

# READY RECKONER FOR QUNTY SURVEYOR



# **A READY RECKONER FOR QUANTITY SURVEYORS**

## **Objective**

This book is intended and designed for day to day reference mainly by quantity surveyors, contract managers, architects, estimators, site engineers and middle order executives of the construction industry who deals with quantity surveying, estimating, analysis of rates, drafting of specifications, supervision of works and checking of interim and final bills. Also it is useful in legal and financial aspects of quantity surveying and in preparing, defending claims, disputes etc.

## **Targeted People**

Quantity Surveyors, Contract Managers, architects, Estimators, Site Engineers etc.,

## **Most Likely Users**

Billing Engineers, Middle order Executives like QC Engineers , site supervisors, Contractors, Sub-contractors, and consultants and students.

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**UNITS AND CONVERSION FACTORS****Conversion of Rates**

<b>Sno</b>	<b>To convert</b>	<b>Factor</b>	<b>To obtain</b>
1	Rft	3.28	Rmt
2	Sq feet	10.764	Sqmt
3	Cubic feet	35.315	Cubic Mt
4	Lb(Pound)	2.2046	Kg
5	Cwt	1.9684	Quintal
6	Gallon	0.22	Lt
7	Tonn/Sqft	10.937	Tonne/Sqmt
8	Acre	2.471	Hectare

<b>CONVERSION FACTORS</b>				<b>UNITS OF MEASURES</b>	
<b>Metric to British</b>		<b>British to Metric</b>			
<b>LENGTH</b>					
1 CM	0.3937in ch	1 inch	25.4 mm	1 mile	8 furlongs
1meter	3.2808 ft	1 ft	0.3048 m	1 furlong	10 chains
1meter	39.3696 inch	1 yard	0.9144 m	1 chain	22 yards
1 meter	1.0936 yard	1mile	1.609 km	1 nautical mile	6080 ft
1 KM	0.6214 mile	1 chain	20.116 8 m		
<b>AREA</b>					
1 sqcm	0.1550 sqinch	1 sqinch	6.4516 sqcm	1 Acre	4840 sqyds
		1 sqft	0.0929 sqm	1 sqmile	640 Acres
1 sqm	10.76 sqft	1 sqyd	0.8361 sqm	1 hectare	10000 sqm
1 sqm	1.1960 sqyd			1 sqkm	10 <sup>6</sup> sqm
1 hectare	2.4170 Acre	1 Acre	0.4047 ha	1 sqkm	100 ha
1 sqkm	0.3861 sqmile	1 sqmile	2.59 sqkm		
1 sqkm	247.1045 Acres	1 sqmile	259.0h a	1 sqm	10 sqdm
<b>VOLUME</b>					
1 cum	35.3147 cuft	1 cuft	28.316 1 lt	1 cuft	1728 cuinch
1 cum	1.3080 cuyd	1 cuft	0.0283 cum	1 cum	1000 cudm
1 cum	219.97 gallon	1 cuft	28.316 1 cudm	1 cudm	1 lt
1 cum	264.18 gallon	1gallon	4.5460 liters	1 cuft water	6.24 gallon
<b>WEIGHT</b>					

1 kg	2.2046 lb	1 lb	0.4536 kg	1 lb	16 oz
10 gm	0.322 oz	1 oz	31.103 5 gm		
1 tonne	1000 kg	1 quintal	220.46 lb		
DENSITY (mass/volume)					
1 gm/cc	0.0361 lb/cuinch	1 lb/cuinch	27.699 gm/cc	1 cuft of water	62.4 lb
1 kg/cum	0.0624 lb/cft	1 lb/cft	16.018 5 kg/cum		
1 tonn/cu m	62.4 lb/cft	1 tonn/cu m	0.7525 t/cuyd	1 tonn/cuyd	1.329 tonne/cu m

\* Nautical mile is a distance on the earth's surface at the sea level of 1 min of arc( 1/60 of degree) of longitude of earth at the equator. Equatorial diameter of the earth is 7926.72 miles.

**Mensuration****WEIGHTS OF BUILDING MATERIALS**

(Ret: IS: 1911-1967)

<b>Material</b>	<b>Weight in kg per cubic</b>
<b>Acoustical material</b>	240
Stag wood	270
<b>Aggregate</b>	
Broken stone, dry broken bricks:	1600 to 1870
Fine	1450
Coarse	1010
Foam slag aggregate	700
Sand, dry, clean	1540 to 1600
Shingle, 3mm to 38mm	1460
<b>Bricks</b>	
Common burnt clay	1600 to 1920
Engineering bricks	2160
Pressed bricks	1760 to 1840
Refractory bricks	1760 to 2000
<b>Cement</b>	
Ordinary and aluminous	1440
Rapid hardening	1280
<b>Cement concrete, plain</b>	
Using stone aggregate	2240 to 2400
<b>Light weight concrete</b>	
Cellular ('Siporex' etc.)	640
With foam slag aggregate	960 to 1840
Aerated	760
<b>Chemicals</b>	
Gypsum powder	1410 to 1760
Salt, Common	960
<b>Coal</b>	
Coal	850
Coal dust	700
Coke, furnace or gas	500
Charcoal	300
<b>Lime</b>	
Slaked, fresh	580 to 640
Unslaked lime	1180

<b>Material</b>	<b>Weight in kg per cubic</b>
Slaked lime	1020
<b>Metals</b>	
Aluminum, cast	2580 to 2710
Aluminum, wrought	2640 to 2800
Brass	8550
Copper, cast	8790
Copper, wrought	8840
Iron, pig	7200
Iron, cast, gray	7030 to 7130
Iron, wrought	7700
Steel, cast	7850
Brick masonry	1920
Concrete	2420
Earth compacted	1750
Glass	2560
Rubber	960
RR masonry	2300
Hollow Block masonry	2500
Alum	1700
Flat Asbestos sheet	2.04 Kg / Sqm
Water	1000
Ice	910
Salt	1020

**B)** To know the weight of sheets of aluminum , copper, steel etc,  
We must know the thickness corresponding to gauges denoted. They are as under.

<b>Standard Wire Gauge</b>		<b>Steel</b>	<b>Copper</b>	<b>Aluminum</b>
24 <sup>G</sup>	0.63mm	4.94	5.54	1.7
22 <sup>G</sup>	0.80 mm	6.27	7.04	2.16
20 <sup>G</sup>	1.00 mm	7.84	8.8	2.7
18 <sup>G</sup>	1.25 mm	9.8	11	3.36
16 <sup>G</sup>	1.60 mm	12.55	14.08	4.32
14 <sup>G</sup>	2.00 mm	15.69	17.60	5.40
12 <sup>G</sup>	2.50 mm	19.61	22.00	6.75
10 <sup>G</sup>	3.15 mm	24.70	27.72	8.51
8 <sup>G</sup>	4.00 mm	31.36	35.2	10.8

**C) Plates**

Plate	Plain Steel Plates	Steel Chequered Plates
5 mm	39.2 Kg/Sqm	45.3 Kg/Sqm
6 mm	47.1 Kg/Sqm	53.2 Kg/Sqm
7 mm	54.9 Kg/Sqm	61.1 Kg/Sqm
8 mm	62.8 Kg/Sqm	68.9 Kg/Sqm
10 mm	78.5 Kg/Sqm	84.6 Kg/Sqm
12 mm	94.2 Kg/Sqm	100.3 Kg/Sqm

**D) Details of Rounds, Fabric & Structural Steel Weight of M.S. Rounds & Torsteel:-**

Size (mm)	Area(Cm <sup>2</sup> )	Wt.(Kg/mt)	Length/ ton(mt)
6	0.283	0.222	4510
8	0.503	0.395	2532
10	0.785	0.617	1621
12	1.131	0.888	1125
16	2.011	1.578	633
18	2.545	2.000	500
20	3.142	2.466	405
22	3.801	2.980	336
25	4.909	3.854	260
28	6.157	4.830	207
32	8.042	6.313	159
36	10.179	7.990	125
40	12.566	9.864	101

**E) Weight of Aluminum Sheets**

SWG	Inch	MM	L.B./SFT	Kg/SFT	Kg 8'x4'	Kg 8'x3'	Kg 6'x3'
3/8"	0.375	9.53	5.29	2.399	76.740	57.540	43.17
3/0"	0.372	9.54	5.24	2.376	75.890	57.080	42.81
2/0"	0.348	8.84	4.91	2.227	71.210	53.430	40.05
1/0"	0.324	8.03	4.57	2.072	66.300	49.720	37.27
5/16	0.312	7.93	4.40	1.995	63.860	47.900	35.91
1	0.300	7.62	4.23	1.918	61.370	46.630	34.49
2	0.276	7.01	3.89	1.764	56.410	42.350	31.75
3	0.252	6.40	3.55	1.610	51.560	38.690	29.02
1/4"	0.250	6.35	3.52	1.596	51.166	38.380	28.74
4	0.232	5.89	3.27	1.483	47.480	35.600	26.39
5	0.212	5.48	2.99	1.356	43.370	32.510	24.40
6	0.192	4.88	2.71	1.229	38.280	29.480	22.08

3/16"	0.187	4.75	2.64	1.197	38.270	28.710	21.530
7	0.176	4.47	2.48	1.125	36.600	27.040	20.26
8	0.160	4.06	2.26	1.025	32.730	24.520	18.42
9	0.144	3.66	2.03	0.921	29.480	22.080	16.61
10	0.128	3.25	1.80	0.186	26.170	19.650	14.73
1/8"	0.125	3.18	1.76	0.798	25.570	19.190	14.37
11	0.116	2.95	1.64	0.744	23.720	17.830	13.32
12	0.104	2.64	1.47	0.667	21.250	15.950	11.96
13	0.092	2.34	1.30	0.590	18.810	14.090	10.60
14	0.080	2.03	1.13	0.512	16.320	12.240	9.210
15	0.072	1.83	1.02	0.462	14.730	11.050	8.380
16	0.064	1.63	0.902	0.409	13.090	9.830	7.130
17	0.056	1.42	0.792	0.359	11.480	8.610	5.430
18	0.048	1.22	0.677	0.307	9.830	7.330	5.520
19	0.040	1.02	0.564	0.255	8.160	6.116	4.610
20	0.036	0.914	0.508	0.230	7.33	5.520	4.110
21	0.032	0.813	0.451	0.205	6.520	4.409	3.650
22	0.028	0.711	0.395	0.179	5.720	4.300	3.190
23	0.024	0.610	0.388	0.153	4.810	3.640	2.720
24	0.022	0.559	0.310	0.141	4.470	3.340	2.480
25	0.020	0.508	0.232	0.128	4.060	3.080	2.280
26	0.018	0.457	0.254	0.115	3.650	2.740	2.030

### F) Weight of Selected structural steel sections:

Designation	Weight/meter	Sectional area	Width/Flange
	W-Kg	A-Cm <sup>2</sup>	B-mm
ISMB-100	11.5	14.60	75
ISMB-125	13.0	16.60	75
ISMB-150	14.9	19.00	80
ISMB-200	25.4	32.33	100
ISMB-300	44.2	56.26	140
ISMB-400	61.6	78.46	140
ISMB-450	72.4	92.27	150
ISMB-500	86.9	110.21	180
ISMB-600	122.6	156.21	210
ISMC-75	6.8	8.67	40
ISMC-100	9.20	11.70	50
ISMC-125	12.7	16.19	65
ISMC-150	16.4	20.88	75
ISMC-200	22.10	28.21	75
ISMC-225	25.9	33.01	80
ISMC-300	35.8	45.64	90

ISMC-400	49.4	62.93	100
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**G)Details of Various Angle sections:**

Designation	Thickness (mm)	Sectional area (Cm <sup>2</sup> )	Weight/meter
ISA 20X20	3.0	1.12	0.9
	4.0	1.45	1.1
25X25	3.0	1.41	1.1
	4.0	1.84	1.40
	5.0	2.25	1.80
30X30	3.0	1.73	1.40
	4.0	2.26	1.80
	5.0	2.77	2.2
35X35	3.0	2.03	1.60
	4.0	2.66	2.10
	5.0	3.27	2.6
	6.0	3.86	3.0
40X40	3.0	2.34	1.8
	4.0	3.07	2.40
	5.0	3.78	3.0
	6.0	4.47	3.5
45X45	3.0	2.64	2.10
	4.0	3.47	2.7
	5.0	4.28	3.4
	6.0	5.07	4.0
50X50	3.0	2.95	2.3
	4.0	3.88	3.0
	5.0	4.79	3.82
	6.0	5.68	4.5
55X55	5.0	5.27	4.10
	6.0	6.26	4.9
	8.0	8.18	6.4
	10.0	10.02	7.9
60X60	5.0	5.75	4.5
	6.0	6.84	5.4
	8.0	8.96	7.0
	10.0	11.00	8.60
65X65	5.0	6.25	4.9

	6.0	7.44	5.8
	8.0	9.76	7.7
	10.0	12.00	9.4
70X70	5.0	6.77	5.3
	6.0	8.06	6.3
	8.0	10.58	8.3
	10.0	13.02	10.2
75X75	5.0	7.27	5.7
	6.0	8.66	6.8
	8.0	7.38	8.9
	10.0	14.02	11.0
80X80	6.0	9.29	7.3
	8.0	12.21	9.6
	10.0	15.05	11.8
	12.0	17.81	14.0
90X90	6.0	10.47	8.2
	8.0	13.79	10.8
	10.0	17.03	13.40
	12.0	20.19	15.8
100X100	6.0	11.67	9.2
	8.0	15.39	12.1
	10.0	19.03	14.90
	12.0	22.59	17.7

**Details of square boxes** (closed structures –RHS/SHS, Reference IS -4923:1997)

Section	Depth in mm	Width in mm	Thickness in mm	Sectional area in sq-cm	Weight in kg/m
25x25	25	25	2.6	2.16	1.69
	25	25	3.2	2.53	1.987
30x30	30	30	2.6	2.68	2.1
	30	30	3.2	3.17	2.49
	30	30	4.0	3.75	2.94
32X32	32	32	2.6	2.88	2.26
	32	32	3.2	3.42	2.69
	32	32	4.0	4.07	3.19
35X35	35	35	2.6	3.2	2.51
	35	35	3.2	3.81	2.99

	35	35	4.0	4.55	3.55
38X38	38	38	2.6	3.51	2.75
	38	38	2.90	2.86	3.03
	38	38	3.2	4.19	3.29
	38	38	3.6	4.62	3.63
	38	38	4.00	5.03	3.95
40x40	40	40	2.6	3.72	2.92
	40	40	3.2	4.45	3.49
	40	40	3.60	4.91	3.85
	40	40	4.0	5.35	4.2
45x45	45	45	2.6	4.24	3.32
	45	45	2.9	4.67	3.66
	45	45	3.2	5.09	3.99
	45	45	3.6	5.63	4.44
	45	45	4.5	6.67	5.31
49.5x49.5	49.5	49.5	2.9	5.19	4.07
	49.5	49.5	3.6	6.28	4.93
	49.5	49.5	4.5	7.58	5.95
63.5x63.5	63.5	63.5	3.2	7.45	5.85
	63.5	63.5	3.6	8.29	6.51
	63.5	63.5	4.5	10.10	7.93
72x72	72	72	3.2	8.54	6.7
	72	72	4.0	10.47	8.22
			4.8	12.31	9.66
75x75	75	75	3.2	8.93	7.01
			4.0	10.95	8.59
			4.9	13.12	10.3
88.9x88.9	88.9	88.9	3.6	11.95	9.38
			4.5	14.67	11.52
			4.9	15.85	12.44
91.5x91.5	91.5	91.5	3.6	12.32	9.67
			4.5	15.14	11.88
			5.4	17.85	14.01
100x100	100	100	4.0	14.95	11.73
			5.0	18.36	14.41
			6.0	21.63	16.98
13.5x113.5	113.5	113.5	4.5	19.1	14.99

