly with screws.	0.07	223.	Cupboard lock	0.07
			224.	Drawer lock	0.05
			225.	Casement stay, any size	0.02
209.	Bolt socket (thimble) let into brick/stone/concrete including cutting chases and grouting in.	0.04	226.	Fanlight catch with pivot and plate ...	0.07
			227.	Drawer pull	0.02
210.	Fixing bolt staple to wood. ...	0.01	228.	Hat peg or coat hook	0.02
211.	Butt hinge 25 to 75 mm size. ...	0.04	229.	Wire hook and eye	0.01
212.	Butt hinge 100 to 125 mm size. ...	0.06	230.	Hasp and staple, any size	0.02
213.	Parliament hinge, any size. ...	0.06	231.	Finger plate	0.02
214.	Piano hinge (per metre length). ...	0.14	232.	Towel rail including a pair of brackets plugged to walls	0.06
215.	Floor door stopper fixed in floor. ...	0.07	233.	Ball catch for cupboard shutter	0.02
			234.	Hydraulic door closer	0.05
216.	Galvanised wire cloth or gauze fixed in squares to open rebated joinery (constant per sq m).	0.20	235.	Fixing XPM or wire netting 12 to 15 mm mesh to timber frames (constant per sq m)	0.07
217.	Knob.	0.02	236.	Fixing magic eye (peep hole) ...	0.05

METALWORKER

Sl. No.	Description of work	Unit of work	Labour constant in days	
			Blacksmith/fitter/ carpenter	Mazdoor
237.	Mild steel sheets, plain, upto 1.6 mm thick, black or galvanised, in cladding to walls or gates, fixed with screws/nails/rivets to timber or steel frames with joints rivetted or welted	sq m	0.12	0.12
238.	-Ditto- but in hearths, chullah hoods, water tanks, water troughs, ducts, funnels etc., fixed with -do-	sq m	0.28	0.28
239.	Add to item 237 if corrugated sheets are used	sq m	0.03	0.03
240.	Expanded metal or welded steel fabric, cut to length, bent to shape, tied with wire or fixed with metal staples to wooden or steel members. (Fixing cover/edge strips of timber or metal not included)	kg	0.08	0.08
241.	Fixing only chain link fencing of any size or type, including line wires. (Erecting poles/rails not included)	sq m	0.03	0.06
242.	Plain or stranded mild steel galvanised wire in cattle fencing, including straining and fixing to poles of steel timber or concrete.	100 m of wire run	0.10	0.45
243.	Two strand barbed wire of any description in fencing including straining and fixing to -ditto-	100 m of wire run	0.15	0.75

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Labour constants in days		
			Fitter	Mason/ Carpenter	Mazdoor
244.	Erection and fixing only of collapsible steel door/gate top-hung, including fixing top and bottom runners, holdfasts, lugs etc., complete.	sq m	0.05	0.25	0.50
245.	Erection and fixing only of steel rolling shutter made up of inter locking steel laths, including guides, top cover, locking arrangement etc., any type.	sq m	0.30	0.15	0.45
246.	Erection and fixing only of steel/aluminium windows of any description to lugs in masonry or screwed to wooden plugs/rough grounds (excluding fabrication, glazing, painting and pointing with mastic to edges)	sq m	-	0.10	0.20
247.	Erection and fixing only of steel doors to lugs/holdfast embedded in masonry/concrete (excluding -do-)	sq m	-	0.15	0.20
248.	Erection and fixing of aluminium doors including any sidelights to lugs/holdfasts embedded in masonry or fixing with screws to wooden plugs/rough grounds, (excluding -do-)	sq m	0.10	0.15	0.20

		Labour constant in days per quintal				
		Black-smith	Fitter/ welder	Mason/ carpenter	Helper/ semiskilled labourer	Mazdoor
249.	Fixing only cast iron articles like brackets , gully traps, gratings, railings, frames and manhole covers, fire/soot doors, valve boxes and the like	-	-	2.80	-	2.80
250.	Purpose made mild steel bolts exceeding 30 cm long, including square or hexagonal head, screw-threaded one or both ends, nuts and washers etc., complete ...					
	(i) 10 or 12 mm dia					
	(a) Fabrication	7.00	3.00	-	7.00	2.00
	(b) Fixing	-	1.00	2.00	1.50	1.00
	(ii) 14 to 20 mm dia					
	(a) Fabrication	4.00	1.50	-	4.00	1.00
	(b) Fixing	-	0.75	1.50	0.90	1.00
	(iii) Exceeding 20 mm dia					
	(a) Fabrication	2.25	0.80	-	2.50	1.00
	(b) Fixing	-	0.60	0.60	0.50	0.50
251.	Small articles like holdfasts, hooks for ceiling fans, two/three way straps for wooden trusses, angle cleats, wall ties, bands/straps/stays for fixing pipes/gutters, pintle hinges, large hasp and staples, hand made sliding bolts and the like					
	(a) Fabrication	5.50	-	-	5.50	1.00
	(b) Fixing	-	-	1.80	-	1.80
252.	Chimney bars, bearers, tongues or water bars of window frames, window guard bars, unframed T or L section supports for shelves etc.,					
	(a) Fabrication	1.90	-	-	1.90	-
	(b) Fixing	-	-	1.25	-	1.25
253.	Railings, flat iron core for wooden/plastic handrails, wind ties, fencing posts/struts, fillets for securing weldmesh etc.,					
	(a) Fabrication	2.00	0.65	-	2.65	-
	(b) Fixing	-	-	1.80	-	1.80

LABOUR CONSTANTS

Sl. No.	Description of work	Labour constants in days per quintal				
		Black-smith	Fitter/ welder	Mason/ carpenter	Helper/ semiskilled labourer	Mazdoor
254.	Framed work as in grills, gratings, framed guard bars, ladders etc., including necessary forging, welding, bolting, rivetting etc., :-					
	Fabrication	3.85	1.90	-	3.85	3.85
	Fixing	-	-	1.75	-	1.75
255.	Framed work as in compound gates, wicket gates etc., having purposemade pintle-hinges, stops, sliding bolts, locking arrangement etc., including -do-					
	Fabrication	4.50	1.90	-	4.50	3.85
	Fixing	-	0.50	1.25	0.50	1.25
256.	Small framed brackets made out of rolled steel sections including -do- (weight not exceeding 10 kg per bracket) :-					
	Fabrication	3.40	1.65	-	3.40	3.40
	Fixing	-	-	1.90	-	1.90
257.	Structural steelwork in rolled steel single sections, cut, hoisted and fixed independantly in position without connecting plates					
	Fabrication	0.25	-	-	0.10	0.20
	Erection and fixing	-	0.27	-	-	1.40
258.	Structural steelwork in main/cross beams, hip/jack rafters, purlins, rails/guides for sliding doors etc., fixed with cleats/connecting plates including necessary bolting, rivetting, welding etc.					
	Fabrication	0.45	0.30	-	0.30	0.40
	Erection and fixing	-	1.30	-	0.45	1.50
259.	Plate girders or stanchions built up of single sections with flange plates, caps, bases, splices, angle brackets, cleats and other connections including -do-					
	Fabrication	1.05	0.70	-	0.90	0.90
	Erection and fixing	-	0.85	-	0.35	1.00
260.	Compound / lattice girders and stanchions, stagings for water tanks etc., built up from two or more rolled steel sections including caps, bases, splices, brackets, gusset plates etc., including -do-					
	Fabrication	2.85	1.90	-	2.45	2.45
	Erection and fixing	-	2.15	-	0.85	2.50
261.	Framing for cladding or north light glazing, etc., out of rolled steel sections fixed with angle cleats, connecting plates, gussets etc., including -do-					
	Fabrication	1.80	1.20	-	1.55	1.55
	Erection and fixing	-	2.60	-	1.00	3.00
262.	Framed steel roof trusses, trussed purlins, crane gantries, heavy bracket frames with cleats, gusset plates etc., including -do-					
	Fabrication	2.55	1.70	-	2.20	2.20
	Erection and fixing	-	3.20	-	1.30	3.75
263.	Mild steel framed, hinged or sliding gates/doors made up of rolled steel sections with gussets, rails, braces, hinges, stops, locking devices etc., including -do- (steel sheet cladding and running rails/ guides considered separately)					
	Fabrication	2.40	1.60	-	2.00	2.00
	Fixing	-	1.60	-	0.65	1.85

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Labour constants in days	
			Skilled tradesman	Mazdoor/ bhisti
	ROOFING AND RAIN WATER GOODS			
264.	Corrugated mild steel sheeting, any gauge, black or galvanised laid with 1 or 1.5 corrugation side lap, fixed with coach screws and washers in roofs or cladding to walls.	sq m	0.08	0.07
265.	-Do- but fixed with J or L shaped hook bolts and nuts, with bitumen and galvanised limpet washers	sq m	0.10	0.09
266.	Extra over items 264 and 265 for fixing curved sheets, of any radius (as in Nissan huts, Lahore sheds etc.,)	sq m	0.02	0.02
267.	Extra over items 264 and 265 if sheets are secured to each other by bolting or rivetting at :-			
	(a) side laps, at 20 cm c/c	metre	0.03	0.03
	(b) end laps, at each corrugation	metre	0.08	0.08
268.	Extra over items 264 and 265 for :-			
	(a) raking cutting at hips/valleys etc., or square cutting and waste at abutuments	metre	0.04	0.03
	(b) circular cutting	metre	0.06	0.05
269.	Plain mild steel sheeting, any gauge, black or galvanised, in flashings, ridges, hips and valley gutters (length x girth) :-			
	(a) fabrication	sq m	0.23	0.10
	(b) fixing	sq m	0.10	0.10
270.	-Do- in semicircular eaves gutter, 150 mm dia, fixed to flat iron brackets (brackets not included) :-			
	(a) fabrication	metre	0.09	0.09
	(b) fixing	metre	0.10	0.10
271.	Extra over item 270 for each internal or external angle, and drop end for connection to downtake pipe including necessary welted or soldered joints etc., ...	Each	0.23	0.10
272.	-Do- but for stopped end	Each	0.14	0.07
273.	Corrugated or semi-corrugated AC sheets in roof or cladding to walls, fixed with coach screws and washers	sq m	0.10	0.09
274.	-Do- but fixed with J or L shaped hook bolts and nuts, with bitumen and galvanised limpet washers	sq m	0.11	0.10
275.	Extra over items 273 and 274 for :-			
	(a) raking cutting at hips/valleys etc., or square cutting at abutments, verges etc., ...	metre	0.04	0.04
	(b) circular cutting	metre	0.05	0.05

Sl. No.	Description of work	Unit of work	Labour constant in days	
			Skilled worker	Mazdoor
276.	Fixing accessories of AC roof sheeting :-			
	(a) Ridges, any kind	metre	0.05	0.08
	(b) Apron pieces	metre	0.12	0.15
	(c) Barge boards and corner pieces	metre	0.10	0.12
	(d) North light curves	metre	0.08	0.10
	(e) Eaves filler pieces	metre	0.06	0.07
	(f) S type louvers	metre	0.13	0.11
	(g) Cowl type vent	Each	0.14	0.12
	(h) Ridge finial	Each	0.07	0.09
	(j) Roof light	Each	0.25	0.25
	(k) Expansion joint in roof sheeting	metre	0.08	0.10

Sl. No.	Description of work	Unit of work	Labour constants in days	
			Skilled worker	Mazdoor
277.	Fixing AC rain water goods:-			
	(a) Eaves gutter	metre	0.07	0.10
	(b) Boundary wall or valley gutter	metre	0.08	0.10
	(c) All specials in (a) and (b) above	Each	0.10	0.10
	(d) Rain water pipes any size	metre	0.07	0.25
	(e) All specials in (d) except junctions	Each	0.04	0.15
	(f) Junction, single	Each	0.08	0.20
	(g) Junction, double	Each	0.14	0.25
	(h) Rain water heads	Each	0.33	0.25

Note : *Constants in item 277 include for fixing holder bats wherever appropriate.*

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of work	Labour constant in days		
			Skilled worker	Roof tiler	Mazdoor/ bhisti
278.	Fixing standard pipe holder bats to walls, comprising two semi-circular halves of flat iron and cast iron base fixed to plugs.	Each	0.03	-	0.09
279.	Laying Manglore pattern roof tiles (fixing battens excluded) ...	sq m	-	0.06	0.12
280.	Laying ridge/hip tiles to suit Manglore tile roof, including bedding and jointing in lime or cement mortar.	metre	-	0.05	0.10
281.	Raking cutting to Manglore tiles at hips and valleys. ...	metre	-	0.06	0.01
282.	Straight cutting to -do- at abutments, chimney stacks/verges. ...	metre	-	0.04	0.01
283.	Bedding Manglore tiles at eaves/verges in lime/cement mortar. ...	metre	-	0.03	0.04
284.	Drilling holes in eaves tiles and screwing to eaves battens. ...	100 Nos	-	0.70	0.70
285.	Stone slab roofing (40 mm slabs) laid over concrete or wooden joists, set and pointed at top and soffit in cement/lime mortar. ...	sq m	0.14	-	0.24
286.	Add/deduct from item 285 for each variation of 5 mm thickness....	sq m	0.02	-	0.03
287.	80 mm thick (average consolidated thickness) mud phuska on flat roofs, including 25 mm thick mud plaster and gobri leeping. ...	sq m	0.15	-	0.45
288.	Add/deduct from item 287 for every variation of 10 mm thickness....	sq m	0.01	-	0.04
289.	Deduct from item 22 if gobri leeping is not required	sq m	-	-	0.03
290.	Filling cinder and light ramming (in hollows for WC pans/baths left for future expansion.)	cu m	-	-	1.06
291.	Grading flat roof surface by (mixing and) laying cinder concrete, any mix, to required slope, finished even	cu m	0.09	-	2.10
292.	Cutting out cracks to V shape and grouting with rich cement mortar (in lime terracing/roof slabs/adjoining parapets)	metre	0.06	-	0.08
293.	-Do- but filled with a mixture of hot bitumen and sand after brushing the crack with hot bitumen	metre	0.08	-	0.10
294.	Lime concrete terracing in roof, including mixing lime concrete, treated with gur and belfruit, and rounding junctions with walls (tack coat of bitumen not included)	cu m	1.00	-	6.20
295.	Extra over item 294 for smooth trowelled finish	sq m	0.04	-	-

			Skilled worker	Tar/bitumen sprayer	Mazdoor/ bhisti
296.	Tack coat of hot bitumen to top of roof slabs, including preparation of surfaces (and blinding with pea gravel if ordered)	sq m	-	0.02	0.04
297.	Priming roof surface with bituminous emulsion primer	sq m	-	0.02	0.02
298.	Four course normal waterproofing treatment consisting of first and third course of hot bitumen coat, second course consisting of bituminous felt and fourth course of grit/pea gravel blinding (grading of surface initially to slopes not included)	sq m	0.01	0.07	0.11
299.	Six course heavy waterproofing treatment consisting of first, third and fifth courses of hot bitumen coat, second and fourth courses consisting of bituminous felt and sixth/final course consisting of grit/pea gravel blinding (-ditto-)	sq m	0.02	0.11	0.16
300.	Cutting groove in wall and making good after tucking in waterproofing treatment	metre	0.07	-	0.07
301.	C.I. socketed rain water pipes, fixed to walls, cement mortar joints, upto 150 mm dia, including securing clamps/holder bats	metre	0.11	-	0.22
302.	Accessories/specials for C.I. socketed pipes :-				
	(a) Offsets, bends, elbows, shoes, diminishing pieces, rain water heads etc.	Each	0.14	-	0.22
	(b) Branches single	Each	0.30	-	0.22
	(c) Branches double	Each	0.37	-	0.22

LABOUR CONSTANTS

Sl. No.	Description of work	Labour constant in days for a team of one carpenter and one mazdoor together			
		Fixed with nails	Fixing with screws	Add if fixed to ceiling	Fixed by other means as described
		Unit of work : per square metre			
	CEILINGS, LININGS AND WALL BOARDING				
	Note : *For work in narrow widths as in pelmets and the like increase respective labour constants by 30%.*				
303.	A.C. building boards 4 to 7 mm thick, fixed with countersunk srews, holes drilled, screw heads covered with plaster of paris	-	0.09	0.03	-
304.	Fibre insulation boards, particle insulation boards and tiles (plain or perforated), wood wool building slabs and the like.	0.05	0.07	0.02	-
305.	Wood wool building slabs fixed with hot blown type bitumen (Labour for a team of one bitumen worker, one mazdoor and one carpenter). ...	-	-	-	0.03
306.	Standard or tempered hard board	-	0.08	0.02	-
307.	Plywood of any description or thickness upto 12 mm	0.05	0.07	0.03	-
308.	Wood particle boards, any type, upto 25 mm thick	0.04	0.06	0.03	-
309.	Block board, any thickness	-	0.08	-	-
310.	Hessian cloth/other textiles fixed with nails	0.04	-	0.01	-
311.	Mineral wool or glass fibre blankets, cut to required size/shape and placed in walls or ceilings as per manufacturer's instructions	-	-	-	0.07
312.	Decorative laminates ('Formica' etc) fixed with adhesive to timber or timber based surfaces	-	-	-	0.35
		Unit of work : per metre			
313.	Fixing cover strips of any material with screws over joints, including mitres at intersections	-	0.01	0.01	-

PAVINGS AND FLOOR FINISHES

		Labour constants in days per sq m	
		Mason/paviour	Mazdoor/bhisti
	(Constants in flooring section include for labour in mixing mortar/concrete wherever relevant)		
314.	75 mm thick lime concrete sub-base for floors	0.05	0.28
315.	100 mm thick cement concrete sub-base for floors	0.05	0.30
316.	Add or deduct from items 314 and 315 for every 5 mm thickness over or under.	-	0.01
317.	25 mm thick floor finish consisting of cement concrete laid in bays to an even finish	0.04	0.17
318.	Extra over item 317 for :-		
	(a) Each 5 mm of additional thickness of floor finish ...	-	0.03
	(b) finishing to a fine steel trowelled smooth surface without using extra cement.	0.03	0.01
	(c) -Do- but using extra cement	0.02	0.01
	(d) making chequered impressions	0.01	0.01
	(e) 2 to 3 mm thick finishing coat with neat cement mixed with pigment and fine sand, steel trowelled to a fine smooth surface (machine polishing not included)	0.05	0.01

Note : *Labour constants given in items 317 and 318 (a), (b) and (d) also apply to granolithic topping of floors.*

LABOUR CONSTANTS

Sl. No.	Description of work	Labour constants in days per sq m	
		Mason/ paviour	Mazdoor/ bhisti
319. (a)	15 mm thick wearproof topping, incorporating metallic hardener (such as 'Ironite' etc.,) with granolithic concrete mix, laid in bays and finished fair and even with a steel trowel ...	0.06	0.15
(b)	-Do- but 20 mm thick	0.07	0.17
320.	Treating floor with three dressings of sodium silicate solution	-	0.03
321.	Brushing or sprinkling subfloors with neat cement slurry	0.01	0.01
322. (a)	Precast concrete slabs 40 mm thick, in flooring, bedded on 15 mm thick layer of mortar, jointed and pointed flush (including labour in making precast slabs)	0.15	0.40
(b)	-Do- but 50 mm thick	0.16	0.45
(c)	As in (a) above but except labour in making precast slabs	0.13	0.32
(d)	As in (b) above but except -do-	0.14	0.37
(e)	Add to items (a) or (b) above if precast slabs are finished smooth using extra cement ...	0.04	0.01
323.	Brick floor using old size conventional bricks :-		
	(a) bricks laid flat :		
(i)	laid dry on 25 mm thick sand cushion, joints filled with sand ...	0.02	0.07
(ii)	-do- but joints pointed flush in cement mortar	0.07	0.16
(iii)	bedded grouted and pointed flush in same mortar as work proceeeds ...	0.09	0.18
	(b) bricks laid on edge :		
(i)	As in (a) (i) above	0.03	0.09
(ii)	As in (a) (ii) above	0.08	0.17
(iii)	As in (a) (iii) above	0.10	0.19
324.	Stone sett paving, laid to herringbone or other pattern, using stone setts of size 20 to 25 cm long, 15 to 20 cm wide and 15 cm deep, bedded on 20 mm layer of mortar, 20 mm joints filled with mortar (with admixture of metallic hardener), and finished flush	0.85	0.30
325.	Extra over item 324 for area of floor in edging using stone setts 45 cm deep	1.45	0.50
326.	Self faced sandstone/limestone slabs 25 to 40 mm thick, bedded (average 15 to 20 mm bedding), jointed and pointed in any mortar (including rough dressing and squaring to edges) ...	0.16	0.11
327.	Self faced limestone such as 'Shahbad' or 'Kudappah' slabs 25 to 30 mm thick (using ready polished slabs of uniform size) bedded on 10 to 20 mm thick layer with fine flush pointed joints in any mortar.	0.12	0.11
328.	Add to item 327 if in treads and risers of steps, and in skirting	0.06	0.05
329.	Add to item 327 if in dado	0.10	-

Note on polisher :*Labour constant given in IS : 7272 (Part I) for machine polishing @ 0.50 day per sq m of polisher and 0.40 day per sq m of polishing machine appears to be much too high as per trade enquiries made with polishing sub-contractors. Further, considering idle time of machine, constant for the polisher and polishing machine may be taken as same.*

Sl. No.	Description of work	Labour constants in days per sq m		
		Mason/ paviour	Polisher	Mazdoor/ bhisti
330.	10 mm thick terrazo cast in situ in floors, including cutting grinding and polishing (underlayer and devider strips not included)	0.10	0.12	0.22
331.	Add or deduct from item 330 for each mm of thickness over or under ...	0.005	-	0.015
332.	Extra over terrazo topping cast in situ, for work in :-			
(a)	borders/margins in different shade, 7 to 30 cm wide	0.02	-	0.02
(b)	treads/risers of steps, and skirting (hand polished)	0.03	0.18	0.03
(c)	dado (hand polished)	0.05	0.18	0.03

LABOUR CONSTANTS

Sl. No.	Description of work	Labour constants in days per sq m		
		Mason/ paviour	Polisher	Mazdoor/ bhisti
333.	Precast cement/terrazo tiles (initial machine cut to top surface given during manufacture in factory), set jointed and pointed in neat cement slurry, in floors, including cutting and polishing with machine (screed not included) ...	0.10	0.10	0.20
334.	Add to item 333 if in dado or full tile high skirting, hand polished (backing screed not included)	0.04	0.18	0.04
335.	Add to item 333 if in half tile high skirting or in risers and treads of steps, hand polished (-do-)	0.05	0.15	0.05
336.	Bees wax polishing to terrazo cast in situ finish or to cement/terrazo tiles in floor, dado/skirtings etc., ...	-	0.02	0.02
337.	Glazed earthenware tiles, about 15 cm x 15 cm in size (or of rectangular shape), 6 mm thick, in floors, set, jointed and pointed in neat cement (screed not included)	0.55	-	0.55
338.	-Do- but in skirtings and dado, including on window cills (-do-) ...	0.65	-	0.65
339.	Linoleum cut to size and laid loose in floor	0.01	-	0.01
340.	Rubber sheets or PVC sheets, with or without integral fibre or asbestos backing, or linoleum sheets, cut to size and sealed down in floors with approved adhesive ...	0.08	-	0.04
341.	Rubber tiles/PVC tiles/PVC asbestos tiles, laid with approved adhesive in floor ...	0.10	-	0.05
342.	Wood block (parquet) flooring laid to pattern, using ready manufactured blocks 19 to 40 mm thick, bedded and jointed in hot or cold bitumastic (screed, sanding and polishing is not included in the constants)	0.15	-	0.15
	Note : *Labour constants for two block border/margin, nosing to floor, and raking cutting for parquet flooring will be 0.40 day per metre and for circular cutting 0.12 day per metre of pavior/carpenter.*			
343.	Screeding to floors average 15 mm thick in cement/lime mortar to required levels/ falls (preparatory to laying floor finish)	0.06	-	0.12
344.	Add or deduct from item 343 for every 5 mm thickness less or more ...	0.01	-	0.02

Sundry Labours - Floor Finishes

		Labour constants in days per running metre	
		Mason/pavior	Mazdoor/bhisti
345.	Extra over cast-in-situ finishes (such as terrazo, ordinary or granolithic concrete - with or without metallic floor hardener etc.) for following labours :		
	(a) internal rounded angles, internal coving, or external angle or champher or nosing upto 25 mm radius	0.03	0.03
	(b) fair stopped edge	0.02	0.02
	(c) aluminium/plastic/asbestos/glass deviding strips to form bay :		
	(i) in floors	0.02	0.02
	(ii) in vertical faces	0.025	0.02
	(d) Aluminium (or any other kind) angle or non-slip pattern edging to treads of steps.	0.02	0.01
346.	Raking cutting to floor finish consisting of :-		
	(a) bricks laid flat	0.03	-
	(b) bricks laid on edge	0.04	-
	(c) cement/terrazo tiles	0.10	0.02
	(d) glazed earthnware tiles	0.10	-
	(e) rubber/vinyl/PVC asbestos tiles	0.02	0.01

Note : *For circular cutting increase the labour constants in item 346 (c) to (e) by three times. No addition required on item 346 (a) and (b).*

Sl. No.	Description of work	Labour constants in days per sq m		
		Plasterer	Mazdoor	Bhisti

PLASTERING AND POINTING

Notes : *(a) Labour constants for plastering and pointing include for mixing mortar. They do not include for raking out joints. Raking out joints as the work proceeds is included in labour constants for brickwork/stonework.*

(b) For work in the following situations labour constants for plasterer (but not for mazdoor/bhisti) should be increased using the multipliers indicated below :-

Situation		Multiplier
Circular work	...	2
Spherical surfaces	...	3.5
Patch repairs/small quantities	...	1.5
Sides and soffits of beams	...	2

347. 15 mm thick plastering, one coat work, finished even fair and smooth in ceilings and soffits	0.08	0.11	0.05
348. 15 mm thick rendering, evenly finished, to fair faces of brickwork or to concrete surfaces including scoring surface for next coat/key for tiling etc., where required.	0.05	0.11	0.04
349. -Do- but to rubble masonry walls or to rough face of one brick thick walls built in old size bricks	0.07	0.11	0.04
350. Add or deduct from items 347 to 349 for every variation of 5 mm in the thickness of plaster (prorata for variations less or more than 5 mm)	0.015	0.015	-
351. Add to items 348 and 349 if work is executed as plaster in single coat finished to an even, fair and smooth surface without using extra cement	0.01	0.01	-

Notes : *(i) In the case of plastering in two coats, constants given in items 348, 350 and 351 will apply for the second coat.*

(ii) If third (final) coat is to be applied as a setting coat, labour constants for the second coat will be same as in items 348 and 350.

(iii) Labour time for bhisti for second coat mentioned in (i) and (ii) above may be reduced by 50% if the second coat is applied within 2 or 3 days, thus not requiring curing of the first coat for full 7 days.

