J) **Suggested Specification Table (For ESA of Laboratory Instruction*):**

Laboratory Instruction Number	Short Laboratory Experiment Title	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE 1.1	Estimate the quantities and prepare abstract of cost for RCC slab from given working drawing.	30	24	06
LE 1.2	Estimate the quantities and prepare abstract of cost for RCC beam from given working drawing.			
LE 1.3	Estimate the quantities and prepare abstract of cost for RCC staircase from given working drawing.			
LE 1.4	Estimate the quantities and prepare abstract of cost for RCC column and footing from given working drawing.			
LE 2.1	Estimate the quantities and prepare abstract of cost for steel beam and column with base from given working drawing.			
LE 2.2	Estimate the quantities and prepare abstract of cost for steel truss from given working drawing.			
LE 2.3	Estimate the quantities and prepare abstract of cost for GIC roof and AC roof from given working drawing			
LE 3.1	Estimate the quantities and prepare abstract of cost of hume pipe culvert from given working drawing.			
LE 3.2	Estimate the quantities and prepare abstract of cost of slab culvert from given working drawing.			
LE 3.3	Estimate the quantities and prepare abstract of cost of single span R.C.C.T beam bridge from given working drawing.			
LE 4.1	Estimate the quantities and prepare abstract of cost for water supply works in buildings from given working drawing.			
LE 4.2	Estimate the quantities and prepare abstract of cost			

ESTIMATE OF R.C.C. ROOF SLAB

Example 2 — Prepare a detailed estimate of a R.C.C. Roof Slab of 3 metres clear span and 6 metres long from the given drawings (Fig. 5-4). R.C.C. work including centering and shuttering and steel reinforcement in detail shall be taken separately.

Also prepare a schedule of bars.

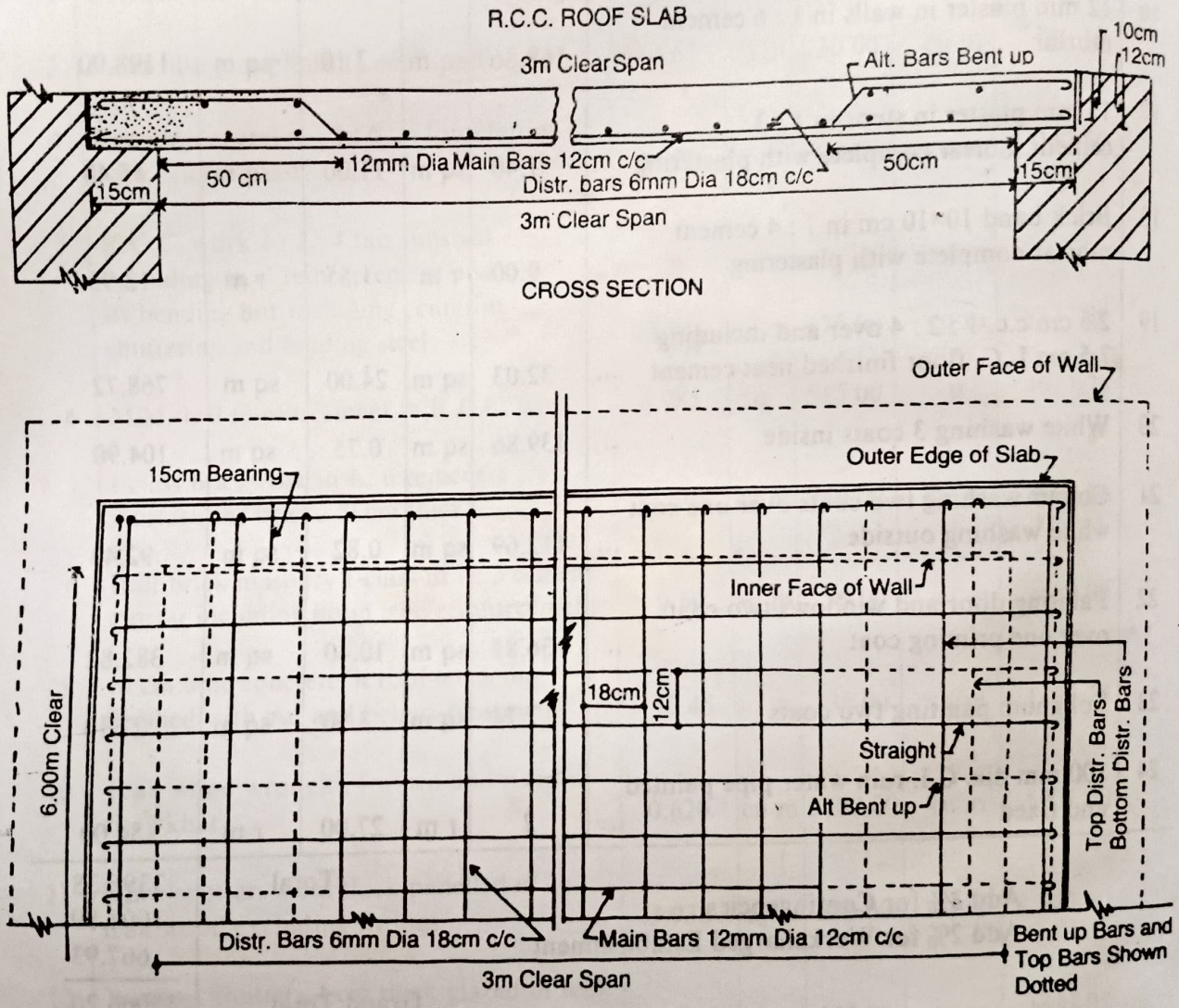


Fig. 5-4

Note— *In plan bent up and top bars have been shown in dotted lines.*

Details of Measurement and Calculation of Quantities (Ex. 2)

