Al-Mansour University College

قسم الهندسة المدنية | Civil Eng. Dept.

المرحلة الرابعة | 4^{th}. Stage

Construction Methods & Quantity Survey

2022 - 2023

Lec.1

المسح الكمي وطرق التشييد

Asst. Esraa Thami

Al-Mansour University College

Civil Engineering Department

Fourth Stage

Quantity Surveying

Estimation and Costing

1. Drawings like plan, elevation and sections of important points.
2. Detailed specifications about (Architectural, structural and MEP drawings) & properties of materials etc.
3. Standard schedule of rates of the current year.

NEED FOR ESTIMATION AND COSTING

1. Estimate give an idea of the cost of the work and hence its feasibility can be determined whether the project could be taken up with in the funds available or not.
2. Estimate gives an idea of time required for the completion of the work.
3. Estimate is required to invite the tenders and Quotations and to arrange contract.
4. Estimate is also required to control the expenditure during the execution of work.
5. Estimate decides whether the proposed plan matches the funds available or not.

Cost of Structure:

Cost of labor

Cost of material

permit fees for construction water, electricity from concerned authorities

Consulting Engineers fees:

Cost of supervision

Types of Construction Estimations:

There are several kinds of estimating techniques; these can be grouped into two main categories:

1. Approximate Estimations.

2. Detailed Estimations.

1. **Approximate Estimations:** this type of estimation is useful before starting detailed design.

The main objectives of this type of estimation are:

1. To estimate the cost of construction approximately in a short time.
2. To carry out a comparative study between different design alternatives.
3.

Types of Approximate Estimations:

1. **Floor Area Method:** in this method an approximate cost (material and labour) per square meter will be used for this estimation. This cost per square is either used evenly among all stories or may be higher relatively for lower stories.

Example:

A multi-story building of plan area $(20 \times 35)m$ consisting of a basement, ground floor, first floor ,second floor and the roof. The total cost of construction including (material and labour) was 1260,000,000 I.D.

Estimate the cost of one square meter based on the following two assumptions:

A. The cost per square meter is constant amon other stories.

Solution:

A. First Assumption:

Basement Area=$20 \times 35 =$700m^2

Ground floor Area =$20 \times 35 =$700m^2

First floor Area =$20 \times 35 =$700m^2

Second flo 700m^2 Roof Area =$20 \times$

$35 =$700m^2

Total Area 3500 m^2

Cost per square meter= $\frac{1260.000,000}{3500}$ = 360,000 I.D

B. Second Assumption:

Basement area(Equivalent) =$700 \times 0.6 =$420m^2

Ground floor area=$20 \times 35 =$700m^2

First floor area=$20 \times 35 =$700m^2

Second floor area=$20 \times 35 =$700m^2

Roof area(Equivalent) =$700 \times 0.4 =$280m^2

Total Area 2800 m^2 ,Cost per square meter= $\frac{1260.000,000}{2800}$ = 450,000 I.D

Cost of basement=$0.6 \times 450,000 =$270,000m^2

Cost of roof=$0.4 \times 450,000 =$180,000m^2

2. **Cubical Method:** This method is more accurate than the square meter of floor area method. Since it takes into account the third dimension (the height)

Solution

Basement volume=$20 \times 35 \times 2.8 =$1960m^3

Ground floor volume =$20 \times 35 \times 3.0 =$2100m^3

First floor volume =$20 \times 35 \times 3.0 =$2100m^3

Second floor volume =$20 \times 35 \times 3.0 =$2100m^3

Roof volume =$20 \times 35 \times 3.0 =$2100m^3

Total volume 10360 m^3

Cost per cubic meter= $\frac{3600.000,000}{10360}$ = 348,000 I.D

2. Detailed Estimations:

Detailed estimate of the cost of a project is prepared by determining the quantities

satisfactory completion of the work.

Steps in Preparation of an Estimate

1. Taking off Dimension:
2. Squaring Dimension:
3. Working up Abstraction
4. Billing of quantities:

Measurement of Materials and Works:

The units of measurements are mainly categorized for their nature, shape and size and for making payments to the contractor. The principle of units of measurements normally consists of the following:

1. Single units work like doors, windows, trusses etc., are expressed in numbers.
2. Works consists linear measurements (L.M) involve length like pipe.
3. Works consists of a real surface measurements involve area like plastering, white washing, partitions of specified thickness etc., are expressed in square meters (m^2).
4. Works consists of cubical con olume like earth work, cement concrete, Masonry etc. are expressed in Cubic meters.