352. Setting coat in cement mortar 3 to 6 mm thick finished to a hard even, fair and smooth surface, in walls	0.05	0.05	0.02
353. -Do- but in ceilings and soffits	0.07	0.05	0.02
354. Slaking selected fat lime, sifting to obtain fine lime putty, and applying neeru finish 1 to 2 mm thick to obtain an even, fair and smooth surface polished with a steel trowel as final coat to walls	0.06	0.06	0.01
355. -Do- but in ceilings	0.08	0.06	0.01
356. Sand faced plaster consisting of 5 mm thick coat of cement plaster (on previously rendered surface) and tapping it all over with cork lined wooden float to produce a sand grained texture	0.05	0.05	0.02
357. Applying rough cast cement plaster coat (on previously rendered surface which is still green)	0.06	0.06	0.03
358. Extra labour required in providing dry pebble dash finish (on and immediately after freshly applied rendering)	0.04	0.03	-
359. Taking down old plaster from brick or stone walls, raking out the joints, hacking for key and scrubbing down, where old plaster is in :-			
(a) mud mortar	-	0.08	-
(b) lime mortar	-	0.15	-
(c) cement mortar / gauged mortar	-	0.23	-

LABOUR CONSTANTS

Sl. No.	Description of work	Labour constants in days per runing metre	
		Plasterer	Mazdoor
360.	Extra labour in plastering for :-		
(a)	work in isolated unconnnected portions upto 30 cm width or girth including cutting to edges, stopped ends, forming corners etc., as in bands, skirtings etc.	0.04	0.04
(b)	neatly finishing wall plaster at junction of wall with treads and risers of steps, nosings or in exposed stepped skirting of stairs (each edge measured)	0.01	0.01
(c)	forming external or internal rounded angles exceeding 80 mm and not exceeding 200 mm girth.	0.08	0.08
(d)	forming V or square grooves in plaster upto 10 mm wide on face and upto 10 mm deep ...	0.03	-
(e)	-Do- but upto 15 mm wide on face and upto 15 mm deep	0.05	-
(f)	cornices upto 150 mm girth to required profile	0.07	0.07
(g)	-do- but exceeding 150 mm and upto 225 mm in girth	0.09	0.09
(h)	-do- but exceeding 225 mm and upto 300 mm in girth	0.10	0.10
361.	Time required for sundry labours given in (a) to (f) below is already included in relevant constants for plastering :-		
(a)	Forming slightly rounded internal or external angles	0.02	0.02
(b)	Forming internal or external rounded angles, 25 mm girth	0.03	0.03
(c)	-Do- but 60 mm girth (not requiring any cutting of masonry)	0.05	0.05
(d)	-Do- but 80 mm girth (-ditto-)	0.07	0.07
(e)	Forming square or champhered finished edges (upto 15 mm thick) to raised plaster panels or to skirting/dado projecting beyond the general face of plaster	0.01	0.01
(f)	-Do- but for plaster raised by more than 15 mm beyond general face	0.02	0.02

Sl. No.	Description of work	Labour constants in days per sq m	
		Plasterer	Mazdoor/ bhisti
362.	Raking out joints of old brick walls built in :-		
(a)	mud mortar	-	0.06
(b)	lime mortar	-	0.10
(c)	cement/cement-lime mortar	-	0.12
363.	Raking out joints of old rubble masonry or concrete block walling in :-		
(a)	mud mortar	-	0.05
(b)	lime mortar	-	0.06
(c)	cement/cement-lime mortar	-	0.07
364.	Raking out joints of old self faced stone slab floor or precast concrete slab floor pointed in cement mortar	-	0.03
365.	Raking out fresh mortar joints of rubble walling as work proceeds	0.03	-
366.	-Do- but of brick walling, as work proceeds	0.04	-
367.	Pointing on brickwork :-		
(a)	Flush, in different mortar as a separate operation	0.08	0.12
(b)	Ruled or keyed	0.09	0.12
(c)	Cut or weather struck	0.10	0.12
(d)	Raised and cut	1.70	0.40
368.	Pointing on brick flooring laid flat :-		
(a)	Flush, in different mortar as a separate operation	0.05	0.10
(b)	Ruled	0.06	0.10

Sl. No.	Description of work	Labour constants in days per sq m	
		Plasterer	Mazdoor/ bhisti
369.	Pointing on brick flooring laid on edge :-		
	(a) Flush, in different mortar as a separate operation	0.06	0.10
	(b) Ruled	0.08	0.10
370.	Pointing to brick tile flooring :-		
	(a) Flush, in different mortar as a separate operation	0.03	0.07
	(b) Ruled	0.04	0.07
371.	Pointing to brick tile facing, with bricks laid flat in stretchers :-		
	(a) Flush, in different mortar as a separate operation	0.12	0.16
	(b) Ruled	0.13	0.16
	(c) Cut or weather struck	0.16	0.16
	(d) Raised and cut	1.90	0.40
372.	Pointing on concrete block walling or on coursed ashlar stone masonry :-		
	(a) Flush, in different mortar as a separate operation	0.08	0.12
	(b) Ruled or keyed	0.09	0.12
	(c) Raised and cut (or tuck pointing)	0.17	0.17
373.	Pointing on random rubble stone masonry, uncoursed/brought upto courses :-		
	(a) Flush, in different mortar as a separate operation	0.10	0.14
	(b) Ruled or keyed	0.11	0.14
	(c) Raised and cut (or tuck pointing)	0.20	0.20
374.	Pointing on squared rubble stone masonry, coursed or uncoursed :-		
	(a) Flush, in different mortar as a separate operation	0.09	0.13
	(b) Ruled or keyed	0.10	0.13
	(c) Raised and cut (or tuck pointing))	0.19	0.19
375.	Pointing to self faced stone slab flooring or precast concrete slab floor :-		
	(a) Flush, in different mortar as a separate operation	0.04	0.08
	(b) Ruled or keyed	0.05	0.08

WHITE / COLOUR-WASHING, DISTEMPERING ETC.

	Category of Labour	Labour constant in days per 10 sq m			
		Walls		Ceilings	
376. Brooming down plastered/unplastered surfaces of new or old work.	Mazdoor	0.02		0.03	
377. Cleaning old decorated surfaces using steel wire brushes/sand paper.	Mazdoor	0.03		0.05	
378. Preparing old decorated surfaces spoiled by smoke/soot by scraping and washing with water or cleaning with soap/caustic soda and water, or removing grease/oil spots with chemicals.	Mazdoor	0.10		0.15	
379. Complete removal of old decorative treatment like distemper etc.	Mazdoor	0.15		0.22	
		First coat	Each subsequent coat	First coat	Each subsequent coat
380. Clearcolling plastered surfaces	Lime-washer	0.06	-	0.07	-
	Mazdoor	0.03	-	0.03	-
381. Chalk whitening/lime washing to new, or to undecorated plastered surfaces.	Lime-washer	0.07	-	0.10	-
	Mazdoor	0.03	-	0.04	-

LABOUR CONSTANTS

Sl. No.	Description of work	Category of Labour	Labour constants in days per 10 sq m			
			Walls		Ceilings	
			First coat	Each subsequent coat	First coat	Each subsequent coat
382.	White washing/colour washing, each subsequent coat or renewal coat	Lime-washer	-	0.06	-	0.08
		Mazdoor	-	0.03	-	0.04
383.	Sizing plastered surface with oil-size putty to a hard, smooth and even surface	Painter	0.36	-	0.43	-
384.	Applying ordinary dry washable distemper ...	Painter	0.20	0.13	0.25	0.16
		Mazdoor	0.05	0.04	0.05	0.04
385.	Applying oil bound washable distemper or acrylic emulsion paint	Painter	0.25	0.20	0.30	0.24
		Mazdoor	0.06	0.05	0.06	0.05
386.	Applying waterproof cement paint (such as 'Snowcem' etc.	Painter	0.30	0.25	-	-
		Mazdoor	0.10	0.10	-	-
		Bhisti	0.10	0.10	-	-

Note : *Add 30% extra labour on items 381, 382, or 384 to 386 if work is done on rough cast plaster/pebble dash surface.*

GLAZING

Sl. No.	Description of work	Labour constant for glazier in days per sq m of work			
		Upto 0.10 sq m per pane	Exceeding 0.10 and not exceeding 0.50 sq m per pane	Exceeding 0.50 and not exceeding 1 sq m per pane	Exceeding one sq m per pane
387.	Cutting glass panes to required dimensions (preparatory to glazing) of :-				
	(a) clear/ready- frosted sheet glass of ordinary or selected glazing quality 2 to 4.8 mm thick	0.07	0.06	0.05	0.04
	(b) -ditto- but 5.5 or 6.3 mm thick	0.09	0.07	0.06	0.05
	(c) figured, patterned or pin headed glass 3 or 4 mm thick.	0.08	0.07	0.06	0.05
	(d) -ditto- but 5 to 6 mm thick	0.09	0.08	0.07	0.06
	(e) rough cast wired glass 6.4 mm thick ...	0.10	0.09	0.07	0.06
	(f) rough cast wired and figured/patterned glass 6.4 mm thick.	0.11	0.10	0.08	0.07
	(g) heat absorbing ('Calorex' etc) glass 3 mm thick.	0.07	0.06	0.05	0.04
	(h) -ditto- 5 or 6 mm thick	0.09	0.07	0.06	0.05
	(i) 6 mm thick polished plate glass	0.09	0.07	0.06	0.05

[Before using constants given below on this page, please refer notes applicable to item 388 given on next page]

Sl. No.	Description of work	Labour constant for glazier in days per sq m				
		Timber doors/windows/partitions			Metal doors/windows	
		With putty	With beads fixed with sprig/brads/ panel pins	With beads fixed with cups and screws	With putty	Fixed with metal beads
388.	Glazing in any kind of glass of any thickness, using glass panes cut to required dimensions (for cutting see item 387) in panes of sizes :-					
	(a) not exceeding 0.10 sq m per pane ...	0.18	0.19	0.23	0.20	0.21
	(b) 0.10 to 0.50 sq m per pane	0.14	0.15	0.18	0.16	0.17
	(c) 0.50 to 1 sq m per pane	0.10	0.11	0.13	0.12	0.12
	(d) exceeding 1 sq m per pane	0.08	0.09	0.11	0.10	0.11

Sl. No.	Description of work	Unit of work	Labour constants in days of glazier
	Notes applicable to item 388 :-		
	(i) Add 0.01 day of mazdoor or helper per sq m of work to the constants given in item 388 (a) and 388 (b)		
	(ii) Add 0.03 day of mazdoor or helper per sq m of work to the constants given in item 388 (c) and 388 (d).		
	(iii) Add 10% to the constants of glazier for work in second storey and above if done from outside standing on scaffolds.		
	(iv) Add 50% to the constants of glazier for work done off ladders, in small quantities.		
389.	Sundry glazier's work :-		
	(a) Grinding, obscuring or frosting clear glass at site of work	sq m	0.17
	(b) Silvering (for mirrors)	sq m	0.65
	(c) Hack out broken glass and putty/remove glass and beads, from timber joinery.	sq m	0.25
	(d) Hack out broken glass and putty from metal casements including removing/ punching out old spring clips/pins etc.	sq m	0.30
	(e) Salvaging old serviceable glass from wooden or metal casements and removing to store	sq m	0.40
	(f) Grinding and rounding off edges of glass of any type below 4 mm in thickness.	m	0.05
	(g) -Ditto- but 4 mm in thickness	m	0.07
	(h) Circular cutting on glass upto 4 mm thick	m	0.13
	(i) -Ditto- but exceeding 4 mm thick	m	0.16
	(j) Drilling holes upto 12 mm dia in glass not exceeding 4 mm thick ...	Each	0.02
	(k) -Ditto- but in glass exceeding 4 mm thick	Each	0.03
	(l) Fixing mirror with plywood backing to wall with 4 dome headed chromium plated screws, including plugging to walls ...	Each	0.20

PAINTING, POLISHING, VARNISHING, TARRING, OILING ETC.

Notes :*Labour constants given in this section, unless mentioned otherwise, are for plain surfaces measured nett. Before working out a rate for an item of work as displayed in the Bill of Quantities to be priced, the labour constant should be adjusted where applicable by the multiplying factor mentioned against various types of uneven surfaces listed in the table given below. If the method of measurement adopted for working out quantities varies with the method of measurement mentioned in the table below, further adjustments in the constants may become necessary.*

Method of Measurement

(a) All measurements to be taken flat, i.e. not girthed.

(b) Areas of timber or metal doors / windows etc., to be measured flat on face inclusive of frame / chowkat. Edges, chocks, cleats, beads fittings etc., shall not be measured separately. No deduction to be made for glass panes or gauzed areas.

(c) Tile / slate battening to be measured flat overall, not girthed, and no deduction to be made for open spaces between battens.

(d) Trellis work, guard bars, balusters, gratings, grills, XPM / weldmesh, steel railings and gates, open palisade fencing and the like to be measured flat overall without deducting open spaces, and supporting members / frames etc., not to be measured separately.

(e) Steel rolling shutters / collapsible gates to be measured for the size of opening. Top cover of rolling shutters to be measured separately for both (internal and external) faces.

LABOUR CONSTANTS

Multipliers for converting uneven surfaces into equivalent plain area

Description of uneven surface	Multiplier to obtain equivalent plain area	Description of uneven surface	Multiplier to obtain equivalent plain area
	For each side		**For each side**
Panelled or battened joinery	1.30	Partly glazed or gauzed and partly steel sheet cladded steel doors .	0.80
Flush doors	1.20	Corrugated steel sheets	1.14
Glazed or gauzed joinery	0.80	Corrugated A. C. sheets	1.20
Partly panelled and partly glazed/gauzed joinery	1.00	Semi-corrugated A. C. sheets	1.10
Fully venetianed/louvred joinery	1.80		**For painting all over**
Weather boarding	1.20	Wooden trellis or jaffri	2.00
Wood shingle roofing	1.10	Tile/slate roof battening	0.80
Steel rolling shutters	1.10	Guard bars, gratings, grills, XPM/weldmesh, gates etc.	1.00
Fully glazed or gauzed steel doors and windows	0.50	Collapsible shutters or gates	1.50

Sl. No.	Description of work	Unit of Work	Labour constant in days of painter or polisher	
			First Coat	Each subsequent coat

Note : *Constants given for painting and allied work are for working off the floor or scaffolding. For ladder work where scaffolding is not provided painter's time should be increased by 15% and an additional allowance of one mazdoor for 2 painters (or 50% of painter's time) made.*

390.	Prepare surface and apply creosote oil or linseed oil or a coal tar mixture to timber or wood based surfaces	10 sq m	0.25	0.15
391.	Tarring to small articles like holdfasts, gully gratings, ends of posts, or backs of chowkats etc., where area of tarring is less than 0.10 sq m per article.	100 Nos	0.50	-
392.	Tarring ends of posts, backs of chowkats and the like, where area of tarring exceeds 0.10 and does not exceed 0.50 sq m per article.	100 Nos.	1.00	-
393.	Prepare timber / wood based surfaces and apply :-			
	(a) bees-wax polish	10 sq m	1.00	0.60
	(b) varnish	10 sq m	1.65	0.90
	(c) French polish	10 sq m	3.50	1.90
	(d) French polish to faces of teak lipping of block-boards, drawer tops and similar narrow widths (upto 40 mm wide) unconnected with other polished areas	10 m	0.75	0.60
			New work including cleaning surfaces and setting out	Renewal coat
394.	Painting traffic lines by hand, single coat, 10 cm wide with road marking paint on concrete pavements or tar roads (gaps between short lengths to be deducted	10 m	0.10	0.08
395.	Painting traffic lines/letters/signs/arrows/dashes etc., exceeding 10 cm wide on -ditto- (-ditto-)	sq m	0.30	0.25

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of Work	Labour constants in days of oil painter				
			Prepare surface	Knotting/ stopping	Priming coat	Under coat	Finishing coat
	Note : *Reduce constants in items 398 and 399 by 20% for undercoat/finishing coat if aluminium paint is used.*						
396.	Painting timber surfaces with ready mixed oil paint/ natural or synthetic enamel paint	10 sq m	0.20	0.15	0.25	0.35	0.37
397.	Painting to wood based surfaces like block board, plywood etc., with -do-	10 sq m	0.12	0.10	0.25	0.35	0.37
398.	Painting to metal surfaces with -do- ...	10 sq m	0.12	-	0.35	0.35	0.35
399.	Painting to small metal articles like switch-blocks, straps etc., if unconnected with other painting work.	100 Nos	0.60	-	1.50	1.85	1.90
400.	Painting to concrete surfaces or smooth finished plaster surfaces or asbestos cement surfaces ...	10 sq m	0.15	-	0.30	0.35	0.37

Painting letters etc. on walls / pavements / roads	Unit of work	Labour constants in days of painter
401. Painting in background (white/black or any other colour) of any size or shape, preparatory to painting in letters	sq m	0.30
402. Painting letters upto 2 cm high on any smooth surface like plastered walls etc.	10 Nos	0.10
403. Extra over item 402 for every cm additional height above 2 cm ...	10 Nos	0.04
404. Painting commas, stops, hyphens, brackets, etc., any size	10 Nos	0.04

Hanging wall paper	Labour constants in days of paper-hanger per 10 sq m	
	Walls	Ceilings
405. Stripping old paper and cleaning	0.10	0.10
406. Cleaning down surfaces and stopping holes etc.	0.06	0.06
407. Sizing to surfaces	0.04	0.06
408. Hanging lining or ordinary wall-paper	0.20	0.30
409. Hanging wall-paper of light raised pattern	0.30	0.42
410. Hanging wall-paper of heavy raised pattern or of heavy fabric pattern ...	0.50	0.70

WATER SUPPLY, PLUMBING, DRAINS AND SANITARY FITTINGS

	Unit of Work	Labour constant in days of	
		Pipe layer	Mazdoor
411. Laying, aligning and keeping ready for jointing, in trenches or on ground, cast iron pipes for water / sewage mains, of any class or kind, in any length per pipe, spigot and socket or flanged (excavation, earthwork and jointing of pipes not included)	Per Quintal	0.07	0.14
412. Laying aligning and keeping ready for jointing, in trenches or on ground, specials suitable for spigot and socket or flanged cast iron pipes of any class or kind (-ditto-)	Per Quintal	0.14	0.35

Notes : *(a) To work out labour constant per metre for laying cast iron pipes, multiply the total weight in quintals of 10 pipes by the constants given in item 411 for each category of labour, and devide the product by the length of 10 pipes in metres as laid.*

(b) To work out labour constants for laying only of each special fitting for cast iron pipes, multiply weight of each fitting in quintals by the labour constant per quintal for each category of labourer given in item 412.

Sl. No.	Description of work	Labour constant in days per joint for a team of one jointer and one mazdoor			
		Type of joint			
		For spigot and socket pipes			For flanged pipes
		Run lead	Lead wool	Using rubber gaskets such as 'Tyton'	With rubber or fibre board inserts, bolts and nuts
413.	Joints between cast iron pipes and cast iron pipe/specials, of :-				
(a)	80 mm diameter	0.11	0.09	0.04	0.05
(b)	100 mm diameter	0.14	0.12	0.05	0.06
(c)	125 mm diameter	0.16	0.14	0.06	0.07
(d)	150 mm diameter	0.18	0.16	0.07	0.08
(e)	200 mm diameter	0.27	0.23	0.10	0.12
(f)	250 mm diameter	0.36	0.30	0.13	0.14
(g)	300 mm diameter	0.40	0.33	0.15	0.16
(h)	350 mm diameter	0.49	0.40	-	0.19
(i)	400 mm diameter	0.55	0.46	-	0.21
(j)	450 mm diameter	0.70	0.62	-	0.23
(k)	500 mm diameter	0.80	0.68	-	0.27

	Unit of Work	Category of Labourer	Labour constant in days				
			Diameter of pipe / pipe special in mm				
			80 mm	100 mm	150 mm	250 mm	300 mm
414. Laying only asbestos cement pressure pipes of any class in trenches or on ground, (of any length per pipe)	per m	Pipelayer	0.02	0.02	0.03	0.05	0.06
		Mazdoor	0.03	0.05	0.09	0.15	0.18
415. Laying only cast iron specials suitable for asbestos cement pressure pipes	Each	Pipelayer	0.01	0.01	0.02	0.06	0.07
		Mazdoor	0.02	0.02	0.05	0.12	0.14
416. Making joint between asbestos cement pressure pipes or between pipes and cast iron specials, using cast iron detachable joint with gasket.	Each	Pipelayer	0.08	0.10	0.17	0.35	0.40
		Mazdoor	0.08	0.10	0.17	0.35	0.40

	Labour constant in days per metre		
	Pipelayer	Jointer (or mason)	Mazdoor
417. Reinforced concrete pipes laid and jointed with concrete collar, plastic ring insert, jute braiding dipped in bitumen and collar caulked with cement mortar for :-			
(a) 100 mm dia pipes	0.02	0.08	0.10
(b) 150 mm dia pipes	0.03	0.09	0.11
(c) 200 mm dia pipes	0.04	0.12	0.14
(d) 250 mm dia pipes	0.05	0.15	0.20
(e) 300 mm dia pipes	0.10	0.20	0.28
(f) 450 mm dia pipes	0.15	0.35	0.50
(g) 500 mm dia pipes	0.20	0.45	0.65

Note : *Where single length of concrete pipe is to be laid (as in cross-drain for foot paths etc.,) jointer's time is not to be added.*

LABOUR CONSTANTS

Sl. No.	Description of work	Category of Labourer	Labour constants in days per metre Internal diameter of pipes in mm 15	20	25	32	40	50
418.	Steel water tubing, any grade, with screwed socket joints, including cutting/threading pipes where required and fixing tube fittings such as bends, single or double tee junctions connectors, unions, backnuts etc., (but not including fixing of fixtures such as taps, showers, stop-cocks etc.,) :-							
	(a) laid in trenches (excavation/earthwork not included)	Plumber	0.01	0.01	0.01	0.01	0.02	0.02
		Mazdoor	0.02	0.02	0.03	0.03	0.03	0.03
	(b) fixed to walls, ceilings or floors, secured with clips/wall hooks including plugging (cutting chases for concealed work excluded)	Plumber	0.07	0.08	0.08	0.08	0.10	0.11
		Mazdoor	0.07	0.07	0.07	0.10	0.13	0.16

			External diameter of pipes in mm 16	20	25	32	40	50
419.	Polythelene and unplasticised PVC pipes, low or high density, including all necessary specials, cutting and jointing as specified :-							
	(a) laid in trenches (excavation/earthwork not included)	Plumber	0.01	0.01	0.01	0.01	0.02	0.02
		Mazdoor	0.01	0.01	0.01	0.01	0.01	0.01
	(b) fixed to walls, ceilings or floors, secured with clips/wall hooks including plugging (cutting chases for concealed work excluded)	Plumber	0.05	0.06	0.06	0.06	0.08	0.09
		Mazdoor	0.05	0.05	0.05	0.05	0.06	0.07

			Labour constant in days (Unit : Each) Internal diameter of pipes in mm 50	80	100	150	250	300
420.	Cutting cast iron pipes for reducing to required length before laying, including filing to remove burrs etc.,	Fitter	0.08	0.12	0.15	0.23	0.30	0.40
		Mazdoor	0.08	0.12	0.15	0.23	0.30	0.40

			Internal diameter of pipes in mm (Unit = Each) Upto 15	20	25 & 32	40 & 50
421.	Cutting steel water tubing to required length and cutting threads on cut end for screwed socket joints	Plumber	0.04	0.06	0.08	0.16
		Mazdoor	0.03	0.03	0.04	0.05

		Labour constant in days per fitting Plumber	Mazdoor
422.	Fixing to water supply tubing :-		
	(a) Taps and cocks of any kind and diameter	0.05	0.05
	(b) Stop-cocks, stop valves and gate valves other than in concealed work :-		
	(i) upto 20 mm dia	0.06	0.06
	(ii) 25 and 32 mm dia	0.08	0.08
	(iii) 40 and 50 mm dia	0.09	0.09
	(c) Ball valves :-		
	(i) upto 20 mm dia	0.05	0.05
	(ii) 25 and 32 mm dia	0.07	0.07
	(iii) 40 and 50 mm dia	0.08	0.08
	(d) Shower rose suitable for 15 to 20 mm dia pipe	0.06	0.06

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of Work	Category of Labourer	Labour constants in days (of 8 hours) per unit of work		
				Internal diameter of pipes / specials		
				50 mm	75 mm	100 mm
423.	Cast iron (spun or sand cast) spigot and socket, soil, waste and vent pipes, with or without ears, fixed to walls, including jointing with spun yarn and cement mortar (fittings measured separately).	per m	Plumber Mazdoor	0.04 0.08	0.05 0.09	0.05 0.10
424.	-Ditto- but laid in trenches or under floor	per m	Plumber Mazdoor	0.03 0.04	0.03 0.04	0.03 0.05
425.	Fixing cast iron fittings suitable for pipes in items 423 & 424 above, including cutting of pipes where required, and extra joints in spun yarn and cement mortar :-					
	(a) bends, duck foot bends, diminishing pieces, single branches, swan necks, with or without access doors	Each	Plumber Mazdoor	0.05 0.08	0.06 0.09	0.06 0.11
	(b) Double branches	Each	Plumber Mazdoor	0.06 0.08	0.07 0.09	0.07 0.11
	(c) P or S trap, nahni trap or floor trap (any size of outlet)	Each	Plumber Mazdoor	- -	- -	0.15 0.20
426.	Extra over items 423 to 425 above for run lead (or lead wool) caulked joints in lieu of cement joints	per joint	Plumber Mazdoor	0.04 0.02	0.05 0.04	0.06 0.05
427.	Asbestos cement soil, waste and vent pipes fixed to walls with standard holder bats and jointed with spun yarn and cement mortar (fittings measured separately)	per m	Plumber Mazdoor	0.04 0.08	0.05 0.09	0.05 0.10
428.	Asbestos cement fittings suitable for pipes in item 427 above including cutting of pipes and extra joints where involved :-					
	(a) Bends, diminishing pieces, single branch pieces, swan necks etc., with or without access doors	Each	Plumber Mazdoor	0.03 0.03	0.04 0.04	0.05 0.05
	(b) Double branches	Each	Plumber Mazdoor	0.05 0.04	0.05 0.04	0.06 0.05
	(c) Slotted vent cowl or vent cap cowl	Each	Plumber Mazdoor	0.02 0.02	0.03 0.03	0.03 0.03