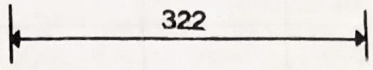
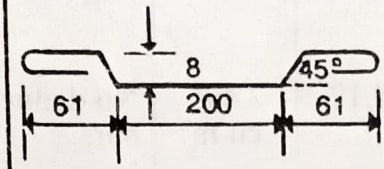
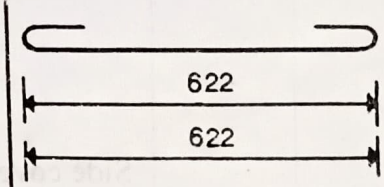
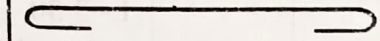
Item No.	Particulars of items and details of works	No.	Length m	Breadth m	Height or Depth m	Quantity	Explanatory notes
1	**R.C.C. work** 1 : 2 : 3 excluding steel and its bending but including centering and shuttering and binding steel	1	6.30	3.30	0.12	2.495 cu m	No deduction for steel bars.
2	**Steel bars** including bending (mild steel in R.C.C work— Main bars 12 mm dia. @ 0.89 kg/m— Straight bars 24 cm c/c (No = $\frac{6.30-.08}{.24}+1$ =27)	27	3.44				Side cover 4 cm L=3.30 — 2 side covers + 2 hooks =3.30 — .08 + (18 × .012)=3.44 m.
	Bent up bars 24 cm c/c (No = $\frac{6.30-.08}{.24}$ =26)	26	3.52				Adding one depth 8 cm for two bent ups.
		Total	184.40	@ .89 =184.40	kg/m ×.89=	164.12 kg	
	Distribution bars 6 mm (dia. @0.22 kg/m)— Bottom bars central portion 18 cm c/c (No = $\frac{2.00}{.18}+1$ = 12)	12	6.33				l=6.30 - .08 + (18×.006)= 6.33 m
	Bottom bars two sides	2×3	6.33				
	Top bars two sides	2×3	6.33				
			Total =	151.92	@ .22	kg/m	
				151.92	× .22 =	33.42 kg.	
					Total	197.54 kg = 1.975	quintal

ABSTRACT OF ESTIMATED COST

1. R.C.C. work 1 : 2 : 4 excluding steel and its bending but including centering and shuttering and bending of steel	2.495 cu m @ 675.00 per cu m =	Rs. 1684.12
2. Steel bars including bending (mild steel) in R.C.C. work	1.975 q @ 515.00 per quintal =	Rs. 1017.13
	Total	Rs. 2701.25
Add 5% for Contingencies and Workcharged Establishment		Rs. 135.06
	Grand Total	Rs. 2836.31

(Schedule of bars given in the next page 232.).

SCHEDULE OF BARS -- R.C.C. SLAB

DESCRIPTION OF BARS	SHAPE OF BENDING DIMENSIONS IN cm.	LENGTH OF EACH m	NO.	TOTAL LENGTH m	WEIGHT kg.
MAIN STRAIGHT BARS 12 mm. DIA		3.44	27	92.88	
MAIN BENT UP BARS 12mm. DIA		3.52	26	91.52	
				184.40	164.12
BOTTOM DISTRIBUTING BARS 6mm. DIA		6.33	18	113.94	
TOP DISTRIBUTING BARS 6 mm. DIA		6.33	6	37.98	
				151.92	33.42

Note.-- (i) Centering and shuttering are included in the R. C. C. work. If centering and shuttering

between bars. *...ends add one depth in*

ESTIMATING OF R. C. C. BEAM

Example 7. -- Prepare a detailed estimate of a R. C. C. beam of 8 metre clear span and 75 cm x 40 cm in section from the given drawings (Fig. 5-5). Steel in detail and R. C. C. work shall be calculated separately. Also prepare a schedule of bars.