			4.8	20.28	15.92
			5.4	22.6	17.74
			6.0	24.87	19.53
125x125	125	125	4.5	21.17	16.62
			5.0	23.36	18.33
			6.0	27.63	21.69
132x132	132	132	4.8	23.83	18.71
			5.4	26.59	20.88
			6.0	29.31	23.01
150x150	150	150	5.0	28.36	22.26
			6.0	33.63	26.4
50x25	50	25	3.2	4.13	3.2
60x40	60	40	2.9	5.25	4.12
66x33	66	33	2.9	5.19	4.07
	66	33	3.6	6.28	4.93
			4.5	7.58	5.95
70x30	70	30	52.9	5.25	4.12
			3.2	5.73	4.5
			4.0	6.95	5.45
80x40	80	40	2.9	6.41	5.03
			3.2	7.01	5.5
			4.0	8.55	6.71
96x48	96	48	3.2	8.54	6.7
			4.0	10.47	8.22
			4.8	12.31	9.66
100x50	100	50	3.2	8.93	7.01
			4.0	10.95	8.59
122x61	122	61	3.6	12.32	9.67
			4.5	15.14	11.88
			5.4	17.85	14.01
127x50	127	50	3.6	11.89	9.34
			4.6	14.89	11.69
145x82	145	82	4.8	20.28	15.92
			5.4	22.6	17.74
172x92	172	92	4.2	23.83	18.71
			5.4	26.59	20.88

**Weight of mild steel stips**

Thickness In mm	1.6	1.8	2.0	2.24	2.5	2.8	3.15	3.55	4.00	4.50	5.0	6.0	8.0	10.0
Width in mm	Weight in kg/metre													
100	1.3	1.4	1.6	1.8	2.0	2.2	2.5	2.8	3.1	3.5	3.9	4.7	6.3	7.8
125	1.6	1.8	2.0	2.2	2.4	2.7	3.1	3.5	3.9	4.4	4.9	5.9	7.8	9.8
160	2.0	2.3	2.5	2.8	3.1	3.5	4.0	4.5	5.0	5.6	6.3	7.5	10.0	12.6
200	2.5	2.8	3.1	3.5	3.9	4.4	4.9	5.6	6.3	7.1	7.8	9.4	12.6	15.7
250	3.1	3.5	3.9	4.4	4.9	5.5	6.2	7.0	7.8	8.8	9.8	11.8	15.7	19.0
320	4.0	4.5	5.0	5.6	6.3	7.0	7.9	8.9	10.0	11.3	12.6	15.1	20.1	25.4
400	5.0	5.6	6.3	7.0	7.8	8.8	9.9	11.1	12.6	14.1	15.7	18.8	25.1	31.4
500	6.3	7.1	7.8	8.8	9.8	11	12.4	13.9	15.7	17.7	19.6	23.6	31.4	39.2
650	8.2	9.2	10.2	11.4	12.8	14.3	16.1	18.1	20.4	23	25.5	30.6	40.8	51
800	10.0	11.3	12.6	14.1	15.7	17.6	19.8	22.3	25.1	28.3	31.4	37.7	50.2	62.8
950	-	13.4	14.9	16.7	18.6	20.9	23.5	26.5	29.8	33.6	37.3	44.7	59.7	74.6
1050	-	-	16.5	18.5	20.6	23.1	26	29.3	33	37.1	41.2	49.6	65.9	82.4
1150	-	-	-	20.2	22.6	25.3	28.4	32	36.1	40.6	45.1	54.2	72.2	90.3
1250	-	-	-	-	24.5	27.5	30.9	34.8	39.2	44.2	39.1	58.9	78.5	98.1
1300	-	-	-	-	-	28.6	32.1	36.2	40.8	45.9	51	61.2	81.6	102
1450	-	-	-	-	-	-	35.8	40.4	45.5	51.2	56.9	68.3	91.1	113.8
1550	-	-	-	-	-	-	38.3	43.2	48.7	54.7	60.8	73	97.3	121.7

**Weight of mild steel flats**

Thickness In mm	3.0	4.0	5.0	6.0	8.0	10	12	16	18	20	25	32	40
Width in mm	Weight in kg/m												
10	0.2	0.3	0.4	0.5									
15	0.4	0.5	0.60	0.7	0.9								
20	0.5	0.6	0.8	0.9	1.3	1.6							
25	0.6	0.8	1.0	1.2	1.6	2.0	2.4						
30	0.7	0.9	1.2	1.4	1.9	2.4	2.8	3.8					
35	0.8	1.1	1.4	1.6	2.2	2.8	3.3	4.4	5.0	5.5			
40	0.9	1.3	1.6	1.9	2.5	3.1	3.8	5.0	5.6	6.3			
45	1.1	1.4	1.8	2.1	2.8	3.5	4.2	5.6	6.4	7.1			
50	1.2	1.6	2.0	2.4	3.1	3.9	4.7	6.3	7.1	7.8	9.8		
55	1.3	1.7	2.2	2.6	3.4	4.3	5.2	6.9	7.8	8.6	10.8		
60	1.4	1.9	2.4	2.8	3.8	4.7	5.6	7.5	8.5	9.4	11.8	15.1	
65	-	-	-	3.1	4.1	5.1	6.1	8.2	9.2	10.2	12.8	16.3	20.4
70	-	-	-	3.3	4.4	5.5	6.6	8.8	9.9	11	13.7	17.6	22.0
75	-	-	-	3.5	4.7	5.9	7.1	9.4	10.6	11.8	14.7	18.8	23.6
80	-	-	-	3.8	5.0	6.3	7.5	10.0	11.3	12.6	15.7	20.1	25.1
90	-	-	-	4.2	5.6	7.1	8.5	11.3	12.7	14.1	17.7	22.6	28.3
100	-	-	-	4.7	6.3	7.8	9.4	12.6	14.1	15.7	19.6	25.1	31.4
110	-	-	-	5.2	6.9	8.6	10.4	13.8	15.5	17.3	21.6	27.6	34.5



**Approximate weight of wire in kg per 1000 meter**

		Steel	Copper
23/24 <sup>G</sup>	0.60 mm $\Phi$	2.49	2.77
21/22 <sup>G</sup>	0.8 mm $\Phi$	4.01	4.47
19/20 <sup>G</sup>	1.00 mm $\Phi$	6.27	6.98
18 <sup>G</sup>	1.25 mm $\Phi$	9.8	10.9
16 <sup>G</sup>	1.6 mm $\Phi$	16.04	17.86
14 <sup>G</sup>	2.00 mm $\Phi$	25.08	27.91
12 <sup>G</sup>	2.5 mm $\Phi$	39.40	43.4
10 <sup>G</sup>	3.15 mm $\Phi$	62.00	70.00

**J) Hoop iron -20<sup>G</sup>** 20 mm width -13 kg/100 Metre  
25 mm -19.4 kg/100 Metre

**K) Weight of prestressing wires and strands**

Cable size	Internal diameter of sheathing in mm	Weight of cable in kg / meter
12 nos 5 mm wire	30	1.850
12 nos 7 mm wire	39	3.625
12 nos 8 mm wire	42	4.735
13 mm strand	-	0.735

**L) Nominal weight of plain galvanized sheet in kg /m<sup>2</sup>**

Gauge	Thick-ness mm	Class I with 750 <sup>G</sup> zinc coating	Class II with 600 <sup>G</sup> zinc coating	Class III with 50 <sup>G</sup> zinc coating	Class IV with 378 <sup>G</sup> zinc coating
24 <sup>G</sup>	0.63	5.7	5.55	5.4	5.32
22 <sup>G</sup>	0.8	7.03	6.88	6.73	6.66
20 <sup>G</sup>	1.00	8.6	8.45	8.3	8.22
18 <sup>G</sup>	1.25	10.56	10.41	10.26	10.19
16 <sup>G</sup>	1.60	13.31	13.16	13.01	12.94

M) **C.I S/S** Pipes Both centrifugally cast & vertically cast up to 750 dia and above this size only vertically cast

Details		Total weight of a pipe		
Nominal dia of pipe	Nominal length of pipe	LA class 20 kg/ cm <sup>2</sup> test pressure	Class A of 25kg/cm <sup>2</sup>	Class B of 30 Kg/cm <sup>2</sup>
80 Φ	4.5 m	64 kg	69.5 kg	74.5 kg
100 Φ	5.5m	109	120	128
150 Φ	5.5m	177	194	209
200 Φ		259	281	304
300 Φ		450	492	533
400 Φ		690	754	814
450 Φ		832	914	986
600 Φ		1298	1417	1535
750 Φ		1876	2051	2225
900 Φ			2791	3024
1200 Φ			4623	4993
1500 Φ			7223	7833

N) **Flange pipes vertically sand cast pipes**

Nominal dia	Barrel weight kg of One metre		Approx wt of one Flange	Dia of Bolts mm	No of Bolts
	Class A	Class B			
80 Φ	16.0	17.3	3.7	16 Φ	4
100 Φ	20.5	22.0	4.2	16 Φ	8
150 Φ	33.2	35.9	6.7	20 Φ	8
200 Φ	48.1	52.1	9.3	20 Φ	8
300 Φ	84.0	91.4	14.8	20 Φ	12
400 Φ	128.7	139.5	23.4	24 Φ	16
450 Φ	156.0	169.0	26.5	24 Φ	20
600 Φ	241.0	262	44	27 Φ	20
750 Φ	348.9	380.6	69.8	27 Φ	24
900 Φ	474.3	516.6	94.6	30 Φ	28
1200 Φ	783.1	851.6	173	36 Φ	32
1500 Φ	1222.1	1333.1	276.2	39 Φ	40

**C.I rain water pipe (IS 1230:1957)**

Internal Bore	Weight per pipe of 1.8 m Length
75 mm	11.0 kg
100 mm	14.0 kg
150 mm	26.0 kg

**Weight of spirals (hard -drawn steel ) in socket of R/R Joint RCC pipes of different Classes (kg/no)**

Internal dia in mm of pipes	NP2 Class	NP 3 Class	NP 4 Class	P1 Class	P2 Class	P3 Class
1	2	3	4	5	6	7
80	.08	0.08	0.08	0.08	0.08	0.08
100	0.09	0.09	0.09	0.09	0.09	0.09
150	0.12	0.12	0.12	0.12	0.12	0.15
200	0.14	0.14	0.21	0.14	0.21	0.35
225	0.15	0.15	0.26	0.15	0.26	0.43
250	0.16	0.16	0.31	0.16	0.31	0.51
300	0.45	0.45	0.53	0.45	0.53	0.84
350	0.51	0.64	0.64	0.51	0.74	1.24
400	0.56	0.71	0.71	0.56	0.99	1.66
450	0.63	0.76	0.76	0.63	1.23	2.26
500	0.68	0.87	1.08	0.68	1.57	2.85
600	0.81	1.00	2.12	1.52	2.88	4.74
700	0.92	2.16	3.02	1.79	3.96	6.79
800	1.14	2.87	4.67	2.04	6.28	9.99
900	1.50	4.06	6.03	2.63	8.29	-
1000	1.91	-	-	3.33	1.29	-
1100	2.34	-	-	4.08	-	-
1200	2.8	-	-	4.9	-	-
1400	3.82	-	-	-	-	-
1600	5.64	-	-	-	-	-
1800	7.25	-	-	-	-	-
2000	11.78	-	-	-	-	-
2200	12.88	-	-	-	-	-

**Note 1** Longitudinal Reinforcement shall be proportional to the length of socket cage

**Note 2** If mild steel used for spiral reinforcement, the weight specified above shall be increased to 140/125.

**Weight of concrete pipes**

<b>No</b>	<b>Material</b>	<b>Internal Dia in mm</b>	<b>Weight Kg/Rmt</b>
1	Class NP 1 (unreinforced non pressure pipes )	80	19
		100	22
		150	31
		250	41
		300	71
		350	86
		400	97
2	Class NP 2 (Reinforced concrete light duty, non pressure pipes)	450	110
		80	20
		100	24
		150	33
		250	52
		300	75
		350	92
		400	104
		450	128
		500	141
		600	193
		700	223
		800	287
		900	358
3	Class NP 3 (Reinforced concrete heavy duty, non pressure pipes )	1000	438
		1200	620
		1400	834
		1600	1013
		1800	1283
		350	240
		400	269
		450	297
		500	325
		600	410
700	470		
800	604		
900	754		
1000	829		
1100	1054		
1200	1140		

4	Class P 1 (Reinforced concrete pressure pipes safe for 2 kg per cm <sup>2</sup> )	80	20
		100	24
		150	33
		250	52
		300	75
		350	92
		400	104
		450	128
		500	141
		600	193
		700	223
		800	287
		900	358
		1000	437
1100	525		
1200	620		
5	Class P 2 (Reinforced concrete pressure pipes safe for 4 kg per cm <sup>2</sup> )	80	20
		100	24
		150	33
		250	63
		300	103
		350	134
		400	170
		450	188
		500	230
		600	326
6	Class P 3 (Reinforced concrete pressure pipes safe for 6 kg per cm <sup>2</sup> )	80	20
		100	24
		150	34
		250	75
		300	117
		350	168
		400	208

**Use of unreinforced and reinforced concrete pipes**

Class	Description	Conditions where normally used
NP 1	Unreinforced concrete non-pressure pipes	For drainage and irrigation use above ground or in shallow trenches
NP2	Reinforced concrete, light duty, non-pressure pipes	For drainage and irrigation use for culverts carrying light traffic
NP3	Reinforced concrete , medium duty , non-pressure pipes	For drainage and irrigation use for culverts carrying medium traffics
NP4	Reinforced concrete, heavy duty non-pressure pipes	For drainage and irrigation use for culverts carrying heavy traffic such as railway loading
P1	Reinforced concrete pressure pipes tested to a hydrostatic pressure of 0.2 MPa ,(20m head)	For use on gravity mains , the site test pressure not exceeding 2/3 of the hydro static test pressure.
P2	Reinforced concrete pressure pipes tested to a hydrostatic pressure of 0.4 MPa ,(40m head)	For use on pumping mains , the site test pressure not exceeding half of the hydro static test pressure.
P3	Reinforced concrete pressure pipes tested to a hydrostatic pressure of 0.6 MPa ,(60m head)	-do-

**Cast iron floor/Nahni traps ( Ref IS 3989:1984)**

Des- Creation	Designation Diameter / Size (Nominal Bore of Out let)	Diameter Of inlet Grating	Total depth	Weight (approx ) of each trap
Cast iron Floor trap	50 mm	100 mm	175 mm	2.5 kg
	75	100	225	4.8
	100	200	296	7.5
Cast iron Nahni trap	50	165	175	5.5
	75	165	225	6.5

**Barbed wire – 2 ply**

Gauge	Gap b/w 2 barbs	Length in a bundle of ½ CWT or 25 kg
12 <sup>G</sup>	75 mm	153 m
14 <sup>G</sup>	75 mm	300 m

**Galvanized steel barb fencing wire**

Description	Weight of		Length/ ton
	100 yd	100 m	
<i>12 SWG line wire</i>	Lb	Kg	M
2 Point ordinary : Barbs round 1 wire only 5" apart	19	9.43	10602
2 Point ordinary : Barbs round 1 wire only 6" apart	18.5	9.18	10890
2 Point Thickset : barbs round 1 wire only 2.5" apart	21	10.42	9594
4 Point ordinary : Barbs round 1 wire only 6" apart	20	9.92	10080
4 Point Thickset : Barbs round 1 wire only 3" apart	25	12.40	8064
4 Point ordinary : Barbs round both wire only 6" apart	20	9.92	10080
4 Point Thickset : Barbs round 1 wire only 3" apart	25	12.4	8064
<i>14 SWG line wire</i>			
4 Point Thickset : Barbs round 1 wire only 3" apart	16	7.94	12600
4 Point Thickset : Barbs round 1 wire only 6" apart	13	6.45	15516

**Minimum weight bitumen felt in kg**

Bitumen felts are available in widths of 90 cm and 100 cm and in length of 10m or 20 m

Sno	Type of felt	For 10 M <sup>2</sup>				
		Untreated base	Saturant	Contant	Bitumen content	Minimum wt of the finished bitumen felt in dry condition with mica powder
A	Fibre base					
	1) Type 1 under lay	4.0	3.6	-	3.6	7.6
	2) Type 2 Self Finished felt	5.0	4.5	12.9	12.0	22.6
B	Hessain base					
	1)Type 3 self Finished Felt grade 1	2.3	1.8	17.7	12.1	23.0
	2)Type3 Self finished felt Grade 2	2.3	1.8	31.8	20.2	37.1