				Internal diameter in millimetres					
				100	150	200	230	250	300
429.	Salt glazed stoneware pipes for drains, laid in trenches and jointed in cement mortar as specified (excavation and earthwork excluded)	per m	Mason Mazdoor	0.07 0.14	0.10 0.17	0.12 0.19	0.13 0.22	0.15 0.23	0.17 0.25
430.	Specials for salt glazed stoneware drain pipe including extra joints (-do-)								
	(a) bends	Each	Mason Mazdoor	0.04 0.08	0.06 0.10	0.07 0.11	0.08 0.13	0.09 0.14	0.10 0.15
	(b) single Y junctions	Each	Mason Mazdoor	0.08 0.13	0.12 0.16	0.14 0.18	0.16 0.21	0.18 0.22	0.20 0.24
	(c) double Y junctions	Each	Mason Mazdoor	0.12 0.15	0.18 0.18	0.21 0.21	0.24 0.24	0.27 0.25	0.30 0.27

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of Work	Labour constants in days (of 8 hours) per unit of work	
			Plumber (or mason)	Mazdoor
431.	Fixing wash down water closet pedestal pattern, with integral P or S trap, seat and cover, low or high level flushing tank, PVC flexible pipe connection from stop cock to flushing tank, flushing pipe, and joining up (to water supply and drainage pipes separately laid)	Each	1.00	1.00
432.	Fixing water closet, squat pattern, with separate P or S trap, foot rests, high level flushing tank, PVC flexible pipe from stop cock to flushing tank, flushing pipe, including lime concrete bedding and joining up (to water supply and drainage pipes separately laid)	Each	1.30	1.30
433.	-Ditto- but without high level flushing tank (flushing pipe connected to water supply pipe controlled by self closing concussive type press cock. Fixing of press cock excluded)	Each	0.90	0.90
434.	Fixing and connecting up sink/wash hand basin, medium or large size, including brackets, pillar tap, PVC pipe connection, grating with union, discharge pipe etc., complete	Each	0.60	0.60
435.	-Ditto- but small size	Each	0.50	0.50
436.	Fixing corner or flat back urinal to wall and pointing around including fixing grating with union and discharge pipe and connection to flushing pipe ...	Each	0.40	0.40
437.	Fixing automatic cast iron flushing cistern including brackets for urinal(s), and connecting up to supply and discharge pipes	Each	0.40	0.40
438.	Fixing storage type water heaters for baths and connecting up outlets and inlets for water supply (wiring and electrical connections excluded) ...	Each	0.70	0.70
439.	Preparing foundation and installing small electric booster pump including joining up to (separately laid) pipes on suction and delivery side, and fixing foot valve, strainer etc., complete (wiring for electrical connections excluded) ...	Each	1.10	1.10
440.	Fixing and connecting up nahni trap	Each	0.20	0.20
441.	Fixing gully trap 230 x 300 mm size including inspection chamber in brick work, plastering, fixing frame for cover, etc., and connecting to drain pipe ...	Each	0.35	0.35
442.	Square manholes upto 0.30 sq m clear inner size on plan, upto 0.60 m deep, including concrete foundations, brickwork, plaster, forming haunching and half round drains, connecting up to incoming and outgoing pipes and setting frame for cover (excavation/earthwork excluded)	Each	0.65	0.65
443.	Extra over item 442 for each additional depth of 0.30 m	Each	0.25	0.25
444.	All as in item 442 but 0.45 sq m clear inner size on plan, upto 0.60 m deep ...	Each	0.80	0.80
445.	Extra over item 444 for each additional depth of 0.30 m	Each	0.35	0.35
446.	Round manholes of standard size upto 0.60 m deep, including concrete foundations etc., all as in item 442 above	Each	2.30	2.30
447.	Extra over item 447 for each additional depth of 0.30 m	Each	0.50	0.50
448.	Waterproofing sunk portions in upper floors for baths/toilets or water closets (size of enclosure upto 2.25 sq m on plan) by applying 15 to 20 mm thick waterproof plaster in rich cement mortar	Each	0.90	0.90
449.	Add to item 448 for each additional sq m on plan	Each	0.35	0.35
450.	Extra over labour constants for fixing upto 50 mm bore of pipes, if pipe runs are to be concealed in chases, including cutting chases and making good ...	per m	0.15	0.15
451.	Extra over labour constants for fixing stop cocks for work in conjunction with pipes concealed in chases	Each	0.15	0.20

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of Work	Labour constants in days (of 8 hours) per unit of work	
			Plumber (or mason)	Mazdoor (or bhisti)
452.	Fixing water meter and stop cock for the same to galvanised steel water tubing, including jam nut, socket etc., threading tube and making long screws, complete, suitable for :-			
	(a) pipes upto 25 mm dia	Each	0.30	0.30
	(b) pipes of 40 and 50 mm dia	Each	0.37	0.37
453.	Laying jointing and pointing in rich cement mortar, 150 mm dia half round salt glazed ware channels (excavation, earthwork, preparing subgrade or sub-base not included)	per m	0.05	0.10
454.	Making connection of drain or sewer line with existing manhole including breaking into and making good to walls, floor, plaster, making necessary channels etc., complete (excavation and earthwork not included) :-			
	(a) for 100 and 150 mm dia pipes	Each	0.16	0.16
	(b) for pipes exceeding 150 mm and upto 300 mm dia ...	Each	0.24	0.24
455.	Cutting existing salt glazed ware drain pipe and inserting a Y junction pipe with one loose collar and making necessary joints with stiff of cement mortar and spun yarn for :-			
	(a) 100 mm dia pipe	Each	0.50	0.50
	(b) 150 mm dia pipe	Each	0.75	0.75
	(c) 200 to 250 mm dia pipes	Each	1.25	1.25
	(d) 300 mm dia pipe	Each	1.50	1.50
456.	Testing drains, new or old, by filling with water including temporary fixing of pipes/bends, etc. to equalise pressure :-			
	(a) pipes upto 150 mm dia	per 10 metres	0.17	0.17
	(b) pipes exceeding 150 mm and upto 300 mm dia ...	per 10 metres	0.25	0.25
457.	Testing manholes, new or old, by -do-	Each	0.43	0.25
458.	Smoke testing each independant system of soil and vent pipes upto connection with manhole, using smoke testing machine (use of ladders included where necessary)	Each	0.50	0.50

ELECTRICAL WORK (INTERNAL)

Note on Point Wiring items

Labour constants for point wiring, where relevant, include for fixing of :

(a) Battens (including corners/bends etc.) screwed to rawl plugs or teak gutties, wooden blocks and boards for mounting switches/sockets/electric fittings like ceiling rose, lamp holders etc., or in the case of conduit wiring for fixing conduits, conduit fittings and accessories, joint/terminal boxes, boxes for mounting switches/sockets/fan regulators etc.

(b) Fixing cable to battens or drawing through conduits, including to and fro lead from distribution board/switches/fans/fan regulators/electrical fittings etc.

(c) Earthwire to earthing connections.

Labour constants for point wiring do not include for :-

(a) Fixing/connecting up of switches/ceiling roses/fans/fan regulators/sockets/holders etc.

(b) Submain wiring/submain earthing from main switch control board to distribution board.

(c) Cutting chases/making good for concealed conduits or for sinking of boxes.

(d) Fixing of blocks/boards for mounting distribution boards/iron clad switches.

The helper associated with wireman will be one who can carry out unimportant labours like cutting pockets in brickwork, fixing teak gutties, drilling holes for rawl plugs, handling/handing up wiring materials and the like under directions from the wireman.

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of Work	Labour constants in days (of 8 hours) per unit of work	
			Wireman or electrician	Helper or mazdoor
459.	Point wiring for one light point or fan point or bell/buzzer point controlled by one switch/push button, or for one 3 pin socket outlet fixed on an independant board :-			
	(a) on wooden battens	Each	0.45	0.75
	(b) in surface or concealed conduits (cutting chases and making good to the same for concealed work excluded)	Each	0.75	1.00
	Note : *Add 50 % extra to constants in item 459 (a) or (b) for each additional light point controlled by the same switch or for one light point controlled by two, two-way switches.*			
460.	Point wiring for 2 or 3 pin socket on the same board with other switches (for wiring on battens as well as in conduits)	Each	0.10	-
461.	Fixing and connecting up :-			
	(a) pendants, lampholders, shades, switches, push buttons, bells/buzzers ...	Each	0.04	0.04
	(b) ceiling rose	Each	0.02	0.02
	(c) fluorescent single tube light mounting rail complete with accessories, fixed directly to wall/ceiling, including plugs/gutties for fixing ...	Each	0.12	0.10
	(d) -do- but for twin tube light	Each	0.15	0.10
	(e) as in (c) or (d) above but including decorative cover reflector, grille etc.,	Each	0.30	0.10
	(f) single bulb decorative light fitting of any kind, including shade, back-plate etc., bracket or handi type	Each	0.20	0.05
	(g) 3 pin switch socket outlet	Each	0.14	-
	(h) flameproof or watertight bulk head fitting and light fitting ...	Each	0.06	0.06
	(j) ceiling fan	Each	0.16	0.16
	(k) fan regulator	Each	0.05	0.05
	(l) exhaust fan	Each	0.18	0.18
	(m) 15 to 60 amps double pole ironclad switchfuse with neutral link 240/480 volts including drilling holes on the board	Each	0.08	0.08
	(n) -do- but triple pole	Each	0.10	0.10
	(p) iron clad distribution boards, 2 to 4 ways, 250 volts, 15 amps per way, including drilling holes on boards	Each	0.09	0.09
	(q) -do- 6 to 8 ways	Each	0.11	0.11
	(r) -do- but 10 to 12 ways	Each	0.13	0.13
	(s) bus bar chamber, 3 strip, 100 amps, iron clad, 450 mm long ...	Each	0.45	0.45
	(t) -do- but 4 strip, 200 amps, 600 mm long	Each	0.50	0.50
	(v) electric meter	Each	0.40	-

			Fitter and mason	Painter	Mazdoor
462.	Framed, sheet metal clad, hinged meter fixing board, with locking arrangement, including fabrication, painting and fixing, of size 300 x 450 mm ...	Each	0.62	0.03	0.65
463.	-Ditto- but 600 x 900 mm size	Each	1.20	0.06	1.20

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of Work	Labour constants in days (of 8 hours) per unit of work	
			Lineman or wireman	Mazdoor
464.	Earthing complete, with steel plate electrode/steel pipe buried directly in ground, earth wire protected by galvanised iron pipe and connected to main switch control board, including charcoal/salt filling etc., complete (excavation/ earthwork, concrete, brickwork, setting cast iron frame and cover not included).	Each	0.75	0.75
465.	Earth connection with galvanised steel wire fixed on surface of wall or in recess (cutting chases and making good excluded)	10 m	0.12	0.12
	ELECTRICAL WORK (EXTERNAL)			
466.	Erection of steel tubular or prestressed concrete poles 9 metres long (excavation/ earthwork, concrete and transportation/unloading of poles to points along the required alignment of overhead line not included)	Each	0.33	1.20
467.	Extra over item 466 for each additional 0.5 m length of pole ...	Each	-	0.20
468.	Erection, fixing and tightening stay assembly complete including stay rod, anchor plate, thimble, stay clamps, turn buckle, stay wire etc., complete (fabrication, excavation/earthwork/concrete not included)	Each set	0.33	1.33
469.	Fixing in position cross arms of steel angle or channel sections including backplates, clamps etc., complete for 2 or 4 wire overhead line (For complete item of fabricating and fixing add 2.22 days of fitter, 0.92 days of blacksmith and further 3.30 days of mazdoor)	Quintal	1.63	3.25
470.	Fixing procelain insulators of pin/shackle/reel/loop type on cross arms of poles.	Each	0.03	0.06
471.	Running out and fixing galvanised steel bearer wire for overhead lines ...	100 m	0.13	0.56
472.	Fabricating and erecting hexagonal/rectangular/ring type cable guards made out of 4 mm galvanised steel wire	Each	0.04	0.12
473.	Running out and fixing aluminium bare conductor steel reinforced 7/2.11 mm to 7/3 mm diameter, or aluminium bare conductor 7/1.96 to 7/3.1 mm diameter including binding to insulators	100 m	0.50	2.50
474.	-Ditto- but of 7/3.35 mm diameter and above including -do- ...	100 m	0.90	3.00
475.	Fixing vice type line connectors or vice type taps for service wire ...	Each	0.05	0.10
476.	Fixing porcelain aerial fuses for line wire with brass contact bolts and nuts ...	Each	0.04	0.08
477.	Fixing 'Danger' notice plate for LT or HT overhead line ...	Each	0.03	0.06
478.	Fixing take-off service brackets/house service brackets for house service connection (Fabrication not included. Add 0.05 days of mason's time to the constants for this item).	Each	0.17	0.50
479.	Fixing twin core weatherproof 240/415 volts grade cable for service conection, including fixing 4 mm suspension wire and insulated suspension hangers 1 m apart (for run between the take-off service bracket upto house service bracket)	per 10 m	0.15	0.48
480.	Dismantling overhead lines (conductor, GI wire, cross arms, insulators etc.,) complete except poles	100 m	0.20	0.40
481.	Dismantling poles embedded in concrete foundations	Each	0.33	2.75
482.	Laying 1.1 KV grade power cable (single, 2, 3, 3.5 or 4 core direct in ground including sand cushioning and protective brick covering (excluding joints/cable boxes/excavation and earthwork)			
	(a) upto 25 sq mm cross-section	10 m	0.60	3.00
	(b) exceeding 25 but not exceeding 120 sq mm cross-section ...	10 m	0.80	4.00
	(c) exceeding 120 but not exceeding 400 sq mm cross-section ...	10 m	0.80	5.00

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of Work	Labour constants in days (of 8 hours) per unit of work	
			Lineman or wireman	Mazdoor
483.	Add to item 482 for each additional power cable in horizontal formation in the same trench :			
	(a) upto 25 sq mm cross-section	10 m	0.38	1.93
	(b) exceeding 25 but not exceeding 120 sq mm cross-section ...	10 m	0.50	2.57
	(c) exceeding 120 but not exceeding 400 sq mm cross section ...	10 m	0.61	3.21
484.	Laying 1.1 KV grade power cable (single, 2, 3, 3.5 or 4 core) PVC insulated and PVC sheathed in existing open masonry duct :			
	(a) upto 25 sq mm cross-section	10 m	0.30	1.50
	(b) exceeding 25 but not exceeding 400 sq mm cross section ...	10 m	0.40	2.00
485.	Fixing route marker in cement concrete ... ... (Add 0.13 days time of mason to constants for item 485)	Each	-	0.20
486.	Galvanised iron plate 10 sq cm size, bolted to 60 cm long angle iron fixed in ground (Add 0.13 days time of fitter and 0.08 days time of painter to constants for item 486).	Each	-	0.15
			Cable-jointer	Mazdoor
487.	Cable jointing with epoxy resin (outdoor) for end termination including fixing lugs, ferrules, using cable jointing kit, plastic mould, clamps etc., for 1.1 KV grade PVC insulated and PVC sheathed aluminium conductor cable of :			
	(a) 2 x 16, 2 x 25, 2 x 35, 3 x 16, 3 x 25, or 3 x 35 sq mm size ...	Each	0.38	0.38
	(b) 3.5 x 25, 3.5 x 35, 4 x 16, 4 x 25, 2 x 50, 3 x 50, or 3 x 70 sq mm size	Each	0.50	0.50
	(c) 3.5 x 50, 3.5 x 70, 4 x 35, or 4 x 50 sq mm size ...	Each	0.66	0.66
488.	Cable jointing with epoxy resin for straight through joint including fixing lugs/ ferrules, using cable jointing kit, compound, hardner, plastic mould etc., for 1.1 KV grade PVC insulated and PVC sheathed aluminium conductor cable of :			
	(a) sizes as in item 487 (a) above	Each	0.50	0.50
	(b) sizes as in item 487 (b) above	Each	0.66	0.66
	(c) sizes as in item 487 (c) above	Each	0.80	0.80
489.	Making end termination with brass compression gland for 1.1 KV grade PVC insulated and PVC sheathed aluminium conductor cable of 2 x 10, 2 x 16, 3 x 10, 4 x 10, 2 x 25, 2 x 35, 2 x 50, 3 x 16, 3 x 25, 3 x 35, 3 x 50, 3.5 x 25, 4 x 16 sq mm size	Each	0.13	0.13
490.	-Ditto- but of 3 x 70, 3 x 95, 3.5 x 35, 3.5 x 50, 3.5 x 70, 4 x 25, 4 x 35, or 4 x 50 sq mm size	Each	0.17	0.17
	ROAD WORK		Constant for labour or use of plant in days	
			Roller	Mazdoor
491.	Preparation of subgrade by dressing surfaces to camber, watering and keeping ready for rolling	10 sq m	-	0.027
492.	Rolling and consolidating formation surfaces, including filling depressions which occur during rolling, using :			
	(a) hand roller of 0.2 to 0.5 tonne capacity ...	10 sq m	0.08	0.08
	(b) animal roller of 0.08 to 1.5 tonne capacity ...	10 sq m	0.036	0..036
	(c) power roller upto 5 tonne capacity ...	10 sq m	0.017	0.008
	(d) power roller of 8 tonne capacity ...	10 sq m	0.016	0.007
	(e) power roller of 10 to 12 tonne capacity ...	10 sq m	0.011	0.005

LABOUR CONSTANTS

Sl. No.	Description of work	Constants for labour/use of plant in days per 10 sq m of work	
		Mazdoor/mate bhisti or chowkidar	Power roller
493.	Laying stone/kankar /boulder soling, properly handpacked (or base course using oversize road metal) to the required gradient/camber/superelevation, including watering spreading blinding material and consolidating with a power roller for :		
	(a) 100 mm spread thickness	0.95	0.006
	(b) 150 mm spread thickness	1.43	0.009
	(c) 200 mm spread thickness	2.03	0.012
494.	Laying brick soling with overburnt or well burnt bricks, filling interstices, blinding, watering and rolling with power roller :		
	(a) consisting of one layer of bricks laid flat ...	0.77	0.004
	(a) consisting of one layer of bricks laid on edge ...	1.18	0.006
	(a) consisting of two layers of bricks laid flat ...	1.56	0.008
495.	Light wearing surfaces, like berms, walkways, etc., made up of murrum, shingle, kankar, gravel, red bajri etc., including blinding, watering and rolling with power roller :		
	(a) 50 mm spread thickness	0.19	0.016
	(b) 75 mm spread thickness	0.29	0.024
	(c) 100 mm spread thickness	0.38	0.033
	Note : *In item 495 if light wearing surface is to be consolidated by hand ramming instead of rolling, add 0.44, 0.55 and 0.69 days for 50, 75, and 100 mm thicknesses respectively to the constant for mazdoor, in lieu of roller time.*		
496.	Waterbound macadam carpet, spread, levelled, watered and consolidated with power roller to required gradient, camber and superelevation :		
	(a) 100 mm compacted thickness (equivalent of about 120 to 140 mm spread thickness - screenings extra	1.30	0.05
	(b) 75 mm compacted thickness (equivalent of about 90 to 110 mm spread thickness - screenings extra)	1.00	0.04
497.	Preparing road surfaces, new or old, by brushing with wire brushes, brooming and fanning with gunny bags :		
	(a) waterbound macadam surfaces	0.55	-
	(b) black topped surfaces	0.33	-

Sl. No.	Description of work	Constant for labour/use of plant in days per 10 sq m of work				
		Mazdoor/mate/ bhisti/chowkidar	Mistry	Bitumen sprayer unit	Bitumen boiler	Power roller
498.	Applying priming/tack coat, manually @ 10 kg tar/bitumen per 10 sq m ...	0.25	0.003	0.006	0.004	-
499.	(a) Surface dressing one coat work using 20 kg bitumen and 0.14 cu m stone chippings per 10 sq m and rolling ...	0.42	0.008	0.011	0.007	0.011
	(b) -Ditto- but two coat work using 20 kg bitumen with 0.15 cu m chippings for first coat, 12 kg bitumen with 0.10 cu m chippings for second coat and both coats rolled separately ...	0.78	0.013	0.017	0.018	0.017
500.	Renewal coat of surface dressing using 12 kg bitumen and 0.10 cu m stone chippings and rolling ...	0.28	0.005	0.006	0.004	0.006

LABOUR CONSTANTS

Sl. No.	Description of work	Constants for labour/use of plant in days per 10 sq m of work					
		Mazdoor/mate/ bhisti/chowkidar	Mistry	Bitumen sprayer unit	Bitumen mixer	Bitumen boiler (if required)	Power roller
501.	Bituminous premixed carpet, 20 mm consolidated thickness, using 0.27 cu m of stone chippings mixed with 14.6 kg of binder, rolled and compacted to required gradient and camber ...	0.58	0.019	-	0.004	0.013	0.011
502.	Premixed bituminous macadam as specified, 50 mm consolidated thickness rolled and compacted to required camber and gradient (preparing surfaces, tack coat and seal coat not included) ...	2.34	0.036	-	0.10	0.36	0.034
503.	-Ditto- but 75 mm consolidated thickness	3.48	0.054	-	0.15	0.54	0.051
504.	Liquid seal coat (IRC type 'A') using 9.8 kg of hot bitumen (sprayed), blinded with 0.09 cu m stone chippings of 6 mm size per 10 sq m and rolling ...	0.40	0.005	0.006	-	0.006	0.006
505.	Premixed sand seal coat (IRC type 'B') using 0.06 cu m sand and 6.8 kg hot bitumen per 10 sq m, mixed spread and rolled ...	0.36	0.006	-	0.001	0.005	0.006

Note : *For concrete roads / pavements constants given in concrete section are applicable.*

		Unit of Work	Category of Labourer	Labour constants in days per unit of work
506.	Filling expansion joints in concrete pavings etc., with premoulded bituminous joint filler (constant worked out is for 15 cm depth of joint filler, but converted into sq m and is also applicable for other depths of joints)	sq m	Mazdoor Mason	0.067 0.022
507.	Priming top cavity in expansion joints (left after filling with premoulded bituminous joint filler as in item 506 above) and filling with hot sealing compound (constant is for 10 metre length of joint sealed, for each sq cm cross-section of joint filled with sealing compound)	10 m (per sq cm cross-section	Mason Mazdoor	0.01 0.02
508.	Placing (at the time of concreting) 20 mm dia steel dowel bars one metre long with ferrules, at 400 mm centres along the length of expansion joint, including cutting notches/holes in formwork and (later) in premoulded bituminous filler at the time of finishing the joints	10 m (of expansion joint)	Black-smith Helper Mazdoor	0.19 0.19 0.06
509.	Forming construction joint 10 mm wide, 30 mm deep and (later) filling with sealing compound or hot bitumen	10 m	Mason Mazdoor	0.15 0.15
510.	Forming dummy joint (contraction) 10 mm wide, 65 mm deep and (later) filling with sealing compond or hot bitumen.	10 m	Mason Mazdoor	0.25 0.25
511.	Scarifying waterbound macadam, bitumen macadam or other black topped surfaces by hand, not exceeding 50 mm deep ...	10 sq m	Mazdoor	0.44
512.	-Ditto- but exceeding 50 and not exceeding 100 mm deep ...	10 sq m	Mazdoor	0.77
513.	Repairing pot holes by sweeping clean of mud/dust, filling with fine screened road metal, watering, well ramming etc. including cutting edges upto 25 mm deep (measurement will be for area of pot holes) ...	sq m	Mazdoor	0.17
514.	-Ditto- but filled with premixed bituminous mixture (stone metal and hot bitumen) sealed with binder and blinded with stone chippings, hand rammed (or power rolled)	sq m	Mazdoor	0.62
515.	Screening road metal, chippings etc. at site, including removing screened materials clear of screen and stacking (measurement for metal before screening)	cu m	Mazdoor	0.35

LABOUR CONSTANTS

DEMOLITION AND DISMANTLING

Notes : *(a) Labour constants for demolition and dismantling include for stacking serviceable materials and disposal of debris within 100 m lead.*

(b) Constants are for work upto floor two level (i.e. ground floor including foundations upto 1 m depth and two upper storeys including roof of floor two level). For work in higher storeys make extra allowance as given in relevant items.

(c) The term dismantling signifies taking up or down without causing any avoidable damage to the articles/material being removed.

Sl. No.	Description of work	Mazdoor days per cu m
	Demolition of :-	
516.	Lime concrete	1.20
517.	Unreinforced cement concrete upto 15 cm thickness or cross-section	2.45
518.	-Ditto- but more than 15 cm thick	4.00
519.	Reinforced cement concrete or reinforced brickwork of any description (Also see item 527)	4.15
520.	Brickwork or rubble stone masonry in mud mortar	1.10
522.	-Ditto- but in lime mortar	1.40
	Demolition of :-	
522.	Brickwork or rubble stone masonry in cement mortar	3.10
523.	Ashlar faced stone maasonry in lime or cement mortar	3.40
524.	Ashlar faced stone masonry in lime or cement mortar	3.85
525.	Marble/precast concrete work in lime or cement mortar	2.45
526.	Mud phuska in roof	1.10

Sl. No.	Description of work	Unit of Work	Category of Labourer	Labour constants in days per unit of work
527.	Extra over item 519 for cutting steel bars where required (cross-sectional area of concrete/reinforced brickwork cut to be measured)	sq m	Blacksmith Mazdoor	0.50 0.50
528.	Demolition of brick tiles in terraces	sq m	Mazdoor	0.12
529.	Extra over items 516 to 526 for every additional storey height above floor two level (if materials are carried down by head load)	cu m	Mazdoor	0.30
530.	Separating and cleaning/straightening reinforcement bars from demolished concrete or reinforced brickwork	quintal	Blacksmith Mazdoor	0.25 0.50
531.	Salvaging whole re-usable bricks from demolished brickwork built in mud mortar by removing mortar and cleaning, including stacking ...	1000 Nos	Mazdoor	4.40
532.	-Ditto- but if in lime mortar	1000 Nos	Mazdoor	5.00
533.	-Ditto- but if cement mortar	1000 Nos	Mazdoor	6.20
534.	Salvaging re-usable stones and undamaged precast concrete articles from demolished work including removing mortar and stacking ...	cu m	Mazdoor	0.65
535.	Dismantling tiles/stone slabs in floors etc., laid in lime or cement mortar:-			
	(a) tiles upto 25 mm thickness	10 sq m	Mazdoor	0.90
	(b) tiles exceeding 25 mm and upto 40 mm thickness ...	10 sq m	Mazdoor	1.30
	(c) stone slabs in floor etc., ...	10 sq m	Mazdoor	2.90
	Note : *Add 0.06, 0.12 and 0.24 mazdoor days per 100 sq m respectively to constants for items 535 (a), (b) and (c) for work in every additional storey height above floor two level.*			
536.	Dismantling sheet roofing (measured for actual area of roof) :-			
	(a) CGI sheets in roofing including plain GI sheets in ridges, hips, valleys and gutters.	10 sq m	Carpenter Mazdoor	0.25 0.65
	(b) Corrugated or semi-corrugated AC sheets in roofing fixed with coach screws or with J/hook bolts, including ridges, hips and valley specials of asbestos cement.	10 sq m	Carpenter Mazdoor	0.30 0.70

LABOUR CONSTANTS

Sl. No.	Description of work	Unit of Work	Labour constants in days	
			Carpenter/ Blacksmith/ Mason	Mazdoor
537.	Demolishing jack arches including steel joists, in roof/floor :-			
	(a) in lime mortar	cu m	-	1.35
	(b) in cement mortar	cu m	-	2.00
538.	Dismantling tiled roofing :-			
	(a) single layer of Mangalore/Raniganj/Allahabad pattern or country type tiles	10 sq m	-	1.30
	(b) double layer, of -do-	10 sq m	-	1.90
539.	Demolishing thatched roof including bamboo jaffri, capping to ridges, hips etc.,	10 sq m	-	0.45
540.	Dismantling timber battens in roof, any size :-			
	(a) upto 15 cm apart	10 sq m	-	1.40
	(b) exceeding 15 cm apart	10 sq m	-	1.20
541.	Dismantling purlins and rafters from roof, upto 40 sq cm in cross-section, of any kind of timber	100 m	-	2.10
542.	Dismantling wooden trusses, any span, any type	Each	0.65	2.00
543.	Dismantling steel trusses, without dismembering	Per m of span	0.15	0.30
544.	Dismantling timber planks in eaves/barge/valleys, roof, floor or ceiling ...	10 sq m	0.35	0.70
545.	Ditto, but in wall linings and partitions	10 sq m	0.25	0.50
546.	Dismantling wooden trellis work including framing	10 sq m	0.25	0.60

MISCELLANEOUS

547. Initial layout of a building.

Allow one mason and 8 labourers working for half a day for every 200 sq m of built up area (this will include the labour in the initial layout and creating semi-permanent brick stub pillars with reference points marked in plaster on top).