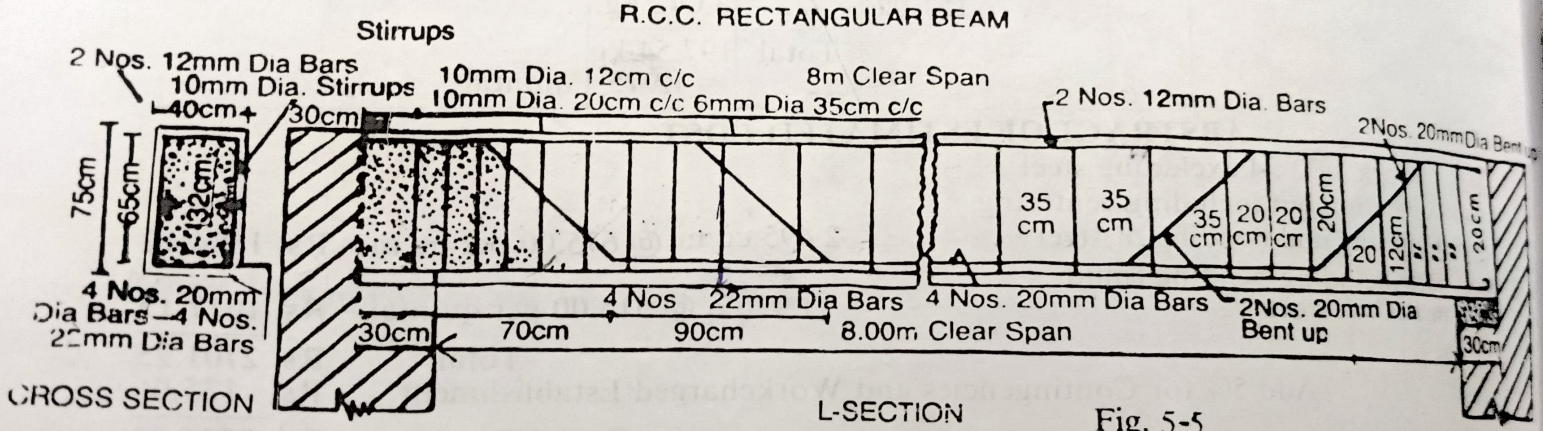


Fig. 5-5

Details of Measurement and Calculations of Quantities (Ex. 3)

Item No.	Particulars of items and details of works	No.	Length m	Breadth m	Height or Depth m	Quantity	Explanatory notes
1	**R.C.C. work** 1:2:4 excluding steel and its bending but including centering and shuttering and binding of steel ...	1	8.60	0.40	0.75	2.58 cu m	No deduction for vol. of steel bars.
2	**Steel bars including bending** (mild steel) in R.C.C. work						
	Main bars—						
	22 mm dia. straight bars @ 2.98 kg/m	4	8.92 =	35.68	×2.98= kg	106.33 kg	L=8.60 – 2 end covers +2 hooks=8.60 – (2×4 cm) + (18 × 22 mm) = 8.92 m
	20 mm dia. bent up bars @ 2.47 kg/m	4	9.48 =	37.92	×2.47= kg	93.66 kg	L=8.60 – 2 end covers +2 hooks+one depth =8.60 – 8 cm + (18 × 20 mm) + 60 cm = 9.48 m
	12 mm dia top bars @ 0.89 kg/m ...	2	8.74 =	17.48	×0.89= kg	15.56 kg	L=8.60 – 2 end covers +2 hooks=8.60 – 8 cm + (18 × 12 mm) = 8.74 m*
	Stirrups, 10 mm dia. bars @ 0.62 kg/m—						
	At end 12 cm c. to c.	5×2	2.42				L=(65×2+32×2 cm+2 hooks +extra 30 cm=194 cm +(18×10mm)+30 cm=2.42m
	Next at 20 cm c. to c. ...	4×2	2.42				
	Total	18×	2.42 =	40.32	×0.62=	27.01 kg	
	Stirrups 6 mm dia. @ 0.22 kg/m—						
	At central remaining length of 5.20 m at 35 cm c. to c. ...	14	2.42				
	Total	14×	2.42 =	33.88	0.22 kg	=7.45 kg	
					Total	250.01 = 2.5	kg quintal

* *12 mm dia. top (construction) bars; may be short of length in between bent up bars with some over-laps and two hooks = 480 cm + 1 depth + 2 overlaps + 2 hooks = 480 cm + 60 cm + 2 × 20 cm + (8 × 12 mm) = 602 cm = 6.02 m.*

ABSTRACT OF ESTIMATED COST (EX. 3)

Item No.	Particulars of items of work	Quantity	Unit	Rate Rs. P.	Per	Amount Rs. P.
1	R.C.C. work 1 : 2 : 4 excluding steel and its bending but including centering and shuttering and binding of steel	2.58	cu m	675.00	cu m	1714.50
2	Steel bars including bending (mild steel) in R.C.C. work	2.50	quintal	515.00	quintal	1287.50
					Total	3002.00
	Add 3 % for Contingencies and 2% for Workcharged Establishment					150.00
					Grand Total	3152.00

SCHEDULE OF BARS R.C.C. BEAM

Description of Bars	Shape of Bending Dimensions in cm	Length of each m	No	Total Length m	Weight kg
MAIN STRAIGHT BARS 22mm DIA	852	8.92	4	35.68	106.33
MAIN BENT UP BARS 20mm DIA	60, 45°, 96, 660, 96	9.48	2	18.96	46.83
MAIN BENT UP BARS 20mm DIA	60, 45°, 186, 480, 186	9.48	2	18.96	46.83
TOP STRAIGHT BARS 20mm DIA	852	8.74	2	17.48	15.56
STIRRUPS 10 mm DIA	10mm DIA, 65, 32	2.24	18	40.32	25.00
STIRRUPS 6 mm DIA	32, 6 mm DIA, 65	14	31.36	6.90	

Note—(i) If centering and shuttering is paid separately, the area and cost can be found as follows:—

Area of centering and shuttering=(Bottom and two vertical sides × length + two ends.
= [(40 cm + 2 × 75 cm) × 8.60 m] + (2 × 40 cm × 75 cm) = (1.90 × 8.60) + (2 × .40 × .75)
= 16.34 + .60 = 16.94 sq m.