**Standard Wire Gauge**

SWG Dia	Dia (Inch)	Dia Mm	SWG No	Dia (inch)	Dia Mm	SWG Dia	Dia (inch)	Dia Mm
7/0	0.500	12.7000	13	0.092	2.2368	32	0.0108	0.2743
6/0	0.465	11.7856	14	0.080	2.030	33	0.0100	0.2540
5/0	0.432	10.9728	15	0.072	1.8288	34	0.0092	0.2347
4/0	0.400	10.1600	16	0.064	1.6256	35	0.0084	0.2134
3/0	0.372	9.488	17	0.056	1.4224	36	0.0076	0.1930
2/0	0.348	8.8392	18	0.048	1.2199	37	0.0068	0.1727
1/0	0.324	8.2296	19	0.040	1.0160	38	0.0060	0.1524
1	0.300	7.6200	20	0.036	0.9144	39	0.0052	0.1321
2	0.276	7.0104	21	0.032	0.8128	40	0.0048	0.1219
3	0.252	6.4008	22	0.028	0.7112	41	0.0044	0.1118
4	0.232	5.8928	23	0.024	0.6096	42	0.0040	0.0106
5	0.212	5.3848	24	0.022	0.5588	43	0.0036	0.0914
6	0.192	4.8168	25	0.020	0.5080	44	0.0032	0.0613
7	0.176	4.4704	26	0.018	0.4572	45	0.0028	0.0711
8	0.160	4.0640	27	0.0164	0.4166	46	0.0024	0.0610
9	0.114	3.6576	28	0.0148	0.3759	47	0.0020	0.0580
10	0.128	3.2515	29	0.0136	0.3454	48	0.0016	0.0406
11	0.116	2.9454	30	0.0214	0.3150	49	0.0012	0.0305
12	0.104	2.6416	31	0.0116	0.2946	50	0.0010	0.0254

**THEORITICAL CEMENT CONSUMPTION**

Sno	Description of item	Mix by Volume	Unit	Cement In Kg	Constant In bags
<b>Cement concrete</b>					
1	Mixed cement concrete delivered on bunker	1:1.5:3	Cum	402.83	8.05
		1:2:4		308.53	6.17
		1:2:5		268.55	5.37
		1:2.5:4		253.18	5.06
		1:3:6		213.20	4.26
		1:4:8		161.95	3.24
		1:5:10		129.15	2.58
		1:7:12		104.55	2.09
2	Mixed cement concrete using all in aggregate delivered on bunker	1:5	Cum	312.63	6.25
		1:6		264.45	5.29
		1:8		206.03	4.12
		1:12		138.38	2.77
<b>MORTARS</b>					
3	Cement and sand mortars	1:1	Cum	1058.82	21.18
		1:2		699.05	13.98
		1:3		493.03	9.86
		1:4		382.33	7.65
		1:6		254.20	5.08
		1:8		192.70	3.85
4	Gauged mortar(cement lime and sand mortar)	1:1:6	Cum	244.98	4.90
		1:1:8		189.63	3.79
		1:2:9		164.00	3.28
		1:5:10		147.60	2.95
		1:7:12		120.95	2.42
5.	<b>BRICKWORK</b>				
				Old size	Modular
	Brickwork in well burnt bricks straight on plan or to curve exe 6M mean inner radius, built in cement, built in gauged mortar	1:3	Cum	123.00	113.38
		1:4		95.84	87.96
		1:6		64.05	58.47
1:8		47.98		44.32	

6	<b>Stone masonry</b> Walling of random or polygonal rubble uncoarsed or brought upto coarses well bonded bedded and solidly hearted in cement mortar	1:3	Cum	147.60	2.95
		1:4		114.80	2.29
		1:6		65.00	1.51
		1:8		58.94	1.18
7	Walling of random or polygonal rubble uncoarsed or brought upto coarses well bonded bedded and solidly hearted in gauged mortar	1:1:6	Cum	73.80	1.48
		1:1:8		114.80	2.29
		1:1:9		49.71	0.99
8	<b>Plastering</b> 10mm (1/2" ) th. Rendering or screeding on bricks or concrete surface in cement and sand mortar	1:2	Sqm	11.79	0.24
		1:3		8.41	0.17
		1:4		6.77	0.14
		1:6		4.66	0.09
9	10mm (1/2" ) th. Rendering or screeding on bricks or concrete surface in cement and gauged mortar	1:1:8	Sqm	3.38	0.07
		1:2:9		2.82	0.06
10	10 mm (1/2") th. Rendering or screeding on stone masonry surfaces or lathing in cement and sand mortar	1:2	Sqm	15.68	0.31
		1:3		11.17	0.22
		1:4		8.41	0.17
		1:6		5.64	0.11
11	10 mm (1/2") th. Rendering or screeding on stone masonry surfaces or lathing in cement and gauged mortar	1:1:8	Sqm	4.20	0.08
		1:2:9		3.64	0.07
		1:4		2.51	0.05
12	Add to or deduct from serial item no. 8 &10 for each 5mm(1/4") th. In CM over or under 10 mm (1/2") on concrete, brick, lathing or stone masonry surfaces	1:2	Sqm	4.77	0.10
		1:3		3.38	0.07
		1:4		2.51	0.05
		1:6		1.69	0.03
13	-ditto- item no.9&11 in gauged mortar	1:1:8	Sqm	1.38	0.03
		1:2:9		1.13	0.02

14	<b>POINTING</b>				
	Raking cut joints to a depth of 10 mm and flush keyed or stuck pointing on brick work	1:2	Sqm	2.51	0.05
		1:3		1.69	0.03
		1:4		1.39	0.03
15	Raking cut joints to a depth of 10 mm and flush keyed or stuck pointing on random rubble masonry, uncoarsed or brought to coarsed, with 20mm thick joints in CM	1:2	Sqm	2.51	0.05
		1:3		1.69	0.03
		1:4		2.83	0.06
	16	Struck, keyed or flush pointing to squared rubble coursed or uncoursed walling in cement mortar	1:2	Sqm	1.39
1:3			1.13		0.02
1:4			0.85		0.01
17	Bastard tuck or manson's V-joint pointing to squared rubble coursed or uncoursed masonry in cement mortar	1:2	Sqm	5.02	0.10
		1:3		3.64	0.07
		1:4		2.82	0.06
18	Bastard tuck or manson's V-joint pointing to random rubble masonry uncoursed or brought to coarsed in cement mortar	1:2	Sqm	5.02	0.10
		1:3		3.64	0.07
		1:4		2.82	0.06
19	<b>Brick Flooring</b>				
	Hard burnt brick floors, laid flat jointed and pointed flush in cement and sand mortar	1:3	Sqm	11.17	0.22
		1:6		5.64	0.11
20	- ditto- but bricks laid on edge ditto	1:3	Sqm	15.68	0.31
		1:6		8.41	0.17
21	<b>Surface finishing to concrete floors</b>				
	Flooring with wool or steel hand float as ordered cement concrete floor surface to fair and even surface using extra cement		Sqm	1.38	0.03
22	<b>Granolithic Flooring</b>				
	30 mm thick granolithic concrete floor tapping	1:1:2	Sqm	16.09	0.32

	spread over ordinary concrete floors etc, including floating or troweling to an even and fair surface				
23	10 mm (3/8") thick layer of terrazzo (consisting of one part of mixture of cement and marble powder to 1.5 parts of approved crushed stone chipping, 4 to 7 mm size laid level or to false including cut and polished finish	1:1:5	Sqm	8.71	0.17
24	<b>Terrazzo flooring</b> 10 mm thick layer of terrazzo (consisting of 3 parts of cement mixed with one 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 false	1;1:2	Sqm	8.71	0.174

### Consumption of Building Materials

#### Mortars : Estimation of quantity of materials

Sl no	Mortar Mix (unit 1 M <sup>3</sup> )	Unit	Requirement of materials			
			Sand ( M <sup>3</sup> )	Cement		Lime ( M <sup>3</sup> )
				M <sup>3</sup>	Bags	
1	1 cement : 1 fine/ coarse sand	1 Cum	0.7125	0.7175	20.4	
2	1 cement : 2 fine/ coarse sand	- do-	0.95	0.475	13.6	
3	1 cement : 3 fine/ coarse sand	- do-	1.07	0.357	10.2	
4	1 cement : 4 fine/ coarse sand	- do-	1.07	0.268	7.6	
5	1 cement : 5 fine/ coarse sand	- do-	1.07	0.214	6.2	
6	1 cement : 6 fine/ coarse sand	- do-	1.07	0.178	5.0	
7	1 cement : 1 lime putty : 6 sand	- do-	1.07	0.178	5.0	0.178
8	1 cement : 2 lime putty : 9 sand	- do-	1.07	0.119	3.4	0.238

Note : one quintal of un slaked lime will yield approximately 0.158 cum of lime putty . one quintal of unslaked lime occupies 0.129 cum by volume.

**Masonry : Estimation of quantity of materials .**

Sl no	Masonry type ( unit 1 M <sup>3</sup> )	Mortar require ment	Mortar mix	Bricks (no)	Sand in M <sup>3</sup>	Quantity of cement	
						M <sup>3</sup>	Bags
1	Brickwork	25 %	1: 6`	494	0.27	0.045	1.3
2	Brickwork	25 %	1:5	494	0.27	0.054	1.6
3	Brickwork	25 %	1: 4	494	0.27	0.067	1.9
4	Brickwork	25 %	1: 3	494	0.27	0.089	2.6
5	Random rubble Stone masonry	30 %	1:6	Stone 1 cum bond stones 7 no	0.35	0.059	1.7
6	Coursed rubble Stone masonry	33 %	1 : 6	Stone 1.21 cum bond stone 7 no	0.32	0.054	1.5

**Concrete : Estimation of quantity of materials**

Sl no	Concrete mix	Coarse aggregate (M <sup>3</sup> )	Sand (M <sup>3</sup> )	Cement	
				M <sup>3</sup>	Bags
1	1 :1 :2	0.85	0.43	0.425	12.2
2	1 :1.5 :3	0.85	0.43	0.283	8.0
3	1 :2 :4	0.89	0.45	0.223	6.4
4	1 :3 :6	0.92	0.46	0.154	4.4
5	1 :4 :8	0.95	0.48	0.118	3.4
6	1 :5 :10	0.97	0.46	0.091	2.6

- Cement bag weighing 50 kg has volumetric content of 0.035 cum

**RCC : Estimation of quantity of reinforcement**

Reinforcement as % of concrete volume	Volume of steel (M <sup>3</sup> )	Quantity of steel (kg)	For rough estimation of reinforcement in RCC the following rule of thumb may be adopted	Quantity of steel in kg/ M <sup>3</sup> of concrete volume
1	0.01	78	Lightly reinforced structures (slabs etc)	70
2	0.02	157	Medium reinforced structures (beams etc)	80-90
3	0.03	235	Heavily reinforced structures (columns, T beams ,etc)	110-120

**Plastering : Estimation of quantity of materials**

Thickness of plaster (mm)	Mortar quantity (M <sup>3</sup> )	Cement : sand(1:3)		Cement :sand (1:4)		Cement : sand(1: 6)	
		Cement (Bags)	Sand(M <sup>3</sup> )	Cement (Bags)	Sand(M <sup>3</sup> )	Cement (Bags)	Sand(M <sup>3</sup> )
6	0.072	0.73	0.077	0.55	0.077	0.37	0.077
10	0.12	1.22	0.128	0.91	0.128	0.61	0.128
12	0.144	1.47	0.154	1.10	0.154	0.73	0.154
15	0.172	1.75	0.184	3.31	0.184	0.88	0.184
18	0.216	2.2	0.231	1.65	0.231	1.1	0.231
20	0.224	2.29	0.240	1.71	0.240	1.14	0.240

**Pointing : Estimation of quantity of materials**

Item (unit 10 M <sup>2</sup> )	Mortar (M <sup>3</sup> )	Sand (M <sup>3</sup> )	Quantity of cement	
			Cum	Bags
Brick masonry walls	0.03	0.032	0.0107	0.31
Brick masonry walls*	0.046	0.049	0.016	0.47
Brick Flooring	0.02	0.022	0.0072	0.2
Brick tile work	0.046	0.049	0.016	0.47
Stone work	0.023	0.025	0.008	0.24
Stone work *	0.038	0.41	0.014	0.039
Sand stone slab pavement	0.015	0.016	0.0053	0.16

**Note :** The above estimate of quantities is for mortar mix 1: 3 The estimate of quantities is for raised and cut pointing

**Flooring : Marble stone : Estimation of quantity of materials**

Item (unit 10 M <sup>2</sup> )	Under layer			Marble slab (M <sup>2</sup> )	White cement (kg)
	Bedding mortar(M <sup>3</sup> )`	Coarse sand(M <sup>3</sup> ) `	Cement (kg)		
Marble stone flooring with 20 mm thick marble stone over 20 mm avg thick base and jointed with grey cement slurry including rubbing and polishing	0.224	0.24	85.7 + 44.0 *	11.5 incl of 15 % wastage	6.0 for grouting joints

complete with base mortar of 1: 4					
30 mm thick marble slab in risers of steps, skirting , dado , walls and pillars laid on 12mm thick (avg) base of cement mortar 1: 3 and jointed with grey cement slurry including rubbing and polishing complete	0.144	0.154	73.4+44.0	11.5 including wastage	6.0 for pointing

\*Inclusive of grey cement for slurry @ 4.4 kg/sqm

## Painting and Polishing

Paint preserves, protects and decorates surfaces and enables them to be cleaned easily.

**Types of paints:** There are seven types of paints, used commonly are :

**i) Oil paints:** These are the traditional type having a linseed oil medium. Finishes vary from flat to oil-gloss. Oil paints dry by evaporation of the solvent and by oxidation, synthetic paints have replaced them.

**ii) Synthetic paint:** The medium for these is a chemical compound, one type being oil-modified alkyd resin. They have the advantage over oil paints in setting more quickly and offering greater durability where corrosion is a main concern. They also have better flow and are easier to apply.

**iii) Water paints:** Known also as distempers they are used mainly on internal walls and ceilings and most of them give a flat finish. They have a drying oil or varnish medium emulsified in water. They are prepared on the site by adding water to make a paste. Emulsion paint has superseded water paint.

**iv) Emulsion Paints:** These are mostly used on wall surfaces. Oil bound distemper is a type of emulsion paint. An emulsion paint has the pigments and medium dispersed as small globules in water. Oil, synthetic resin and bitumen are the common mediums. Among different emulsion paints are alkyd, bitumen, polyvinyl acetate and styrene emulsion paints. The finish obtained is flat to egg shell gloss.

**v) Varnishes:** These are of two kinds, oil varnish and spirit varnish. They are used to give a transparent film to a surface. The relative proportion of the oil and the resin control the usage; if the oil is predominant a more elastic varnish results for external work. If the solvent is the major ingredient, a high gloss, which dries rapidly, is obtained for internal work. Spirit varnishes are solution of shellac and other spirit resins dissolved in commercial alcohol (methylated spirits). They are only suitable for internal surfaces like furniture (e.g. is French polishing). Poly urethane varnish is a type of resin varnish producing a very durable finish.

**vi) Cellulose Paints:** They are mostly used as spray paints in car industry because they dry very quickly by evaporation of solvents. They are not satisfactory for general building work but can be used for furniture and fittings in houses.

**vii) Special paints:** Among the many kinds are aluminum paints, bituminous paints, chlorinated rubber paints, fire-resistant paints, heat-resisting paints, fungicidal paints, texture paints etc., These are used for special applications and manufacturer's instructions should be followed for thinning and applications of the required number of coats.