Standard Measurement:

No.	Item	Unit	Quantity	Unit Price
1	Site clearing (small area) Site clearing (Large area)	Lump Sum m^2		
2	**Earthworks:** Excavation (Cut) Embankment (Fill)	 m^3 m^3		
3	**Preparation under Foundation:** Spreading and compaction of boulders under foundation (thickness *5-10 cm*) Subbase (thickness *10* cm) Pouring of blinding concrete *10 cm*			
4	**Concrete:** Specifications in details: (f'c), mixing rate, ….) 1. **Foundation:** Plain concrete for *foundation* (Reinforced concrete for *foundation* (no formwork) Reinforced concrete for *foundation* (with *formwork*) 2. **Columns:** Reinforced concrete 3. **Beams:** Reinforced concrete 4. **Slabs:** Reinforced concrete 5. **Other members:** R.C 6. **D.P.C** layer Concrete (10-15cm) 7. **Beams over openings (Lintels)** (windows, doors, …)	 m^3 m^3 m^3 m^3 m^3 LM LM		
5	**Masonry works:** **1.** Brick walls 24 cm thi partitions 12 cm thickness **2.** Brick partitions 8 cm thickness	 m^3 m^2 m^2		
6	External plastering and pointing	m^2		
7	Internal plastering Painting	m^2 m^2		
8	Flooring: 1. Pouring of plain (*or reinforced with fabric wire net: bar diameter 4, 5, 6mm*) concrete under tiles. 2. 25mm cement concrete over 25 mm concrete floor.	 m^2 m^2		

	3. Paving of floor by tiles (type mosaic, … . (size 30x30, 40x40 , .. . work shall include filling of joints among the tiles with white cement mortar. 4. Colored Tiles (hexagonal shape)	m^2 m^2		
9	Skirting with ceramic tiles (height 10, 15, 20, … cm	LM		
10	Installation of ceramic tiles for kitchen, toilets, bathrooms, washing rooms, ….	m^2		
11	**Roofing:** • Cleaning of the roof • Spreading of film coat (emulsified asphalt) • Spreading of hot tar • Spreading of asphaltic sheets • Spreading of clean silt layer thi of concrete tiles 80x80 cm conceding correct slope for drainage • Filling of joints with approved sealant	m^2		
12	**Doors:** 1. Steel doors 2. Wooden doors 3. Aluminum doors 4. Plastic doors 5. Composite doors	Each (Number)		
13	**Windows:** Include all details *Same as doors* in addition to glass thickness and color if included: 1. Steel windows 2. Wooden windows 3. Aluminum windows 4. Plastic windows	m^2		
14	Glazing: Refer to thickness, color, brand	m^2		
15	**Partitioning:** 1. Gypsum board 2. Aluminum partitions 3. Plastic partitions 4. Wooden partitions	m^2		
16	False ceilings	m^2		
17	**Mechanical:** Plumbing: 1. Galvanized steel pipes (1in, 3/4in, 1/2in, …) including all fixtures 2. Hand wash basin 3. Sink	LM Each Each		

	4. Water Tank	Each		
	5. Water Bump	Each		
	6. Valve (diameter)	Each		
	7. Shower	Each		
	Sanitary: Shower basin			
		LM		
		Each		
		Each		
18	Electrical:			
	1. Internal Light (describe details)	Each		
	2. External Light	Each		
	3. Switch	Each		
	4. Socket 13A, 15A, 20A, ..	Each		
	5. Industrial Socket	Each		
	6. Circuit breaker 25A, 30A, 60A, 100A, ….	Each		
	7. Board	Each		
	8. Electric meter	Each		
	9. Cable supply (details)	LM		
	10. Connect with public system	LS		
19	Stair:			
	Mosaic steps	Each		
	Stair rail	LM		
20	Sheds	m^2		
	Other works			

Local Measurement method (trade system):

Divide the project by items (activities) according to the order of construction

Sq	Item (description)	Unit	Number	Dimensions			Quantity	+/-		Final Quantity
				Length	Width	Height		+	-	
1										
2										
3										

Al-Mansour University College

قسم الهندسة المدنية

Civil Eng. Dept.

المرحلة الرابعة

4th. Stage

Construction Methods & Quantity Survey

2022 - 2023

2

المسح الكمي وطرق التشييد

Asst. Esraa Thami

Methods of Measurements:

1. **Group System Method:**

In this method, the project is divided into different work groups. For convential buildings for instance, the work groups are:

- Work items below N.G.L. (i.e., foundations).
- Reinforced concrete skeleton work (columns, beams and slaps).
- Partitioning.
- External and internal plastering.
- Tiling.
- M ning).
- Electrical works.
- Plumbing.

Item no.	Description of items	Dimensions	Quantity	Notes

2. **Trade System Method (Local Method):**

In this method the project is divided into different activities. The activities are arranged into sequential order. It is the most common and popular method. Below is the typical table used in this method: -

Sq	Item (description)	Unit	Number	Dimensions			Quantity		Final Quantity
				Length	Width	Height	+	-	
1									
2									
3									

The negative quantity represents a correction for extra dimensions that may be taken for some items.