548. For casting, curing and testing of cubes of concrete.

Allow 0.5 days of unskilled labourer per cube. (This will be over and above the skilled laboratory technicians/engineer in charge of the site laboratory.)

549. Labour required in tidying up the site and clearance of rubbish after completion of work on a building project.

Ranges from 20 to 65 days of unskilled labour with one to 4 mates for supervision depending on the area of site.

550. Detailed cleaning of buildings by removing paint splashes, sundry mortar droppings, dust settled on completed items, shoe marks of the construction labourers moving about, cleaning up toilets etc., used by labourers, wiping up joinery, and final wet mopping of floors etc., preparatory to handing over to owner :-

Allow 2 labour days per 100 sq m of built up area of building.

OR

Allow 0.05 % of the cost of all other items of work in the building.

CEMENT CONSTANTS

Cement constants based on experiments carried out by the CBRI Rookee and the Concrete Association of India are given below. *These constants include an allowance of 2.5 % for wastage* and are in use in the MES Department for working out estimated requirement of cement.

These constants may be considered applicable for ordinary Portland cement, Portland pozzolana cement, Portland slag cement, high alumina cement, sulphate resisting cement, and to Portland white cement for purposes of estimating, analysing prices and for approving rates payable to contractors.

Description of Item	Mix by volume	Unit	Cement constant in kg
Cement Concrete			
Mixed cement concrete delivered on banker	1 : 1½ : 3	cu m	402.83
	1 : 2 : 4	cu m	308.53
	1 : 2 : 5	cu m	268.55
	1 : 2½ : 5	cu m	253.18
	1 : 3 : 6	cu m	213.20
	1 : 4 : 8	cu m	161.95
	1 : 5 : 10	cu m	129.15
	1 : 7 : 12	cu m	104.55
Mixed cement concrete using all-in aggregate delivered on banker	1 : 5	cu m	312.63
	1 : 6	cu m	264.45
	1 : 8	cu m	206.03
	1 : 12	cu m	138.38
Mortars			
Cement and sand mortar	1 : 1	cu m	1058.83
	1 : 2	cu m	699.05
	1 : 3	cu m	493.03
	1 : 4	cu m	382.33
	1 : 6	cu m	254.20
	1 : 8	cu m	192.70
Gauged mortar (cement : lime : sand)	1 : 1 : 6	cu m	244.98
	1 : 1 : 8	cu m	189.63
	1 : 2 : 9	cu m	164.00
	1 : 5 : 10	cu m	147.60
	1 : 7 : 12	cu m	120.95
Brickwork			
Brickwork in well burnt bricks built in cement and sand mortar using old size bricks.	1 : 3	cu m	123.00
	1 : 4	cu m	95.84
	1 : 6	cu m	64.06
	1 : 8	cu m	47.93
-Ditto- but using modular size bricks.	1 : 3	cu m	113.30
	1 : 4	cu m	87.90
	1 : 6	cu m	58.40
	1 : 8	cu m	44.30
Brick work in well burnt bricks, built in gauged mortar (cement : lime : sand), using old size bricks.	1 : 1 : 6	cu m	60.48
	1 : 1 : 8	cu m	47.93
	1 : 2 : 9	cu m	40.49
-Ditto- but using modular size bricks	1 : 1 : 6	cu m	56.80
	1 : 1 : 8	cu m	43.60
	1 : 2 : 9	cu m	37.70
Stone Masonry			
Walling of random or polygonal rubble, uncoursed or brought up to courses in cement mortar.	1 : 3	cu m	147.60
	1 : 4	cu m	114.80
	1 : 6	cu m	75.34
	1 : 8	cu m	58.94

Description of Item	Mix by volume	Unit	Cement constant in kg
Stone Masonry (contd)			
Walling of random or polygonal rubble, uncoursed or brought up to courses, in gauged mortar (cement : lime : sand)	1 : 1 : 6	cu m	73.80
	1 : 1 : 8	cu m	56.89
	1 : 2 : 9	cu m	49.71
Plastering			
10 mm (0.5 inch) thick rendering or screeding on brick or concrete surfaces in cement and sand mortar	1 : 2	sq m	11.79
	1 : 3	sq m	8.41
	1 : 4	sq m	6.77
	1 : 6	sq m	4.46
-Ditto- but on stone masonry surfaces or lathing	1 : 2	sq m	15.68
	1 : 3	sq m	11.17
	1 : 4	sq m	8.41
	1 : 6	sq m	5.64
Add or deduct for each 5 mm (0.25 inch) thickness over or under 10 mm (0.5 inch) on concrete, brick, lathing or stone masonry surfaces (cement mortar)	1 : 2	sq m	4.77
	1 : 3	sq m	3.38
	1 : 4	sq m	2.51
	1 : 6	sq m	1.69
10 mm (0.5 inch) thick rendering or screeding on brick or concrete surfaces in gauged mortar (cement : lime : sand)	1 : 1 : 8	sq m	3.38
	1 : 2 : 9	sq m	2.82
-Ditto- but on stone masonry surfaces or lathing	1 : 1 : 8	sq m	4.20
	1 : 2 : 9	sq m	3.64
Add or deduct for each 5 mm (0.25 inch) thickness over or under 10 mm (0.50 inch) on concrete, brick lathing or stone masonry surfaces (gauged mortar)	1 : 1 : 8	sq m	1.38
	1 : 2 : 9	sq m	1.13
Pointing			
Raking out joints to a depth of 10 mm and providing flush, keyed or struck pointing in cement mortar , on brick surfaces.	1 : 2	sq m	2.51
	1 : 3	sq m	1.69
	1 : 4	sq m	1.39

CEMENT CONSTANTS

Description of Item	Mix by volume	Unit	Cement constant in kg
Pointing (contd)			
Raking out joints to a depth of 10 mm and providing flush, keyed or struck pointing to random rubble masonry uncoursed or brought upto courses (20 mm thick joints) with cement and sand mortar	1 : 2 1 : 3 1 : 4	sq m sq m sq m	5.02 3.95 2.83
-Ditto- but to squared rubble coursed or uncoursed masonry	1 : 2 1 : 3 1 : 4	sq m sq m sq m	3.95 2.82 2.26
Raking out joints to a depth of 10 mm and providing bastard tuck or mason's V joint pointing to random rubble masonry, uncoursed or brought up to courses	1 : 2 1 : 3 1 : 4	sq m sq m sq m	6.15 4.46 3.64
-Ditto- but to squared rubble, coursed or uncoursed masonry	1 : 2 1 : 3 1 : 4	sq m sq m sq m	5.02 3.64 2.82
Raking out joints to a depth of 10 mm and providing flush, keyed or struck pointing to block in course, or ashlar or concrete block walling, with cement and sand mortar	1 : 2 1 : 3 1 : 4	sq m sq m sq m	1.39 1.13 0.85
Brick flooring			
Brick floors, laid flat, jointed and pointed flush in cement and sand mortar	1 : 3 1 : 6	sq m sq m	11.17 5.64
-Ditto- but laid on edge	1 : 3 1 : 6	sq m sq m	15.68 8.41
Finish to Concrete Floor			
Finishing top of cement-concrete floor to a fair and even surface using extra cement		sq m	1.38
Granolithic Floor			
30 mm thick granolithic concrete topping finished even and fair	1 : 1 : 2	sq m	16.09
Terrazo Floor			
10 mm thick layer of terrazo (consisting of 3 parts of cement mixed with 1 part of marble powder by weight; and one part of such mixture by volume mixed with 1.5 parts by volume of crushed marble or other approved stone chippings laid to levels or falls.	As described	sq m	8.71

Note : ***Additional cement constants given below and on next page have been worked out at par with the basic cement constants given above.***

Description of Item	Mix by volume	Unit	Cement constant in kg
Finishing exposed faces of concrete			
Finishing exposed faces of concrete with 5 to 6 mm thick plaster in cement mortar	1 : 3	sq m	3.55
-Ditto- (but with unit of measurement as cu m of concrete finished on its exposed faces) for concrete in the following situations :-			
Walls, chimneys and shafts	1 : 3	cu m	20.00
Precast/cast in situ kerbs, steps and the like	1 : 3	cu m	30.00
Beams, plinth beams, bressemurs, large lintels, columns, pillars, piers, posts struts and the like	1 : 3	cu m	30.00
Slabs in floor, roof, landing, balcony, canopy, shelves etc.	1 : 3	cu m	31.00
Finishing exposed faces of concrete			
Finishing exposed faces of concrete with 5 to 6 mm thick plaster in cement and sand mortar (with unit of measurement as cu m of concrete finished on exposed faces) in following situations :-			
Staircases	1 : 3	cu m	40.00
Domes, vaults, shell roofs and folded plates	1 : 3	cu m	47.00
Parapets, copings, bed/anchor blocks, window cills and small articles	1 : 3	cu m	59.00
Projecting portion of chajjas	1 : 3	cu m	61.00
Vertical and horizontal fins forming box windows, RCC louvers and the like	1 : 3	cu m	148.00

CEMENT CONSTANTS

Description of Item	Mix by volume	Unit	Cement constant in kg
Concrete			
Setting only in position using cement and sand mortar the following type of precast concrete articles :-			
Kerbs, steps and the like	1 : 4	cu m	12.75
Copings/bed plates, anchor/bed blocks, window cills etc.,	1 : 4	cu m	3.75
Small lintels	1 : 4	cu m	9.75
Jally 25 to 30 mm thickness	1 : 4	sq m	1.25
Concrete Block Walling			
Walling with precast (solid or closed cavity) concrete block walling any thickness	1 : 4	cu m	35.99
	1 : 6	cu m	23.93
	1 : 8	cu m	18.14
Brickwork (1 cm thick Joints)			
Using old size bricks, of 23 x 11 x 7 cm actual size :-			
Half brick thick walls in cement and sand mortar	1 : 3	sq m	11.62
	1 : 4	sq m	9.01
-Do- but in gauged mortar (cement : lime : sand)	1 : 1 : 6	sq m	5.78
Pardi walls, with bricks laid on edge, in cement and sand mortar	1 : 1	sq m	9.77
	1 : 2	sq m	6.45
	1 : 3	sq m	4.55
	1 : 4	sq m	3.53
Honeycomb brickwork, one brick thick, in cement and sand mortar	1 : 2	sq m	12.83
	1 : 3	sq m	9.05
	1 : 4	sq m	7.01
Honeycomb brickwork half brick thick, in cement and sand mortar	1 : 2	sq m	5.88
	1 : 3	sq m	4.14
	1 : 4	sq m	3.21
Honeycomb brickwork with bricks laid on edge (thickness of wall equal to thickness of brick)	1 : 2	sq m	2.87
	1 : 3	sq m	2.02
	1 : 4	sq m	1.57
Using bricks tiles of 23 x 11 x 4.5 cm actual size :-			
One tile thick walls in cement and sand mortar	1 : 4	cu m	106.77
	1 : 6	cu m	70.99
-Do- but in gauged mortar (cement : lime : sand)	1 : 1 : 6	cu m	68.42
Half tile thick facing in cement and sand mortar (built integrally with main wall)	1 : 3	sq m	18.58
	1 : 4	sq m	14.41
	1 : 6	sq m	9.58
Half tile thick wall in cement and sand mortar	1 : 3	sq m	13.11
	1 : 4	sq m	10.17
Brick tile wall, with tiles laid on edge in pardi walls, vertical fins etc., in cement and sand mortar.	1 : 1	sq m	5.87
	1 : 2	sq m	3.87
	1 : 3	sq m	2.73
Honeycomb bick-tile-work one brick-tile thick, in cement and sand mortar	1 : 2	sq m	16.50
	1 : 3	sq m	11.64
	1 : 4	sq m	9.02
Honeycomb brick-tile-work half brick-tile thick, in cement and sand mortar	1 : 2	sq m	7.75
	1 : 3	sq m	5.46
	1 : 4	sq m	4.24
Honeycomb brick-tile-work with tiles laid on edge (thickness of wall equal to thickness of tile)	1 : 1	sq m	2.70
	1 : 2	sq m	1.78
	1 : 3	sq m	1.25
Using modular bricks of 19 x 9 x 9 cm actual size :-			
Half brick thick walls (ie 9 cm thick), in cement and sand mortar	1 : 3	sq m	8.59
	1 : 4	sq m	6.66
-Do- but in gauged mortar (cement : lime : sand)	1 : 1 : 6	sq m	4.27
Honeycomb brickwork, one brick thick in cement and sand mortar	1 : 2	sq m	10.31
	1 : 3	sq m	7.28
	1 : 4	sq m	5.64
Honeycomb brickwork, half brick thick in cement and sand mortar	1 : 2	sq m	4.59
	1 : 3	sq m	3.23
	1 : 4	sq m	2.51
Miscellaneous			
Extra for joining new brick wall with old in cement and sand mortar, using old size or modular bricks (constant is for the area of cross-section of new wall joining with old)	1 : 4	sq m	2.72
	1 : 6	sq m	1.81
-Do- but with gauged mortar (cement : lime : sand)	1 : 1 : 6	sq m	1.74
Making good to chases cut in brick walls, with cement and sand mortar after fixing pipes, conduits etc., for concealed work	1 : 6	per metre	0.90
Note : *Size of chase cut by hand usually does not vary with the diameter of pipe embedded.*			
Making good to holes in slab after passing pipes, with cement concrete 1:2:4, and finishing up to match with surrounding surfaces.	1 : 2 : 4	Each	0.70
Pointing in cement and stone dust mortar to stone veneer work in wall lining	1 : 2	sq m	1.70

MATERIAL CONSTANTS

EXCAVATION

Excavation Without Timbering

Depths to which excavation in trenches in the following kinds of strata will retain a vertical face, for short periods required in building operations, without falling in may be taken as follows -

Clean dry sand and gravel	:	0	to	0.33	m	Well drained loam	:	1.6	to	2.6 m
Moist sand and surface mould	:	0.3	to	1	m	Compact gravelly soil	:	3	to	5 m
Soft or ordinary earth	:	0.6	to	1.3	m	Well drained stiff clay	:	3	to	4 m

Angle of Repose (or Natural Slopes)

Natural slopes of earth, ie angle at which thrown-up soils will stand of their own accord without slipping and without the necessity of retaining walls are given in the table below. Slopes vary with the condition of soil, ie whether dry, moist, loose, very loose etc.

Type of Soil	Angle of repose	Ratio of base of slope to height	Type of Soil	Angle of repose	Ratio of base of slope to height
Alluvial soil, dry	27°	2 : 1	Earth vegetable, very wet	18°	3 : 1
Clay, dry	39°	1.25 : 1	Earth vegetable, punned	63°	0.50 : 1
Clay, well drained	45°	1 : 1	Gravel, compact	45°	1 : 1
Clay, damp and plastic	27°	2 : 1	Gravel, with sand	38°	1.25 : 1
Earth, compact	50°	0.75 : 1	Peat, firm	45°	1 : 1
Earth vegetable, dry and loose	29°	1.75 : 1	Sand, fine and dry	33°	1.50 : 1
Earth vegetable, moist	45°	1 : 1	Sand, loose and moist	29°	1.75 : 1
			Shingle, loose	39°	1.25 : 1

Increase in Bulk

Approximate increase in bulk of different kinds of soil (when excavated from natural undisturbed ground and thrown up into a heap) may be taken as follows :

Sand and gravel	...	:	12.5 %	Murrum or chalk depending on size of pieces	:	33.33 %
Earth and clay	...	:	25 %	Rock depending on size of pieces	:	50 %

Deduction

Deductions to be made from the volume of loose heaps of different kinds of soils to arrive at the contents before breaking up undisturbed ground will be as follows :

Sand and gravel	...	11 %	Murrum or chalk	...	25 %
Earth and clay	...	20 %	Rock	...	35 %

Economical Distances for Removal of Soil etc.

Economical distances for different modes of removal of spoils for Indian conditions vary considerably with the wages demanded by labourers, type of labourers (ie male, female or boys) and cartage rates payable to bullock carts, motor lorries etc. For estimating purposes average economical distances may be taken as follows :

Head loads	...	upto 50 m	Bullock carts	...	300 to 900 m
Wheel barrows	...	50 to 300 m	Motor lorries	...	Distances exceeding 600 m

MATERIAL CONSTANTS

Planking and Strutting (Excavation Support)

Open timbering is used for moderately firm ground. For open timbering, usually 38 mm thick poling boards for 30 % of area of the face of excavation to be supported, with waling of 100 mm x 100 mm size and horizontal or raking struts cut from 125 mm dia ballies are employed.

Close timbering is similar to open timbering, except that poling boards are employed for 100 % of area of the face of excavation to be supported. Close timbering is employed for loose ground.

Type of excavation	Type of support required	Timber required for single use per sq m of face of excavation	Notes
In trenches	Open timbering	0.033 cu m	Timber requirement indicated should be increased by 8 % to allow for wastage in cutting to the required size.
	Close timbering	0.058 cu m	
Over areas	Open timbering	0.029 cu m	Upto 10 uses of timber may be possible. The number of reuses will however be limited by the extent and magnitude of work, alterations that may be required to cut sizes when using in new locations etc.
	Close timbering	0.052 cu m	
In shafts, wells and cesspits.	Open timbering	0.032 cu m	The price analysis should take into account the scrap value of timber.
	Close timbering	0.063 cu m	

Excavating Rock by Blasting

Rock excavation using blasting powder and fuses

Materials required per 10 cu m of excavation

Type of excavation	Soft/disintegrated rock		Hard rock	
	Powder in kg	No of fuses	Powder in kg	No of fuses
Excavation over areas exceeding 30 cm in depth and exceeding 1.5 m in width.	1.97	2	3.93	4
Excavation in trenches not exceeding 1.5 m in width.	2.52	3	6.42	7

Rock excavation using dynamite

Materials required per 10 cu m of excavation

Type of rock	Dynamite required in kg per 10 cu m of rock
Sandstone	1.20 to 2.40
Trap	1.20 to 4.20
Granite or Hornblende	1.20 to 4.70
Cement concrete	1.80 to 3.60
Quartz	1.80 to 4.20
Gneiss	3.60 to 4.70
Limestone and marble	4.40 to 6.00

Requirement of explosives varies with the extent of restriction in space, small/large magnitude of work, and controlled blasting that may be necessary. The lower figures in the ranges indicated for requirement of dynamite are applicable for open unrestricted blasting.

Average requirement of explosives etc., for 100 cu m of excavation by blasting in hilly terrain for road building operations may be taken as :-

Explosive (dynamite)	:	35 kg	Detonators	:	17 Nos.
Safety fuse	:	17 m	Detonating fuse	:	50 m

Hardcore

Spread thickness of hardcore is reduced by about 15 to 25 % due to compaction depending upon the nature and grading of material used and the degree of compaction achieved. This in turn signifies that for each cu m of finished work materials required for hardcore will be 1.8 to 1.33 cu m.

MATERIAL CONSTANTS

MORTAR AND CONCRETE

Water

Water required for mortar and concrete varies from 26 to 36 litres per bag (50 kg) of cement depending on the mix/proportion of mortar or concrete, moisture content of aggregate and the water-cement ratio adopted.

Shrinkage

Cement shrinks when wetted	15 to 30 %	Dry cement and sand *mix* shrinks when wetted	25 to 35 %
Sand shrinks when wetted	20 to 30 %	Dry cement concrete *mix* shrinks when wetted	20 %

Mud Mortar

For mud mortar, requirement of suitable dry earth may be taken as 1.20 cu m for 1 cu m of mud mortar.

Lime

1 quintal of unslaked lime yields 0.158 cu m of lime putty.
1 cu m of unslaked lime yields 1.225 cu m of lime putty.
1 quintal of unslaked lime occupies 0.129 cu m of volume.

Lime Mortar

Material required exclusive of wastage		
Mix by volume (Lime putty : Sand)	Materials required per cu m of mortar	
	Lime putty in cu m (or unslaked lime in quintals and in cu m)	Fine sand in cu m
1 : 1	0.7125 (4.51 q or 0.58 cu m)	0.7125
1 : 2	0.475 (3.01 q or 0.39 cu m)	0.95
1 : 3	0.357 (2.26 q or 0.29 cu m)	1.07

Note : *For lime : surkhi mortar, requirement of surkhi can be taken same as requirement of sand indicated above, requirement of lime putty also remaining unchanged.*

Lime Concrete

Materials required for 1 cu m of lime concrete consisting 100 parts of graded coarse aggregate mixed with 40 parts of lime mortar (both by volume) are as follows exclusive of wastage :-

0.84 cu m of graded coarse aggegate of 40 mm size
0.40 cu m of ready mixed wet lime mortar.

Note : *For mud concrete, the constants for lime concrete may be adopted substituting requirement of mud mortar for the requirement of lime mortar as given above.*

Cement Mortar and Cement-Lime Gauged Mortar

For requirement of cement for various mixes of cement mortar or cement-lime-sand mortar refer cement constants. Requirement of water may be taken as 140 litres per cu m of mortar.

Sand required per cu m of cement and sand mortar			
Mix by volume	Sand in cu m	Mix by volume	Sand in cu m
1 : 1	0.7125	1 : 5	1.07
1 : 2	0.95	1 : 6	1.07
1 : 3	1.07	1 : 7	1.07
1 : 4	1.07	1 : 8	1.07

(Quantity of sand is exclusive of wastage)

Lime putty and sand required per cu m of cement-lime-sand mortar		
Mix by volume	Lime putty in cu m	Sand in cu m
Cement : Lime : Sand		
1 : 1 : 6	0.178	1.07
1 : 1 : 8	0.134	1.07
1 : 2 : 9	0.238	1.07

(Constants are exclusive of wastage)

MATERIAL CONSTANTS

Cement Concrete

Refer cement constants for requirement of cement for various mixes of concrete. To the requirement of coarse and fine aggregate indicated below add 2.5 % to allow for wastage.

Mix by volume Cement : Sand : Aggregate	Size of coarse aggregate used	Coarse/fine aggregate required per cubic metre of concrete			
		Using shingle and coarse aggregate		Using crushed stone as coarse aggregate	
		Sand in cu m	Shingle in cu m	Sand in cu m	Crushed stone in cu m
1 : 1 : 2	20 mm	0.35	0.70	0.38	0.75
1 : 1½ : 3	20 mm	0.39	0.78	0.42	0.83
1 : 2 : 4	20 mm	0.41	0.82	0.44	0.88
1 : 3 : 6	40 mm	0.43	0.86	0.45	0.90
1 : 4 : 8	40 mm	0.45	0.90	0.47	0.95
1 : 5 :10	40 mm	0.45	0.90	0.47	0.95

Reinforcement

Reinforcement is sometimes expressed as sectional area of steel used compared to the sectional area of concrete, ie 1 % of steel in an RCC slab will mean that if the slab is cut, the cross-section will reveal 0.01 sq m of steel bars for every sq m of sectional area of slab.

1 % reinforcement will indicate 78 kg steel per cu m of concrete (based on steel weighing 7830 kg per cu m).

Reinforcement usually required in various situations is as follows :-

Culverts and foundations	0.5 to 1 %	Columns and struts	1 to 3 %
Landing, floor and roof slabs	1 to 1.5 %	Beams, lintels, and braces	2 to 3 %
Arches and walls	1 to 2 %	Piles and connections	2 to 5 %

Binding or tying wire for reinforcement may be taken as 0.9 to 1.3 kg per quintal of reinforcement.

Wastage of steel will depend on the size of off-cuts and the possibility of using the off-cuts in situations like chajjas, canopies etc. Wastage of steel in reinforcement varies from 2 to 10 %.

Formwork and Centering

When analysing rates of formwork and centering, assessment of the number of times that the timber can be used is of great importance. It is usual to assume upto 16 uses depending on the nature and the magnitude of work.

Quantities of materials, including wastage, required for 10 sq m of formwork in various situations are given below, *and these are for first or single use.* Allow for nails and spikes at the rate of about 4 to 5 kg for first use and 1 kg for each subsequent use for 10 sq m of formwork.

Materials required per 10 sq m of formwork including 5 % wastage.

Sl. No.	Situation where formwork is to be provided	Boarding in sq m	Scantlings or battens in cu m	Ballies or struts in metres
1.	Foundations, footings, bases of columns and mass concrete	11.00	0.064	13
2.	Soffits of suspended landing/roof/floor slabs upto 200 mm thick	10.50	0.105	82
3.	-Ditto- but exceeding 200 mm in thickness ...	10.50	0.118	100
4.	Walls, partitions, parapets and the like	10.50	0.034	28
5.	Columns, piers etc.	13.70	0.060	38
6.	-Ditto- but circular on plan	12.00	0.110	64
7.	Sides and soffits of beams, lintels and the like	11.50	0.060	38
8.	Edges of slabs and breaks in suspended floors	20.00	0.060	-
9.	Staircases	10.50	0.070	11
10.	Chullah hoods, chajjas, etc.	11.50	0.013	5
11.	Soffits of semi-cylinrical shells of radius upto 3 metres ...	10.50	0.960	70
12.	Soffits of domes, vaults and shell roofs, sperical in shape, that is curved in both horizontal and vertical planes	12.00	1.160	-

MATERIAL CONSTANTS

Colouring of Concrete/Mortar

Dry cement is thoroughly mixed with pigment before mixing with sand and aggregate. Quantity of dry pigment to be mixed with one bag of cement (50 kg) is as follows :

Colour	Pigment to be mixed with 50 kg bag of cement	Colour	Pigment to be mixed with 50 kg bag of of cement
Black	5.56 kg black oxide of manganese or any other carbon black.	Buff	2.08 kg yellow ochre.
Blue	8.14 kg azure blue or ultramarine.	Red	8.14 kg red oxide of iron.