### Schedule for painting New Surfaces:

Sno	Type of finish	Primer coat	Under coat	Finishing
1	White wash	1 coat of white wash	-	2coats
2	Color wash	1 coat of color wash	-	2coats
3	Dry distemper	Clear Cole, size, etc	Filler to be used if required	2coats
4	Oil bound distemper	1 coat of alkali resistant cement primer	-do-	2coats
5	Emulsion paint	1 coat of emulsion paint	-do-	2coats
6	Flat/ semi gloss paint	1 coat of alkali resistant cement primer	-do-	2coats
7	Acrylic emulsion	1 coat of alkali resistant cement primer	-do-	2coats
8	Cement paint	1 coat of cement paint	Nil	2 coats

### Spreading Capacity of Different Paints

Type of finish	Covering capacity (New work)
<i>Internal finishes:</i>	
Lime for white washing	33-34 m <sup>2</sup> / quintal for 3 coats
Plastic emulsion paints on primed and puttied smooth surfaces by brushing	30-35 m <sup>2</sup> / lt/coat 19-20 m <sup>2</sup> / lt for 2 coats 13-14 m <sup>2</sup> / lt for 3 coats
Washable oil bound distemper, spreading by brushing	20-25 m <sup>2</sup> / kg per coat 12-15 m <sup>2</sup> / kg per 2 coats 7-8 m <sup>2</sup> / kg for 3 coats
Cement primer	20-25 m <sup>2</sup> / lit coat

Exterior wall finishes	
Acrylic emulsion paints	5.5-6.0 m <sup>2</sup> /lit for 2 coats
Cement paints	2 – 4 m <sup>2</sup> a/kg for 2 coats for Cement-sand plaster, depends on its texture
Metal/ Wood finishes	
Synthetic enamel paint	15-22 m <sup>2</sup> / lit /coat 10-12 m <sup>2</sup> /lit for 2 coats
Aluminum paint (dual pack)	20-22 m <sup>2</sup> /lit / coat
Metal primer	18-20 m <sup>2</sup> / lit /coat
Wood Primer	18-20 m <sup>2</sup> / lit /coat
Clear Wood Finishes	
Copal varnish	10-13 m <sup>2</sup> / lit /coat
French polish (ready mixed)	12-15 m <sup>2</sup> / lit /coat
Melamanised finishes	8-10 m <sup>2</sup> / lit /coat by brushing 5-6 m <sup>2</sup> / lit /coat by spraying
Poly urethane clear wood finish by brushing	8-10 m <sup>2</sup> / lit /coat
Sealer	8-10 m <sup>2</sup> / lit /coat by brushing

### Measurements: Equivalent Plain Areas of Uneven surface

SN	Description of work	How measured	Multiplying co-efficient
1	Paneled or framed and braced doors, window, etc	Measured flat <sup>s</sup>	1.3 (each side)
2	Flush doors	-do-	1.2(each side)
3	Part paneled and part glazed or gauzed doors, windows, etc.,	-do-	1.0(each side)
4	Fully glazed or gauzed doors, windows etc	-do-	0.8(each side)
5	Fully venetioned or louvered doors, windows etc	-do-	1.8(each side)
6	Trellis(or jaffri) work one way or two way	Measured flat <sup>#</sup>	2 for painting all over
7	Carved or enriched work	Measured flat	2(each side)
8	Wood shingle roofing measured flat	1.0(each side)	
9	Boarding with cover fillets	Measured flat	1.05(each

	and match boarding		side)
10	Tiles & slate battering	Measured flat, #	0.8 for painting all over
	Steel work, doors, windows etc		
11	Plain sheet steel doors & windows	Measured flat	1.1 (each side)
12	Fully glazed or gauzed steel doors and windows*	Measured flat	0.5 (each side)
13	Partly paneled and partly glazed or gauzed doors and windows	Measured flat	0.8 (each side)
14	Corrugated sheet steel doors and windows	Measured flat	1.25 (each side)
15	Collapsible gate measured flat	measured flat	1.5 for painting all over
16	Rolling shutters of interlocked laths	Measured flat	1.1 (each side)
17	Expanded metal, grill work, MS bars in window frame, railing, palisade fencing, balustrade gates inc, standards, braces, stays etc in timber or steel	Measured flat #	1 (for paint all over)
18	CGI sheathing in roof, side cladding etc.,	Measured flat (not girthed)	1.14 (each side)
19	AC corrugated sheeting in roofs, side cladding, etc	-do-	1.2 (each side)
20	Wire gauze shutters including painting of wire gauge	-do-	1.0 (each side)

\$- Measured flat ( Not girthed) including chowkat or frame, edges, chocks, cleats etc shall be deemed to be included in the item.

# - No deduction for open spaces, supporting members shall not be measured separately.

\*- Excludes painting of wire gauge portion

**Essentials for proper welding procedures**

- 1 Correct electrode size
- 2 Correct current
- 3 Correct arc length or voltage
- 4 Correct travel speed
- 5 Correct electrode angle

Besides the steady sizzling sound that correct arc procedures, the shape of the molten pool and the movement of the metal at the rear of the pool serve as a guide in checking weld quality. In a correctly made deposit the ripples produced on the bead will be uniform and the bead will be smooth , with no over lap or under cut.

**1. Correct electrode size**

The correct choice of electrodes size involves consideration of a variety of factors, such as the type , position , and preparation of the joint , the ability of the electrodes to carry high current values without injury to the weld metal or loss of deposition efficiency ,

The mass of work metal and its ability to maintain its original properties after welding, the characteristics of the assembly with reference to effect of stresses set up by heat application the practicability of specific requirements as welding quality and cost of achieving the desired results.

**2. Correct current**

If the current on equipment is too high or low, you are certain to be disappointed in your weld, if too high the electrode melted too fast and your molten pool is large and irregular .If too low, there is not enough heat to melt the base and your molten pool will be too small, will pile up, and look irregular.

**3. Correct arc length**

If the arc is total long or voltage too high the metal melts off the electrode in large globules which wobble from side to side as the arc wavers, giving a wide, spattered and regular bead with poor fusion arc is too short, or voltage too low, there is not enough heat to melt the base metal property and the electrode quite sticks to the work, giving a high, uneven bead, having irregular rippled with fusion

#### 4. Correct Travel speed

When your speed is too fast your pool does not last long enough, impurities and gas are locked in. The bead is narrow and ripples are pointed. When speed is too slow the metal piles up, the bead is high and wide, with a reference straight ripple

#### 5. Correct electrode angle

The electrode angle is of particular importance in fillet welding and deep groove welding

Generally speaking When making a fillet weld ,the electrode Should be held so that It bisects the angle between the plates (as shown at right ) and is perpendicular to the line of weld. If under cut occurs in the vertical member, lower the angle of the arc and direct the arc towards the vertical member.

Causes and cures of common welding troubles

#### **Porous welds why**

1. Excessively long or short arc length
2. Welding current too high
3. Insufficient or damp shielding gas
4. Too fast travel speed
5. Base metal surface covered with oil grease, moisture, rust, mill scale, etc
6. Wet unclean or damage electrode

#### **What to do**

1. Maintain proper arc length
2. Use proper welding current
3. Increase gas flow rate & check gas purity
4. Properly maintain and store electrodes
- 5.Reduce travel speed

#### **Cracked welds Why**

1. Insufficient weld size
2. Excessive joint restraint
3. Poor joint design and/or preparation
4. Filler metal does not match base metal
5. rapid cooling rate
6. Base metal surface covered with oil grease, moisture, rust, dirt or mill scale

**What to do**

1. Adjust weld size to part thickness
2. Reduce joint restraint through proper design
3. Select the proper joint design
4. use more ductile filler
5. Reduce cooling rate through preheat
6. Properly clean base metal prior to welding

**Undercutting why**

1. Faulty electrode manipulation
2. Welding current too high
3. Too long an arc length
4. Too fast travel speed
5. Arc blow

**What to do**

1. Pause of side of the bead when using a weaving technique
2. Use proper electrode angles
3. Use proper welding current for electrodes size]
4. Reduce arc length
5. reduce travel speed
6. reduce effects of arc blow

**Distortion why**

1. Improper tack welding and /or faulty
2. Improper bead sequence
3. Improper set up and fixturing
4. Excessive weld size

**What to do**

1. Tack weld parts with allowance for distortion
2. Use of bead sequencing
3. Tack or clamp parts securely
4. Make welds to specified size

**Spatter why**

1. Arc below
2. Welding current too high
3. Too long an arc length
4. Wet unclean or damaged electrode

**What to do**

1. Attempt to reduce the affect of arc below
2. Reduce welding current
3. Reduce arc length
4. Properly maintain and store electrodes

**Lack of fusion why**

1. Improper travel speed
2. Welding current too low
3. Faulty joint preparation
4. Too large an electrode diameter
5. Magnetic arc below
6. Wrong electrode angle

**Overlapping why**

1. Too slow travel speed.
2. Incorrect electrode angle.
3. Too large an electrode.

**What to do**

1. Increase travel speed.
2. Use proper electrode angles.
3. Use a smaller electrode size.

**Poor penetration why**

1. Travel speed to fast.
2. Welding current too low.
3. Poor joint design and/or preparation.
4. Electrode diameter too large.
5. Wrong type of electrode.
6. Excessively long arc length.

**What to do**

1. Decrease travel speed.
2. Increase welding current.
3. Increase root opening or decrease root face.
4. Use smaller electrode.
5. Use electrode with deeper penetration characteristics.
6. Reduce arc length.

**Magnetic arc blow why**

1. Unbalanced magnetic field during welding.
2. Excessive magnetism in parts of fixture.

**What to do**

1. Use alternating current.
2. Reduce welding current and arc length.
3. Change the location of the work connection of the work piece.

**Inclusion why**

1. Incomplete slag removal between passes.
2. Erratic travel speed.
3. Too wide a weaving motion.
4. Too large an electrode.
5. Letting slag run ahead of arc.
6. Tungsten spitting or sticking.

**What to do**

1. Completely remove slag between passes.
2. Use a uniform travel speed.
3. Reduce width of waving technique.
4. Use a smaller electrode size of better access to joint.
5. Increase travel speed or change electrode angle or reduce arc length.
6. Properly prepare tungsten and use proper currents.

**Handling:**

Normally the packing used by manufactures is strong enough to sustain normal handling; Average weight of one wooden case is 50 to 60 kgs. Including the weight of case (The weight can be handled manually also.) with the new developments in materials handling systems, it would not be difficult for nay industry to handling this weight. However, mishandling is going to damage the packing and also the electrodes coating.

What are the main trouble spot, where mishandling is likely

1. Loading & unloading of material. Usually this job is done by persons attached to transporting agencies and neither the supplier nor the receiver has direct control over stage, there can be two alternatives.
  - i) To reduce the weight to 20/25 kgs.
  - ii) To increases the weight to 300/400 kgs.

This first alternative can ensure that a person can easily carry the case, and there is less temptation to throw it. Second alternative will mean only mechanized handling, where safer handling can be expected.

But reducing weight per case will result in increased packing cost. On the other hand bulk packing will require suitable mechanized systems an additional investment. Because of these reasons the packing of 50-60 kgs. Electrodes per case reduced to 20/25 kgs.

### Storage:

The place where electrodes are stored should have relative humidity below 50% and normal room temp. say 30-35°C. These are ideal conditions. It is also necessary that electrodes are stored in a separate area where oil, grease, and other similar hazardous items are not stored.

Higher humidity results in absorption of moisture by electrode coverings. This moisture is the source for Hydrogen. As we all know, hydrogen can have adverse effects on weldments. For this reason proper storage, handling and conditioning of electrodes in necessary.

AWS A 5.1 recommends the following storage conditions:

<b>AWS Class</b>	<b>Temp.</b>	<b>Relative Humidity</b>
i) E 6010, E6011	Ambient	-----
ii) E 6012, E6013 E 7016, E7018 etc.	30°C +10°C	Max 50%

Electrode manufacturers provide a certain degree of moisture resistant packing by using polythene bags. Numbers of bags used per packet vary from 1 to 3, depending upon the type of

covering and permissible limit of moisture contents in the flux coating.

Coating moisture contents requirements have been specified in AWS / A 5.5 which are reproduced here.

AWS CODING (As per AWS A 5.5)	COATING MOISTURE Maximum percent (after reconditioning)
E 7015	
E 7016 } E 7018	0.40
E 8015	
E 8016 } E 8018	0.20
E 9015	
E 9016 } E 9018	0.15
E 100	
E 110 } E 120	0.15
E 12018 MI	0.10

Since the possibilities of moisture pick up in transportation and storage can not totally eliminated, there is a need for re drying or re baking of electrodes before use. In other words conditioning of the electrodes.

AWS / A 5.1 (Table) recommends re drying of electrodes for conditioning electrode. Manufacture also may be consulted for any special conditioning, procedure required for their products.

- A) Cellulosic type electrodes conforming to E6010 and E6011 need no re drying as the moisture picked up by coating has no adverse effect on welding. It has been observed that moisture pick up improves performance.
- B) Retic type electrodes conforming to E6012, E6013, E7024 and High iron Oxide/iron Powder type coating electrodes do

not pick up much moisture and hence can be dried to 135°C for 1 hour to drive out the moisture.

- C) Low Hydrogen (LH) type electrode coatings are most susceptible to absorption of moisture.

All critical properties like Gr 1 radiography, toughness at subzero temp, resistance to delayed cracking etc. can be obtained by use of LH type of electrodes Hence the proper conditioning of electrodes is very important.

The ideal re drying temperature and time is as follows:

	Temp.	Time
	350°C	1 hour.
Or	250°C	2 hours.

Once the electrodes are re dried, they should be transferred to holding Ovens where temperature should be maintained around 60°C. A few electrodes should be taken at a time from this holding oven. This procedure will ensure that the amount of hydrogen is controlled to desired level.

Failure to control the level of hydrogen will result in serious defects in weldment, such as porosity, cold cracking, reduced toughness etc, these problems increase as the parent metal strength, harden ability and joint restrain increase. Based on the experiment carried out on the 'MOISTURE PICK UP' by LH type, electrodes, it is observed that the 'Coating moisture content' can go as high as 3.2% if the electrodes are exposed to 75% Relative Humidity for a week. If these electrodes are not conditioned before use, they might evolve diffusible hydrogen to the extent of 17/18, ml per 100 gm weld deposit against the acceptable level which vary from, 2 ml to 10ml/100 gms.

From these observations, it is clear that storage & handling play very vital role in obtaining best or worst results. Hence the consumers must strictly follow the recommendations for storage and conditioning of electrodes to avoid tragic consequences in terms of defects, failure and rectifications costs.

### Notes on rock and blasting

While Granite and Deccan Trip being of ligneous originate of harder varieties lime stone, sand stone and shale are softer varieties particular of some varieties of rock.

Variety	Sp. Gravity(g/cc)	Solid density Tonne/m <sup>3</sup>	Bulk density Tonne/m <sup>3</sup>
Basalt	2.8-3.0	3.02	2.00
Dolomite	2.8-2.9	2.87	1.85
Granite	2.6-2.9	2.72	1.78
Lime stone	2.4-2.9	2.64	1.68
Quartzite	2.0-2.8	2.57	1.68
Sand stone	2.0-2.8	2.42	1.52
Shale	2.4-2.8	2.57	1.68
Trap Rock	2.6-3.0	2.78	1.85

It is important to maintain proper records of the following salient points.

1. Blasting ratio: Normally 8 to 10 t/kg. or 3 to 4 m<sup>3</sup>/kg of 80% gelatin with 4 detonators and 1.83 meter of fuse wire.(Qty. of rock broken per kg. of explosive)
2. drilling ratio: 0.42 to 1.5 m<sup>3</sup>/per drill meter of 25mm cartridge.(Qty. of rock broken per mt. of drilling)
3. Secondary blasting: Avg. charge ratio is on 25mm x 200mm cartridge of S.G. 80% for every 2 cu.m. (kg. of explosive/100 cu.m of rock)

#### 4. Typical charges for primary blasting in hard variety.

Dia. of hole(m)	Dia. of cartridge(mm)	Depth of hole(m)	Burden(m)	Spacing(m)	Solid vol. of rock/hole(m <sup>3</sup> )	Charge/hole. Kg.	Charge/ratio m <sup>3</sup> /kg.
32	25	1.0	0.6	0.7	0.42	0.14	3.00
		1.5	0.8	1.0	1.20	0.42	2.87
		2.0	1.0	1.1	2.20	0.70	3.14
		2.5	1.1	1.3	3.58	1.12	3.10
		3.0	1.2	1.3	4.68	1.54	

**Drill speed & jack Hammers**

	In hard rock	In soft rock
Manually	2m/day	4m/day
Mechanical (pneumatic)	4m/hour	8m/hour
Life of steel drill	300m	600m
Life of jack hammer	30,000 Drill meter	

**Information on Explosives.**

Explosive is a mixture of a mixture of substance whose stable equilibrium is upset if subjected to severe shock resulting in a violent release of energy in the form of shock wave accompanied by rapid conversion of the explosive in to a large volume of gases at high temp. and pressure. In practice the necessary shock is provided by a detonator or detonating fuse.

Blasting Accessories:

1. Exploder
2. Ohm meter
3. Shot-firing cable twin core 300mm long & each core consisting of conductor of atleast 4 copper wires of not less than 0.46mm dia.
4. Wooden stemming rod.
5. Scraper of brass, aluminum or wood to pick the cartridge prior to inserting the detonator or detonating fuse.
6. A crimper of nonferrous non-sparking material is required for crimping the detonator to the fuse.

**Code of good practice in shot-firing:**

1. Explosives and detonators should always be separately kept or transported.
2. To deal with explosives only non-sparking materials like wood or brass should be used.
3. To check the shot hole with a scraper or stemming rod before insertion of cartridge.
4. Not to force a detonator to a cartridge.