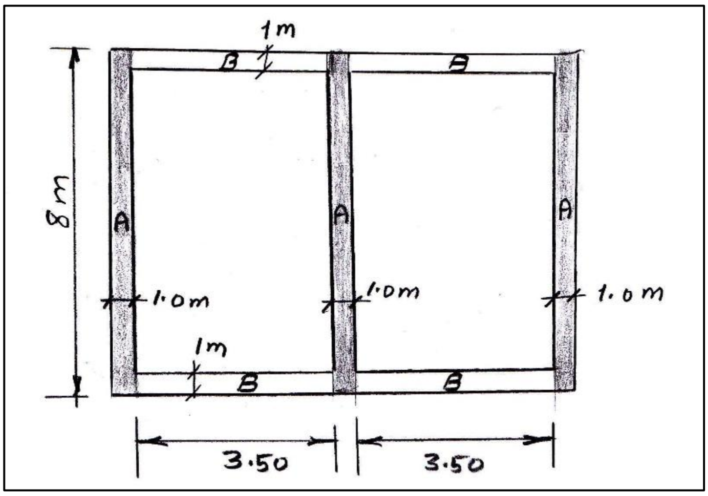
All results for construction activities are then assembled in a final table. This final table is called the bills of quantities for cost estimation:

Item No.	Details	Unit	Quantity	Price per unit	Item cost

Length Measurements:

There are two methods for length measurements which are: **up two:** consist of four parts, each of length (B)

Length of group



Group 1(Axes A)=3*8=24 m

Group 2(Axes B)=4*3.5=14 m

Total=38 m

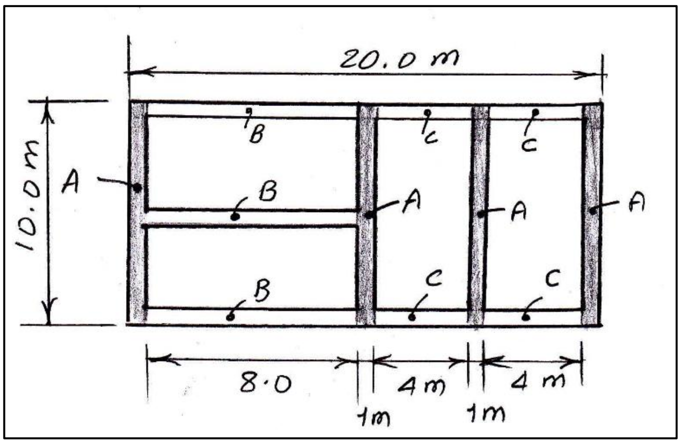
Example (2) :

Group 1(Axes A)=4*10=40 m

Group 2(Axes B)=3*8=24 m

Group 3(Axes C)=4*4=16 m

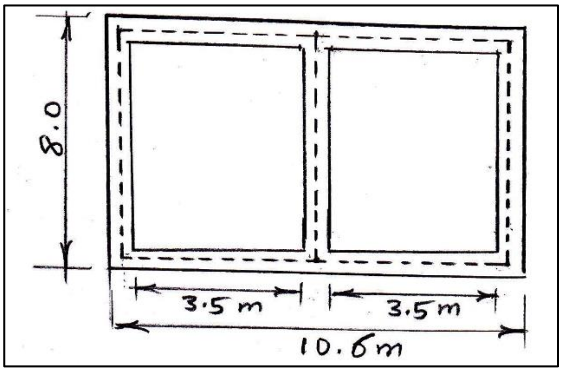
Total=80 m



2. **Central Lines Method:** opular method

Example (1):

Use the central lines method, calculate the total length of the wall footing (strip footing) plan shown below. The footing width is 1.2 meter.



Solution:

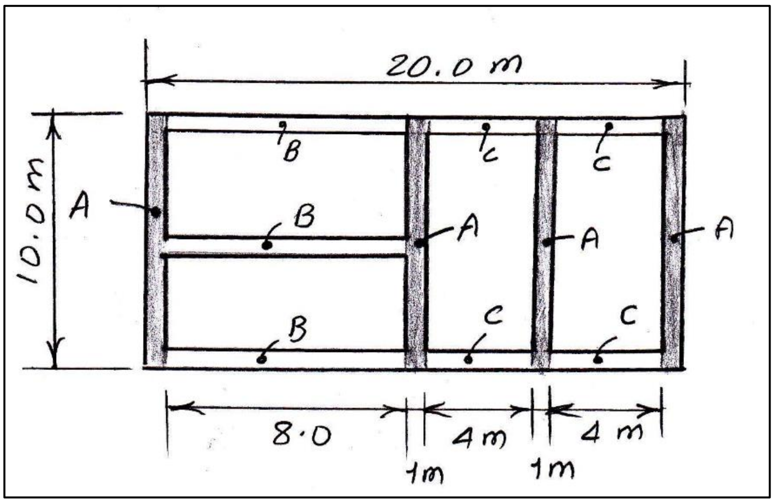
$\sum Cl$ **length=3(8-2×** $\frac{1.2}{2}$**)** $+\mathbf{4(3.5+1.2)}-\mathbf{2}(\frac{1}{2}\times\mathbf{1.2})$