BRICKWORK

Burning Bricks

Fuel required for making burnt bricks is as follows :-

Wood fuel (clamp burning)	:	4 to 4.30 quintals per 1000 bricks.
Coal dust (kiln burning)	:	1.30 to 1.50 quintals per 1000 bricks.

Brick and Mortar Requirement

As brick sizes differ widely, the method of working out the brick and mortar requirement is explained below :

Data

Size of bricks : 19 x 9 x 9 cm (modular or new size brick, with frog of 10 x 4 x 1 cm size)
Size of joint : 1 cm thick.

For one brick thick wall in English bond

In the header course each brick along with half a joint on both sides ocupy 0.10 m length of the course. Ten bricks with joints will be required for 1 m length of header course.

In the stretcher course each pair of stretchers with half a joint at ends will occupy 0.20 m length of the course. Five pairs of stretchers ie 10 bricks with joints will be required for 1 m length of stretcher course.

Each header and stretcher course with half a joint at top and bottom will make up 0.10 m height of the wall. 5 header courses and 5 stretcher courses will make up 1 metre height of wall.

A portion of 1 m long, 1 m high and 19 cm wide wall will have :-

Volume of brickwork	:	0.19 cu m		
Number of bricks	:	10 courses x 10 bricks each course	=	100 bricks.
Volume occupied by bricks	:	100 x 0.19 x 0.09 x 0.09	=	0.1539 cu m
Volume occupied by joints	:	0.19 - 0.1539	=	0.0361 cu m
Mortar to fill up frogs	:	100 x 0.10 x 0.04 x 0.01	=	0.0040 cu m
Total mortar requirement	:	0.0361 + 0.0040	=	0.0401 cu m

If the cubical contents of one brick thick wall are calculated on the basis of 190 mm (actual) thickness of wall, the material constants work out to 527 bricks and 0.21 cu m of mortar per cubic metre of brickwork without allowing for any wastage, using modular bricks.

If however, the cubical contents of one brick thick wall are calculated on the basis of 200 mm (nominal) thickness of wall, the material constants work out to 500 bricks and 0.20 cu m of mortar per cubic metre of brickwork without allowing for any wastage, using modular bricks.

Basis of calculation for the material constants given hereinafter for brickwork are as follows :-

(a) Dimensions of modular size bricks have been taken as 19 x 9 x 9 cm with a frog of 10 x 4 x 1 cm size.

(b) Dimensions of old size bricks have been taken as 9 x 4.375 x 2.75 inches (= 22.86 x 11.11 x 6.985 cm) with a frog of 12.7 x 5.1 x 1 cm size.

(c) Dimensions of old size brick tiles have been taken as 9 x 4.375 x 1.75 inches (= 22.86 x 11.11 x 4.445 cm) without any frog.

(d) Thickness of joints has been taken as 1 cm throughout.

(e) The constants are applicable for cubical contents of brickwork measured for nominal thickness of walls ie one brick thick walls using modular bricks measured as 20 cm thick, and one brick thick wall using old size bricks (or old size brick tiles) measured as 23 cm thick.

(f) For brickwork measured in sq m for half brick thick walls etc., the considerations about nominal thickness/actual thickness of walls mentioned in (e) above obviously do not apply.

(g) Allowance has been made for mortar used up in filling up pores in brick surfaces and occasional thicker joints required for aligning perpends, ie vertical joints. This allowance has not been made in the illustrative example given above. (This note (g) applies to constants given for concrete block masonry work on next page also).

MATERIAL CONSTANTS

Type of brickwork	Unit	Material constants for brickwork (without wastage), using :-					
		Modular bricks		Old size bricks		Old size brick tiles	
		Bricks in Nos.	Mortar in cu m	Bricks in Nos.	Mortar in cu m	Brick tiles in Nos.	Mortar in cu m
20 cm (nominal) thick walls using modular bricks, or 23 cm (nominal) thick walls using old size bricks or old size brick tiles	cu m	500	0.224	455	0.246	655	0.272
Half brick thick walls, or walls half brick tile thick	sq m	50	0.017	53	0.023	77	0.026
Brick on edge walls,or walls with brick tiles on edge	sq m	-	-	35	0.009	35	0.0054
Half brick tile facing, built integrally with other walls	sq m	-	-	-	-	77	0.036
Honeycomb brickwork half brick thick, or half brick tile thick	sq m	36	0.0064	38	0.0082	55	0.011
Honeycomb brickwork one brick thick, or one brick tile thick	sq m	75	0.0144	77	0.0179	112	0.0230
Honeycomb brickwork laid on edge, (ie thickness of wall equal to the thickness of brick or thickness of brick tile)	sq m	-	-	25	0.0040	25	0.0025

Note :*In the constants given above an adequate allowance has been made for the mortar joint at the perifery of the honeycomb brickwork area with the main brickwork/walling etc.*

Length of hoop iron or 6 mm dia steel bar required for strengthening thin brick walls (joints one cm thick)

Hoop iron or steel bar placed at :-	Half brick thick wall built with modular bricks	Half brick thick wall built with old size bricks	Half brick tile thick wall built with old size brick tiles	Wall built with old size bricks or brick tiles on edge (thickness of wall equal to thickness of brick or brick tile)
Every course	10 m/sq m	12.52 m/sq m	18.37 m/sq m	8.26 m/sq m
Alternate course	5 m/sq m	6.26 m/sq m	9.19 m/sq m	4.13 m/sq m
Every third course	3.33 m/sq m	4.17 m/sq m	6.12 m/sq m	2.75 m/sq m
Every fourth course	2.50 m/sq m	3.13 m/sq m	4.59 m/sq m	2.07 m/sq m

Solid or cavity Concrete blocks and mortar required (exclusive of wastage) for block masonry

Size of concrete blocks and thickness of joints considered for constant	Unit	20 cm thick wall using 20 cm (actual) thick blocks	15 cm thick wall using 15 cm (actual) thick blocks	10 cm thick wall using 10 cm (actual) thick blocks
Using blocks 29 cm long and 19 cm high on face (actual dimensions) with 10 mm thick joints	sq m	16.67 blocks, and 0.0176 cu m mortar	16.67 blocks, and 0.0133 cu m mortar	16.67 blocks, and 0.0089 cu m mortar
-Ditto- but with 12.5 mm thick joints	sq m	16.33 blocks, and 0.0216 cu m mortar	16.33 blocks, and 0.0170 cu m mortar	16.33 blocks, and 0.0108 cu m mortar
Using blocks 39 cm long and 19 cm high on face (actual dimensions) with 10 mm thick joints	sq m	12.50 blocks and 0.0160 cu m mortar	12.50 blocks and 0.0120 cu m mortar	12.50 blocks and 0.0080 cu m mortar
-Ditto- but with 12.5 mm thick joints	sq m	12.27 blocks, and 0.0197 cu m mortar	12.27 blocks, and 0.0147 cu m mortar	12.27 blocks, and 0.0098 cu m mortar

MATERIAL CONSTANTS

STONE MASONRY

Type of stone masonry	Materials required including wastage			Notes
	Quarry stones in cu m	Headers/through stones in Nos	Mortar in cu m	
Random rubble, polygonal rubble or squared rubble masonry, uncoursed or brought upto courses	1.10 to 1.15	7	0.30	Higher requirement of quarry stones for squared rubble regular coursed masonry and ashlar masonry is due to wastage in dressing the stones to the required regular heights and shapes
Squared rubble, regular coursed masonry	1.15 to 1.25	7	0.28	
Ashlar masonry	1.3 to 1.40	7	0.12	

WOODWORK AND JOINERY

Wastage in Timber

Wastage in converting round logs into square sleepers	20 %
Wastage in converting squared sleepers into large scantlings	10 %
Wastage in converting squared sleepers into fillets/boarding	12 to 30 %
Wastage in cutting timber in stock sizes to required finished lengths	5 %
Wastage in planing clean sawn timber into finished sizes	5 to 8 %

Notes : *Wastage in planing clean sawn timber into finished sizes should not be reflected in the rates for measured work where tolerance for planed surfaces is allowed in the finished sizes of the timber work.*

As an ample precaution, quoted rates should allow for an overall wastage of 7.5 % on the quantity of timber measured for finished nominal sizes to arrive at the quantity of clean sawn timber to be purchased in sizes stocked at the saw mills.

Nails

Requirement of nails for carpenter's work varies from 1.5 to 3.5 kg per cu m of timber depending on the kind of work, sections of timber used, etc.

BUILDER'S HARDWARE

Measurement of Size

In terms of the relevant Indian Standard specifications the sizes of various articles of builder's hardware are to be measured as follows :-

Article	How measured	Article	How measured
Butt hinges	Length of joint or knuckle	Locking bolts, sliding bolts, skeleton tower bolts, and aldrop bolts.	Length of bolt.
Parliament hinges	Width between flanges		
Piano hinges	Overall width of flaps (opened)	Hasp and staples :-	
Spring hinges (double acting)	Length of spring cylinder for regulating spring	(a) Wire type	Overall length of hasp including the hinged plate
Blank hinges to be used along with spring hinges	Length of joint or knuckle	(b) Plate type (safety type)	Length from centre of hinge to the end of the hasp, excluding the hinged plate.
Tee hinges	Length of the leaf from joint to its pointed end.	Handles, drawer pulls, and drawer handles	Grip length.
Strap hinges	Length of any leaf from joint to its pointed end.	Cupboard locks	Vertical length of face across the body excluding the box staple or striking plate.
Door springs (rat tail type)	Distance from the centre of the spindle to centre of roller	Knobs	Maximum dia of the knob
Spring patent helical	-Ditto-	Hydraulic door closer	Weight and width of door to which it it suitable.
Barrel tower bolts/semi-barrel tower bolts, made of steel	Length of bolt	Rim latches, mortice lock, mortice night latch, mortice latch verticle type	Horizontal length of face across the body, excluding the box staple or striking plate.
-Ditto- but of non-ferrous metal	Length of barrel		

MATERIAL CONSTANTS

BUILDER'S HARDWARE

Requirement of wood screws for fixing various sizes of builder's hardware items is given below. Length of screw will, to a certain extent, vary with thickness of timber to which the article is fixed.

Size in mm	No of screws required	IS Designation
Steel butt hinges Light weight		
15	4	2
25	4	2
40	4	3
50	4	3
65	6	4
75	6	5
100	8	6
Steel butt hinges Medium weight		
20	4	3
25	4	4
40	4	5
50	4	6
65	6	6
75	6	8
90	6	8
100	8	9
125	8	10
150	8	10
Steel butt hinges Heavy weight		
50	6	8
65	6	8
75	6	9
90	6	9
100	8	12
125	8	12
150	10	12
175	10	14
200	10	14
Steel butt hinges Square type		
50	4	6
65	6	8
75	6	8
90	6	9
100	8	9
Steel butt hinges Broad type		
50	4	6
75	6	8
100	8	9
125	8	10
150	8	10
Aluminium butt hinges		
50	4	6
65	4	6
75	6	6 to 10
90	8	10
100	8	10 to 12
125	10	10 to 12
150	12	12
Brass butt hinges (for cabinets)		
25	4	2
30	4	4
40	6	4
50	6	4

Size in mm	No of screws required	IS Designation
Parliament hinges Aluminium/brass/steel		
50	6	8
65	6	8
75	6	8
100	8	10
125	8	10
150	8	10
175	8	10
200	8	10

Piano hinges (1.825 m lengths)

Both 30 and 40 mm sizes require two screws (at every 75 mm centres) of IS Designation 5

Double acting spring hinges		
100	8	10
125	8	10
150	8	10

Blank hinges for use in conjunction with double acting spring hinges are available in 70 and 75 mm size each requiring 6 screws of IS Designation 10

Steel tee hinges Light weight		
75	6	6
100	6	6
125	7	6
150	7	6
200	7	8
250	8	8
300	8	8
350	11	9
400	11	9
Steel tee hinges Medium weight		
75	6	6
100	6	6
125	7	8
150	7	8
200	7	8
250	8	9
300	8	9
350	11	10
400	11	10
450	11	12
500	12	12
Steel tee hinges Heavy weight		
150	7	10
200	7	10
300	10	10
400	11	12
500	12	14

Size in mm	No of screws required	IS Designation
Steel strap hinges Light weight		
75	6	6
100	6	6
125	8	6
150	8	6
200	8	8
250	10	8
300	10	8
350	14	9
400	14	9
Steel strap hinges Medium weight		
75	6	6
100	6	6
125	8	8
150	8	8
200	8	8
300	10	9
400	14	10
500	16	12
Steel strap hinges Heavy weight		
150	8	10
200	8	10
300	12	10
400	14	12
500	16	14
600	16	14

Door springs - Rat tail type

These are available in 300 and 375 mm size and require (per set) 6 wood screws of IS Designation 10.

Barrel Tower Bolts and semi barrel tower bolts		
75	6	6
100	6	6
125	6	6
150	8	6
175	8	6
200	8	6
225	8	6
250	10	6
300	10	6
375	10	6
400	10	6
Rivetted/spot welded steel tower bolts		
100	8	6
125	8	6
150	8	6
175	8	6
200	8	6
225	8	6
250	10	6
300	10	6
375	10	6
450	12	6
600	14	6

Size in mm	No of screws required	IS Designation
Skeleton Tower bolts		
375	14	6
450	14	6
600	16	6
750	18	6
900	20	6
Mild steel sliding door bolts (Aldrop) for use with padlocks		
150	10	9
200	12	9
250	14	9
300	14	9
375	16	9
450	16	9

(For all sizes carriage bolts, 6 per set are also required)

Non-ferrous metal sliding door bolts (Aldrop) for use with padlocks, Brass, Types 1 & 2, and Aluminium Type 3		
150	16	4
200	16	4
250	16	4
300	16	4
350	16	4
375	16	4
400	16	4
450	16	4
Hasp and staple (safety)		
90	7	5
115	7	5
150	8	8
175	8	8
Hasp & staple (wire type)		
65	4	6
75	4	6
90	4	6
100	5	6
125	8	6
150	8	10
175	8	10
Door handles (type 1)		
75	4	6
100	4	6
125	4	6
150	4	6
Door handles (type 2)		
75	4	6
100	4	6
115	6	8
135	6	8
Door handles (type 3)		
75	2	6
90	4	6
100	4	6

MATERIAL CONSTANTS

STEEL AND IRONWORK

Wastage

Wastage of steel in steelwork varies widely with the lengths of sections available/purchased and the actual lengths required in the work, and may range from 2 to 10 %. A higher proportion of wastage invariably occurs in steel plates for gussets, fabrication of girders, base/sole plates etc. In analysing prices, 10 % wastage in plates and 5 % wastage in other steel sections is usually allowed for.

Priming Coat

Rates are occasionally required to be quoted for steel and ironwork inclusive of the shop coat or priming coat of oil paint. For structural and other steelwork in building operations the area of painting required for shop coat usually works out to an average of 3.50 sq m per quintal of steel.

Rivets and Bolts

The weight of rivets/bolts for rivetted/bolted up connections varies from 1.5 to 3.5 kg per quintal for light steelwork and from 4.5 to 5.5 kg per quintal for built up sections in structural steelwork in buildings. Weight of bolts required in fully bolted up steelwork is marginally higher than weight of rivets required for fully rivetted connections per quintal of steelwork.

ROOF COVERING

Type of tiling	Size	Number of tiles required per 10 sq m
Single layer country tiles	20 x 13 cm	1300
Allahabad tiling, single	30.5 x 38 cm	114 flat and 114 half round.
Allahabad tiling, double	15 x 19 cm	227 flat + 227 half round + 227 semihexagonal.
Manglore pattern tiling	41 x 23.5 cm	141

Type of ridge or hip tiles	Numbers required per 100 m length	Mortar required per 100 m length of ridges or hips	
		If bedded solid	If only jointed and pointed
Manglore pattern	330	0.75 cu m	0.20 cu m
Allahabad pattern	330 ridges + 340 elbows	0.75 cu m	0.20 cu m

Note : *Add 5 % wastage in the above constants for tiling to allow for breakage/mortar droppings.*

Corrugated Galvanised Iron Sheeting in Roof

Laps

One corrugation side lap = 55 mm. One and half corrugations side lap = 85 mm. End lap = 150 mm (minimum)

Requirement of Materials

Weight in kg of CGI sheets required per 100 sq m of roof area (actual)

Particulars	Class and gauge of sheets			
	0.80 mm thick (22 gauge)		0.63 mm thick (24 gauge)	
	Class 2	Class 3	Class 2	Class 3
	kg	kg	kg	kg
With one corrugation side laps				
(a) Using sheets with 10 corrugations	846	828	683	664
(b) Weight of 10 corrugation sheet for the portion in end lap	21. 16	20. 70	17. 07	16. 61
(c) Using sheets with 8 corrugations	867	848	699	680
(d) Weight of 8 corrugation sheet for the portion in end lap	21. 67	21. 20	17. 48	17. 01
With one and half corrugation side laps				
(a) Using sheets with 10 corrugations	877	858	708	689
(b) Weight of 10 corrugation sheet for the portion in end lap	21. 44	20. 97	17. 29	16. 83
(c) Using sheets with 8 corrugations	908	888	733	713
(d) Weight of 8 corrugation sheet for the portion in end lap	22. 68	22. 18	18. 29	17. 80

Note : *The above constants are based on roof with sloping length of 5.85 m covered in 2 sheets 3 m long each (with one central end-lap of 15 cm), and with length along eaves board equal to ten widths of sheets. For different lengths of sheets used, constants should be adjusted on the basis of weight of the portion of sheet in end lap per 100 sq m of sheeting.*

MATERIAL CONSTANTS

The quantity of 6 mm dia 65 to 75 mm long screws, or hook/crank bolts 8 mm dia with one nut each, along with one curved galvanised washer per screw or hook/crank bolt depends on the centre to centre distance of bearers. 3 screws or hook/crank bolts are required per width of sheet along the length of bearer, and the numbers work out as follows :-

Particulars	Number of screws or hook/crank bolts required per 100 sq m sheeting	
	8 corrugation sheets	10 corrugation sheets
With one corrugation side laps	Nos.	Nos.
Bearers at 0.5 m centres ...	800	655
Bearers at 0.75 m centres ...	575	470
Bearers at 1 m centres ...	460	375
With one and half corrugation side laps		
Bearers at 0.5 m centres ...	840	680
Bearers at 0.75 m centres ...	600	485
Bearers at 1 m centres ...	480	390

Sheets *if ordered* to be secured by bolting or rivetting at 20 cm centres for side laps, and on every corrugation for end laps will require following quantities of 6 mm dia galvanised short cone-headed bolts and nuts, each with a pair of curved galvanised washers, or 6 mm dia galvanised rivets, each *where indicated* with a pair of galvanised plain round washers, per 100 sq m of sheeting :-

Particulars	8 corrugation sheets	10 corrugation sheets
Side laps	Nos.	Nos.
With one corrugation side laps	790	640
With one and half corrugation side laps	820	665
End laps (For roof as per the footnote on previous page)		
With one corrugation side laps	199	199
With one and half corrugation side laps	206	206

Plain GI Sheet Ridging

60 Nos. of 1.83 m long, 38 cm girth ridges along with 660 Nos. of galvanised coach headed screws and 600 Nos. of flat circular washers are required per 100 m length of ridging.

A. C. Sheets for Roofing and Side-cladding

(Ref IS : 459 - 1970)

Particulars	Corrugated Sheets	Semi-corrugated Sheets
Standard lengths	1.50, 1.75, 2.00, 2.50, & 3.00 m long for both types	
Thickness (Tolerance (-) 0.5 mm, (+) Free)	6 mm	6 mm
Overall width	1050 mm	1100 mm
Effective laid width, allowing for side lap	1006 mm	1014 mm
Corrugation - Overall depth & centre to centre distance	48 mm @ 146 mm centres	45 mm @ 338 mm centres
Side lap	44 mm	86 mm
End lap (minimum)	150 mm	150 mm
Covering efficiency (varies with roof size & sheet length)	Range 87 to 91 %	Range 84 to 89 %
Purlin spacing (maximum) for roof	1.40 metres	1.40 metres
Spacing of runner supports (maximum) for side cladding	1.70 metres	1.70 metres
Maximum free overhang at eaves etc.	300 mm	300 mm
Area of sheets per metric tonne (unpacked, on ground)	74.74 sq m	83.68 sq m

MATERIAL CONSTANTS

A. C. Sheets for Roofing and Side-cladding (*contd*)

$$N = \frac{L - SL}{W - SL}$$

Where N = No of sheets per row; L = Length of roof in metres; SL = One side-lap of sheets in metres; W = Overall width of one sheet in metres.

Use the above formula to find out the number of sheets required in one row to cover the length of roof on plan. If N is not a whole number, N should be rounded up to form a full number and the side lap will have to be suitably increased.

The formula given above will also assist in estimating the quantity of specials like the number of pairs of ridge capping, or the number of apron pieces/eaves filler pieces/north light curves/ventilator curves etc. In using the above formula for estimating specials, the value of L, SL, and W is that of the corresponding roofing sheets ignoring the length of 'special' given in the catalogue of the manufacturer, and N is the number of specials required.

For estimating the number of 8 mm dia GI hook bolts/ crank bolts etc., used in case of steel purlins, or GI coach screws used in case of timber purlins, the number of GI hook bolts or coach screws required will be the number of sheets in one row, plus one, multiplied by the number of purlins in the corresponding roof slope.

Length of hook bolts required will be the depth of the steel purlin (+) 75 mm for fixing sheets on intermediate purlins (i.e. not involving end lap) and depth of steel purlin (+) 90 mm on end laps (i.e. where four sheets meet).

Along with each hook/crank bolt (i/c one nut) and along with each coach screw allow for one bitumen washer 25 mm diameter 3 mm thick, and one GI flat washer 2 mm thick.

GI seam bolts and nuts along with bitumen washer and GI washer are used for stitching ridge cappings, cornerpieces, ventilator and north light curves etc.

CEILINGS, LININGS AND WALL-BOARDING

When working out rates for ceilings, linings and wallboarding the sizes in which the boards/plywood etc., are to be fixed and the sizes in which the same are manufactured/available, and the consequent wastage, if any, are of importance. Architects are expected to give due thought to this aspect when preparing working drawings. Even wastage due to marginal areas can, in most cases be avoided by suitable spacing of supports thereby ensuring that the marginal widths/lengths are in aesthetic/symmetrical submultiples of the standard sizes of boards.

Working out the percentage of wastage involved should be the first step in working out rates for ceilings/linings etc. Assuming any standard figure for wastage may turn out to be hazardous.

Plaster of Paris Ceiling

For making plaster of Paris ceiling tiles about 160 kg of plaster of Paris (gypsum anhydrous) and 10.5 sq m of hessian cloth (both quantities inclusive of wastage) will be required to make 10 sq m of tiles (including closing gaps between tiles with plaster of Paris after fixing in position where ordered).

For in-situ plaster of Paris ceiling 10 mm thick, on 25 x 6 mm wooden strips and chicken wire mesh reinforcement fixed to wooden framework, following materials will be required for 10 sq m of ceiling (exclusive of wooden framework), including wastage :-

25 x 6 mm wooden strips, 35 mm c/c = 0.047 cu m. Nails = 0.75 kg.
Chicken wire mesh = 10.5 sq m. Plaster of Paris = 207 kg.
The above quantities are inclusive of wastage.

FLOOR FINISHES AND PAVINGS

Granolithic Floor

Granolithic concrete floor topping, consisting 1 part cement : 1 part stone dust : 2 parts of granite chips will require the following materials per sq m :-

For 25 mm thickness : 19.60 kg cement, 0.027 cu m stone chips and 0.014 cu m stone dust.
For 30 mm thickness : 22.10 kg cement, 0.030 cu m stone chips and 0.016 cu m stone dust.

Wearproof Topping

For wearproof topping, matallic floor hardener and cement are mixed in dry state. One part of such a mixture is mixed with two parts by volume of crushed granite chips of 6 mm size, and water added. Materials required per sq m of wearproof topping are :-

For 15 mm wearproof topping : 25 kg of cement & hardener mix and 0.017 cu m of granite chips.
For 20 mm wearproof topping : 33 kg of cement & hardener mix and 0.022 cu m of granite chips.

Breakdown of the quantity of cement and weight of hardener will depend on the proportion recommended by the manufacturer. For example, if the recommended proportion is 1 part of hardener : 4 parts of cement by weight, then for 15 mm thick topping 5 kg of hardener and 20 kg of cement will be required per sq m.

MATERIAL CONSTANTS

Concrete Floors

Requirement of cement, sand and aggregate for concrete floors and sub-bases can easily be arrived at by working out the cubical contents of concrete for the specified thickness and applying the constants given for concrete of the required mix. When working out the cubical contents of concrete in sub-bases laid on hardcore or rammed murrum, about 5 to 8 mm extra thickness should be taken into account to allow for un-even nature of the surface on which the concrete is laid. When finishing layer of concrete is laid on prepared concrete sub-base or on RCC floor/roof slabs, about 3 mm extra thickness should be allowed for key/undulations in the sub-base or RCC slab.

15 to 25 kg of cement in the form of cement slurry should be allowed per 10-sq m of flooring for providing bond between any two layers of concrete in flooring.

Mortar Layers/Bedding Screeds for Stone Slab Flooring, etc.

When calculating requirement (cubical contents) of mortar, additional thickness (over and above the specified thickness of bedding layer in floors) as explained above for concrete floors should be taken into account.

For mortar requirement in backing screed in vertical surfaces like dado etc., refer material constants for plastering.

Cement Required for Setting Bricks, Stone Slabs and Tiles etc., in Floor.

Flooring material of the thicker variety like bricks, stone slabs, plain or coloured cement tiles and terrazo tiles etc., are laid directly on the mortar bedding layer, and as the laying of mortar bedding and laying of the bricks/tiles etc., proceeds simultaneously no additional cement (apart from grouting the joints which is considered separately) is required. Thinner varieties of tiles like glazed tiles, 'Spartek' ceramic tiles etc., are usually laid on semi-hardened bedding layer and require about 4.40 kg of cement per sq m in the form of neat cement slurry for setting in place in flooring. For fixing thinner varieties of tiles to hardened backing screed, in vertical surfaces like dado etc., a layer of neat cement of stiff consistency is employed, and the cement required will vary from 9 kg (for 5 mm layer) to 18 kg (for 10 mm layer) per sq m.

White or grey cement, or a mixture of white and grey cement (in the form of neat cement slurry) required for grouting 1 mm thick joints in tile-work, including about 50 % wastage varies from :-

0.30 kg per sq m for 100 x 100 x 5 mm thick tiles
to
0.60 kg per sq m for 200 x 200 x 20 mm thick tiles.