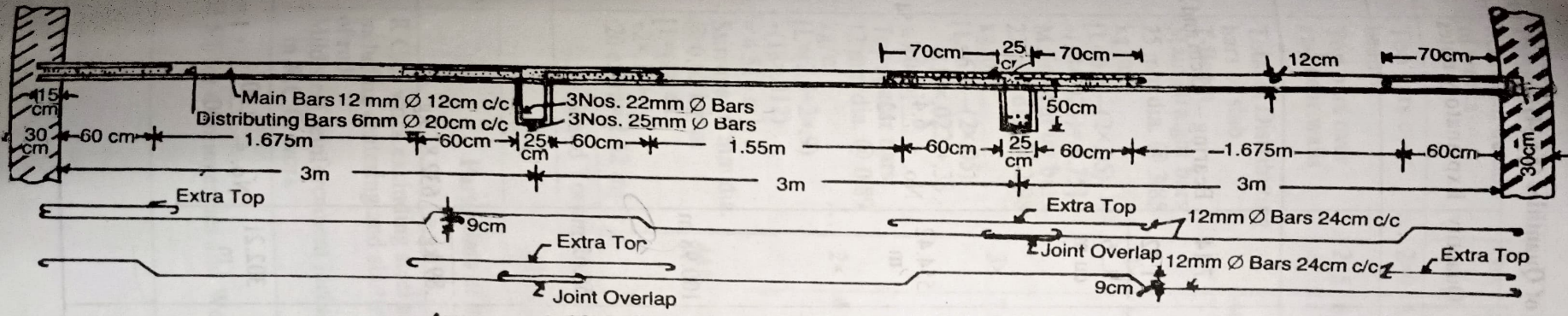
Cost of centering and shuttering @ Rs. 20.00 per sq m = 16.94 × 20.00 = Rs. 338.80.

(ii) For over-lapping at joints 5% of the whole steel may be provided in the estimate.

Length for hooks and bent ups in steel reinforcement bars—For two hooks take length as 18 dia. of bar. For 45° bent ups at both ends add one depth in between bars (see page 214).

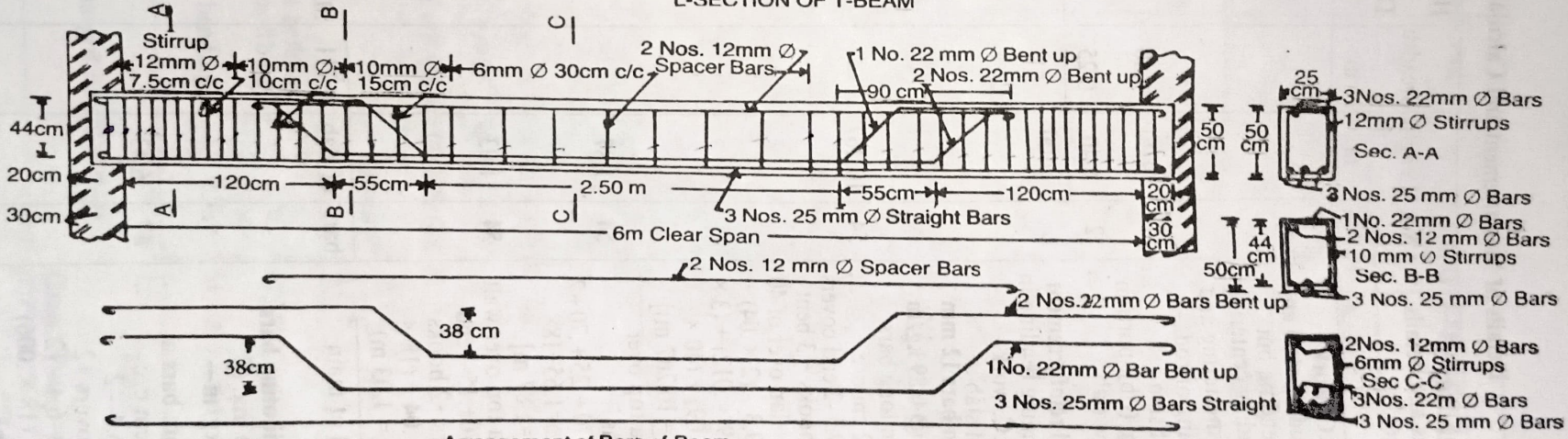
Example 4—Prepare a detailed estimate of the R.C.C. T-beam slab of the roof of a room 6 m × 9 m from the given drawing (Fig. 5-6). R.C.C. work shall include centering and shuttering and binding of rods in position but shall exclude steel including bending in reinforcements which shall be taken under a separate item.