Two Junctions (T) عدد التقاطعات التي تمثل شكل

T

Example (2):

Using the central lines method. (width of footing (w)is 1 meter)



Solution:

$\sum Cl$ **length=4(10-2×** $\frac{1}{2}$**)** $+ \mathbf{3}\left(\mathbf{8+2\times\frac{1}{2}}\right)+\mathbf{4}\left(\mathbf{4+2\times\frac{1}{2}}\right)-\mathbf{6}(\frac{1}{2})$

=80 m

Note

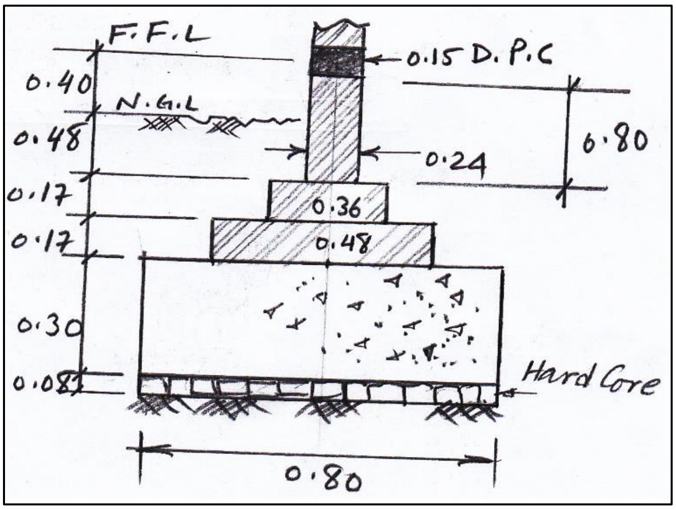
No. of T
عدد التقاطعات=6

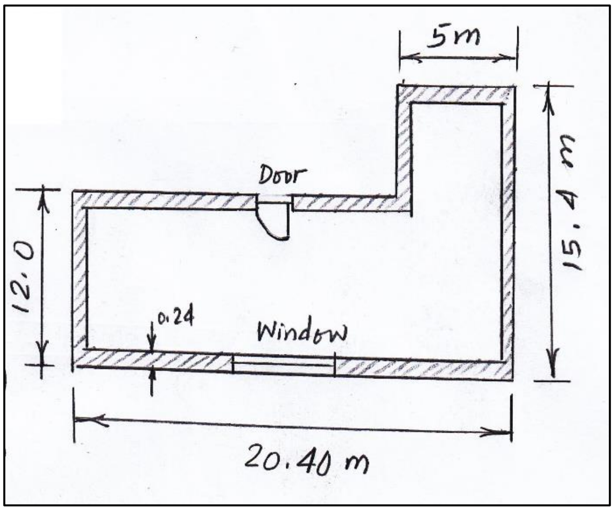
Wعرض الاساس

Application examples

Example (1):

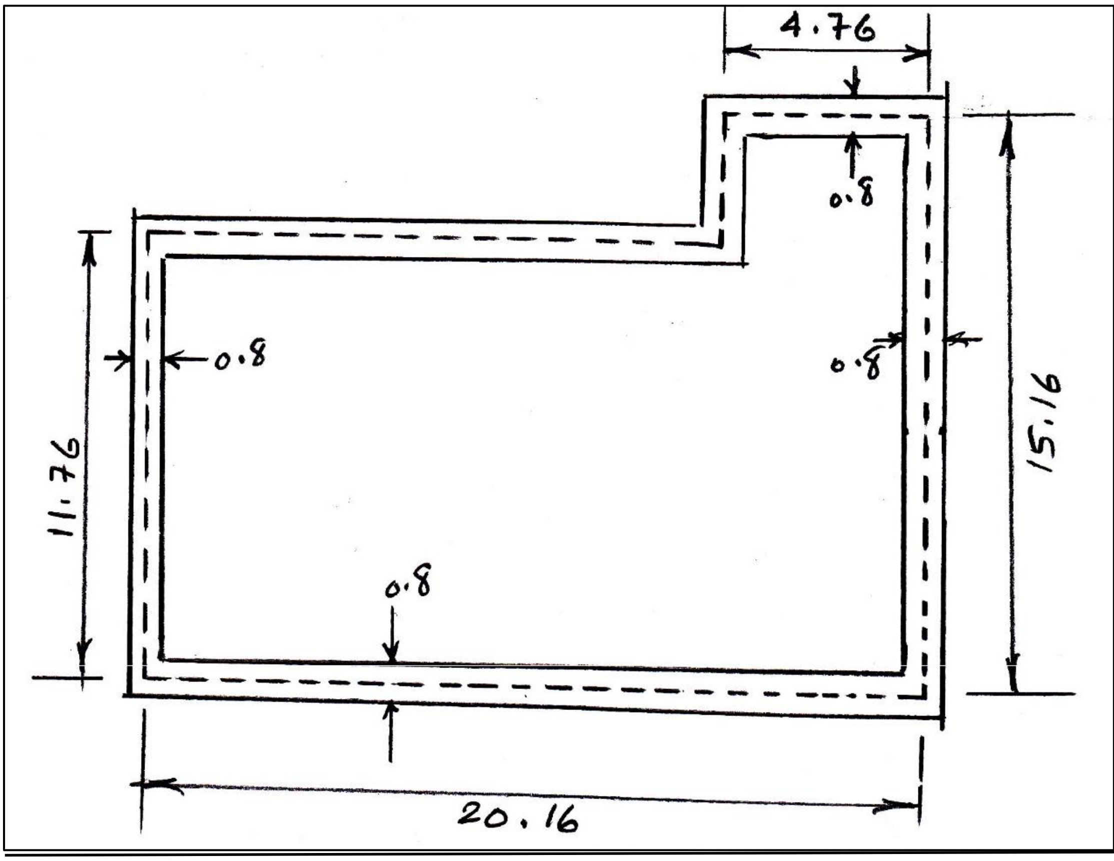
Estimate th below the D.P.C for the plan shown in fig. use the central lines method for this plan.