Note : *Approximately 1860 kg of cement will yield 1 cu m of cement paste after mixing water.*

Brick Flooring

The number of bricks and brick-tiles required per sq m of brick flooring with 1 cm thick joints are as given below without wastage. Mortar indicated is for grouting the joints only, exclusive of the bedding layer. Allowance has been made for pores in brick faces and occasional thicker joints.

Type of brick flooring in single layer	With modular bricks 19 x 9 x 9 cm size		With old size bricks 22.86 x 11.11 x 6.985 cm		With old size brick tiles 22.86 x 11.11 x 4.445 cm	
	Brick-Nos	Mortar cu m	Brick-Nos	Mortar cu m	Tiles - Nos	Mortar cu m
Laid flat	50	0.0141	35	0.0091	35	0.0058
Laid on edge	50	0.0141	53	0.0194	77	0.0261

Tile Work

The number of square or rectangular tiles of various sizes required per sq m of flooring (with 1 mm thick joints) are given below exclusive of wastage. Sizes indicated are actual sizes. Wastage in tiles in raking cutting varies from 7 tiles per lineal metre for 150 x 150 mm tiles to 3 tiles per lineal metre for 225 x 225 mm size tiles. Wastage in tiles in straight cutting will be 1 devided by length or width of tile in metres, yeilding a constant for wastage of tiles in numbers per metre as the maximum figure, but this can be minimised to a considerable extent by using the cut tiles in similar locations.

Size of tiles in mm	No. of tiles per sq m	Size of tiles in mm	No. of tiles per sq m	Size of tiles in mm	No. of tiles per sq m
25 x 25	1480	150 x 150	44	305 x 305	11
50 x 50	385	152 x 152	43	500 x 500	4
98.5 x 98.5	101	152.4 x 152.4	43	100 x 200	50
99 x 99	100	198.5 x 198.5	26	105 x 203	47
100 x 100	98	200 x 200	25	125 x 250	32
108 x 108	85	203 x 203	24	105 x 305	31
148.5 x 148.5	45	250 x 250	16	150 x 300	22
149 x 149	45	300 x 300	11	152.5 x 305	22
				200 x 320	16

MATERIAL CONSTANTS

Terrazo Cast-in-Situ

		Materials required for 10 sq m of top layer of terrazo		
		Cement in kg	Marble chips in kg	Marble powder in kg
1.	Top layer of terrazo cast-in-situ, consisting 3 parts of cement by weight mixed with 1 part of marble powder by weight, and one such part of cement-marble powder mix by volume mixed with 1.75 parts by volume of marble chips of 2 to 4 mm size (ie Grade 0 size) :-			
(i)	5 mm thick layer	26	61.10	8.65
(ii)	6 mm thick layer	31	73.30	10.40
2.	-Ditto- but using marble chips of 4 to 7 mm size (ie Grade 1 size) :-			
(i)	7 mm thick layer	37	85.50	12.10
(ii)	8 mm thick layer	42	97.80	13.85
(iii)	9 mm thick layer	47	110.00	15.60
3.	All as in item 1 above, but one part of cement-marble powder mix by volume mixed with 1.50 parts by volume of marble chips of size 7 to 10 mm (ie Grade 2 size)			
(i)	10 mm thick layer	57	118.80	19.00
(ii)	11 mm thick layer	63	130.70	20.80
(iii)	12 mm thick layer	69	142.60	22.70

Notes *(a) Average weight of marble chips is 1710 kg per cu m.*
(b) For applying cement slurry as bond between underlayer and terrazo topping allow 25 kg of grey/white cement per 10 sq m of terrazo topping.
(c) Allow 2.5 % wastage on all material constants given in the above table.
(d) Materials required for plain concrete in underlayer to be worked out as per constants given for concrete.
(e) Pigments to be used for obtaining different shades/colours of terrazo will be in the following proportions :-

Colour / shade	Mixing Proportions		
Red	1 kg red oxide of iron	:	15 to 20 kg grey cement.
Black	1 kg carbon black	:	25 to 40 kg grey cement.
Bottle green	1 kg green chromium oxide	:	15 to 30 kg grey cement.
Pink	1 kg red oxide of iron	:	100 to 300 kg white cement.
Cream	1 kg yellow oxide of iron	:	100 to 400 kg white cement.
Yellow	1 kg yellow oxide of iron	:	25 to 75 kg white cement.
Light green	1 kg green chromium oxide	:	50 to 150 kg white cement.
Fawn	1 kg yellow oxide of iron	:	6 kg grey cement + 4 kg white cement.
French grey	No Pigment required	:	Mix 1 to 2 parts of grey cement with 4 parts of white cement by weight.

Crazy Marble Paving

		Constants exclusive of wastage			
		Per 10 sq m of crazy marble paving			
		Cement (grey, white, or mixture)	Marble chips	Marble powder	Marble slabs (irregular random broken pieces)
	Crazy marble paving, using random irregular size broken marble slabs of mixed shades/colours, but of uniform thickness, gaps filled with terrazo mixture (as indicated for the mix in description of items 1 or 2 of terrazo cast-in-situ above), trowelled to a smooth even surface and machine polished :-	kg	kg	kg	kg
(i)	for top layer, 20 mm thick ...	31	73.30	10.40	392
(ii)	for top layer, 30 mm thick ...	47	110.00	15.60	588
(iii)	for top layer, 40 mm thick ...	62	146.60	20.80	783

Note : *Constant is exclusive of cement concrete underlayer. Allow 25 kg cement per 10 sq m of paving for cement slurry as bond between underlayer and topping. Area of marble slabs will be in the region of about 72 to 75 % of the area of paving. Allow for pigments same as for terrazo.*

MATERIAL CONSTANTS

PLASTERING AND POINTING

Mortar Requirement

The obvious procedure for calculating the quantity of sand and cement (and/or lime) required per sq m of plaster of various thicknesses is to work out the volume of mortar required per sq m of plaster and to apply material constants for mortar to the same, after allowing for about 2.5 % wastage for mortar droppings.

Thickness of plaster, however, is calculated from the proudest part of the surface plastered. The volume of mortar worked out (ie product of area and thickness of plaster), therefore needs to be increased by predetermined extents based on data collected from actual plastering work to allow for key (raked out joints etc.,) pores, undulations, uneven surfaces and consolidation of mortar due to trowelling.

The extent of raked out joints available for key in plastering varies with the face dimensions of bricks of various kinds. Further, one brick thick walls with traditional bricks present a fair face on one side and a rough uneven face on the other side.

Nature of surface to be plastered	Extra thickness of plaster to be considered when calculating volume of mortar	
Smooth concrete surface, hacked to form key for plaster	1 mm	Average group value for concrete surface may be taken as 1.3 mm
Rough concrete surface, produced by clean sawn formwork	1.3 mm	
Surface of concrete block masonry work, joints raked 1 cm	1.6 mm	
Fair face of brick walls using old size bricks, -do-	4.3 mm	Average group value for fair brick surfaces may be taken as 4 mm
Face of brick walls using modular bricks, -do-	3.7 mm	
Rough (inner) face of brick walls using old size bricks -do-	6.6 mm	Average group value for rough surfaces may be taken as 8 mm
Surface of random or polygonal stone masonry -do-	9.1 mm	
Reed/Ekra walling (for each face)	5 mm	
Surface of first/second coat of plaster (in two or three coat work) scored to form key for next coat of plaster	0.6 mm	

The above data assumes a fair quality of workmanship, in plaster work as well as in the brickwork/concrete/stonework etc., on which the plaster is applied. Higher quantity of mortar than indicated above may be required due to uneven sizes/irregularities in the bricks used and due to a tendency in plastering artisans to apply mortar in layers thicker than specified.

Material Constants for Special Items of Plaster

For special items of plaster, the materials required for the undercoat (ie rendering including dubbing), of the thickness as specified which is usually 10 mm thick from the proudest part of the surface to be plastered, should be worked out as for general items of plaster.

Material constants for the special finishing coat inclusive of wastage are given below :-

Type of special finish applied (undercoat to be as specified)	Lime putty (wet)	Cement	Sand	Crushed stone or gravel, 6 to 12 mm size	Crushed stone or pebbles, 10 to 20 mm size
	cu m	kg	cu m	cu m	cu m
Note : *Material constants are per 10 sq m excluding undercoat*					
1. 5 mm thick sand faced plaster in cement and sand mortar (1:4)	-	25.00	0.07	-	-
2. Rough cast plaster finish consisting 1 part cement : 1 part crushed stone or gravel 6 to 12 mm size : 1 part sand	-	80.00	0.055	0.055	-
3. Pebbledash (or drydash) finish, (on freshly applied undercoat)	-	5.00	-	-	0.10
4. Neeru finish 1.5 mm thick	0.02	-	-	-	-
5. Lime punning 3 mm thick, with 1 part lime putty : 1 part fine sand	0.025	-	0.025	-	-

MATERIAL CONSTANTS

Pointing

Mortar required for pointing 10 sq m of surface (inclusive of wastage)

Type of surface to which pointing is done	Mortar cu m	Type of surface to which pointing is done	Mortar cu m
Flush, keyed or struck pointing to brickwork on fair face.	0.0355	Pointing with bastard tuck or mason's 'V' joint to random rubble masonry.	0.0912
-Do- but to random rubble masonry	0.0753	-Do- but to squared rubble masonry coursed or uncoursed.	0.0731
-Do- but to squared rubble, coursed or uncoursed masonry	0.0576	Flush, keyed or struck pointing to ashlar or block-in-course stone masonry or to concrete block walling.	0.0217
-Do- but to facing of brick tiles	0.0555		

WHITE/COLOUR-WASHING AND DISTEMPERING ETC.

Specifications adopted by various departments/agencies, and the covering capacities claimed by manufacturers for their paint and allied products differ considerably. Material constants given below are the average values.

Type of finish	Materials required per 10 sq m of surface	First coat	Each subsequent coat
White washing to walls or underside of ceilings.	Slaked lime	1.20 kg	0.80 kg
	Glue	3 grams	2 grams
	Ultramarine blue ...	4 grams	2 grams
	Sodium chloride ...	155 grams	105 grams
Cement wash to walls or underside of ceilings.	Cement	1.07 kg	1 kg

Note : *For colour-washing, materials required for each coat (after initial coat of white-wash) will be same as given for 'each subsequent coat' of white-wash, except that in place of ultramarine blue, 80 to 100 grams of mineral colour will be required.*

Waterproof cement based paint of proprietory brand (suitable for mixing with water) such as 'Snowcem' or similar, on :-			
fibre board surface and the like ...	Dry powder ...	3.00 kg	for two coats
smooth concrete surface ...	Dry powder ...	3.05 kg	for two coats
plastered surface (plain) ...	Dry powder ...	4.00 kg	for two coats
un-plastered brick wall face ...	Dry powder ...	4.40 kg	for two coats
unplastered concrete block walling ...	Dry powder ...	4.65 kg	for two coats
roughcast or pebbledash plaster ...	Dry powder ...	7.70 kg	for two coats
Puttying plastered surfaces to a smooth even finish ...	... ...	0.20 kg	of putty
Clearcolling plastered surface with glue solution (1 kg glue : 15 kg water)	Glue ...	80 grams	
Priming plastered surface with proprietory brand of primer (preparatory to applying distemper) ...	Primer ...	0.80 to 0.90 litre	
Priming coat of whiting to plastered surface ...	Whiting ...	1.00 kg	
Distempering with dry distemper (washable) of proprietory brand	Dry distemper powder	1.35 kg	for two coats
Distempering with oil-bound distemper (washable quality) of proprietory brand	Oil bound distemper paste	1.50 kg	for two coats
Acrylic emulsion paint to plastered neeru finished surfaces, (or on ordinary plastered surface given oil-putty treatment to make it smooth and even)	Acrylic emulsion paint	0.90 litre	for white shade (three coat work)
		0.70 litre	for other than white shade (three coats)

Note : *When analysing prices, allowance for brushes, sand paper etc., is usually made at the rate of 5 % of the calculated labour wages for each unit of white washing, distempering etc.*

MATERIAL CONSTANTS

GLAZING

Wastage

Where glass is purchased in bulk in stock sizes and cut to sizes required for fixing, 10 to 15 % wastage is required to be allowed on glass.

If glass is purchased ready-cut to required sizes for fixing by builder's employees, 5 % allowance is made for waste.

Where glass is fixed by a subcontractor at all-inclusive rates for glazing, an allowance of 1 % will cover breakages subsequent to glazing but before handing over the building to the owner.

Almost all builders find it cheaper and convenient to employ a subcontractor for glazing work at rates inclusive of labour and materials.

Where subcontractors are employed, the local trade customs should be taken into account in the working out of rates to be quoted by a builder. FPS system is still prevalent in the glazing trade. In some localities the sizes of individual glass panes are rounded up to the nearest dimension of 3 inches, which means that a pane of size 10 x 22 inches will be measured as 2 sq ft . Another custom that may be come across is to charge panes less than 1 sq ft area as 1 sq ft. Scaffolding is to be provided by the builder to the subcontractor.

Requirement of Glazing Putty

The requirement of glazing putty given below is for glazing with oil putty without beads. The element of backputtying accounts for 20 % of the requirement of glazing putty given in the table below. Where glass panes are back-puttied and fixed with timber beads to wooden joinery, glazing putty required will be 20 % of the requirement indicated in the table below.

Range of area of each pane	Putty required in kg per sq m of glazing	
	To wood sashes	To steel windows
Upto 0.1 sq m	1.07	1.32
0.1 to 0.2 sq m	0.68	1.04
0.2 to 0.3 sq m	0.54	0.63
0.3 to 0.4 sq m	0.49	0.59
0.4 to 0.5 sq m	0.44	0.54
0.5 to 0.6 sq m	0.39	0.49
Exceeding 0.6 sq m	0.34	0.44

The *average* requirement of putty in kg per sq m of glazing in panes not exceeding 0.5 sq m per pane for timber joinery and steel windows may be taken as 0.65 kg and 0.82 kg respectively.

PAINTING, POLISHING, VARNISHING ETC.

Equivalent Plain Areas

Attention is drawn to page 77 of this book where multiplying factors for converting area of uneven surfaces into equivalent plain area for the purpose of painting etc., are given. The material constants given below are applicable for work on plain areas.

Material Constants

Covering capacities claimed by manufacturers of paint and allied products differ considerably. Further, the type and nature of surfaces, workmanship etc., met with in one job may differ from another. The material constants given below should be treated as average indicative figures for estimating purposes, and used with caution and discrimination when employed for indenting stores.

Description of work	Materials required for 10 sq m of surface	
Timber and wood-based surfaces		
Oiling with creosote or raw linseed oil to wrought timber	Creosote or raw linseed oil	0.80 litre - first coat 0.55 litre - second coat
-Do- but to clean sawn timber	Creosote or raw linseed oil	1.15 litres- first coat 0.75 litre - second coat
Tarring to clean sawn timber surfaces	Coal tar	3.00 litres

MATERIAL CONSTANTS

Description of work	Material required for 10 sq m of surface	
Timber and woodbased surfaces		
Preparatory work before painting/polishing/varnishing etc., (to be allowed for where specified) :-		
(i) Knotting	Patent shellac knotting ...	0.07 litre
(ii) Stopping	Putty for stopping ...	0.20 kg
(iii) Staining wrought surfaces using spirit based stainer liquid	Stainer liquid ...	0.63 litre
(iv) Staining clean sawn surfaces using linseed oil based stainer liquid	Stainer liquid ...	1.00 litre
(v) Sizing wrought surfaces with weak size of thinned shellac varnish, sparingly applied ...	Sizing ...	0.30 litre
Priming coat of oil paint to wrought timber or smooth woodbbased surfaces		
(i) Using aluminium primer	Primer ...	0.50 litre
(ii) Using lead based primer	Primer ...	0.85 litre
Oil painting to wrought surfaces after priming coat (allow for the number of coats as ordered) ...	Oil paint - First coat ...	0.63 litre
	Second coat ...	0.56 litre
	Third coat ...	0.45 litre
	Oil gloss coat ...	0.42 litre
Renewal coats of oil paint on old oil painted surfaces ...	Oil paint - First coat ...	0.56 litre
	Second coat ...	0.50 litre
Painting to wrought surfaces using synthetic enamel paint, after suitable undercoat or priming coat ...	En. paint - First coat ...	0.70 litre
	Second coat ...	0.56 litre
Varnishing to wrought surfaces, consisting :-		
(i) Flat coat of hard-drying flatting varnish (applicable for two coat work) ...	Varnish ...	0.60 litre
(ii) Finishing coat of varnish (after flat coat) where two coat work is specified	Varnish ...	0.50 litre
(iii) Varnishing in one coat work ...	Varnish ...	0.60 litre
Bees wax polishing to wrought surfaces using wax dissolved in a mixture of turpentine and linseed oil ...	Bees wax ...	0.12 kg
	Turpentine ...	0.07 litre
	Linseed oil ...	0.10 litre
French polishing	French polish (spirit base)	2.50 litres
Special blackboard paint (after priming coat) ...	Black board paint - Each coat	0.50 litre
Natural clear melaminised wood finish, matt or glossy ...	Wood finish (single coat) ...	1.00 litre
Steel and iron surfaces		
Treating galvanised surface with mordant solution ...	Mordant solution ...	0.35 litre
Priming coat	Red lead primer ...	0.66 litre
	Red oxide zinc chrome primer	0.70 litre
	Aluminium red oxide primer	0.50 litre
Oil painting (after priming coat)	Oil paint - First coat ...	0.60 litre
	Finishing coat ...	0.55 litre
	Synthetic enamel - each coat	0.45 litre
	Black japan - each coat	0.60 litre
	Aluminium paint - each coat	0.45 litre
	Bituminised black paint	0.80 litre
Plastered surfaces		
Priming coat	Primer (suitable for plaster)	0.85 litre
Oil painting after priming coat	Oil paint (undercoat)	0.85 litre
	Oil paint (finishing coat)	0.75 litre
Painting with synthetic enamel after priming coat ...	Synthetic enamel (each coat)	0.75 litre

MATERIAL CONSTANTS

WATER SUPPLY, PLUMBING, DRAINS AND SANITARY FITTINGS

Effective Pipe Lengths and Number of Joints

The number of pipes required can be worked out by deviding the total length of piping of a particular diameter required in the job by the working (effective) length per pipe making due allowance for pipe specials like bends, tees, valves etc. This also facilitates working out the number of joints required. Pipes are available in various working lengths. The recommended working lengths for various kinds of pipes in relevant IS specifications are as follows :-

Type of pipe and applicable IS Specification No.	Recommended working length(s) per pipe
1. **Centrifugally cast (spun) iron pressure pipes** for water, gas and sewage *(IS : 1536 - 1976)*	
(i) Socket and spigot pipes (class LA, A & B)	3.66, 4, 4.88, 5, 5.5 and 6 m
(ii) Flanged pipes with screwed flanges class A and B	2, 2.8, 3, 4, 4.88, 5, 5.5 and 6 m
2. **Vertically cast iron pressure pipes** for water, gas and sewage *(IS : 1537 - 1976)*	
(i) Socket and spigot pipes (class A and B) ...	3.66, 4, 4.88, 5 and 5.5 m
(ii) Flanged pipes (class A and B) ...	2 to 3 m for 80 mm nominal diameter and 2 to 4 m for 100 to 1500 mm nominal diameter.
3. **Centrifugally cast (spun) iron spigot and socket soil, waste and vent pipes** of 50, 75, 100 and 150 mm diameter *(IS : 3989 - 1984)*	1.5, 1.8, 2.0, 2.5 and 3 m
4. **Sand cast iron spigot and socket pipes** of 50, 75, 100 and 150 mm diameter *(IS : 1729 - 1979)*	-Do-
5. **Concrete pipes** *(IS : 458 - 1971)*	
(i) Unreinforced, non-pressure, type NP 1	1 metre lengths
(ii) Reinforced, non pressure, light duty, type NP 2	2 m lengths for 80, 100, 150, 200 and 250 mm dia 2, 2.5 & 3 m lengths for 300, 350 & 400 mm dia 2.5 and 3 m lengths for 450 mm diameter and above.
(iii) Reinforced, non pressure, heavy duty, type NP 3	2.5 and 3 m lengths for 350 mm to 1200 mm dia.
(iv) Reinforced, non pressure, very heavy duty (railways), type NP 4	2.5 m lengths for 400 to 800 mm dia. 1.25 m lengths for 900 to 1800 mm dia.
(v) Reinforced, pressure pipes, tested for 2 kg/sq cm pressure, type P 1	2.5 m lengths for 80 to 250 mm dia. 2, 2.5 or 3 m lengths for 300 and 350 mm dia. 2.5 & 3 m lengths for 400 to 1200 mm dia.
(vi) Reinforced, pressure pipes, tested for 4 kg/sq cm pressure, type P 2	2 m lengths for 80 to 250 mm dia 2, 2.5 or 3 m lengths for 300 and 350 mm dia. 2.5 or 3 m lengths for 400 to 1200 mm dia.
(vii) Reinforced, pressure pipes, tested for 6 kg/sq cm pressure, type P 3	2 m lengths for 80 to 250 mm dia 2, 2.5 or 3 m lengths for 300, 350 and 400 mm dia.
6. **Asbestos cement pressure pipes** *(IS : 1592 - 1970)*	3 or 4 m for 100 mm dia and less. 4 m lengths for pipes exceeding 100 mm dia.
7. **A. C. building pipes**, for soil, vent, waste and rainwater *(IS : 1626 - 1980, Part I)*	0.5, 1, 1.5, 2 and 3 m lengths.
8. A. C. cement valley gutters, boundary wall gutters and half round gutters *(IS : 1626 - 1980, Part II)*	2 m lengths.
9. **M. S. tubes**, black/galvanised for water distribution, *(IS : 1239 - 1979, Part I)*	Random lengths of 4 to 7 m, grade marked yellow for 'Light', blue for 'Medium' and red for 'Heavy'.
10. **Low density polythelene pipes** *(IS : 3076 - 1985)* for potable water supply.	In coils of 25, 50, 100, 150 and 250 m lengths.
11. **High density polythelene pipes** for potable water supply, sewage and industrial effluents, *(IS : 4984 - 1978)*	In coils or straight lengths of 5 to 20 m.
12. **Unplasticized PVC pipes** for potable water supply *(IS : 4985 - 1981)*	In straight lengths of 4, 5 and 6 m.
13. **Salt glazed stoneware pipes** *(IS : 651 - 1980)*	0.6, 0.75 and 0.9 m lengths (0.6 m length being most commonly used).

MATERIAL CONSTANTS

Materials Required for Pipe Joints

Cast iron socket and spigot pipes
(for water supply and drains laid below ground level)

Nominal internal dia of pipe	Run lead joint			Lead wool joint		Cement mortar (1:1) joint	
	Lead per joint *	Depth of lead joint *	Spun yarn per joint	Lead wool per joint *	Spun yarn per joint *	Cement mortar per joint	Spun yarn per joint
mm	kg	mm	kg	kg	kg	cu m	kg
80	1.8	45	0.10	1.30	0.17	0.00046	0.10
100	2.2	45	0.18	1.70	0.23	0.00060	0.18
150	3.4	50	0.20	2.41	0.34	0.00090	0.20
200	5.0	50	0.30	3.37	0.57	0.00124	0.30
250	6.1	50	0.35	4.11	0.74	0.00166	0.35
300	7.2	55	0.48	4.82	0.82	0.00207	0.48
350	8.4	55	0.60	6.04	1.17	0.00243	0.60
400	9.5	55	0.75	7.00	1.33	0.00270	0.75
450	14.0	55	0.95	9.64	1.84	0.00336	0.95
500	15.0	60	1.00	10.86	1.99	0.00408	1.00
600	19.0	60	1.20	12.79	2.83	0.00546	1.20
750	25.0	60	1.49	15.68	3.52		
900	35.0	65	1.80	18.80	4.25		
1200	52.0	70	2.55	28.44	6.01		

Note : *The above information in columns marked * has been extracted from IS : 3114 - 1985 - Code of practice for laying cast iron pipes. Cement joints are permissible for cast iron gravity sewers.*

Cast iron pipes with flanged and bolted joints

Gasket, one per joint, used between flanges of pipes for making watertight joints may be of compressed fibre board or natural/synthetic rubber of thickness between 1.5 to 3 mm. Thickness and out-to-out diameter of each flange, and the number and diameter of bolts required per joint relevant to each different internal diameter of pipe are given below :-

Nominal internal dia of pipe	Each flange		Bolts required per joint		Nominal internal dia of pipe	Each flange		Bolts required per joint	
	Dia	Thickness	Numbers required	Diameter		Dia	Thickness	Numbers required	Diameter
mm	mm	mm	Nos	mm	mm	mm	mm	Nos	mm
80	200	21	4	16	500	670	33	20	24
100	220	22	8	16	600	780	36	20	27
125	250	22.5	8	16	700	895	38.5	24	27
150	285	23	8	20	750	960	40	24	27
200	340	24.5	8	20	800	1015	41.5	24	30
250	395	26	12	20	900	1115	44	28	30
300	445	27.5	12	20	1000	1230	47	28	33
350	505	29	16	20	1100	1340	50	32	33
400	565	30	16	24	1200	1455	53	32	36
450	615	31.5	20	24	1500	1800	61	40	39

Cast iron (socket and spigot) soil, waste and vent pipes
(Materials required per joint)

Nominal internal diameter of pipe	Cement joint		Run lead joint	
	Cement mortar	Spun yarn	Lead	Spun yarn
	cu m	kg	kg	kg
50	0.00013	0.01	1.00	0.01
75	0.00020	0.015	1.15	0.015
100	0.00029	0.02	1.50	0.02
150	0.00048	0.04	2.50	0.04

MATERIAL CONSTANTS

Materials Required for Pipe Joints *(continued)*

Salt glazed stoneware pipes

Nominal internal dia of pipe	Materials required per joint		Nominal internal dia of pipe	Materials required per joint	
	Cement and sand mortar (1:1)	Spun yarn		Cement and sand mortar (1:1)	Spun yarn
mm	cu m	kg	mm	cu m	kg
100	0.0004	0.012	350	0.0034	0.161
150	0.0007	0.027	400	0.0043	0.180
200	0.0010	0.051	450	0.0050	0.200
230	0.0012	0.066	500	0.0068	0.265
250	0.0019	0.087	600	0.0090	0.395
300	0.0025	0.141			

Non-pressure concrete pipes

Two lengths of hemp rope, approximately equal to the circumference of the pipe and of thickness appropriate to the caulking space are dipped in cement slurry and slipped over the pipe barrel at each side of the collar and pushed in with a caulking tool to the midpoint to ensure even thickness of cement joint inside the collar.

Minimum caulking space (between outside diameter of pipe barrel and inner diameter of the loose concrete collar for jointing) for all non-pressure (NP) type of concrete pipes is 13 mm for pipes upto 250 mm dia, 16 mm for 300, 350 and 400 mm dia and 19 mm for pipes exceeding 400 mm dia.