5. Remove all surplus explosives, vehicles, cover or remove equipment, remove all persons from the site to a safe distance.
6. Install red flag all around at a safe distance with guards to prevent people to enter inside the red zone till all clearance is given by the shot fire.
7. Test the exploder before use.
8. While straightening the lead wires, do not hold the electric detonator by the tube. Grip the wires about 10cm from the detonator with one hand and smooth them out with other. This will avoid any pull on the fuse head.
9. To avoid misfires, avoid damaging the insulation on the lead wires of the electric detonator.
10. To avoid misfires the conductors should be thoroughly cleaned free of grease or dirty wires. While making connections the bare ends of the conductors should be twisted to gather tightly for a length of about 3 cms.
11. Twin core cables have two conductors. Strand of one conductor should not touch the other. Good practice is to stagger the exposed ends in relations to each other.
12. To ensure good insulation and avoid short circuits in wet conditions, use insulating tapes.
13. All connections should be done by shot-firer only. Exploder key should never be parted by him. key should be removed after blaster and cable connection disconnected from the exploder and cable short circuited by twisting together the bare ends of the two conductors.
14. Exploder should be kept in a dry place and similarly the bare conductors.
15. All precautions should be taken against stray currents while blasting near electrically operated machine or high voltage power line.

#### **Procedure for establishing a magazine (for storing explosives)**

An application in form 'C' should be made to the regional Controller of Explosives together with six copies of site plan and magazine construction details who will send the applicant a copy of form 'D' showing safety distances. The applicant will send form again to Regional Controller giving actual safety distances who will forward all the documents to Chief Controller of

Explosives (CCE). CCE will then issue a form 'E' plus a draft copy of the license 'L' and will also pass on one copy of site plan to District Magistrate who will issue a 'No Object Certificate'. Based on this, CCE will allow the applicant to proceed ahead with the construction of the magazine and also issue a license in form of 'L'. On completion of the building the Regional Controller will inspect the magazine and endorse the license. The license must be renewed annually. If the Quantity to be stored does not exceed 100 kg. The applicant should obtain a 'No Objection Certificate' from District Authority and forward this along with form 'C' and the necessary plans as in case of large magazine. For storage up to 5 kg. of nitro compounds, 200 detonators and reasonable quantity of safety fuse, an applicant can be. Made direct to the local authorities who are empowered to issue 'J' form license.

### Use of Gun powder

- a. Up to 10lbs. of Gun powder and fuse wire-no license required in form no 'J' for procurement and storing but blasting license reqd. in form no. 'N'
- b. Not more than 8 holes at a time.
- c. A tampering rod should be of wood only & not iron.
- d. Signaling for warning 200yds. Distance.  
 In small blast  $\frac{1}{2}$  kg. of powder will loosen 2 tons.  
 In huge blast  $\frac{1}{2}$  kg. of powder will loosen 3 tons.

### Table of service powder to fill borings:

Dia. of pipes	$\frac{12\Phi}{}$	$\frac{16\Phi}{}$	$\frac{19\Phi}{}$	$\frac{22\Phi}{}$	$\frac{25\Phi}{}$
Wt. in kg/m	0.12	0.20	0.30	0.40	0.50

### Output of plant and machinery (brief notes)

Calculation of output of production/ construction equipments

#### Production estimating:

The performance of any equipment in terms of output per hour is assessed on the basis of the time required to perform each work cycle. This work cycle can be analysed in terms of fixed element and variable element of time factor.

The production rate in per cum can be worked out on the following basis.

$$\text{Out put per hour in cum} = \frac{60 \text{ minutes} \times \text{Pay load capacity}}{\text{fixed time} + \text{variable time (min)}} \times \text{efficiency factor}$$

Ex- working out output of a tipper :

Pay load capacity= 5 cum ( 9 T of stone metal)

Fixed time = 12 min

Variable time = 15 min Efficiency factor =0.85

Therefore output/ hour =  $\frac{60 \times 0.85 \times 5}{15+12} = 9.44 \text{ cum /hr}$

### Hauling equipment

Rear dumper tipper and Rear dumper trailer are generally used as highway hauling units:

Description	Payload capacity Kg	Capacities			
		Stuck (SAE)Kgs	Heaped 3:1 m3	Heaped2:1 (SAE) m3	Fuel consumption Lt/hr
Dumper Gross engine 320 HP Fly wheel 303 HP Cylinder 6	25410	13.63	15.73	16.97	23.0
Dumper Gross engine 320 HP Fly wheel 303 HP Cylinder 6	22700	12.30	15.00	16.00	22.0

### Loader

Output details – Flywheel power loader – Engine capacity -112HP- Payload 2722kg( 1.53m3 heaped capacity)

One way distance in mt	Average speed Km/hr	Cycle time in Min	Production /Hr		
			No. of work cycle	Heaped capacity m3	Production in M3
7.5	5	0.5	120	1.53	183.60
15	7	0.57	105	1.53	160.65
22.5	8	0.64	93	1.53	142.29
30	9	0.70	85	1.53	130.05

45	11	0.8	75	1.53	114.75
60	13	0.88	68	1.53	104.04

**Bull dozer**

Blade types

- A) Straight                      B) Angle  
C) U-type                         D) Cushion type

Output-track type tractor bulldozer with straight blade in cum /hr

Flywheel- HP	One-way haul distance in meters			
	15m	30m	45m	60m
50-75	220	115	78	73
75-125	375	195	132	123
125-200	514	266	180	169
200-275	705	360	246	229

The production of the **spreading equipment** can be worked out by the following formula

$$\text{Time for completing the job (hr)} = \frac{\text{NO of passes} \times \text{Distance in km}}{\text{Avg. speed (km/hr)} \times \text{eff. factor}}$$

The production per hour of the compacting equipment can be worked to be reasonable accuracy level with the following formula

Compacted soil /sub base / Asphalt concrete in m<sup>3</sup>

$$= \frac{W \times S \times L \times 0.83}{P}$$

W= Effective rolling width of the compactor in m

S= average speed of compactor in m/hr

L= Compacted thickness of material in m

0.83= Efficiency factor

P= Number of Passes required to achieve desired compaction

**Method of computing owning and operating cost of an equipment**

In order to work out the cost of the equipment per hour.; it is necessary to understand the various elements constituting

owning and operating cost. To work out owning and operating of any equipment, typical example is given below.

Description of the loader, Fly wheel power 112 HP

Equipment: Rated pay load 2722 kg

A.	Landed cost at site i.e. 1.53 m <sup>3</sup> GP bucket (for earth )	Rs.15,00,000.00
	Less : Tyre replacement cost	Rs. 40,000.00
	Landed price less cost of tyre	Rs 14,60,000.00
	Less : Resale value	RS 1,50,000.00
B.	Net value for depreciation	RS 13,10,000.00

C. Owning cost

1. Depreciation :  $\frac{\text{Net depreciated value}}{\text{Life in hr}}$   
 $\frac{13,10,000}{16,000} = 81.88/\text{hr}$

Estimated Annual use in hrs:16,000 hrs

2. Interest at 12 % and insurance at 1 % =  
 $\frac{\text{Landed price} \times \% \text{ investment} \times \text{total annual rate}}{\text{Annual use in hrs}}$   
 $= \frac{15,00,000 \times 55 \times 13 \times 1 \times 1}{1600 \times 100 \times 100} = 67.03 / \text{hr}$

Repair cost

3. Tyres :  $\frac{\text{Replacement cost}}{\text{Estimated life}} = \frac{40,000}{3200} = 12.50 \text{ Rs}$

4. Normal repair  $\frac{90 \% \text{ of landed cost} - \text{Tyre cost}}{\text{Total hours}}$   
 $\frac{0.9 \times 15,00,000 - 40,000}{16,000} = 81.88 / \text{hr}$

Service cost

Fuel :  $11 \times 4.00 = \text{RS } 44 / \text{hr}$  (a)

Lubricant grease Etc : LS = Rs 10 /hr (b)

5. Total service cost :  $44 + 10 = \text{Rs } 54 / \text{hr}$

6. Operators salary : Rs 80/8 = Rs 10 /hr

Total owning and

Operating cost /hr :  $1.88 + 67.03 + 12.50 + 81.88 + 54 + 10$   
 $= \text{Rs } 307.29 / \text{hr}$

**List of construction equipments**

1. Asphalt batch mix plant ( 60 – 240 TPH)
2. Asphalt drum mix plant ( up to 150 TPH)
3. Asphalt pavers finishes ( up to 9 m width )
4. Wet mix macadam plant ( 300 TPH)
5. Concrete Kerb line machine
6. Bitumen crusher distributors
7. Road marking machine
8. Controls and auto machine for asphalt plant
9. Port handling equipment – Ship loader, grab type un-loader level loafing cranes, surface mining equipment like bucket wheel excavators, spreaders, mobile transfer conveyors.
10. Crushers Jaw crusher ,Cone crusher , VSI
11. Screens - horizontal , inclined
12. Mobile plants – Wheel mounted, Crawler mounted.
13. Weigh batching and mixing plants-120 m<sup>3</sup> ,60 m<sup>3</sup> 30 m<sup>3</sup>
14. Types of plants – Stationary mixer , Batching star or Lincar bins for storage of aggregates
15. Tower cranes
16. Transit mixer – 4 m<sup>3</sup>, 6 m<sup>3</sup>
17. Bull dozer – 180 HP, 165 HP, 90 HP, 66 HP.
18. Hydraulic excavators -0.44- 1.26 m<sup>3</sup>, 0.44 – 0.7 m<sup>3</sup>, 0.3 m<sup>3</sup>.
19. Motor graders 280 HP, 173 HP, 145 HP.
20. Back hoe loader – 1 cum Loader, 0.24 cum Back hoe.
21. Hydraulic piling rig – 45 Tons ( machine class)
22. Telescopic handler – (similar to hydraulic loader )
23. Vibratory soil compactor
24. Pneumatic tyred roller
25. Plate compactors /Tampers
26. Walk behind rollers
27. Tandem compactors
28. Refuse compactors
29. Tandem rollers
30. Tandem vibratory roller

**Excavator****Shovel and Back hoes: Output Table**

Description	HP of Engine	Fuel Consumption/Hr	Width In m	Nature Of Soil	Bucket Capacity M <sup>3</sup>	Struck Capacity M <sup>3</sup>	Efficiency factor	Cycle time In Min	No Of Work Cycle	Ourput in m <sup>3</sup>
Hydraulic excavator	275/295	30/31	1.68	Loose soil	3.0	2.4	0.8	2.5	24	46.08
			1.58		2.70	2.16	0.8	2.5	24	41.47
			1.6		2.50	2.00 0	0.8	2.5	24	38.40
			1.40		1.7	1.36	0.8	2.5	24	26.11

**LABOUR AND MATERIAL CONSTANTS (IS 10067-1982) NORTH ZONE**

Recommended labour out put constants for building work:

S.no	Description of work	Unit	Labour	Recomm ended constant in days.	Remarks.
1)	Excavation over areas (hard/dense soil),depth up to 1.5m and removal (up to one meter from edge)	M <sup>3</sup>	Mate Mazdoor	0.06 0.62	— —
2)	Excavation in trenches (soft/ loose soil),for foundations not exceeding 1.5m in width and for shafts,wells,cesspits and the like, not exceeding 10m <sup>3</sup> and on plan, depth up to 1.5m and removal(up to one meter away from edge)	M <sup>3</sup>	Mate Mazdoor	0.05 0.50	— —
3)	Returning, filling and ramming of excavated earth in layers not exceeding 20 cm in depth,watering,well ramming and leveling, lead up to 50m	M <sup>3</sup>	Mate Mazdoor Bhisti	0.02 0.25 0.02	— — —
4)	Concrete : Mixing by machine (mixer) at	M <sup>3</sup>	Mazdoor Bhisti	0.50 0.10	— —

	banker, cement concrete (with 20mm graded coarse aggregate)		Mixer operator Mixer	0.07 0.07	– –
5)	Mixer mixed cement concrete	M <sup>3</sup>	mason mazdoor bhisti mixer operator mixer vibrator	0.10 1.63 0.70 0.07 0.07 0.07	– – – – –
6)	Reinforced cement concrete in situ in foundations, footings, bases for columns, etc excluding form work and reinforcement	M <sup>3</sup>	mason mazdoor bhisti mixer operator mixer vibrator	0.17 2.00 0.90 0.07 0.07 0.07	The constants for items include mixing, pouring, consolidating and curing. This does not include fair finish.
7)	Reinforced cement concrete in situ in suspended floors/roofs excluding form work, and reinforcement.	M <sup>3</sup>	mason mazdoor bhisti mixer operator mixer	0.24 2.50 0.90 0.07 0.07 0.07	– – – – –

			vibrator		
8)	Mortars : Mixing by hand, cement mortar of any mix/proportions	M <sup>3</sup>	Mazdoor Bhisti	0.75 0.07	Labour required will be approximately same for different mix proportions.
9)	Brick work (straight walls) : Brick work in walls exceeding one brick thick, in cement / lime mortar	M <sup>3</sup>	mason mazdoor bhisti	0.94 1.80 0.20	The constants include labour involved in scaffolding.
10)	Brick work in walls, one brick thick, in cement/lime mortar	M <sup>2</sup>	mason mazdoor bhisti	0.25 0.40 0.10	The constants could be adopted for brick work with any mix or mortar.
11)	Form work : a) fabrication and erection with all supports, struts, braces, etc, and dressing with oil as cleaning of formwork : 1) rectangular column and walls	M <sup>3</sup> M <sup>2</sup>	Carpenter Mazdoor Carpenter Mazdoor Carpenter Mazdoor	0.25 0.20 0.23 0.20 0.30 0.20	– – – – – –

	2) suspended floors/roofs 3) sides and soffits of beam	M <sup>2</sup>			
12)	Reinforcement: Bar reinforcement including cutting to length, hooked ends, cranking or bending, hoisting and placing in any position, binding wire and holding firmly so as not to be disturbed while placing and ramming of concrete	Quintal	Bar bender Mazdoor	1.00 1.00	— —
13)	Plastering and pointing : a) 15mm thick cement plaster to ceiling including mixing of mortar.  b) 15mm thick cement plaster on brick walls (exterior) including mixing of mortar  c) tuck pointing to random rubble masonry in cement mortar including mixing mortar.	M <sup>2</sup>  M <sup>2</sup>  M <sup>2</sup>	mason mazdoor bhisti  mason mazdoor bhisti  mason mazdoor bhisti	0.08 0.10 0.10  0.06 0.10 0.10  0.10 0.15 0.10	— — — — — — — — — —
14)	Damping proof course : a) Laying damp proof course 40mm thick cement concrete including form work and fair finishing to edges and mixing.	M <sup>3</sup>	mason mazdoor bhisti	0.10 0.10 0.01	— — —

**Material constants in mortars:**

s.no.	Item(mix by volume)	Constants per m <sup>3</sup> of mortar			
		Cement (bags)	Slaked Lime M <sup>3</sup>	Surkhi M <sup>3</sup>	Sand M <sup>3</sup>
1	Cement mortar 1:4 (1 cement : 4 sand)	6.79	–	–	0.9
2	Cement mortar 1:6 (1 cement : 6 sand)	4.65	–	–	0.99
3	composite mortar 1:1:6 (1 cement: 1 lime : 6 sand)	4.48	0.16	–	0.96

**Material constants in concrete:**

s.no.	Item (mix by volume)	Fineness modulus		Size of course (normal gauge)	Constants per M <sup>3</sup> of mortar		
		Fine agg.	Coarse agg		Cement (bags)	Sand M <sup>3</sup>	Shingle M <sup>3</sup>
1.	Cement concrete 1:1.5:3 (1 cement : 1.5 sand :3 shingle)	2.87	6.5	20mm	7.33	0.39	0.78
2.	Cement concrete 1:3:6 (1 cement : 3sand :6shingle)	2.87	6.5	40mm	4.05	0.43	0.86
3.	Cement concrete 1:4:8 (1 cement : 4 sand :8 shingle)	1.26	6.9	40mm	3.2	0.45	0.90

**Material constants for Brick work with modular bricks :**

Sl no	Description of item	Constants per m3 Frog up			Frog down		
		No of bricks	Cement (bags)	Fine sand M <sup>3</sup>	No of bricks	Cement (bags)	Fine sand M <sup>3</sup>
1	Brick work on cement mortar 1:4 (1 cement :4 sand)	5.17	1.41	0.200	517	1.26	0.178
2	Brick work on cement mortar 1:6 (1 cement :6 sand)	517	0.96	0.204	517	0.87	0.182
3	Half brick masonry in cement 1:4 (1 cement :4 sand)	506	1.08	0.153	506	0.94	0.133