R.C.C. T BEAM SLAB FOR A ROOM 6m × 9m



Arrangement of Slab Main Bars Showing Two Rows

L-SECTION OF T-BEAM



Arrangement of Bars of Beam

Fig. 5-6

Details of Measurement and Calculations of Quantities (Ex. 4)

Item No.	Particulars of items and details of works	No.	Length m	Breadth m	Height or Depth m	Quantity	Explanatory notes
1	**R.C.C. work excluding steel** and its bending but including centering and shuttering and binding of rods—						
	Roof slab ...	1	9.30	6.40	.12	7.14	Bearing – 15 cm and 20 cm.
	Beam (rib), portion below slab ...	2	6.40	0.25	.38	1.22	
			Total	—	—	8.36 cu m	
2	**Steel reinforcement** including bending in R.C.C. work—						
	Roof slab						
	Main bars 12 mm dia. @ 0.89 kg/m						
	Main long bars at 12 cm c/c ... [L=9.3–2 end covers + 4 hooks + 3 bent ups + lap over of 40 d = 9.3 – (2 × .04) + (4 × 9 × .012) + (3 × .5 × .09) + (40 × .012 = 10.267 m)]	54	10.267	—	—	554.42 m	No. = $\frac{6.4}{.12}$ + 1 = 54
	Extra top over beams [L=.70+.25+.70+2 hooks=1.65+18× .012 =1.87 m]	54	1.87	—	—	100.98 m	
	Extra top over wall [L=.70+.15—end covers +2 hooks= .85—.04 + (18 × .012) = 1.03 m)	54	1.03	—	—	55.62 m	
	Total of main	bars	of slab	= 711	.02 m ×	.89 kg =	632.81 kg
	Distributing bars 6 mm dia. @ 0.22 kg/m—						
	Bottom bars at 20 cm c/c ... [L = 6.4—2 end covers +2 hooks=6.4 – (2 × .04) + (18 × .006) = 6.43 m]	47	6.43	—	—	302.21 m	No. = $\frac{9.30}{.20}$ + 1 = 47

Item No.	Particulars of items and details of works	No.	Length m	Breadth m	Height or Depth m	Quantity	Explanatory notes
	Top bars over beams ...	2×9	6.43 m	—	—	115.74 m	No. = $\frac{1.65}{.20}$ + 1 = 9
	Top bars over and near walls ...	2×5	6.43 m	—	—	64.30 m	No. = $\frac{.70}{.20}$ + 1 = 5
	Total of Distributing bars of slab		=482.25	m = .22	kg =	106.10	kg
	T-Beam						
	Main straight bars 25 mm dia. @ 3.85 kg/m [L=6.4—(2×.05) +(18×.025)= 6.75]	3×	6.75m	×3.85	kg =	77.96 kg	
	Main bent up bars 22 mm dia. @ 2.98 kg/m ... [L=6.4—(2×.05) +(18×.022)+.38 = 7.076]	3×	7.076m	×2.98	kg =	63.26 kg	Adding one depth for two bent ups.
	Top spacer bars 12 mm dia. @ 0.89 kg/m ... [L=(2.5+2×.9) +(18×.012) = 4.516 m]	2×	4.516m	×.89	kg =	8.04 kg	
	Stirrups 10 mm dia. @ 0.62 kg/m [L=(2×.44 +2×.17+ .20 extra= 1.42 m]	44×	1.42m	×.62	kg =	38.74 kg	
	Grand Total		Total of all bars =	bars of 926.91	T-beam kg =	s 188.00 9.269 q	kg

ABSTRACT OF QUANTITIES (Ex. 4)

Item No.	Particulars of items	Quantity	Rate Rs. P.	Per	Cost Rs. P.
1	R.C.C. work excluding steel and its bending but including centering and shuttering and binding of rods	8.36 cu m	675.00	/ cu m	5643.00
2	Mild steel reinforcement including bending in R.C.C. work	9.269 q	515.00	/ q	4773.54
				Total	10416.54
	Add 5% for Contingencies and Workcharged Establishment				520.83
				Grand Total	10937.37