Nominal internal dia of pipe	NP 2 Pipes	Nominal internal dia of pipe	NP 2 Pipes	NP 3 Pipes
	Cement and sand mortar (1:1) required per collar joint		Cement and sand mortar (1:1) required per collar joint	
mm	cu m	mm	cu m	cu m
80	0.0016	350	0.0067	0.0081
100	0.0019	400	0.0075	0.0088
150	0.0024	450	0.012	0.014
200	0.0030	500	0.013	0.015
225	0.0032	600	0.017	0.019
250	0.0035	700	0.018	0.021
300	0.0057	800	0.024	0.026
1400	0.066	900	0.029	0.032
1600	0.081	1000	0.035	0.038
1800	0.105	1100	0.042	0.045
		1200	0.049	0.052

Asbestos cement building pipes for rainwater, soil, waste and ventilation

Nominal diameter of pipe	Mortar required per joint	Spun yarn per joint
mm	cu m	kg
50	0.00012	0.01
60	0.00014	0.01
80	0.00018	0.015
100	0.00024	0.02
150	0.00042	0.04

Galvanised iron steel tubes with screwed socket joints

Nominal internal dia of pipe	White lead required per joint
mm	grams
15	3.3
20	4.5
25	5.6
32	7.1
40	8.9
50	11.2

Add 5 % of the cost of white lead to cover the cost of small quantity of spun yarn and oil for oiling threads of pipe and socket.

MATERIAL CONSTANTS

Sanitary Appliances

Sizes recommended for sanitary appliances in relevant applicable Indian Standard Specifications are given below for ready reference. These may be found useful in framing items of work, drafting of specifications and in detailing working drawings.

Type of sanitary appliance	Recommended sizes
Wash down water closet, European pedestal type *IS : 2556 (Part II) - 1981*	Patterns 1 and 2. Both patterns have integral 'P' or 'S' trap. Overall dimensions of both patterns (without seat and cover) are identical :- end to end length 500 to 575 mm, width 345 mm, and height 390 mm. Water surface area in Pattern 1 is twice that of Pattern 2. Both patterns have provision for vent horn and are available in P or S trap as ordered.
Seat and cover for European pedestal type water closet. (Hinges of nickel-chromium plated brass/bronze/ steel or of aluminium alloy with anodic coating, or of suitable plastic. Seat and cover available in black white or other colours)	Thermoset seat and cover conforming to IS : 2548 (Part I) - 1983 may be of Type 'A' moulded from phenolic plastics or of Type 'B' moulded from urea-formal dehyde. Thermoplastic seat and cover conforming to IS : 2548 (Part II) - 1983 may be of Type 'A' moulded from polysterene or of Type 'B' moulded from polypropelene.
Water closets, squatting pattern *IS : 2556 (Part III)-1981.* (Total depth exclusive of P or S trap is 290 to 320 mm for 580 mm size 'Long' pan, 310 to 340 mm for 630 mm size 'Long' pan, 280 to 300 mm for small Orissa pan, 300 to 320 mm for large Orissa pan and 290 mm for 'Rural' pan. All squatting pattern WC pans require separate 'P' or 'S' traps.)	*Pattern* — *Size(s)* Long — 580 mm or 630 mm long. Length inclusive of back or front inlet = 685/735 mm Orissa — 580 x 440 mm or 630 x 450 mm inclusive of footrests. Length inclusive of flushing inlet = 655 or 705 mm Rural — 425 mm long and about 650 wide inclusive of integral footrests. Separate footrests (optional) of size 250 x 125 x 15 mm minimum required for 'Long' pattern only.
Squatting plates (Urinals) *IS : 2556 (Part IV/Sec 3) - 1974.*	Sizes 600 x 350 mm or 450 x 350 mm, both 100 mm thick.
Urinals, bowl type *IS : 2556 (Part VI/Sec 1) - 1979.*	Flat back - Size 430 x 260 x 350 mm minimum. Height from top of flushing rim to bottom of outlet 430 mm, projection from wall 260 mm, width 350 mm. Angle back - 340 x 410 x 265 mm, minimum. Height from top of flushing rim to bottom of outlet 340 mm, projection from apex of corner 410 mm, length abutting against each leg of corner 265 mm.
Urinals, half stall *IS : 2556 (Part VI/Sec 2) - 1974.*	*Height* — *Width* — *Projection from wall* Flat back - 580 mm x 380 mm x 350 mm or 450 mm x 350 mm x 300 mm *Height* — *Width* — *Projection from corner* Angle back - 450 mm x 375 mm x 350 mm or 580 mm x 400 mm x 500 mm
Partition slabs for urinals *IS : 2556 (Part VI/Sec 4) - 1974.*	Size, 825 mm height x 450 mm width x 100 mm thick or 675 mm height x 325 mm width x 85 mm thick
Wash basins *IS : 2556 (Part IV) - 1972.*	*Overall width* — *Overall projection from wall surface or apex of corner* — *Overall height* — *No. of taps* Flat back pattern: * 660 mm — 460 mm — 200 mm — 2 (or none) 630 mm — 450 mm — 290 mm — 1 or 2 550 mm — 400 mm — 290 mm — 1 or 2 450 mm — 300 mm — 225 mm — 1 Angle back pattern: 600 mm — 480 mm — 290 mm — 1 or 2 400 mm — 400 mm — 200 mm — 1 or 2 * Designated as surgeon's basin.

MATERIAL CONSTANTS

Type of sanitary appliance	Recommended sizes

Laboratory sinks.
IS : 2556 (Part V) - 1979.

Overall length		*Overall width*		*Overall height*
400 mm	x	250 mm	x	150 mm
450 mm	x	300 mm	x	150 mm
500 mm	x	350 mm	x	150 mm
600 mm	x	400 mm	x	200 mm
600 mm	x	450 mm	x	200 mm

Flushing cisterns
IS : 774 - 1984

(Flush pipe internal diameter to be 32 mm for high level cisterns and 38 mm for low level cisterns. Inlet pipe 15 mm diameter)

Flushing cisterns may be high level (minimum height of 1250 mm between top of pan and underside of cistern) or low level (height not exceeding 300 mm between top of pan and underside of cistern) or coupled ie at the back portion of wash down pedestal pattern water closets, where usually underside of the cistern will be at the level of top of pan.

Dual flush cisterns are of a design which enables the user to cause a short flush of partial discharge when only urine needs to be flushed away or to cause the customary full flush at his option.

IS recommends only 5 or 10 litre capacity flushing cisterns, single or dual flush type, for Indian or European type WC and urinals.

Automatic flushing cisterns for urinals.
IS : 2326 - 1970.

(Internal diameter of flush pipe to be 25 mm.)

Sizes recommended are 5, 10 or 15 litres capacity. Capacity to be worked out on the basis of about 2.5 litres per urinal served, with automatic operation of flushing at intervals not less than 10 minutes and not more than 20 minutes.

ARCHITECTURAL NORMS AND GUIDELINES FOR AVERAGE BODY MEASUREMENT IN INDIA

Type of Fitting or Fixture, Architectural element etc.	*Height from top of floor level in cm*
Top of Kitchen platform	80
Minimum clear opening below slab of kitchen platform to accomodate a cooking gas cylinder	68
Top edge of kitchen sink	74
30 cm wide shelf (to provide full reach upto back of shelf)	150
Lowest shelf in kitchen	50
Front top edge of wash hand basin	85
Top of partitions for urinals	130
Lip of urinal for gentlemen	70
Bottom edge of reflecting surface of mirror fixed behind wash basin	130
Rod of towel rail	90
Bottom of shower rose	200
Stop cock for shower rose	100
Tap in water closet	22

Type of Fitting or Fixture, Architectural element etc.	*Height from top of floor level in cm*
Tap in kitchen ground sink	40
Tap in bath room	70
- Do- if used for taking bath sitting on floor, below the tap	110
Bottom of ceiling fan	260
Top of railing in balcony	90
Top of staircase railing (measured from edge of nosing of steps)	85
	Minium space provision in cm
Depth of wardrobe (for coats)	50
Between walls enclosing wash basin	95
In front of wash basin and wall	65
Edge of dining table and wall	85
Edge of dining table and cabinets	120
Between table and other furniture	60

Note : For comfort in using staircase, the sum of twice the height of risers in cm and one width of tread in cm should come to about 58.5 cm.

: For accomodating two gas cylinders side by side below kitchen platform provide 85 cm clear width.

FORMULAE USEFUL IN VALUATION OF PROPERTY

1. Amount of Re. 1.00

To find the amount that will accumulate at the end of n years if Re. 1.00 is invested today at the rate of interest of i percent per annum.

Amount of Re. 1.00 $= (1 + i)^n$

Where i is the rate of interest viz. 0.03 for 3%, 0.05 for 5% etc. and n is the number of years.

2. Present value of Re. 1.00

To find the present value of Re. 1.00 payable at the end of n years at the rate of interest of i percent per annum.

Present value of Re. 1.00 $= \dfrac{1}{(1 + i)^n}$

Where n is the number of years and i is the rate of interest viz. 0.03 for 3% rate of interest.

3. Amount of Re. 1.00 per annum

To find the amount that will accumulate at the end of n years if Re. 1.00 is invested at the end of every year at the rate of interest of i percent per annum.

Amount of Re. 1.00 per annum $= \dfrac{(1 + i)^n - 1}{i}$

Where n is the number of years and i is the rate of interest viz. 0.03 for 3% rate of interest.

4. Annual sinking fund

To find the amount that should be invested every year at the rate of interest of i percent per annum so that it will accumulate to Re. 1.00 at the end of n years.

Annual Sinking Fund $= \dfrac{i}{(1 + i)^n - 1}$

Where i is the rate of interest viz 0.03 for 3%, and n is the number of years.

5. Present value of Re. 1.00 per annum (Single Rate). (This is also called as the year's purchase (single rate) for n years).

To find the *present* value of the total accumulation at the end of n years if Re. 1.00 is proposed to be invested at the end of every year at the rate of interest of i percent per annum.

Here, i.e. in single rate calculations, it is assumed that the invested capital (present value) can be redeemed by paying into sinking fund an annual amount which will accumulate at compound interest at the same rate percent at which the annual payment of Re. 1.00 will be invested.

Present value of Re. 1.00 per annum (single rate) (i.e. year's purchase (single rate) for n years).

$$\frac{\left[1 - \dfrac{1}{(1 + i)^n}\right]}{i}$$

Where i is the rate of interest per annum viz. 0.03 for 3% and n is the number of years.

6. Present value of Re. 1.00 per annum (Dual Rate)

To find the present value of the total accumulation at the end of n years if Re. 1.00 is proposed to be invested at the end of every year at the rate of interest of i per annum and where allowance is to be made for invested capital (i.e. the present value) to be redeemed at the end of n years by paying into an Annual Sinking Fund at a different rate percent, usually much lower than i.

Present value of Re. 1.00 per annum (dual rate) (i.e. year's purchase (dual rate) for n years).

$$\frac{1 - V}{i - (V \times d)}$$

Where V = Present value of Re. 1.00 receivable at the end of n years at the rate per cent at which an Annual Sinking Fund can be invested.

d = Difference between interest on Re. 1.00 for one year at the two given rates per cent.

i = The rate of interest on the yearly investments that is to be allowed.

INTEREST AND DISCOUNT TABLES

Simple Interest Table for calculating the amount of interest on 100 currency units for any number of days.

Days **Rate of Interest %** **Days**

	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	11	12	
1	0.007	0.008	0.010	0.011	0.012	0.014	0.015	0.016	0.018	0.019	0.021	0.022	0.023	0.025	0.026	0.027	0.030	0.033	1
2	0.014	0.016	0.019	0.022	0.025	0.027	0.030	0.033	0.036	0.038	0.041	0.044	0.047	0.049	0.052	0.055	0.060	0.066	2
3	0.021	0.025	0.029	0.033	0.037	0.041	0.045	0.049	0.053	0.058	0.062	0.066	0.070	0.074	0.078	0.082	0.090	0.099	3
4	0.027	0.033	0.038	0.044	0.049	0.055	0.060	0.066	0.071	0.077	0.082	0.088	0.093	0.099	0.104	0.110	0.121	0.132	4
5	0.034	0.041	0.048	0.055	0.062	0.069	0.075	0.082	0.089	0.096	0.103	0.110	0.116	0.123	0.130	0.137	0.151	0.164	5
6	0.041	0.049	0.058	0.066	0.074	0.082	0.090	0.099	0.107	0.115	0.123	0.132	0.140	0.148	0.156	0.164	0.181	0.197	6
7	0.048	0.058	0.067	0.077	0.086	0.096	0.106	0.115	0.125	0.134	0.144	0.153	0.163	0.173	0.182	0.192	0.211	0.230	7
8	0.055	0.066	0.077	0.088	0.099	0.110	0.121	0.132	0.142	0.153	0.164	0.175	0.186	0.197	0.208	0.210	0.241	0.263	8
9	0.062	0.074	0.086	0.099	0.111	0.123	0.136	0.148	0.160	0.173	0.185	0.197	0.210	0.222	0.234	0.247	0.271	0.296	9
10	0.069	0.082	0.096	0.110	0.123	0.137	0.151	0.164	0.178	0.192	0.206	0.219	0.233	0.247	0.260	0.274	0.301	0.329	10
20	0.137	0.164	0.192	0.219	0.247	0.274	0.301	0.329	0.356	0.384	0.411	0.438	0.466	0.493	0.521	0.548	0.603	0.658	20
30	0.206	0.247	0.288	0.329	0.370	0.411	0.452	0.493	0.534	0.575	0.617	0.658	0.699	0.740	0.781	0.822	0.904	0.986	30
40	0.274	0.329	0.384	0.438	0.493	0.548	0.603	0.658	0.712	0.767	0.822	0.877	0.932	0.986	1.04	1.10	1.21	1.32	40
50	0.343	0.411	0.480	0.548	0.616	0.685	0.754	0.822	0.891	0.959	1.03	1.10	1.16	1.23	1.30	1.37	1.51	1.64	50
60	0.411	0.493	0.575	0.658	0.740	0.822	0.904	0.986	1.07	1.15	1.23	1.32	1.40	1.48	1.56	1.64	1.81	1.97	60
70	0.480	0.575	0.671	0.767	0.863	0.959	1.05	1.15	1.25	1.34	1.44	1.53	1.63	1.73	1.82	1.92	2.11	2.30	70
80	0.548	0.658	0.767	0.877	0.986	1.10	1.21	1.32	1.42	1.53	1.64	1.75	1.86	1.97	2.08	2.19	2.41	2.63	80
90	0.616	0.740	0.863	0.986	1.11	1.23	1.36	1.48	1.60	1.73	1.85	1.97	2.10	2.22	2.34	2.47	2.71	2.96	90
100	0.685	0.822	0.959	1.10	1.223	1.37	1.51	1.64	1.78	1.92	2.06	2.19	2.33	2.74	2.60	2.74	3.01	3.29	100
200	1.37	0.1.64	1.92	2.19	2.19	2.74	3.01	3.29	3.56	3.84	4.11	4.38	4.66	4.93	5.21	5.48	6.03	6.58	200

Compound Interest Table

Year **Rate of Interest %** **Year**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
1	1.01	1.02	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20	1
2	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.17	1.19	1.21	1.23	1.25	1.28	1.30	1.32	1.34	1.37	1.39	1.42	1.44	2
3	1.03	1.06	1.09	1.12	1.16	1.19	1.22	1.26	1.30	1.33	1.37	1.40	1.44	1.48	1.52	1.56	1.60	1.64	1.68	1.73	3
4	1.04	1.08	1.13	1.17	1.22	1.26	1.31	1.36	1.41	1.46	1.52	1.57	1.63	1.69	1.75	1.81	1.87	1.94	2.00	2.07	4
5	1.05	1.10	1.16	1.22	1.28	1.34	1.40	1.47	1.54	1.61	1.68	1.76	1.84	1.93	2.01	2.10	2.19	2.29	2.39	2.49	5
6	1.06	1.12	1.19	1.27	1.34	1.42	1.50	1.59	1.68	1.77	1.86	1.97	2.08	2.20	2.31	2.44	2.56	2.70	2.84	2.99	6
7	1.07	1.14	1.23	1.32	1.41	1.50	1.60	1.71	1.83	1.95	2.07	2.21	2.35	2.51	2.66	2.83	3.00	3.19	3.38	3.58	7
8	1.08	1.17	1.27	1.37	1.48	1.59	1.72	1.85	1.99	2.14	2.30	2.47	2.65	2.86	3.05	3.28	3.51	3.76	4.02	4.30	8
9	1.09	1.19	1.30	1.43	1.55	1.69	1.84	2.00	2.17	2.36	2.55	2.77	3.00	3.26	3.51	3.80	4.10	4.44	4.79	5.16	9
10	1.10	1.21	1.34	1.48	1.63	1.79	1.97	2.16	2.37	2.59	2.83	3.10	3.39	3.71	4.04	4.41	4.80	5.24	5.70	6.19	10
11	1.11	1.24	1.38	1.54	1.71	1.90	2.10	2.33	2.58	2.85	3.14	3.47	3.83	4.24	4.65	5.12	5.62	6.18	6.78	7.43	11
12	1.12	1.26	1.42	1.61	1.80	2.01	2.25	2.52	2.81	3.14	3.49	3.89	4.33	4.83	5.35	5.94	6.57	7.29	8.07	8.92	12
13	1.14	1.29	1.47	1.67	1.89	2.13	2.41	2.72	3.07	3.45	3.87	4.35	4.89	5.50	6.15	6.89	7.69	8.60	9.60	10.70	13
14	1.15	1.31	1.51	1.74	1.98	2.26	2.58	2.94	3.34	3.79	4.29	4.87	5.53	6.27	7.07	7.99	9.00	10.15	11.42	12.84	14
15	1.16	1.34	1.56	1.81	2.08	2.40	2.76	3.17	3.64	4.17	4.77	5.46	6.25	7.15	8.13	9.26	10.52	11.98	13.59	15.41	15
20	1.22	1.48	1.81	2.19	2.65	3.21	3.86	4.66	5.60	6.72	8.03	9.63	11.51	13.77	16.35	19.45	23.07	27.39	32.44	38.35	20

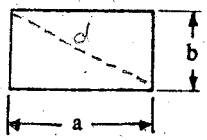
Multiplying Factors for calculating present value of Re 1/- at given rates of interest.

Year **Rate of Interest %** **Year**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
1	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.93	0.92	0.91	0.90	0.89	0.88	0.88	0.87	0.86	0.85	0.85	0.84	0.83	1
2	0.98	0.96	0.94	0.92	0.91	0.89	0.87	0.86	0.84	0.83	0.81	0.80	0.78	0.77	0.76	0.74	0.73	0.72	0.70	0.69	2
3	0.97	0.94	0.92	0.89	0.86	0.84	0.82	0.79	0.77	0.75	0.73	0.71	0.69	0.67	0.66	0.64	0.62	0.61	0.59	0.58	3
4	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.74	0.71	0.68	0.66	0.64	0.61	0.59	0.57	0.55	0.53	0.52	0.50	0.48	4
5	0.95	0.91	0.86	0.82	0.78	0.75	0.71	0.68	0.65	0.62	0.59	0.57	0.54	0.52	0.50	0.48	0.46	0.44	0.42	0.40	5
6	0.94	0.89	0.84	0.79	0.75	0.70	0.67	0.63	0.60	0.56	0.53	0.51	0.48	0.46	0.43	0.41	0.39	0.37	0.35	0.33	6
7	0.93	0.88	0.81	0.76	0.71	0.67	0.62	0.58	0.55	0.51	0.48	0.45	0.43	0.40	0.38	0.35	0.33	0.31	0.30	0.28	7
8	0.92	0.85	0.79	0.73	0.68	0.63	0.58	0.54	0.50	0.47	0.43	0.40	0.38	0.35	0.33	0.31	0.28	0.27	0.25	0.23	8
9	0.91	0.84	0.77	0.70	0.64	0.59	0.54	0.50	0.46	0.42	0.39	0.36	0.33	0.31	0.28	0.26	0.24	0.23	0.21	0.19	9
10	0.91	0.82	0.74	0.66	0.61	0.56	0.51	0.46	0.42	0.39	0.35	0.32	0.29	0.27	0.25	0.23	0.21	0.19	0.18	0.16	10
11	0.90	0.80	0.72	0.65	0.58	0.53	0.48	0.43	0.39	0.35	0.32	0.29	0.26	0.24	0.21	0.20	0.18	0.16	0.15	00.13	11
12	0.89	0.79	0.70	0.62	0.56	0.50	0.44	0.40	0.36	0.32	0.29	0.26	0.23	0.21	0.19	0.17	0.15	0.14	0.12	0.11	12
13	0.88	0.77	0.68	0.60	0.53	0.47	0.41	0.37	0.33	0.29	0.26	0.23	0.20	0.18	0.16	0.15	0.13	0.12	0.10	0.09	13
14	0.87	0.76	0.66	0.58	0.51	0.44	0.39	0.34	0.30	0.26	0.23	0.20	0.18	0.16	0.14	0.13	0.11	0.10	0.09	0.08	14
15	0.86	0.74	0.64	0.56	0.48	0.42	0.36	0.32	0.27	0.24	0.21	0.18	0.16	0.14	0.12	0.11	0.09	0.08	0.07	0.06	15
20	0.82	0.67	0.55	0.46	0.38	0.31	0.26	0.21	0.18	0.15	0.12	0.10	0.09	0.07	0.06	0.05	0.04	0.04	0.03	0.03	20

MENSURATION

AREAS

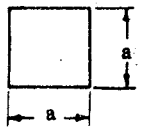


1. Rectangles

(i) $A = ab$

(ii) $d = \sqrt{a^2 + b^2}$

where A = area; a = length; b = breadth; d = diagonal.

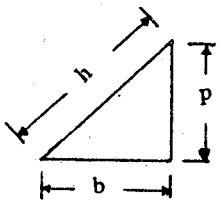


2. Squares

(i) $A = a^2$

(ii) $d = a\sqrt{2}$

where A = area; a = side; d = diagonal.



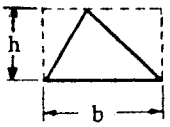
3. Right-angled triangles

(i) $h = \sqrt{b^2 + p^2}$

(ii) $b = \sqrt{(h - p)\ (h + p)}$

(iii) $p = \sqrt{(h - b)\ (h + b)}$

Where h = hypotenuse; b = base; p = perpendicular.



4. Triangles

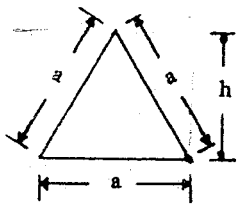
(i) $A = \frac{1}{2}bh$

where A = area; b = base; h = height.

(ii) $A = \sqrt{s(s - a)\ (s - b)\ (s - c)}$

where A = area; a, b and c are the three sides;

and $s = \frac{a + b + c}{2}$

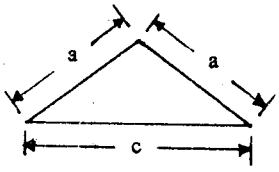


5. Equilateral triangles

(i) $h = \frac{a\sqrt{3}}{2}$

(ii) $A = a^2 \times \frac{\sqrt{3}}{4}$

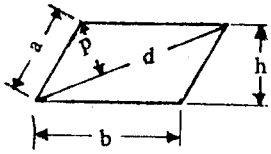
where h = height; a = side; A = area.



6. Isosceles triangles

$A = \frac{c}{4}\sqrt{4a^2 - c^2}$

where A = area; a = side; c = base.



7. Parallelograms

(i) $A = bh$

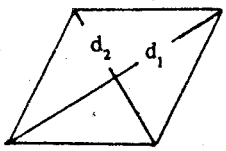
where A = area; b = base; h = height.

(ii) $A = dp$

where A = area; d = diagonal; p = offset of diagonal.

(iii) $A = 2\sqrt{s\ (s - a)\ (s - b)\ (s - d)}$

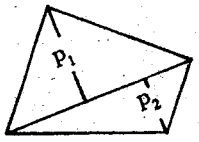
where A = area; d = diagonal; a and b are two adjacent sides; and $s = \frac{a + b + d}{2}$



8. Rhombus

$A = \frac{1}{2}d_1d_2$

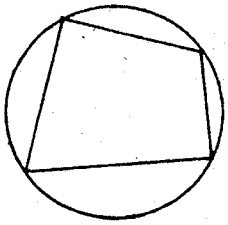
where A = area; d_1 and d_2 are two diagonals.



9. **Quadrilaterals**

$$A = \frac{1}{2} d (p_1 + p_2)$$

where A = area; d = diagonal; p_2 and p_1 are the offsets of the diagonal.

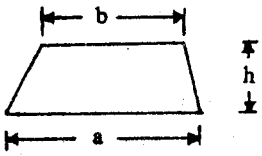


10. **Quadrilaterals inscribed in circles**

$$A = \sqrt{(s - a)\ (s - b)\ (s - c)\ (s - d)}$$

where A = area; a, b, c, d are the sides;

and $s = \frac{a + b + c + d}{2}$



11. **Trapezoids**

$$A = \frac{1}{2} (a + b)\ h$$

Where A = area; a and b are the parallel sides; h = the perpendicular distance between the parallel sides.

12. **Regular polygons**

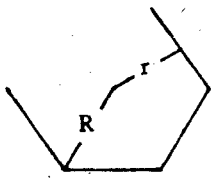
(i) $A = \frac{n}{2} \times ar$

(ii) $A = \frac{na}{2} \sqrt{R^2 - \left(\frac{a}{2}\right)^2}$

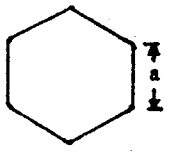
(iii) $A = a^2 \times \frac{n}{4} \cot \frac{180^\circ}{n}$

(iv) $A = r^2 \times n \tan \frac{180^\circ}{n}$

(v) $A = R^2 \times \frac{n}{2} \sin \frac{360^\circ}{n}$



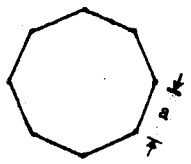
where A = area; n = number of sides; a = side; r = radius of inscribed circle; R = radius of circumscribed circle.



13. **Regular hexagons**

$$A = \frac{3a^2\sqrt{3}}{2}$$

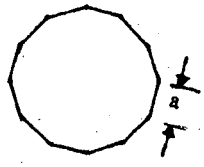
where A = area; a = side.



14. **Regular octagons**

$$A = 2\ a^2\ (1 + \sqrt{2})$$

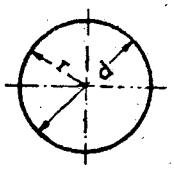
where A = area; a = side.



15. **Regular dodecagons**

$$A = 6\ a^2 \sqrt{\frac{7}{4} + \sqrt{3}}$$

where A = area; a = side.