Solution:

The centerlines of the wall (strip) footing is shown in the figure below:



Item no.	Description of items	Dimensions			Units	Quantity	Notes
		L(m)	W(m)	H(m)			
1.	Earth Excavations	(15.16*2+20.16*2)	0.8	1.2	m^3	67.82	
2.	Hard core	6)*2	0.8	……..	m^2	56.5	Use point 0.8m brick as a hardcore
3.	Concrete (plain)	(15.16+20.16)*2	0.8	0.3	m^3	16.95	Concrete (1:2:4) by volume, $\grave{f}$c = 25 Mpa
4.	Brick wall 0.48m width	(15.16+20.16)*2	0.48	0.17	m^3	23.65	Brick work using cement mortar (1:3) by volume
	0.36m width	(15.16+20.16)*2	0.36	0.17	m^3		
	0.24m width	(15.16+20.16)*2	0.24	0.8	m^3		
5	D.P.C.	(15.16+20.16)*2	…….	…….	m	70.64	Use 0.15m D.P.C

Example:

Estimate the construction items for the hall shown in Fig (1). Use the trade system met ments. Note that the

finishing items will be as following: -

1. Gypsum plastering will be used for indoor (interior) plastering.
2. Emulsion type painting will be used for indoor wall faces.
3. Cement mortar will be used for outdoor wall face plas aic tiles will be used for ground floor finishing. (of size 40 x 40 cm).
4. Ceramic tiles will be used for (W.C) walls and floor of sizes (15 x 30 cm) &

   (30 x 30 cm) respectively.
6. Concrete tiles will be used for the hall roof of dimensions (80 x 80 cm).

The plans and section for this hall are as shown in fig. (1) & fig (2).