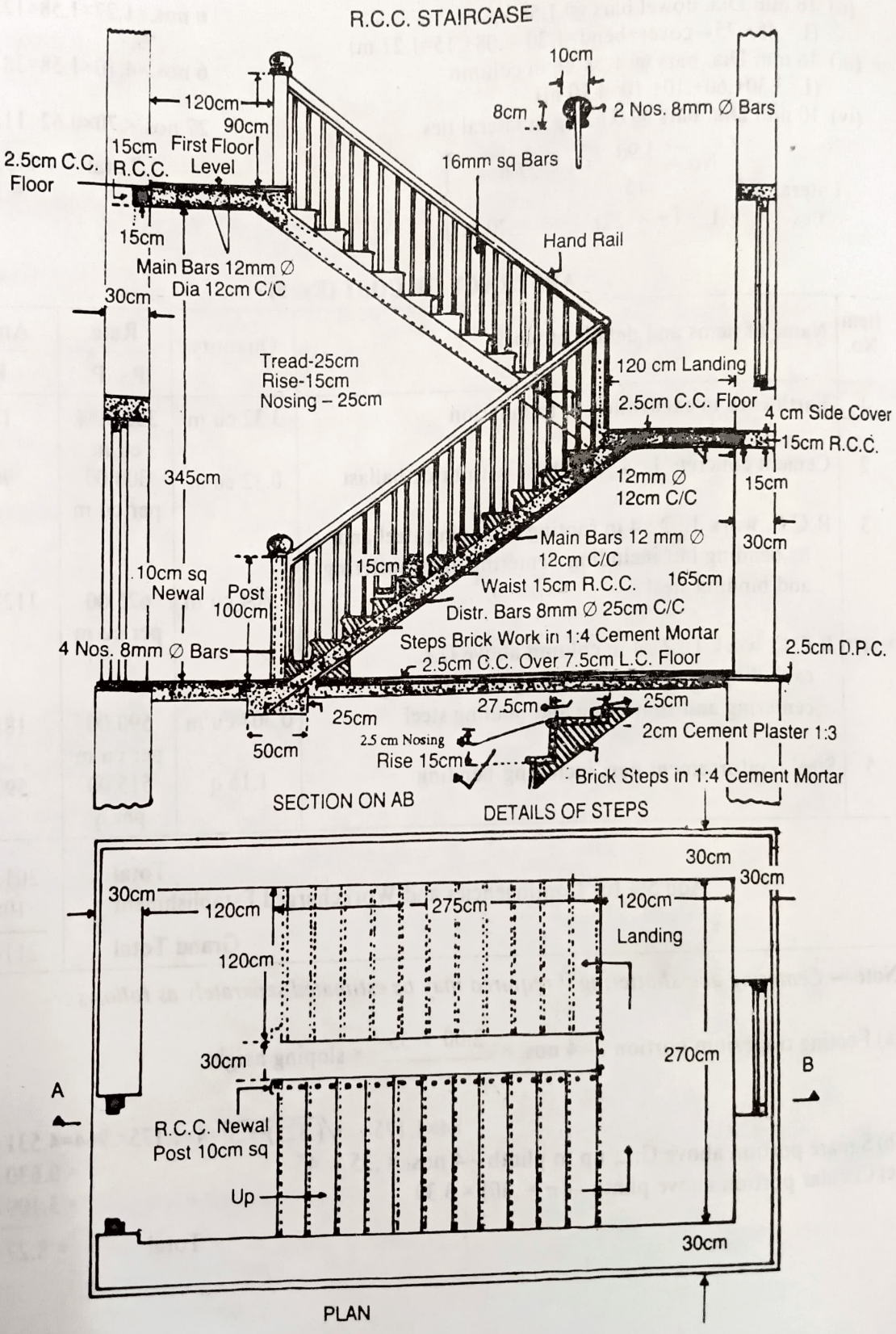

R.C.C. STAIRCASE
10cm
8cm
2 Nos. 8mm ∅ Bars
120cm
90cm
15cm
First Floor Level
2.5cm C.C. Floor
R.C.C.
16mm sq Bars
Hand Rail
15cm
Main Bars 12mm ∅ Dia 12cm C/C
30cm
Tread-25cm
Rise-15cm
Nosing – 25cm
120 cm Landing
2.5cm C.C. Floor
4 cm Side Cover
15cm R.C.C.
345cm
12mm ∅ 12cm C/C
15cm
30cm
Main Bars 12 mm ∅ 12cm C/C
10cm sq Newal Post 100cm
15cm
Waist 15cm R.C.C.
165cm
Distr. Bars 8mm ∅ 25cm C/C
Steps Brick Work in 1:4 Cement Mortar
4 Nos. 8mm ∅ Bars
2.5cm C.C. Over 7.5cm L.C. Floor
2.5cm D.P.C.
27.5cm
25cm
25cm
2cm Cement Plaster 1:3
50cm
2.5 cm Nosing
Rise 15cm
Brick Steps in 1:4 Cement Mortar
SECTION ON AB
DETAILS OF STEPS
30cm
30cm
30cm
120cm
275cm
120cm
Landing
120cm
30cm
270cm
A
B
R.C.C. Newal Post 10cm sq
Up
30cm
PLAN

Fig. 5 8

Example 6 — Prepare a detailed estimate of R.C.C. Staircase from the given plan and section (Fig. 5-8).

Details of Measurement and Calculations of Quantities (Ex. 6)

Item No.	Particulars of items and details of works	No.	Length m	Breadth m	Height or Depth m	Quantity	Explanatory notes
1	**R.C.C. Work 1:2:4** excluding steel and its bending but including centering and shuttering and binding steel—						
	Base of flights in ground floor ...	1	1.20	.50	.25	0.150	$L = \sqrt{2.75^2 + 1.65^2} = 3.21$ m
	Slab of flights (inclined) ...	2	3.21	1.20	.15	1.156	Bearing 15 cm.
	Landing middle and first floor ...	2	2.70	1.35	.15	1.094	
					Total	2.40	cu m
2	**Brickwork in steps** in 1 : 4 cement mortar (cut brickwork)	2×11	1.20	×½ (.25	×.15)	.495	cu m
3	**20 mm cement plaster 1 : 6** in steps finished neat cement floating—						
	Tread and rise ...	2×11	1.20	× (.25	+.15)	10.56	
	Ends of steps ...	2×11	×½×	(.25×	.15)	0.41	
					Total	10.97	sq m
4	**2.5 cm Nosing in steps** in 1 : 3 cement mortar	2×12	1.20	—	—	28.80	r m
5	**2.5 cm c.c. floor 1 : 2 : 4** finished neat cement floating in landings, middle and first floor ...	2	2.70	1.20	—	6.48	sq m
6	**Steel work** including bending in reinforcement and railing—						
	(i) 12 mm Dia. bars @ 0.89 kg in R.C.C. work—Main bars in lower flight and landing ...	11	5.22				L=4.10+.90+.18 dia.=5.00+ (18×.012)=5.22 m
	No. of bars = $\frac{120}{12}$ + 1=11 Nos.						