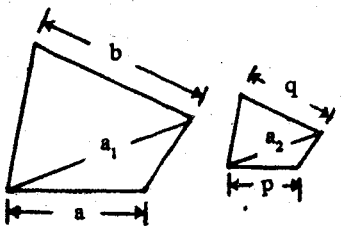


16. Circles

(i) $C = \pi d$

(ii) $A = \pi r^2$

where C = circumference; d = diameter; A = area; r = radius.



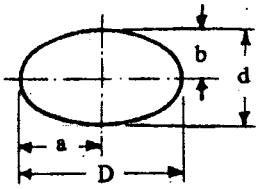
17. Similar figures

(i) $a : b = p : q$

where a and b are lengths in one figure, corresponding to p and q respectively in the other.

(ii) $A_1 : A_2 = (a_1)^2 : (a_2)^2$

where A_1 and A_2 are the areas of the two figures; a_1 and a_2 are corresponding lengths, one in each figure.

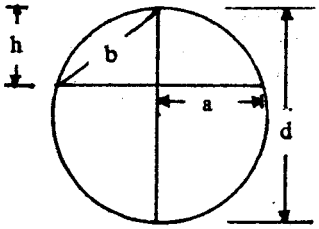


18. Ellipses

$A = \pi ab$ $\quad C = DM$

Where A = area; a = semi-major axis; and b = semi-minor axis; C = circumference; M = multiplier.

If value of $\frac{d}{D}$ = 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 or 0.9 then the corresponding multiplier (M) will be 2.1010, 2.1930, 2.3013, 2.4221, 2.5527, 2.6912, 2.8361, and 2.9866 respectively.

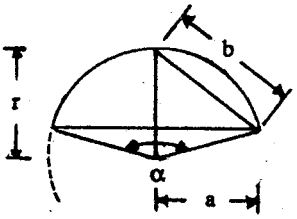


19. Chords of circles

(i) $a = \sqrt{h(d-h)}$

(ii) $A = \sqrt{dh}$

where a = semi-chord of the arc; b = chord of the semi-arc; d = diameter of the circle; h = height of arc.

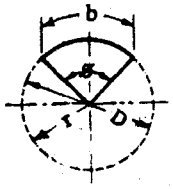


20. Arcs of circles

(i) $L = \frac{\alpha^0}{360} \times 2\pi r$

(ii) $L = \frac{8b - 2a}{3}$

where L = length of the arc; α^0 = central angle of the arc; r = radius of the circle; a = semi-chord of the arc; b = chord of the semi-arc.

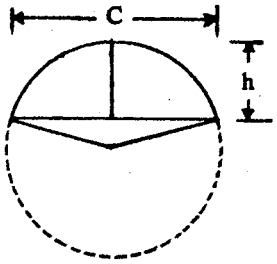


21. Sectors of circles

(i) $A = \frac{ø^0}{360} \times \pi r^2$; $A = \frac{br}{2}$

(ii) $b = \frac{\pi D ø}{360}$

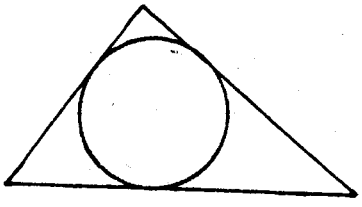
where A = area; $ø^0$ = angle of the sector; b = length of the arc of the sector; r = radius of the circle; D = diameter.



22. Segments of circles

$$A = \frac{4}{3} h \sqrt{\frac{1}{4} C^2 + \frac{2}{5} h^2}$$

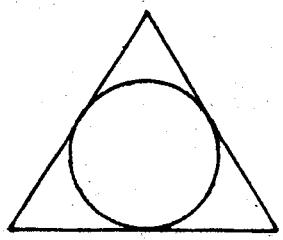
where A = area; h = height of the segment; C = chord of the segment.



23. Circles inscribed in triangles

$$r = \frac{\Delta}{s}$$

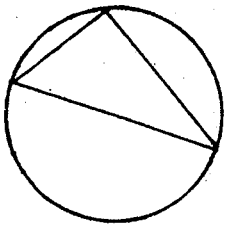
where r = radius of the inscribed circle; Δ = area of the triangle; s = semi-perimeter of the triangle.



24. **Circles inscribed in equilateral triangles**

$$r = \frac{a}{2\sqrt{3}}$$

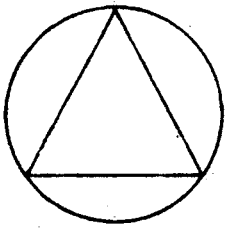
where r = radius of the inscribed circle; a = side of the triangle.



25. **Circles circumscribed about triangles**

$$R = \frac{abc}{4\Delta}$$

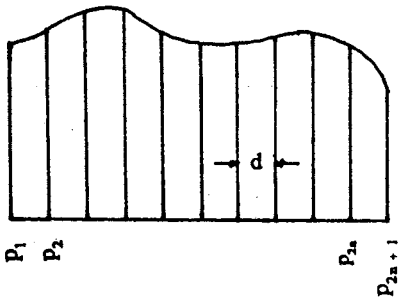
where R = radius of the circumscribing circle; Δ = area of the triangle; a, b and c are the three sides of the triangle.



26. **Circles circumscribed about equilateral triangles**

$$R = \frac{a}{\sqrt{3}}$$

Where R = radius of the circumscribing circle; a = side of the triangle.



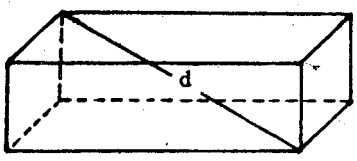
27. **Simpson's Rule**

$$A = \frac{d}{3}\left[P_1 + P_{2n+1} + 2\,(P_3 + P_5 + \ldots\ldots + P_{2n-1}) + 4\,(P_2 + P_4 + \ldots\ldots + P_{2n})\right]$$

where A = area; d = common distance; 2_n = number of equal parts into which the base line is divided; P_1, P_2..... P_{2n+1} are the ordinates taken in order.

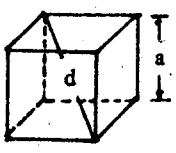
SOLIDS

28. **Rectangular solids**



(i) $V = abc$
(ii) $V = A_1c = A_2b = A_3a$
(iii) $V = \sqrt{A_1 A_2 A_3}$
(iv) $S = 2(ab + bc + ca)$
(v) $d = \sqrt{a^2 + b^2 + c^2}$

where V = volume; S = whole surface; a = length; b = breadth; c = depth; A_1 = area of base; A_2 = area of side; A_3 = area of end; d = diagonal.

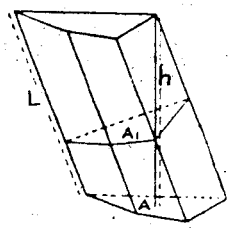


29. **Cubes**

(i) $V = a^3$
(ii) $S = 6a^2$
(iii) $d = a\sqrt{3}$

where V = volume; S = whole surface; a = edge; d = diagonal

30. Prisms and cylinders



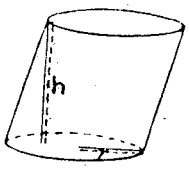
(i) $V = Ah$

(ii) $V = A_1L$

(iii) $S = pL + 2A$

Where V = volume; S = whole surface; A = area of base; A_1 = area of cross-section; h = height; L = length; p = perimeter of cross-section.

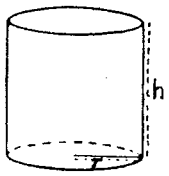
31. Circular cylinders



$V = \pi r^2h$

where V = volume; r = radius of base; h = height.

32. Right circular cylinders

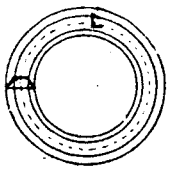


(i) $V = \pi r^2h$

(ii) $S = 2\pi r\ (h + r)$

where V = volume; S = whole surface; r = radius of base; h = height.

33. Rings

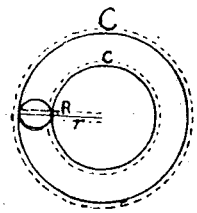


(i) $V = AL$

(ii) $S = pL$

where V= volume; S = whole surface; A = area of cross-section; L = length of mean circumference; p = perimeter of cross-section.

34. Cylindrical rings



(i) $V = \frac{\pi^2}{4}(R + r)(R - r)^2$

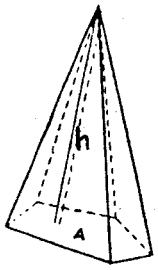
(ii) $V = \frac{1}{32\pi}(C + c)(C - c)^2$

(iii) $S = \pi^2(R^2 - r^2)$

(iv) $S = \frac{1}{4}(C^2 - c^2)$

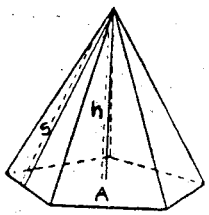
where V= volume; S = whole surface; R = outer radius; r = inner radius; C = outer circumference; c = inner circumference.

35. Pyramids and Cones



$V = \frac{1}{3}Ah$

where V = volume; A = area of base; h = height.

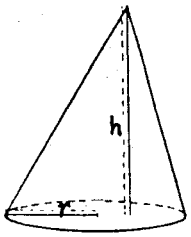


36. Right regular pyramids

(i) $V = \frac{1}{3}Ah$

(ii) $S = \frac{1}{2}ps + A$

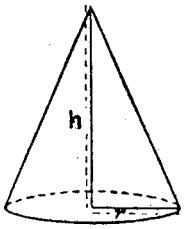
where V = volume; S = whole surface; A = area of base; p = perimeter of base; s = slant height.



37. Circular cones

$V = \frac{1}{3}\pi r^2 h$

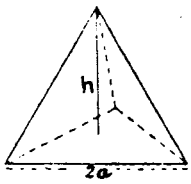
where V = volume; r = radius of base; h = height.



38. Right circular cones

(i) $V = \frac{1}{3}\pi r^2 h$

(ii) $S = \pi r(\sqrt{h^2 + r^2} + r)$
where V = volume; S = whole surface; h = height; r = radius of base.



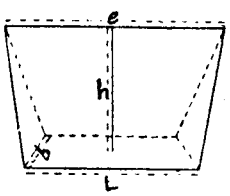
39. Regular tetrahedrons

(i) $V = \frac{2\sqrt{2}}{3}a^3$

(ii) $S = 4a^2\sqrt{3}$

(iii) $h = 2a\sqrt{\frac{2}{3}}$

where V = volume; S = whole surface; 2a = edge; h = height.

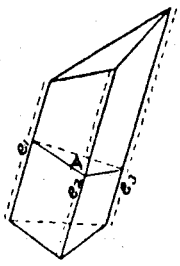


40. Wedges on rectangular bases

(i) $V = \frac{bh}{6}(2L + e)$

(ii) $V = \frac{A}{3}(2L + e)$

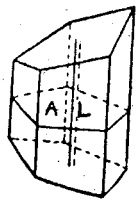
where V = volume; L = length of base; b = breadth of base; e = edge; A = area of cross-section; h = perpendicular height.



41. Wedges on trapezoidal base, or oblique frustra of triangular prisms

$$V = \left(A\,\frac{e_1 + e_2 + e_3}{3}\right)$$

where V = volume; A area of cross-section; e_1, e_2, e_3 are the lengths of the three parallel edges.



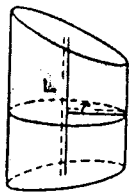
42. **Oblique frustra of any right regular prism**

(i) $V = AL$

(ii) $S = PL$

where V = volume; S = lateral surface; A = area of cross-section; L = mean length; p = perimeter of cross-section; and

$$\text{mean length} = \frac{\text{sum of lengths of parallel edges}}{\text{number of parallel edges}}$$

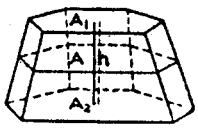


43. **Oblique frustra of right circular cylinders**

(i) $V = \pi r^2 L$

(ii) $S = 2\pi r L$

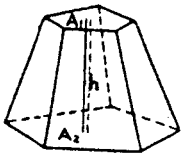
where V = volume; S = curved surface; r = radius of cross-section; L = mean length.



44. **Prismoids**

$$V = \frac{h}{6}(A_1 + A_2 + 4A)$$

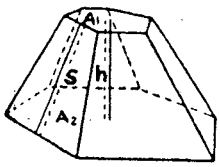
where V = volume; h = height; A_1 and A_2 are the areas of the ends; A = area of mid-section parallel to the ends.



45. **Frustra of pyramids and cones**

(i) $V = \frac{h}{3}(A_1 + A_2 + \sqrt{(A_1 A_2)})$

where V = volume; h = height; A_1 and A_2 are the areas of the ends.

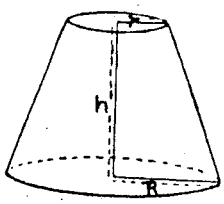


46. **Frustra of right regular pyramids**

(i) $V = \frac{h}{3}(A_1 + A_2 + \sqrt{(A_1 A_2)})$

(ii) $V = \frac{1}{2}s(P + p)$

where V = volume; h = height; A_1 and A_2 are the areas of the ends; P and p are the perimeters of the ends; s = slant height.



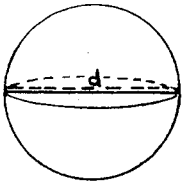
47. **Frusta of right circular cones**

(i) $V = \frac{\pi h}{3}(R^2 + r^2 + Rr)$

(ii) $S = \frac{1}{2}s(C + c)$

(iii) $S = \pi s(R + r)$

where V = volume; S = curved surface; R and r are the radii of the ends; C and c are the circumferences of the ends; s = slant height; h = perpendicular height.



48. **Spheres**

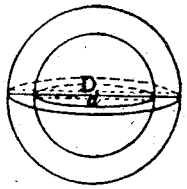
(i) $V = \frac{\pi d^3}{6}$

(ii) $V = \frac{4}{3}\pi r^3$

(iii) $S = \pi d^2$

(iv) $S = 4\pi r^2$

where V = volume; S = surface; d = diameter; r = radius.



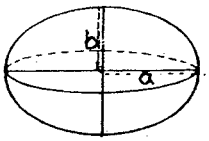
49. **Spherical shells**

(i) $V = \frac{\pi}{6}(D^3 - d^3)$

(ii) $V = \frac{4\pi}{3}(R^3 - r^3)$

(iii) $V = \pi D^2 h$ | (nearly), when the thickness of the shell is very small compared to the outer diameter.

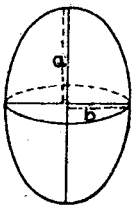
where V = volume; R = outer radius; r = inner radius; D = outer diameter; d = inner diameter; h = thickness of the shell.



50. **Oblate spheroids**

(i) $V = \frac{4}{3}\pi a^2 b$

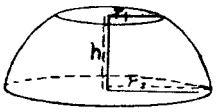
where V = volume; a = semi-major axis; b = semi-minor axis.



51. **Prolate spheroids**

$V = \frac{4}{3}\pi a b^2$

where V = volume; a = semi-major axis; b = semi-minor axis.

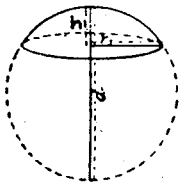


52. **Zones of spheres**

(i) $V = \frac{\pi h}{3}\left[3(r_1^2 + r_2^2) + h^2\right]$

(ii) $S = \pi d h$

where V = volume; S = curved surface; r_1 and r_2 are the radii of the two ends; h = height; d = dia of sphere.



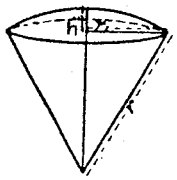
53. **Segments of spheres**

(i) $V = \frac{\pi h}{6}(3r_1^2 + h^2)$

(ii) $V = \frac{\pi h^2}{2}(3d - 2h)$

(iii) $S = \pi d h$

where V = volume; S = curved surface; r_1 = radius of the base of the segment; h = height; d = dia of the sphere.



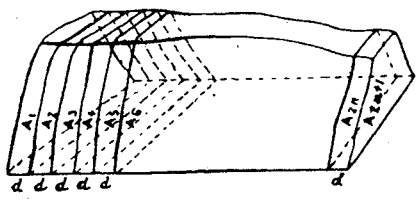
54. **Sectors of Spheres**

(i) $V = \frac{2}{3}\pi r^2 h$

(ii) $V = \frac{1}{3} rs$

(iii) $S = \pi r + \left[2h + \sqrt{(2rh - h^2)}\right]$

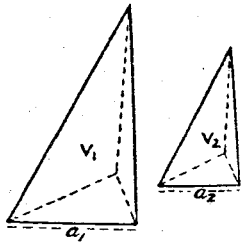
where V = volume; S = whole surface; r = radius of the sphere; h and s are the height and curved surface of the segment of the sphere that forms the base of the sector. $s = 2\pi rh$



55. **Irregular solids whose opposite ends are plane figures lying in parallel planes.**

$$V = \frac{d}{3}\left[A_1 + A_{2n+1} + 2(A_3 + A_5 + \ldots + A_{2n-1}) + 4(A_2 + A_4 + \ldots + A_{2n})\right]$$

where V = volume; 2_n = number of equal parts into which the length of the solid is divided by planes parallel to its ends; d = common distance between the parallel planes $A_1, A_2, A_3 \ldots A_{2n}$, A_{2n+1} are the areas of the transverse sections of the figure made by the parallel planes taken in order.



56. Similar solids

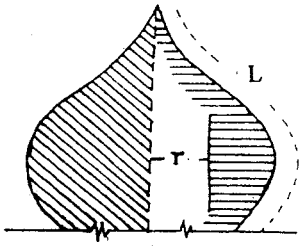
(i) $V_1 : V_2 = a_1^3 : a_2^3$

(ii) $S_1 : S_2 = a_1^2 : a_2^2$

(iii) $a_1 : a_2 = \sqrt[3]{V_1} : \sqrt[3]{V_2}$

(iv) $a_1 : a_2 = \sqrt{S_1} : \sqrt{S_2}$

where V_1 and V_2 are the volumes; S_1 and S_2 are the surfaces; a_1 and a_2 are corresponding linear dimensions of the first and second similar solids respectively.



57. Any figure of revolution on axis, such as domes etc.

Convex surface area = 6.2832 rL
Volume = 6.2832 ra

where a = $\frac{1}{2}$ area of flat sectional surface revealed if the solid is cut into two halfs.
= area of generating surface,
= area of hatched portion (flat) (see sketch).
L = Length of generating line (see sketch).
r = Distance of centre of gravity of generating surface 'a' to the central vertical axis.

58. Spirals

Length of spiral (as in the case of hand rail of a spiral staircase) :
= $n\sqrt{(\text{pitch})^2 + (\pi D)^2}$
where n = number of revolutions
pitch = height gained in each revolution
D = diameter of revolution.

59. Square of same area as a circle

Side = diameter x 0.88623

60. Circle of same area as a square

Diameter = side x 1.12838

61. Square inscribed in circle

Length of one side of a square inscribed in a circle = Diameter of circle x 0.7071.

62. Parabolas and Parabloids

Area of space within the parabola
= Base x $\frac{2}{3}$ perpendicular height

Volume of parabloid (solid)
= $\frac{1}{2}\pi r^2 h$

where r = radius of the base of the parabloid
h = height

63. Irregular Polygons or Quadrilaterals

To find area, devide the polygon or quadrilateral into triangles and calculate areas of triangles using formula at Sl. No. 4 (ii) given on page 118.

THE LAW RELEVANT TO THE BUILDING AND CONSTRUCTION INDUSTRY

There are so many Enactments, Statutes, Rules, Regulations etc., in force that it become impossible to keep track of all of them. Ignorance of Law is, however, not acceptable as an excuse even for the illiterate. A minimum rudimentary awareness of the provisions of Law at least relevant to your own field of activity should therefore be considered as compulsory.

If you choose to ignore a particular provision of any Law or Regulation in force, awareness of it will enable you to anticipate, plan and prepare to face the consequences if any.

It has to be borne in mind that no enactment can be read, interpreted and acted upon in isolation, ie. without taking into account the effect of other pertinent enactments, case law etc. Obtaining expert legal opinion is advisable when taking decision in complicated matters involving legal aspects.

Litigation in Indian Courts of Law is costly, time consuming and terribly frustrating due to delay in the legal process. It is usually more prudent to strike a compromise with the other party involved, if the consequent financial loss is not very large. Time and energy lost in fighting legal battles in a Court of Law, if devoted to your own business or profession may turn out financially more rewarding.

Legal aspects being of considerable importance, a list of enactments, (relevant to the building and construction activity) and the Rules, Regulations etc., framed under them, in the order of importance as perceived by the Author, are given below. Enactments or Regulations made at State level or made by Local State Bodies etc., are not included in this list.

1. Indian Contract Act, (9 of 1872)
2. Arbitration Act, (10 of 1940)
3. *Rules of Arbitration of the Indian Council of Arbitration, (ICA Rules)*
4. Constitution (Fortysixth Amendment) Act, (1982) (Popularly known as the Works Contract Act)
5. Sale of Goods Act, (3 of 1930)
6. Transfer of Property Act, (4 of 1882 as amended by 21 of 1929)
7. Limitation Act, (36 of 1963)
8. *Architects (Professional Conduct) Regulation, (1989)*
9. Explosives Act, (4 of 1884)
10. Explosive Substances Act, (6 of 1908)
11. *The Explosives Rules, (1983)*
12. Forest Act, (16 of 1927)
13. Forest Conservation Act, (69 of 1980)
14. Mines and Minerals (Regulation and Development) Act, (67 of 1957)
15. Minimum Wages Act, (11 of 1948)
16. Workmen's Compensation Act, (8 of 1923)
17. *Workmen's Compensation Rules, (1924)*
18. Contract Labour (Rugulation and Abolition Act, (37 of 1970)
19. Employment of Children Act, (26 of 1938)
20. Equal Remuneration Act, (25 of 1976)
21. Payment of Wages Act, (4 of 1936)
22. Employer's Liability Act, (24 of 1938)
23. Companies Act, (1 of 1956)
24. Income - tax Act, (43 of 1961)
25. Partnership Act, (9 of 1932)
26. Prevention of Corruption Act, (2 of 1947)
27. Specific Relief Act, (47 of 1963)
28. Co-operative Societies Act, (2 of 1912)
29. Official Secrets Act, (19 of 1923)
30. Cantonments Act, (2 of 1924)
31. Cantonments (Amendment) Act, (15 of 1983)
32. Electricity Act, (9 of 1910)
33. *The Indian Electricity Rules, (1956)*
34. Motor Vehicles Act, (4 of 1939)
35. Personal Injuries (Compensation Insurance) Act, (37 of 1963)

Arbitrator's Fees or Remuneration

Arbitrator's fees or remuneration (to be fixed by the Bench of the ICA) as per scales laid down in the Rules of Arbitration of the Indian Council of Arbitration, having regard to the nature of the case and the time taken to decide it are as follows, and could serve as a guideline for Arbitrators even though not connected with the ICA. The scale is exclusive of travelling or outstation expenses, and administrative or other charges.

Amount of claims	*Range of fees*	*Amount of claims*	*Range of fees*
Rs. 50,000 to 1,00,000	Rs. 1,000 to 1,500	Rs. 10,00,001 to 25,00,000	Rs. 5,000 to 8,000
Rs. 1,00,000 to 5,00,000	Rs. 1,250 to 3,000	Rs. 25,00,001 to 50,00,000	Rs. 6,000 to 10,000
Rs. 5,00,001 to 10,00,000	Rs. 2,500 to 6,000	Rs. 50,00,001 to 100,00,000	Rs. 7,000 to 15,000

Time Aspects in Arbitration

The various points at which the aspect of time / dates / periods in Arbitration matters need to be watched are listed below :

In some contracts, reference to Arbitration by either party is not permitted until after completion, alleged completion, or abandonment of works, or the determination of contract.

When an opposite party commences legal proceedings ignoring Arbitration clause, application to the Court for stay of the proceedings under Section 34 of Arbitration Act should be made *before* filing any written statement in the Court or taking any part in the legal proceedings.

An award has to be made within *four* months after the Arbitrator has entered on the reference or after he is called upon to act. The Arbitrator is deemed to have entered upon the reference on the date on which he issues notices to both the parties fixing the date of hearing.

(a) If an Arbitrator delays entering on the reference either party may call upon the Arbitrator by a notice to act, in which case the Arbitrator has to make his award within *four* months from the date of such notice.

(b) The Court has powers to enlarge the time for making the award even if the award has already been made and even after expiry of the prescribed time.

(c) An award made after the expiry of time is not a nullity, but is however liable to be set aside on this ground upon an application by one of the parties.

(d) Where parties acquiese in the delay in making the award by their conduct, such as attendance at proceedings after expiry of time (more than *four* months from date of entering upon reference), the Court may refuse to set aside the award.

A party may ask the Arbitrator to state a special case for opinion of the Court, and if the Arbitrator refuses to do so the party may apply to the Court under Section 5 for revoking authority of the Arbitrator. If the party fails to do so, it is usually too late for him to go to the Court after the award has been made. The party may however take part in the proceedings under protest in writing, wait until award has been made and then go to the Court for setting aside the award.

Arbitrator, by statutory provision has to give notice to both the parties that the award has been made and signed. Application to the Court by any of the parties for filing of the award has to be made within *thirty* days from the date of serving of the notice.

Objections against the award under Sections 16 or 30 must be filed in the Court before expiry of *thirty* days from the date of serving of the notice by the Court of filing of the award. A notice by the Court to the parties, of the filing of the award is a statutory obligation.

There is however, no limitation prescribed for an application for getting an award corrected or modified by the Court under Section 15.

The Limitation Act (36 of 1963)

This Act lays down the period of time within which any suit, appeal or application can be made in a Court of Law for enforcing claims, rightful dues, share of profits, compensation for wrongs, unpaid wages, specific performance of contracts etc.

The period of time within which appeals against judgements, decrees, etc can be made is also laid down. If legal action is not instituted within the Limitation Period, any suit, appeal or application made in a Court of Law will be too late being time-barred.

The Workmen's Compensation Act (8 of 1923)

This Act provides for payment by employers to their workmen (or to dependants of the workmen in cases of death) of compensation for injury by accident. The compensation payable is worked out on the basis of one month's wages of the worker, multiplied by different laid down percentages (depending on death or total / different degrees of disablement etc.,) multiplied by a laid down 'relevant factor' as applicable for the completed years of age of the workman in question.

The party entering into a contract with a builder is in the position of a 'Principal Employer' in respect of workers employed by the builder on the particular contract work.

The Indian Contract Act (9 of 1872)

A very detailed study of this enactment is recommended. A couple of points which are commonly missed or on which wrong notions prevail are elaborated upon here.

Revocation of tender by a contractor is non-effective (nul and void) if the acceptance letter has already been despatched before receipt of the communication revoking the tender, and this is applicable even in cases of revocation letters dated prior to the date of acceptance letter, (even if revocation letter is despatched by Regd Post prior to the date of Acceptance) but received after despatch of the acceptance letter.

Revocation of tender by a tenderer does not confer any right to the party calling for tenders to confiscate 'Earnest Money' attached to the tender, if no contract situation has been established.

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