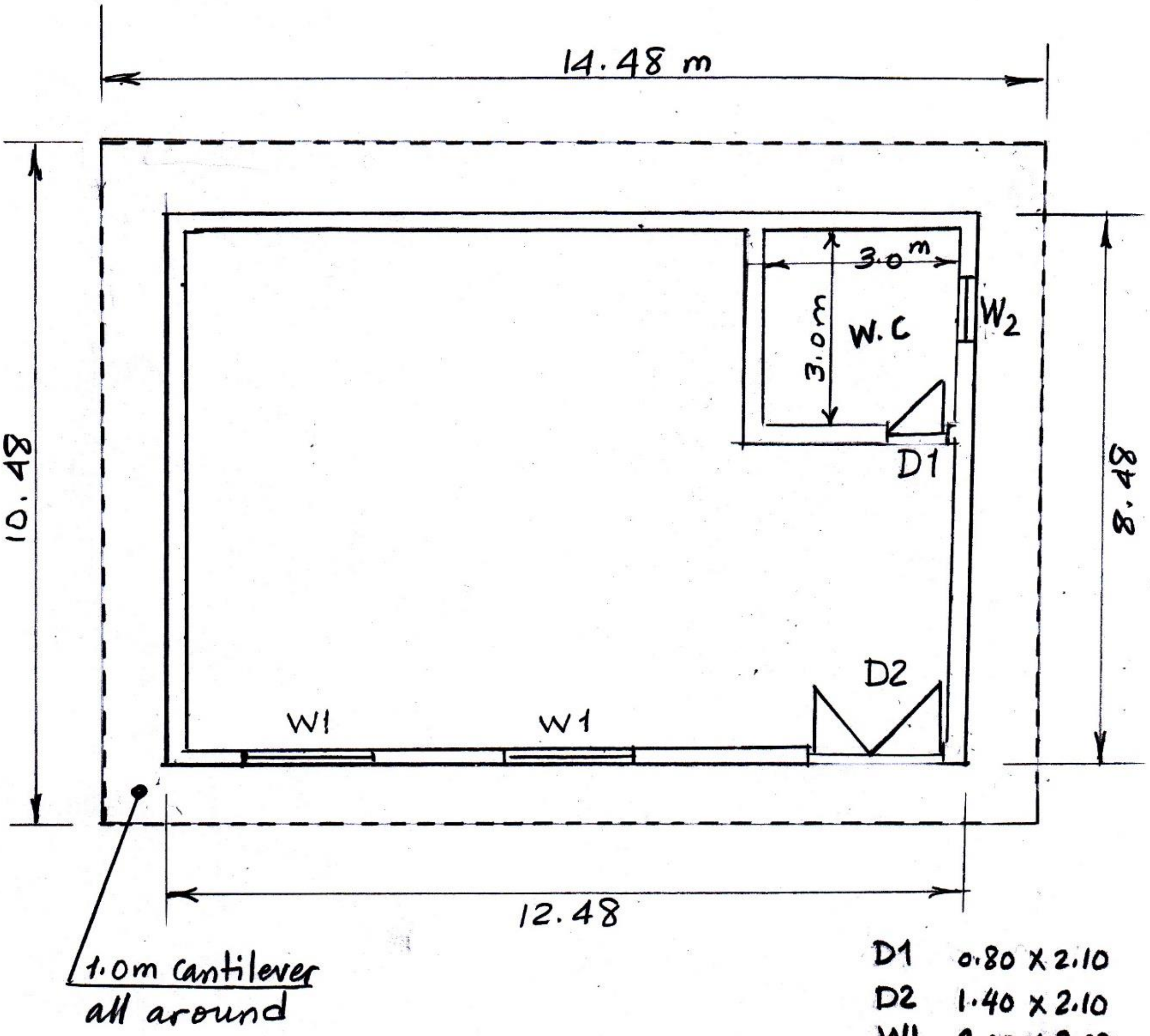
Length of center line (*C.L1*) is:

L1 = 2(8.24+12.24) + 3.24 + 3.24 -2($\frac{0.80}{2}$) = 46.64m (for footing)

By the same method: -

CL.2= 46.96m , *CL.3*= 47.08m, *C.L4* =47.20m for 0.48m, 0.36m & 0.24m brick.

Length of) + (10.48-0.12)] = 49.44m 1



D1	0.80 X 2.10
D2	1.40 X 2.10
W1	2.00 X 2.00
W2	0.70 X 0.50

FiG. (1a): Hall plan
scale (1 : 100)

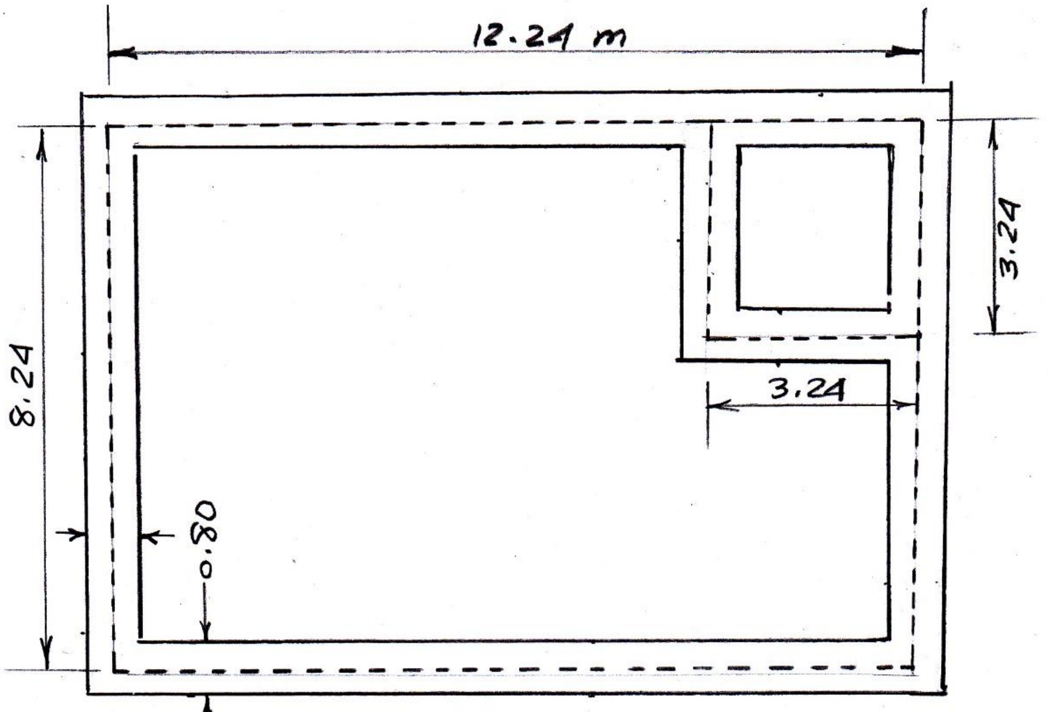


FiG. (1 b) : Foundation Plan.
scale (1 : 100)