Note : *Length of bars measured from drawing.*

Item No.	Particulars of items and details of works	No.	Length m	Breadth m	Height or Depth m	Quantity	Explanatory notes
	Main bars in upper flight and middle and first floor landings ...	11	6.25				L=1.30+3.70 +1.05+18×.012 =6.25 m
	Top bars first floor landings ...	11	1.80				L=1.08+.61+9 ×.012=1.80 m
	Extra bars first floor middle of each landing ...	2	1.49				L=1.20+.15— 2 covers+2 hooks =1.49 m
		Total	148.95	× .89	=	132.56 kg	
	(ii) 8 mm Dia. distributing bars @ .39 kg in R.C.C. work—Lower flight 15 nos. and upper flight 14 nos. ...	29	1.27				L=1.20—2 covers +2 hooks=1.27 m
	Middle landing 9 nos. and upper landing 8 nos. ...	17	2.77				L=2.70—2 covers +2 hooks=2.77 m
			83.92	×.39	=32.73	kg	
	(iii) 16 mm sq bars in railing @ 2.01 kg	47	.90×	2.01	=85.02	kg	No = (11×2×2) +3 in middle landing=47 nos.
					Total	250.3 kg= 2.503 q	
7	**R.C.C. 1 : 2 : 4** hand rail inclusive reinforcement centering and shuttering finished neat cement floating with moulding ...	1	6.82	—	—	6.82 rm	L=2×3.21+.40 = 6.82 m
8	**R.C.C. 1 : 2 : 4 Newal posts** including steel reinforcement and form work finished—						
	Ground floor ...	1	1.00	.10	.10	.01	
	First floor ...	1	.90	.10	.10	.01	
					Total	.02	cu m
9	**Cap of Newal post of c.c.**			—		2 nos.	2 nos.

Note— *Railing may be of grill type or any other type instead of square bars.*

ABSTRACT OF QUANTITIES (Ex. 6)

Item No.	Particulars and items of work	Quantity	Unit	Rate Rs. P.	Per	Cost Rs. P.
1	R.C.C work 1 : 2 : 4 excluding steel and its bending but including centering and shuttering and binding steel ...	2.40	cu m	775.00	/ cu m	1860.00
2	Brickwork in steps in 1 : 4 sand mortar (cut brickwork) ...	0.495	cu m	365.00	/cu m	180.68
3	20 mm cement coarse sand plastering 1 : 3 in steps finished neat cement floating ...	10.97	sq m	9.50	/sq m	104.22
4	2.5 cm Nosing in steps in 1 : 3 cement mortar ...	28.80	r m	5.50	/r m	158.40
5	2.5 cm c.c. floor 1 : 2 : 4 finished neat cement floating ...	6.48	sq m	18.00	/ sq m	116.64
6	Steel work including bending in reinforcement and railing ...	2.503	q	515.00	/ q	1289.05
	R.C.C. 1 : 2 : 4 hand rail including reinforcement, centering and shuttering finished neat cement floating	6.82	r m	24.00	/ r m	163.68
	R.C.C. 1 : 2 : 4 Newal posts including steel reinforcement and form work ...	0.02	cu m	675.00	/cu m	13.50
	Cap of Newal posts ...	2	nos.	10.00	each	20.00
					Total	3906.17
	Add 3% for Contingencies				...	117.18
	Add 2% for Workcharged Establishment				...	78.12
					Grand Total	4101.47

Steps instead of brick work may be of cement concrete monolithic with the slab.

Example 1. — Prepare a detailed estimate of a slab culvert of 1.50 metre span and 4.00 metre roadway from the given drawing (Fig. 8.5). The general specifications are as follows :—

Foundation concrete shall be of cement concrete 1 : 3 : 6 with stone ballast and coarse sand. Masonry shall be of first class brickwork in 1 : 4 cement coarse sand mortar. Slab shall be of R.C.C. 1 : 2 : 4 with reinforcement as per drawing. Exposed surface of brick masonry shall be cement pointed 1 : 2. Road shall be provided with 10 cm thick wearing coat of 1 : 2 : 4 cement concrete. Assume suitable rates.