**Material constants for cement concrete flooring**

Sno	Description of item	Constants for 10 M <sup>2</sup>		
		Cement (bags)	Sand (coarse) M <sup>3</sup>	Coarse aggregate M <sup>2</sup>
1	75 mm thick cement concrete flooring 1: 2:4 (1 cement : 2 sand :4 Shingle 20 mm nominal gauge) finished with a floating coat of neat cement	4.81	0.31	0.62
2	40 mm thick cement concrete flooring 1: 2:4 (1 cement : 2 sand :4 Shingle 20 mm nominal gauge) finished with a floating coat of neat	2.80	0.164	0.328

	cement			
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**Material constants for plastering**

Sl no	Description of item	Constants for 10 M <sup>2</sup>			
		On traditional brick work		On modular brick work	
		Cement bags	Sand (fine) M <sup>3</sup>	Cement bags	Sand (fine) M <sup>3</sup>
1	12 mm cement plaster 1:4 (1 cement : 4 sand)	0.98	0.138	0.95	0.134
2	12 mm cement plaster 1:6 (1 cement : 6 sand)	0.67	0.143	0.78	0.139
3	20 mm cement plaster 1:4 (1 cement : 4 sand)	1.53	0.217	1.51	0.213
4	20 mm cement plaster 1:6 (1 cement : 6 sand)	1.05	0.224	1.03	0.220

**Reference of IS codes :**

IS no	DESCRIPTION OF WORK
5-1978	Color for ready mixed paints & enamels (3 rd revision)
73-1961	Paving Bitumen
206-1981	Tee & strap hinges ( 3 rd revision)
208-1979	Door handles ( 3 rd revision)
217-1961	Cut back bitumen (revised)
226-1975	Structural steel ( std quality ) ( 5 th revision )
269-1976	Ordinary & low heat Portland cement ( 3 <sup>rd</sup> revision)
277-1985	Galvanized steel sheets
278-1978	Galvanized steel barbed wire for fencing
303-1975	Ply wood for general purposes
383-1970	Coarse aggregate & fine aggregate from natural sources for concrete
401-1982	Code of practice for preservation to timber
427-1965	Distemper , dry color as reqd (revised)
428-1969	Distemper oil emulsion , color as reqd (1 st rev)
432-1982	Mild steel & Medium tensile steel bars ( 3 <sup>rd</sup> rev)
455-1976	Portland slag cement
456-1978	Code of practice for plain & reinforced concrete ( 3 rd rev)
458-1971	Concrete pipes ( with & without reinforcement)
516-1959	Methods of test for strength of concrete

525-1968	Varnish, finishing exterior & general purposes
651-1980	Salt glazed Stone ware pipes & fittings
702-1988	Industrial Bitumen
774-1984	Flushing cisterns for water closets & urinals valve less symphonic action
777-1970	Glazed earthen wave tiles
800-1984	Code of practice for Structural steel in general building constructions
814-1974	Covered Electrodes for metal arc welding of structural steel
816-1969	Code of practice for use of metal arc welding for general construction in mild steel
822-1970	Code of procedure for inspection of welds
1081-1960	Code of practice for fixing & glazing of metal doors (aluminum & steel ) windows & ventilators
1195-1978	Bitumen mastic for flooring
1239-1979	Mild steel tubes
1239-1982	Mild steel tubular * other wrought steel pipe fittings
1254-1975	Specifications for Corrugated aluminum sheet
1489-1976	Port land pozzlona cement
1542-1977	Sand for plaster
1566-1982	Hard drawn steel wire fabric for concrete reinforcement
1592-1980	Asbestos cement pressure pipes
1597-1967	Code of practice for construction of stone masonry
1786-1985	High strength deformed steel bars and wires for concrete reinforcement
2065-1983	Code of practice for water supply in building
2202-1983	Wooden flush door ,shutters ,ply wood faces , panels
2386-1963	Methods of test for aggregate for concrete

2645-1975	Integral cement water proofing compounds
2720-1980	Method of test for soils
2911-1985	Code of practice for design and construction of pile and pile foundations
2932-1974	Enamel, synthetic, exterior, under coating and finishing
3043-1987	Code of practice for earthing
3117-1965	Bitumen emulsion for roads
3461-1980	PVC asbestos floor tiles
3764-1966	Safety code for excavation work
4014-1967	Code of practice for steel tubular scaffolding , safety regulations for scaffolding
4648-1968	Guide for electric layout in residential buildings
5410-1969	Cement paint, color as required
6313-1981	Anti Termite measures in building ,constructional measures
6313	Anti Termite measures in building preconstruction chemical treatment measures
6313-1981	Anti Termite measures in building treatment for existing building

**Measurement of materials (IS:1200)**

Name of material	How measured
Aggregate Bricks/stones of 40mm nominal size and above	In M <sup>3</sup> after making a deduction of 7.5 percent from stack measurements and as per type.
Brick/stone aggregates of less than 40mm size cinder, sand, moorum, fly ash, pozzulana, stone, stone dust.	In M <sup>3</sup> of gross stack measurements according to nominal size and type.
Aluminium flats	In kg, stating size
Aluminium strip and edging	In running meter stating size
Asbestos cement products	
Bare boards	Enumerated, stating size.
Ridge	In pairs, according to size and type
Gutters	Enumerated, stating size, type and length
Roof lights, north light curves	Enumerated, stating size and type
Ventilators, eaves fillers, apron pieces, louvers, cowls, ridge finials, septic tanks	Enumerated and described
Bitumen products	
Bitumen felt	In M <sup>3</sup> , stating type, grade and width
Bitumen hot sealing compound	By weight, in kg. grade and type
Bitumen road tar	In tones, stating type
Joint filler (sealing compound)	In kg.
Boards	
Plywood, etc	In M <sup>3</sup> , stating type and thickness
Brick/brick tiles	Enumerated, stating class and size.
Blocks building (clay, cement, stone, etc.)	Enumerated stating size, type and grade, if any

Cement/lime mixture	pozzulana	In kg, stating type
Distemper		In kg.
Doors/windows/ventilators frames		In liner meter and described (outside dimensions measured )
Doors/windows/ventilators (excluding fittings and finishes)		In M <sup>2</sup> and described
Fiber glass felt		In M <sup>2</sup> stating thickness and grade
Filler, fibrous/non fibrous		In M <sup>2</sup> and described
Fillings for doors and windows		Enumerated
Galvanized steel barbed wire		In kg, stating type and size
Galvanized steel sheets(corrugated/plain)		In quintal or enumerated, stating type and size
Glass sheets(plain/pin head/frosted/wired/splinter proof)		In m <sup>2</sup> , stating type, thickness and size.
Glass strips		In running metres, stating thickness and width.
Jali (cement concrete/clay)		In M <sup>2</sup> , stating thickness and type
Lead for caulking		In kg.
Lime		In kg, stating class
Marble chips		In quintal, stating size and described
Marble dust		In kg.
Marble pieces		In kg, stating colour
Marble slab		In m <sup>2</sup> , stating thickness and type
Metal beading		In running metres, stating type and size.
Paints, emulsions and thinners		In litres, stating type and class
Paint (stiff) and pigment		In kg, stating type and class
Pipes and accessories		
Pipe fittings		Enumerated and described
Pipes (except mild steel)		In running metres and described

Rope manila	In kg and described
Rubber rings for pipes	Enumerated and described
Steel	
Mild steel sheets	In tones, stating size and thickness
Mild steel expanded metal	In m <sup>2</sup> and described
Wire fabric/chain fabric	In m <sup>2</sup> and described
Hoop iron/bolts/rivets/structural sections/rails/mild steel pipes	In kg or tones and described
Stone	
Boundary stone/kilometer stone	Enumerated, stating size and type
Kerb stone	Enumerated, stating size
Floor stone slabs	In M <sup>2</sup> and described
Soiling stone, boulder, rubble	In M <sup>2</sup> , after making a deduction of 15 % from gross stack measurements, stating nominal size and type.
Sanitary fittings	
Cisterns/clamps/ cocks/ferrules/ footrests/grating/hydrants/traps /bath tubs/urinal/valves/wash basins/WC pans/showers/towel rails/bidets	Enumerated and described
Tiles	Enumerated, stating type and size.
Timber	
Blocks/baulks	Enumerated, stating type and size
Ballies	Enumerated, specifying diameter and described (diameter shall be measured at 1.5m from the thick end)
Bamboos	Enumerated and described
Scantlings/planks/battens	In m <sup>3</sup> , stating type and size
Tiles (other than sanitary)	In m <sup>3</sup> , stating type and size
Wall tiles/false ceiling tiles/roofing tiles	Enumerated, stating type and size.
Water proofing compound	In kg

Water proofing paste/emulsion/liquid	In litres
Wire	In kg and described
Wire rope	In running meter and described

### Measurement reinforced/plain concrete – recast component

Sn	Classification	Method of measurement
1	Wall panel, floor/roof slabs	In m <sup>2</sup> .
2	Beams unit and columns, trusses, etc	In running metre or numbers
3	Channel unit and purlins	In running metres or numbers
4	String or lacing course, coping, bed plates, anchor blocks, plain window sills, shelves louvers, steps, staircases, etc.	In running metres or numbers
5	Kerbs, edgings, etc	In running metres or numbers
6	Solid block work	In cubic metres or square metre.
7	Hollow block work	In cubic metres or square metre.
8	Light weight partitions	In square meters stating the thickness
9	Door/window frames	In running meters stating the thickness
10	Waffle units	In square metres or numbers
11	Water tank	In numbers
12	Fallies	In square meters of opening fitted stating thickness
13	Fencing posts	In numbers or cubic metres
14	Folded slab	In cubic metres.

**Measurement of plinth and carpet areas of buildings**  
**(Reference IS: 3861 - 1975)**

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

**Carpet area** shall mean the cover area of the usable rooms at any floor level.

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

**Stairs cover (mumty)** is the roofed space over a stair case and its landing, built to enclose only the stair 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 0.01m. work out areas to the nearest 0.01sq.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) garage.

**Measurement of plinth area** – following areas shall be include where occurring in each category of plinth area

(a) Area of the wall at the floor level excluding plinth offsets if any. When the building consists of columns projecting beyond the cladding, the plinth area shall be measured up to 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 air conditioning, 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.

**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 inclusions in the plinth area.

The following shall be excluded from the wall area:

- (a) Pilaster along wall not exceeding 300 sq.m in area, and
- (b) Chullah platform projecting beyond 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 up to 1m beyond the last step of staircase shall be treated as part of the staircase) (f) lift shaft and machine room for lift (g) bath room and lavatory (h) kitchen and pantry (j) store (k) canteen (m) air conditioning duct and plant room (n) shaft for sanitary piping (p) stilled floor and garage.

## **Brief on Specification writing**

### **What is a specification for?**

To be read by the contractor's estimator as the only information available on which to prepare a competitive tender.]

To be read by quantity surveyor to enable a bill of quantities to be prepared as a basis for such competitive tenders.

To be read by the clerk of the works and contractor's agent during the progress of the contract as architect's instructions for carrying out the work.

### **Specification as a basis for tenders**

Contractors prepare the tender from drawings and specifications only. Estimators take their own measurement of the work from the drawings and build up their estimates relying on the specification for a full description of quality, materials and workmanship. Besides this, drawings and specifications, when read together, must indicate everything required to be included in the estimate. If any thing is omitted, some thing that is required is not mentioned or shown, or very obviously necessary or implied, such work will not be part of the contract. If it's carrying out is insisted upon, the contractor will be entitled to extra payment.

### **Specifications for the Quantity Surveyor**

Quantity Surveyor may prepare the bill, instructions must be given by the architect as complete as those required by the contractors when taking their own measurements, and these instructions conveyed in a specification. In this case the architect's specification may not become a contract document. Whilst such a specification should be as complete as possible, omissions are not valid as vital as in the first case. So that the quantity surveyor will find the gaps while preparing the quantities, because every stage in the erection of the building has to be visualized, and questions will arise when ever further information is required to complete the specifications preambles. These preambles should be in CAWS (Common Arrangement of Work Sections for building works) order to enable to easy reading with the measured items. The preambles must convey the specification information to enable the bills to fully describe and accurately represent the quantity and quality of the required work as required by the standard method of measurement.

Note: Essentials in drafting a specification

1. To know what one requires
2. To be able to express it clearly.

### ***Simple definitions – Quantity surveying***

**Estimate:** It is defined as the process of calculating the quantities and costs of the various items required in connection with the work. It is prepared by calculating the quantities, from the dimensions on the drawing for the various items required to complete the project and multiplied by unit cost of the item concerned. To prepare an estimate ,drawings consisting of the plan , elevation and the sections through important points, along with a detailed specification giving specific description of all workmanship , properties and proportion of materials , are required.

**Detailed estimate :** It includes detailed particulars for the quantities, rates and costs of all the items involved for satisfactory completion of a project. Detailed estimates is accompanied by

(a) Report (b) Specifications (c) Detailed drawings showing plans, different sections, key or index plan .etc, (d) Design data and calculations (e) Basis of rates adopted in the estimate .

**Preliminary or approximate or rough estimate :** This is an approximate estimate to find out an approximate cost in a short time and thus enables the authority concerned to consider the financial aspect of the scheme.

**Bill of quantities :** The purpose of the Bill of quantities is to provide a complete list of quantities necessary for the completion of any engineering project and when priced gives the estimated cost of the project.

**Revised estimate:** A revised estimate is a detailed estimate for the for the revised quantities and rates of items of works originally provided in the estimate. Without material of a structural nature from the design originally approved for a project.

**Supplementary estimate:** While a work is in progress, some changes or additional works due to material deviation of a structural nature from the design originally approved may be

thought necessary for the development of a project. An estimate is then prepared to include all such works is known as supplementary estimate.

**Complete estimate:** this is an estimated cost of all items which are related to the work in addition to the main contract or to the detailed estimate.

**Annual maintenance or repair estimate:** After completion of the work it is necessary to maintain the same for its proper function and for the same, an estimate is prepared for the items which require renewal, replacement, repairs etc, in the form of a detailed estimate.

### **Specifications:**

**General specifications:** In general specifications the nature and class of the work and names of the materials that should be used or described and it forms a general idea for the project.

**Detailed specifications:** Detailed specifications describe every item of the work in the estimate. These specify the qualities, quantities and proportion of the materials, workmanship, and the method of preparation and execution for different items of works in a project.

**Contingencies:** the term contingencies indicates the incidental expenses of a miscellaneous character which can not be reasonably predicted during preparation of the estimate.

**Work charged establishment:** the work charged establishment will include such temporary establishments as or employed for the execution or the immediate technical supervision or departmental stores and machinery in connection with a specific work.

**Tools and Plants(T&P) :** For the large projects the cost of tools and plants should be considered an amount of 1% to 1.5% of the estimated cost is provided in the estimate.

**Supplementary Items:** these are the extra substituted items of the works having no approved rates in the contract required for the satisfactory completion of a project, without affecting the drawing and the designs.

**Schedule of Rates:** To facilitate the preparation of estimates, and also to serve as a guide in settling rates in connection with contract agreements, a schedule of rates for each kind of work commonly executed should be maintained by different engineering departments or authorized organizations and kept up to date.

**Re casting of estimate:** After an estimate has been technically sanctioned, it may be decided to make a change in the method originally contemplated for the execution of the work. In such a case, the original abstract should be re-casted for a construction work individually.

**Prime cost:** Prime cost is the net cost purchased cost of an article at shop, and refers to the supply of the article only and not to the carrying out of the work. The fitting and fixing charges are paid separately. In order to execute such items of work a reasonable amount is provided in the estimate.

**Day work:** These are paid on the basis of the actual quantity of materials and labour hours required to complete the job and are denoted as day work.

**Provisional sum:** It is an amount arbitrarily provided by an experienced estimator in the total estimated cost of a project to carry out a special type of work whose details cannot be known at the time of preparing the estimate.

**Contract value:** This is the total amount provided for all schedule items of the work provided in the estimate. And that is the estimated value for the work excluding the amount for contingencies, work charged establishments, tools and plants etc.,

**Contract:** An agreement enforceable by law is a contract. Invariably follows a proposal from one party and its acceptance by the other.

**Tender:** A tender is a written offer submitted by the contractor in pursuance of the notification given, to execute certain work or supply of some specified articles or transport of materials at certain rates with terms and conditions laid down in tender documents.

**Tender Form:** Tender form is a printed standard form of contract giving standard conditions of the contract , general rules and directions for guidance of contractors and also it consists of estimated cost, earnest money, security deposit, time allowed for the work form date of written order to commence, column for signature of contractor before submission of tender.