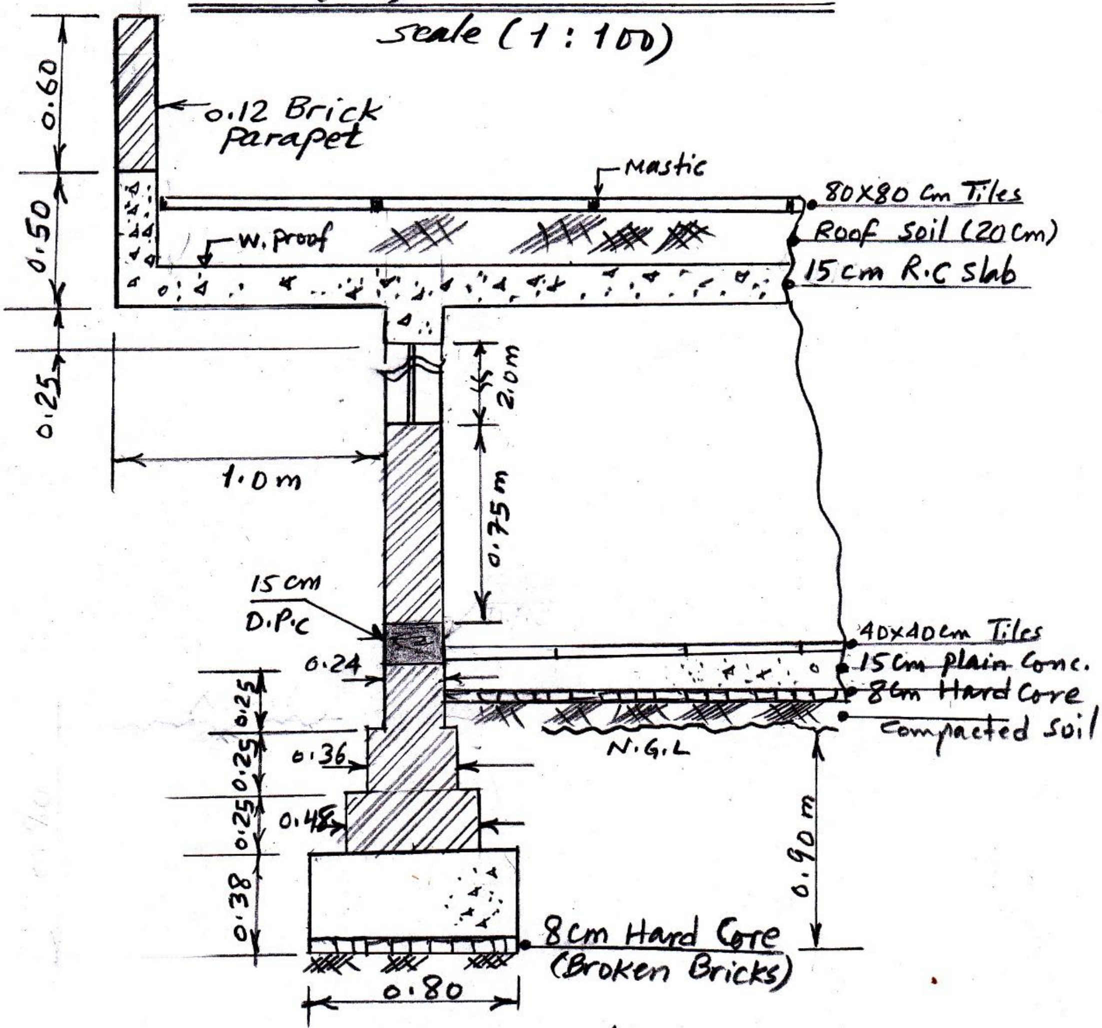


FiG. (2): Hall Section
scale (1 : 25)