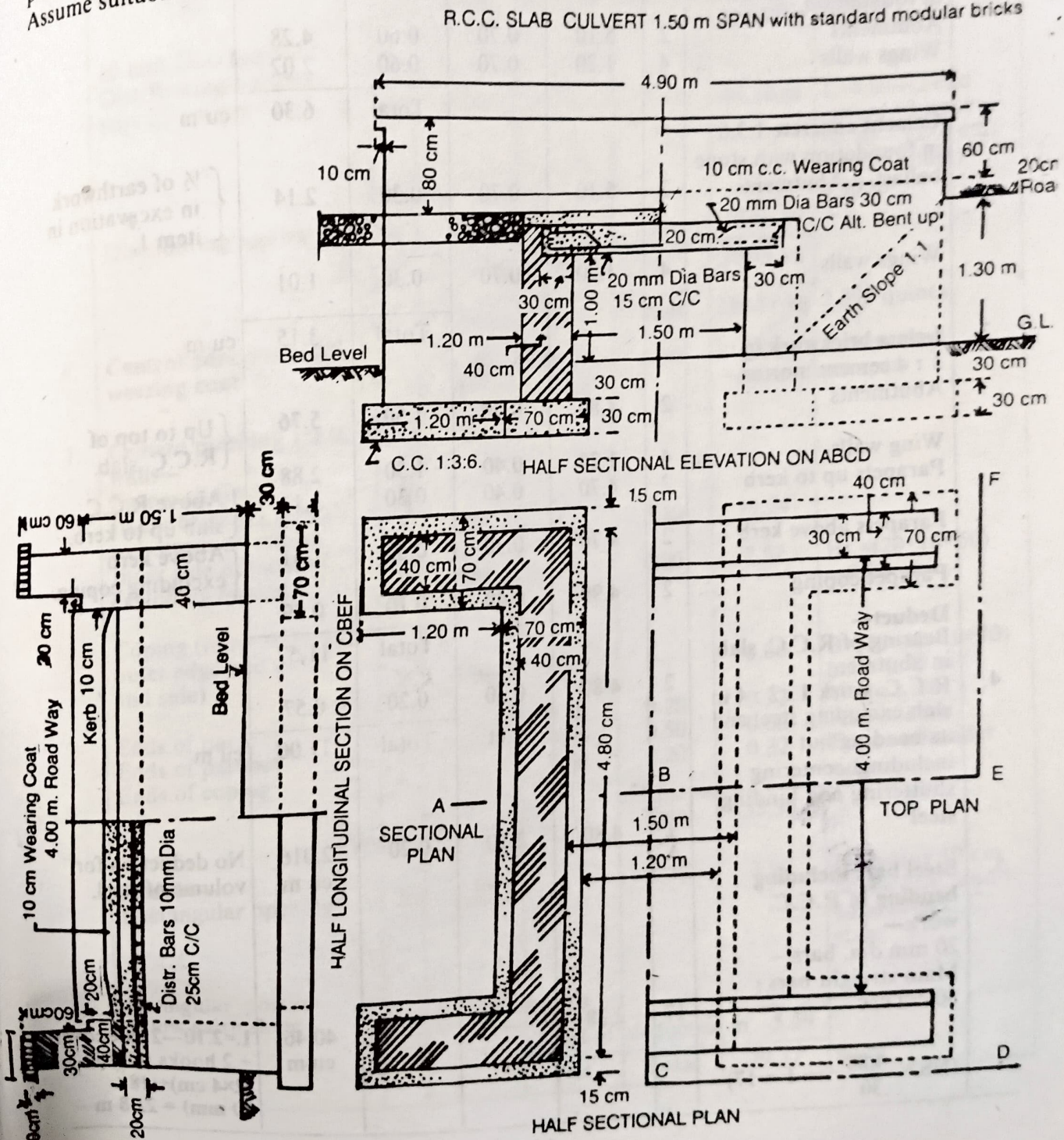


Fig. 8-5

Details of Measurement and Calculation of Quantities (Ex. 1)

Item No.	Particulars of items of works	No.	Length m	Breadth m	Height or Depth m	Quantity	Explanatory notes
1.	**Earthwork in excavation** in foundation —						
	Abutments ...	2	5.10	0.70	0.60	4.28	
	Wings walls ...	4	1.20	0.70	0.60	2.02	
					Total	6.30	cu m
2.	**Cement concrete** 1:3:6 in foundation with stone ballast— Abutments ...	2	5.10	0.70	0.30	2.14	½ of earthwork in excavation in item 1.
	Wings walls ...	4	1.20	0.70	0.30	1.01	
					Total	3.15	cu m
3.	**I-class brickwork in** 1 : 4 cement mortar—						
	Abutments ...	2	4.80	0.40	1.50	5.76	Up to top of R.C.C. slab.
	Wing walls ...	4	1.20	0.40	1.50	2.88	
	Parapets up to kerb ...	2	4.70	0.40	0.30	1.13	Above R.C.C. slab up to kerb.
	Parapets above kerb ...	2	4.70	0.30	0.50	1.41	Above kerb excluding coping.
	Parapet coping ...	2	4.90	0.40	0.10	0.39	
					Total	11.57	
	Deduct— Bearing of R.C.C. slab in abutment	2	4.80	0.30	0.20	0.57	
4.	**R.C.C. work 1 : 2 : 4 in** slab excluding steel and its bending but including centering shuttering and binding steel			Net	Total	11.00	cu m
		1	4.80	2.10	0.20	2.016 cu m	No deduction for volume of steel.
5.	**Steel bars including bending in R.C.C. work—** 20 mm dia. bars— Main straight bars 30 cm c/c ...	17	2.38	—	—	40.46 cu m	L=2.10—2 side covers + 2 hooks = 2.10—(2×4 cm)+(18×20 mm) = 2.38 m
	(No.= $\frac{4.80}{.30}$ + 1 = 17)						