### **Different types of contract :**

**Item rate contract:** Contractors are required to quote rates for individual items of work on the basis of schedule of quantities furnished by the department.

**Percentage rate contract:** The contractors are required to offer to carry out the work at par with the rates shown in the specific price schedule or percentage above or below the rates indicated in the schedule of work attached to the tender.

**Lump sum Contract:** Contractors are required to quote a fixed sum for execution of a work complete in all respect that is according to the drawing, design and specification supplied to them with the tender within the specified time

**Labour contract:** Contractors are required to quote rates for item work exclusive of the element of materials which are supplied by the department free of cost.

**Materials supply contract:** Contractors have to offer the rates for the supply of the required quantity of the materials inclusive of the all local tax, carriage and delivery charges to the specified stores within the time fixed in the tender.

**Cost plus percentage contract:** In tendering for a work on a cost plus basis the contractor is paid the actual cost of the work, plus an agreed percentage in addition, to allow for profit.

**Turnkey contract:** The owner contemplating a construction project desires to deal with only one party for all services, both engineering and construction, in connection with the work.

**Conditional contract :** a Contract is said to be conditional if its performance depends upon some future or uncertain events or contingencies.

**Earnest Money:** Earnest money is an assurance or guarantee in the form of cash on the part of the contractor to keep open for the offer for consideration and to confirm his intentions to take up the

work accepted in his favour for execution as per terms and conditions in the tender.

**Security Deposit:** It is an amount of money which shall be deposited by the contractor whose tender has been accepted in order to render himself liable to the department to pay compensation amounting to the part or whole of his security deposit if the work is not carried out according to the specification, time limit and conditions of contract.

**Retention Money:** When ever any claims for payment of a sum of money arises out of or under the contract against the contractor, the engineer incharge is entitled to withhold and have lien to retain sum in whole or in part from security deposit till finalization or adjustment of any such claim.

**Liquidated Damages:** It is an amount of compensation payable by a contractor to the owner or vice versa due to delayed construction having no relationship with real damage.

**QUICK METHODS FOR ESTIMATING MATERIAL AND LABOUR REQUIREMENTS (CBRI)****Statistical relationships for residential buildings (building portion only)****(A = plinth area of one dwelling in sq.m)**

Material/labour	Units	Statistical relations		
		Single storey	Double storey	Four storey
		Load bearing construction (including foundation)		RCC framed construction (including foundation)
<b>Material</b>				
Bricks	100 no.s	2.26A+66.8	2.51A+63	2.56A-0.0096A <sup>2</sup> -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 <sup>2</sup> -1662
Sand	Cu.m.	0.47A-5.6	0.43A-5.6	0.397A-0.38
<b>Coarse aggregate:</b>				
(i) 20mm and down	Cu.m	0.176A-0.21	0.178A-0.21	0.366A-0.76
(ii) 40mm and down	Cu.m	0.145A+1.5	0.075A+0.78	0.0027A+0.0001A <sup>2</sup> +0.45
Brick aggregate	Cu.m	0.113A-0.83	0.056A-0.42	0.021A+0.01
<b>Timber for :</b>				
(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 form work	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-0.18	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
<b>Labour</b>				
Mason	Day	1.335A+28	1.335A+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-0.0043A2-17.6
Mazdoor	Day	4.769A+32	4.91A+13	5.833A-9.2

**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	units	Statistical relationship
Cement	Tonne	$0.1925A+18.52$	Steel windows	Sq.m	$0.1117A+93.26$
Fine sand	Cum	$0.03A+105.50$	Glass(for glazing)	Sq.m	
Coarse sand	Cum	$0.2592A-80.94$	Primer for painting	Litre	$0.0256A+9.7$
			Oil paint	Litre	$0.0322A+7.24$
Course aggregate :					
(i) 20mm size	Cu.m	$0.2728A-48.50$	Lime	Q	$0.0754A-51.21$
(ii) 10mm 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) form work	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 No.s	$1.1829A-524.23$	Painter	Day	$0.0905A+37.26$
Seel	Tonne	$0.0479A$	Blacksmith	Day	$0.479A$
Flush doors	Sq.m	$0.0636A-17.07$	Mazdoor	Day	$6.055A-2024.37$

**Material and Labour ratio for various trades of building construction**

Sl no	Description of the trade	Material	Labour
1	Excavation and earth work in solis	-	100%
2	Concrete	80%	20%
3	Brick work	75%	25%
4	Wood work (including form work ) and joinery	72%	28%
5	Bilders hard ware	85%	15%
6	Steel and iron work	82%	18%
7	Roof covering	85%	15%
8	Pavings and floor finishes	75%	25%
9	Plastering	65%	35%
10	Glazing	88%	12%
11	Paintitng, white colour wash and distempering on walls and ceiling	65%	35%
12	Water supply	85%	15%
13	Electrifications	85%	15%
14	Sanitary fittings and plumbing	84%	16%
15	Fire fighting installation including connections plumbing items	85%	15%
16	Central air conditioning installation including ducting etc	87%	13%
17	Lifts	86%	14%

**Formulae used 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 % per annum

$$\text{Amount of re 1.00} = (1 + i)^n$$

Where i is the rate of interest viz. 0.03 for 3 %, 0.05 for 5 % etc and n is the No of the years

## 2. Present value of re 1.00

To find the present value of re 1.00 payable at the n years at the rate of interest of i percent/annum

$$\text{Present value of re 1.00} = 1 / (1 + i)^n$$

Where n is the no of years and I is the rate of 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 1 percent per annum.

$$\text{Amount of re 1.00 per annum} = \frac{(1 + i)^n - 1}{i}$$

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 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.

$$\text{Annual sinking fund} = i / ((1 + i)^n - 1)$$

Where i is the rate of interest viz. 0.03 or 3%, and n is the no. 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 in to sinking fund an annual amount which will accumulate at

compound interest at the 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).

$$\frac{[1 - 1/(1+i)^n]}{i}$$

Where i is the rate of interest per annum viz. 0.03 for 3% and n is the no. of yea

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

To find the present value of the total accumulate 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 foe invested capital (i.e. the present value) to be redeemed at the end of n years by paying in to 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).

$$1 - V/i - (V \times d)$$

Where V = Present value of re 1.00 received at the end of n years at the rate percent at which an annual sinking fund can be invested.

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

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

## LEGAL ASPECTS

### Brief on contracts

### Types of Procurement Systems

Traditional:- Item rate, Percentage Rate and Lump sum contracts

Non-traditions:- Construction Management and Project management

Single source: Design and construct, Turnkey, BOOT and variations

Collaborative: Partnering, Joint venture and Allianzing

**Traditional:** Benefits:

Client involvement in the design and construction is limited.

Control systems, documentation and organization of a large industry players are setup to manage in this way

Where designs are completed prior to tenders being invited, the client can have a high degree of confidence in the contract price.

The provision of detailed drawings, specifications, quantities provides a basis for better completion and facilitates quicker evaluation of tenders.

The contract provides for variations/ extra items necessitated during execution

Where a quantity surveyor is engaged in the project, a high level of cost control and monitoring can be achieved.

**Non-Traditional:** Construction Management

Client engages an architect and a construction manager

A Team approach is created

Client is contracted to the architect, construction manager and the individual trade contractor through separate contract

The construction manager is usually engaged as an agent to the client on a fee.

**Non-Traditional:** Project Management

A Project Manager is appointed by the client as the first manager of the project team

A Project Manager may be required to work with the representatives of the client's organization

The client enters separate contract with the Project management, Design Consultant and the Builder.

The project manager is required to take the lead in the overall management of the design process though there is no direct contract between him and the designer.

**Design and Build**

Design and Build and Turnkey procurement methods are closely aligned

The contractor is singularly responsible for both the design and the construction

It is the client's responsibility that the concept design and / or performance specifications are prepared.

A Variation to the design and build may include design, innovate and build strategy.

### **Turnkey**

The builder undertakes all the components of a project.

It faces all He design, construction and performance responsibility under a single entity.

Turnkey projects can be done by lead company which subcontracts out the different aspects of the project, or the principle participant join in a consortium or joint venture agreement

### **BOT family of Contracts**

BOOT : Build Own Operate and Transfer

BOT : Build Operate and Transfer

BOO : Build Own and Operate

BTO : Build Transfer and Operate

BT : Build Transfer

BLT : Build Lease and Transfer

ROT : Rehabilitate Operate and Transfer

The client normally provides a detailed performance criteria  
The bids are normally required to include information relating to the following fundamentals of the project

1. Design concept
2. Contract firm
3. Transfer Period
4. Level of Service to be provided during the operation period

Financial security to complete and operate the facility

Operational cost of the facility upon transfer

### **Collaborative**

**Partnering:** Partnering involves the commitment of two parties to establish a cooperative relationship that promotes a spirit of goodwill and fair dealing with the common view towards the success of a project and is therefore a strategy that is very strongly focused on the win/win principle

**Joint Ventures:** A joint venture is the project-specific joining of firms, on a temporary basis, through combined investment of

capital and expertise to undertake the works. It is defined as the legal binding of two companies for the purposes of providing a competitive advantage that would be difficult to attain alone.

**Strategic Alliances:** Strategic alliances take the partnering concept one step further, promoting not only cooperative relationships but focusing on the benefits of long-term relationships or alliances between the contracting parties. Effectively strategic alliances can be described as an extension of a partnering agreement to encompass a number of projects in order to attain the common long-term goals of both parties.

### **The law relevant to the building and construction industry.**

- Indian Contract Act, (9 of 1872)
- Arbitration Act, (10 of 1940)
- Rules of Arbitration of the Indian council of Arbitration, (ICA Rules)
- Constitution (Forty sixth Amendment), Act, (1982)
- (Popularly known as the works Contract Act)
- Sale of Goods Act, (3 of 1930)
- Transfer of property Act, (4 of 1882 as amended by 21 of 1929)
- Limitation ACT, (36 OF 1963)
- Architects (professional Conduct) regulation, (1989)
- Explosives Act, (4 of 1884)
- Explosives Substance Act, (6 of 1908)
- The Explosives Rules, (1983)
- Forest Act, (16 of 1927)
- Forest Conservation Act, (69 of 1980)
- Mines and Minerals (Regulation and Development) Act, (67 of 1957)
- Minimum Wages Act, (11 of 1948)
- Workmen's Compensation Act, (8 of 1923)
- Workmen's Compensation Rules, (1924)
- Contract Labour (Regulation and Abolition) Act, (37 of 1970)
- Employment of Children Act (26 of 1938)
- Equal Remuneration Children Act, (25 of 1976)
- Payment of Wages Act, (4 of 1936)
- Employer's Liability Act, (24 of 1938)
- Companies Act, (1 of 1956)
- Income – tax Act, (43 of 1961)

- Partnership Act, (9 of 1932)
- Prevention of Corruption Act, (2 of 1947)
- Specific Relief Act, (47 of 1963)
- Co-operation Societies Act, (2 of 1947)
- Official Societies Act, (19 of 1923)
- Cantonments Act, (2 of 1924)
- Cantonments (Amendment) Act, (15 of 1983)
- Electricity Act, (9 of 1910)
- The Indian Electricity Rules, (1956)
- Motor Vehicles Act, (4 of 1939)
- Personal Injuries (Compensation Insurance) Act, (37 of 1963)

## ARBITRATION

*Arbitration is a process of dispute resolution between parties.*

### Definitions

*Rule 1* (i) these rules may be called the “Rules of arbitration of the Indian Council of Arbitration”.

(ii) These rules shall apply where parties have agreed in writing that (a) a dispute has arisen or (b) a dispute which may arise between them in respect of a defined legal relationship whether contractual or not shall be settled under the rules of arbitration.

*Rule 2:* in these rules, the following words have the following meanings:

- “Arbitral Tribunal” means an arbitrator or arbitrators appointed for determining a particular dispute or difference.
- “Arbitral Award” includes an interim award.
- “Committee” means the arbitration Committee of the Council as provided for hereinafter.
- “Council” means the Indian Council of Arbitration.
- “Governing Body” means the Governing Body of the council.

- “Guidelines” means the guidelines for arbitrators and the parties to arbitration for expeditious conduct of the arbitration proceedings given in the Annexure to these Rules.
- “International Commercial Arbitration” means an arbitration relating to disputes arising out of legal relationships, whether Contractual or not, considered as commercial under the law in force in India and where at least one of the parties is (i) an individual who is a national of, or (ii) a body corporate which is incorporated in any country other than India; or (iii) a company or an association or a body of individuals whose central management and control is exercise in any country other than India; or (iv) the Government Undertaking.
- “Party” means a party to an arbitration agreement. it shall include any individual, firm, company, Government, Government organization or Government Undertaking.
- “Panel” means that panel of arbitration maintained by the Council.
- “Registrar” means that the Registrar for the time being appointed by the Committee and includes such other person as the Committee may nominate for carrying out duties of the Registrar under these rules.
- “Rules” means the Rules of Arbitration of the Council.
- “Fast Track Arbitration” means arbitration in accordance with Rule 82.
- Words importing the singular number include, where the context admits or requires, the plural number and vice versa.

“*Disputes are inevitable*”, reasons for many of the disputes are:

\*Drafting of contract agreement is not simple

\*Confusing words

\*Unreasonable decisions

\*Incomplete specifications

\*Incorrect specifications

### **Essential requirements for Arbitration:**

Existence of Arbitration agreement in writing either as a clause in contract or as a separate agreement.

### **Who can be an arbitrator:**

- Persons spelt out in the Arbitration agreement
- Persons form Indian Council of Arbitrators

- Persons from Panel of Arbitrators
- Persons appointed by Court
- Even judges, Advocates in the panel of arbitrator can be appointed.

### **Number of Arbitrators (Sec 10)**

- a) No. as agreed by both parties, should be odd number.
- b) If nothing is agreed, the no should be one.

### **Appointment (Sec-11)**

- a) Parties are free to agree for their own procedure.
- b) If three arbitrators, then one arbitrator each by each party and third arbitrator by the two arbitrators already selected who will act as presiding arbitrator over two.
- c) Time for such appointments are 30 days of receipt of request by either party to the appointing authority.
- d) If the appointing authority fails, then the appointment of arbitrators or 3<sup>rd</sup> arbitrator shall be done by Chief Justice of high court( or any person or institution designated by him)

### **Jurisdiction of Arbitral Tribunals (Sec 16)**

- Arbitral Tribunal can decide its own jurisdiction
- Objection to jurisdiction should be raised not later than submission of defense statement.
- If objection not accepted by Arbitral Tribunal, then objection can be filed in court under section 34.

### **Conduct of Arbitration Proceedings**

- Parties shall be given full opportunity
- Parties free to decide procedure for arbitration proceedings
- If no consent by the parties, then Arbitral Tribunal shall conduct proceedings in the manner it considers appropriate.

### **Hearings**

- a) **Mode:** Parties can agree on the procedure

If no consent, the Tribunal can decide whether oral or only document

**b) Place:** Parties can agree for place of hearing

If no consent, place to be decided by Arbitration Tribunal considering circumstances of the case and convenience of parties

**Rules For Award:**

Award to be decided in accordance with the terms of contract, using trade practice and substantive law in India.

**Arbitral Award**

- It should be reasoned or speaking, in writing and signed.
- It should state rate of future interest or else it shall be 18%.
- Cost of Arbitrator shall be fixed by Arbitral Tribunal.

**Correction of Award**

Request for computational errors/ typographical errors by any party within 30 days of receipt of award. The Arbitral Tribunal may make correction on its own.

**Setting aside Arbitration Award**

Award may be set a side only if :

- A party was under some in-capacity
- Arbitration Agreement is not valid under law
- Party was not given adequate opportunity to present his case
- Award deals with dispute not included in the terms of reference.
- If the Arbitral award is in conflict with the Public policy of India.
- Application for objection within 90 days

**Enforcement**

The Arbitral Award is as good as decree of court.

**INDIAN CONTRACT ACT**

**Definitions**

**a) Proposal:** When one person signifies to another his willingness to do or abstain from doing anything, with a view to obtaining the

assent thereto such as or abstinence, he is said to make a proposal.

**b) Promise:** When the person to whom the proposal is made signifies his assent there to, the proposal is said to be accepted. A proposal when accepted becomes a promise.

**c) Promissor and Promisee:** The person making the proposal is called the promisor, and the person accepting the proposal is called promisee.

**d) Consideration:** When, at the desire of the promisor, the promisee or any other person has done or abstained from doing, or does, or abstains from doing, or promises to do or abstain from doing, something, such act or abstinence of promisee is called consideration for the promise.

**e) Agreement:** Every promise and every set of promises, forming the consideration for each other is an agreement.

**f) Void Agreement:** An agreement not enforceable by law is said to be void.

**g) Contract:** An agreement enforceable by law is a contract.

**h) Voidable Contract:** An agreement which is enforceable by law at the option of one or more of the parties thereto, but not at the option of the other is a voidable contract.

**i) Void Contract:** A contract which ceases to be enforceable by law becomes void when it ceases to be enforceable.

### Various Kinds of Agreements:

**1. Valid Agreement:** An agreement is one which is enforceable by law.

**2. Void Agreement:** An agreement not enforceable by law is said to be void. It has no legal existence at all and is devoid of any legal effect.

**3. Enforceable Agreement:** An agreement enforceable by law is a contract.

**4. Voidable Agreement:** A voidable agreement is one which is enforceable by law at the option of one or more of the parties thereto but not at the option of the other or others.

**5. Unenforceable Agreement:** An unenforceable agreement is valid in law but is incapable of proof because of some technical defect.

**Contract:** Contract is a combination of agreement and enforceability. The test to distinguish between an agreement and a contract is whether it is enforceable by law or not. If it is enforceable by law, it is a contract.

**Free Consent:** Parties to a contract must give their free consent. The parties must be *ad idem*, i.e. both the parties must agree upon the same thing in the same sense.

**An Agreement becomes a contract:**

- Parties to the contract must be competent.
- Parties to the contract must exercise free consent.
- Agreement must be for lawful consideration with a lawful object.
- Agreement must not be expressly declared to be void.

## FINANCIAL ASPECTS

### Accounting Methods

The main theme of contractor's accounting system centers around the determination of income and expense from each of its construction projects i.e., to say each contract is treated as a separate profit center.

The cash method and the accrual method are two basic accounting procedures. Under the cash method, income is taken into account only when cash is actually received, and expense is taken into account only when cash is actually expended.

The cash method is simple and straight forward form of income recognition and no attempt is made to match revenues with the accompanying expenses.

The accrual method is the second basic accounting procedure. Under these method, income is taken into account in the fiscal period during which it is earned, regardless of whether payment is actually received.

**Accounting for long term contracts:**

The tax reform act of 1986 mandates that one of three methods of accounting must be applied by contractors to their long term construction contracts. These are called the percentage of completion method, the percentage of completion- capitalized cost method, and the completed contract method.

**Percentage of completion method:**

The percentage of completion method recognizes job income from long term contracts as the work advances. Thus, the profit is distributed and the taxes are paid over the fiscal year during which the construction is under way. This method has a advantage of recognizing project income periodically on a current basis rather than regularly as contractors are completed.

**Completed contract Method:**

The completed contract method of accounting recognizes project income only when the contract is completed. What actually constitutes completion of a contract for income- reporting purposes has been subject to varying interpretation by the courts. Under the completed contract method, project costs are accumulated during construction using extended period cost capitalization. The scope of contract costs that must be capitalized includes not only the costs directly related to the contracts but also indirect costs attributable to the project. Costs such as general and administrative expenses and interest expense relate to the performance of the contract are included.

These financial statements serve many important functions with respect to external agencies. Bankers, surety and insurance companies, equipment dealers, credit –reporting agencies, and clients are concerned with the contractor's financial status and profit experience. Stock holders, Partners, and others with a proprietary interest use the statements to obtain information concerning the company's financial condition and the status of their investment. Two financial statements of particular importance are the income statements and the balance sheet.

## Financial Reports:

**Budget:** It helps management to plan and control the effective and efficient application of all the resources of the company and it usually covers monetary units such as rupees, estimates the performance potential of the responsibility center.

**Cost Reports:** Cost reports focus on cost data that aids management in controlling cost and taking other related decisions and they also cover products, services, jobs, programmes, divisions, departments, projects.

**Profit and loss account:** It is an activity statement that shows details and result of the company's profit related activities for a period of time.

**Cash flow statement:** It is an activity statement that shows the details of company's activities involving cash during a period of time.

### The income statement

The income statement is an abstract of the nature and the amounts of the company's income and expense for a given period of time, usually a quarter or full fiscal year.

### The balance sheet:

A balance sheet presents a summary of the assets, liabilities, and net worth of the company at a particular time. The basic balance sheet equation may be stated as follows:

$$\text{Assets} = \text{Liabilities} + \text{Net worth}$$

The balance sheet presents in analytical form all company-owned property, or interests in property, and the balancing claims of stockholder or others against this property.

### Financial Ratios:

*Liquidity ratios:* these measures reveal a company's ability meet its financial obligations.

*Activity ratios:* these ratios indicate the level of investment turnover or how well the company is using its working capital and other assets.

*Profitability Ratios:* These values relate company profits to various parameters such as contract volume or total assets.

*Leverage Ratios:* These ratios compare company debt with other financial measures such as total assets or net worth.

### **Equipment Management:**

Management involves making informed judgments about equipments acquisition and financing, establishing a comprehensive preventive maintenance programme, managing accurate and current records of equipment income, expenses, and usage, and establishing an appropriate company policy concerning equipment replacement.

### **Equipment Depreciation:**

Business property steadily declines in value because of age, wear and obsolescence. This reduction in value is called depreciation. Depreciation charges for equipment-oriented contractors account for an appreciable portion of their annual operation expense. Basically depreciation systematically reduces the value of a piece of equipment on an annual basis. The sum of these reductions at any time is depreciation reserve which, when subtracted from the initial cost of equipment, gives its current book value.

### **Procurement:**

Procurement involves the preparation and use of a number of standard documents forms such as requisitions, purchase orders, and subcontractors.

The principle procurements are

1. Purchasing
2. Expediting and receiving
3. Inspections
4. Shipping
5. Subcontractors

### **Cash discounts:**

Cash discounts are in the nature of a premium given in exchange for payment of an invoice before it becomes due, and

the buyer is entitled to the discount only when payment is made within the time specified.

**Title of purchasers:**

1. Cash sale
2. On-approval sale
3. Sale or return
4. Delivery by vendor
5. Shipment by common carrier

**Periodic Payments**

Construction contracts typically provide that partial payments of the contract amount shall be made to the prime contractor as the work progresses. Payments to the contractor at monthly intervals is the more usual contract provision. The pay request may be prepared by the contractor, the architect-engineer, or the owner. The general conditions or supplementary conditions of the contract normally stipulate which party is to have the responsibility and authority for compiling these requests. Such periodic payments made by the owner to the prime contractor or subject to the retainage provisions contained in the construction contract.

**Project cost breakdowns:**

The break down, which is actually a schedule of costs of the various components of the structure, including all work done by sub contractors, is prepared in sufficient detail so that the architect-engineer or owner can readily check the contractor's pay requests.

**Payment requests for lump-sum contracts:**

Usually prepared by the contractor, it includes all sub contracted work as well as that done by the contractor's own forces. For each work classification that it does itself, the contractor estimate the percentage completed and in place. From invoices submitted by the subcontractors, suitable percentage figures are entered for all subcontracted work.

**Payment requests for unit-price contracts:**

Payment requests under unit-price contracts are actual quantities of each bid item completed to date. The determination of quantities accomplished in the field is done in several different

ways, depending on the nature of the particular bid item. On unit-price contracts, the owner or architect-engineer often pay request and sends it to the contractor for checking and approval before payment is made.

**Final payment:**

In building construction, the process typically commences when the contractor having achieved substantial completion, requests the preliminary inspection. The owner or its authorized representative, in company with general contractor and sub contractor personal, inspect the work, list of deficiencies to be completed are corrected is prepared and the engineer issues a certificate of substantial completion. After the deficiencies have been remedied, a final inspection is held and the contractor presents its application for final payment.

**Payment to subcontractor**

The general contractor must check each monthly pay request from a sub contractor to ensure that it is a fair measure of work actually performed. The prime contractor does not wish to allow its subcontractors to be overpaid any more than the owner wants to over pay the general contractor.

**Payments to material suppliers:**

Payments by the contractor to its material suppliers are made in accordance with the terms applicable purchase order or usual commercial terms. For materials is not normally dependent on any disbursement made by the owner to the general contractor, but it is due and payable in full 30days after invoice date, receipt of materials, end of the month in which delivery was made.

**INVESTMENT ANALYSIS****Basic Steps**

1. Estimating CashFlows
2. Estimating the Cost of Capital
3. Applying Appraisal criteria

**Cash Flow**

Cash flow refers to a contractor's income and outgo of cash. The net cash flow is the difference between disbursement and the income over a period of time. A positive cash flow indicates that cash income is exceeding disbursement and a negative cash flow signifies just the opposite. And the contractor must maintain a cash balance sufficient to meet pay rolls, pay for materials, make equipment payments, and satisfy other financial obligations as they become due.

**PROJECT CASH FLOWS**

Cash Flow Stream – Basic Components

Initial Investment

Operating Cash Flows

Terminal Cash Flow

**Cash forecast:**

A Cash forecast is a schedule that summarizes the estimated cash receipts, estimated disbursement, and available cash balances for some period into the future. The preparation of the cash forecast begins with the collection of detailed information regarding future cash income and expenditures.

**APPRAISAL [DECISION MAKING] CRITERIA**

Evaluating Project's Financial Feasibility

Two broad categories

1. Non discounting criteria

    Pay Back Period

    Average Rate of Return

2. Discounting criteria

    Net Present Value      --NPV

    Internal Rate of Return--- IRR

**PRESENT VALUE [PV]**

- Present Value of a Single amount:

$$PV = F_n [1/(1+r)]^n$$

Where,

P = Present Value

F = Future Value

r = Discount rate per period

n = Number of periods

- Present Value of a Cash Flow Stream

$$PV_n = \sum_{t=0}^n \frac{C_t}{(1+r)^t}$$

PV<sub>n</sub> = Present Value of a Cash Flow stream

C<sub>t</sub> = Cash Flow occurring at time t

r = Discount rate

n = Duration of Cash Flow stream

**NET PRESENT VALUE - NPV**

Sum of the Present Value of all expected Cash flows [inflows as well as outflows] associated with an investment / project, taken one year at a time and discounted by a factor which represents the opportunity cost of capital.

$$NPV = \sum_{t=0}^n \frac{C_t}{(1+r)^t}$$

Where,

C<sub>t</sub> = Cash Flow occurring at the end of year t, t = 0....n)

[A cash inflow will have a positive sign,  
whereas a cash outflow has a negative sign]

n = Life of the project

r = Rate of Discount

**INTERNAL RATE OF RETURN [IRR]**

The discount rate which results in NPV = 0  
It is the discount rate in the equation

$$\sum_{t=1}^n \frac{C_t}{(1+r)^t} = 0 \text{ (NPV)}$$

Where

$C_t$  = Cash flow at the end of year  $t$

$r$  = Internal Rate of Return [Discount rate]

$n$  = Life of the project

- ACCEPT, IF NPV IS POSITIVE
- REJECT, IF NPV IS NEGATIVE
- INDIFFEENT , IF NPV IS ZERO

### Computer Usage:

The computer is invaluable and indispensable element in the conduct of a successful construction business.

Areas of computer usage:

1. *Financial accounting*: The computer performs basic accounting functions such as accounts receivable, accounts payable, general ledger, inventory, cash forecast, financial statements, subcontractor control.

2. *Equipment accounting*: Computer maintains records of equipment depreciation, ownership and operating costs, hours of operation, maintenance, spare parts, production rates and units costs.

3. *Payroll*: Using time card input, the computer prepares payroll checks, periodic and special payroll and tax reports, the payroll register, and updates the employee master files.

4. *Purchasing*: The computer participates in the tabulation and handing of bids, purchase order preparation, expediting and shop drawings.

## **PROFESSIONAL ASPECTS**

### **Role of a Quantity Surveyor**

#### **Description**

The elements of Civil Engineering, Economics, Finance, Statistics, Valuation, Management and Law together define the role of Quantity Surveyor.

#### **Tasks and Duties**

- Consult with the clients about the cost of building projects
- Study Architects and the engineers building plans
- Measure and estimate building and material costs for projects
- Prepare reports about projected building costs for clients
- Administer the tendering process for contractors and subcontractors
- Visit building sites to monitor to progress and to check that the work is to budget
- Recalculate costs if the design or material changes
- Certify progress claims from contractors
- Manage the payments for contractors and suppliers
- Prepare a statement of final account recording the actual costs of the project
- Offer services in value management, comparing building costs to similar buildings.
- Prepare building feasibility studies
- Prepare bank reports and offer financial advice to clients
- Consult with other construction industry professionals

Quantity surveyors can specialize in different areas, contractor quantity surveyors mostly work on estimating building costs, managing building contracts and monitoring construction progress. Quantity surveying practices often focus on offering clients financial advice and estimation services for setting up building contracts. They may also be involved in mediation and arbitrations between parties about building contracts.

**Quantity surveyors need to have**

- Skills in reading building plans and estimating building and material costs.
- Good oral and written communication skills.

**Problem solving and negotiation skills**

- Maths and basic accounting skills
- Good organizational and time management skills

**Brief on Building Economics**

■ Economics in general is about the choice in the way that scarce or limited resources and ought to be allocated between their possible uses.

■ Building Economics serves in cost planning technique and this profession well in offering value added services to clients and the concept of elements has been incorporated in to the development of life cycle costing and value management.

■ On private finance initiative schemes, the provider's ability to control costs through the life of the building is central to the profitability of the contract.

■ Cost planning, value management and life cycle costing are essential tools in the development of optimum solutions.

■ To meet construction industry requirements, schematic study of various factors affecting the cost of buildings and their economic consideration in various stages has been made.

**Necessity For Economy In Construction :**

- To limit the client's expenditure
- To achieve a balanced design expenditure
- To provide the client with a value for money project.
- The clients requirements today are more complex than those of past
- The introduction of new constructional techniques, materials and components creates greater problems in assessing the capital and maintenance costs of buildings.

**Factors to consider**

- Site Considerations
- Building Size

- Planning Efficiency
- Plan Shape
- Height
- Storey heights
- Grouping of Buildings

### **Design Cost Management**

- *Design* : The process of producing the required model of a building
- *Cost* :The total price that the builder wants to complete his work
- *Management*: The responsibility for ensuring that the functions of planning, control and feed back are successfully brought in terms of design, cost, time and quality.

### **Value for money in construction**

- May be increased by improving utility with no change in cost,
- Retaining the same utility for less cost or combining an improved utility with a decrease in cost.

## **FIRST AID FACILITIES**

First aid facilities as per Contract Labour (R&A) Act 1970. One box for every 150 Contract labours to contain;

- a. 12 Small sterilized dressings.
- b. 6 medium Size sterilized dressings.
- c. 6 Large size sterilized dressings.
- d. 6 Large size sterilized burn dressings.
- e. 6 (15 gms.) packers sterilized burn wool.
- f. 1 (60 ml.) bottle containing Tincture of Iodine.
- g. 1 (60ml.) bottle containing Salvolatile having the dose and mode of administration indicated on the label for faintness cure.
- h. 1 (30 gms.) bottle of potassium permanganate crystals.
- i. 1 Roll of a adhesive plaster.
- j. A snake bite lancet.
- k. 1 pair Scissors.
- l. 1 copy of the first aid leaflets issued by the Director General, Factory Advice Service and Labour.
- m. A bottle containing 100 tablets (each of 5 grains) of aspirin.

- n. Ointment for burns.
- o. A bottle of Suitable Surgical Anti septic Solution.

**In addition the following items are also advisable.**

1. A Clinical Thermometer.
2. A hot water bag.
3. Tincture of Benzoin.
4. Liquor Ammonia for Scorpion bite.
5. Vaseline.
6. Boric Acid powder.
7. Bicarbonate of soda.

Nothing except the prescribed Contents shall be kept in the First Aid Box.

**SOFTWARE AVAILABLE FOR ESTIMATION**

Super rate analysis 2000,  
Super civil cd.com Build Quant,  
[www.ensoftindia.com](http://www.ensoftindia.com).

QE Pro [www.softtech engr.com](http://www.softtech engr.com)

Geo synthetics for reinforced soil structure [www.polyfelt.com](http://www.polyfelt.com)

[www.intecc.com](http://www.intecc.com)

Email: [bgdtech@vsn.com](mailto:bgdtech@vsn.com)

Email: [dirmar@vsn.com](mailto:dirmar@vsn.com) [www.Beml.co.in](http://www.Beml.co.in)