Item No.	Details	Unit	No.	Length (m)	Width (m)	Height (m)	Quantity (+)	Quantity (-)	Quantity (net)
1.	**Soil Excavation**	m^3	1	46.64	0.80	0.90	33.58	-	33.58
2.	**Hardcore (8cm) (broken Brick)**	m^2	1	46.64	0.80	-	37.30	-	37.30
3.	**Plain Concrete for flooring**	m^3	1	46.64	0.80	0.30	11.20	-	11.20
4.	**Brick work Below D.P.C**	m^3							
	of width 0.48	m^3	1		0.48	0.25	5.64		
	of width 0.36	m^3	1	4722.08	0.36	0.25	4.23		12.70
	of width 0.24	m^3	1	47.20	0.24	0.25	2.83		
							∑ =12.70		
5.	**D.P.C Concrete of 15 cm thickness**	m	1	47.20	-	-	47.20		47.20
6.	**Brick work Above D.P.C**	m^3	1	47585.20	0.24	2.75	31.20		
	Window W1 Reduction	m^3	2	2.00	0.24	2.00		1.92	
	Door D2	m^3	1	1.40	0.24	2.10		0.71	
	Door D1	m^3	1	0.80	0.24	2.10		0.40	
	Window W2	m^3	1	0.70	0.284	0.50		0.08	28.1

Item No.	Details	Unit	No.	Length (m)	Width (m)	Height (m)	Quantity (+)	Quantity (-)	Quantity (net)
7.	**Brick parapet**	m^3	1	49.44	0.12	0.60	3.56		3.56
					Total Brick work items 4,6,7 = 44.36 m^3				
8.	**R.C Lintel**	m^3	1	4747.20	0.24	0.25	2.83		2.83
9.	**R.C Roof of 15 cm thickness**	m^3	1	14.48	10.48	0.15	22.76		22.76
10.	**R.C parapet 0.12 thick**	m^3	1	49.44	0.12	0. 35	2.08		2.08
						R.C items 8,9,10 = 27.67 m^3			
11.	**Roof-water proofing (with parapet skirting)**	m^2	1	14.24	10.24	-	145.80	$\sum =$	155.70
		m^2	1	49.44	-	0.20	9.88		
12.	**Roof soil & tiling (80x80cm)**	m^2	1		10.24	-	145.8		145.8
13.	**Outdoor plastering with cement mortar 1:3**	m^2	1						
	Plastering of brick wall below D.P.C (both sides)	m^2	2	47.08 (*)	-	0.75	70.62		70.62
	Plastering above D.P.C for walls	m^2	1	41.92 (**)	-	3.15	132.1		132.10

	Plastering for cantilever	m^2	1	2(14.48) 2(8.48)	1.0	-	45.92		45.92
	Plastering of parapet	m^2	1	49.92 (***)	-	1.10	54.92		54.92
	Reduction of 50% for doors & windows								
	W1	m^2	2	2.0	-	2.0		4.0	
	D2	m^2	1	1.14	-	2.10		1.2	
	W2	m^2	1	0.70	-	0.5		0.17	
					Outdoor plastering=$\sum = 298m^2$				
14.	**Gypsum plastering (Indoor)**	m^2							
	Roof	m^2	1	12.00	8.00	-	96	-	96.00
	Walls	m^2	1	(8+12)2=40	-	3.08	123.20		123.0
	Reduction of 50% of windows & doors								
	W1	m^2	2	2.00	-	2.00		4.00	
	D2	m^2	1	1.14	-	2.10		1.20	
	D1	m^2	1	0.80	-	2.10		1.68	
					Gypsum plastering=$\sum = 212.00\ m^2$				
15.	**Emulsion painting (Indoor)**	m^2	1		Indoor painting =$\sum = 212.00\ m^2$				

16.	**Ceramic tiling for W.C (Walls)**	m^2	1	2(3+3)=12	-	3.08	36.96		
	Reduction 50%								
	W2	m^2	1	0.70	-	0.50		0.17	
	D1	m^2	1	0.80	-	2.10		0.84	
					Ceramic tiles $=\sum = 35.95\ m^2$				
	Floor Ceramic	m^2	1	3.00	3.00	-	9.00		
					Ceramic tiles $=\sum = 9.00\ m^2$				
17.	**Alum. Windows**								
	W1	m^2	2	2.00	-	2.00	8.00		8.00
	W2	m^2	1	0.70	-	0.50	0.35		0.35
					Alum. Windows=8.35 m^2				
18.	**Wooden door D1 (1.40*2.10)**		1	1.40	-				
	D2 (0.80*2.10)	m^2	1	0.80	-				
19.	**Hardcore 8 cm (Broken Bricks)**	m^2	1	12.00	8.00	-	96	-	96
20.	**Plain Concrete 10 cm (C20 MPa)**	m^2	1	12.00	8.00	-	96	-	96
21.	**Mosaic tiles (40*40)**		1	12.00	8.00	-	96		
	Reduce (W.C) floor	m^2	1		3.24	10.5			
						Mosaic Tiles $=\sum = 85.50\ m^2$			
22.	**Mosaic Skirting 10 cm**	m	1	2(8+12)-2.2	-	-	-	38	38

(*) Average of 46.96m, 47.08m & 47.20

(**) (12.48+8.48)2 = 41.92m

(***) (14.48+10.48)2 = 44.92

Item No.	Details	Unit	No.	Length (m)	Width (m)	Height (m)	Quantity (+)	Quantity (-)	Quantity (net)
1.	**Soil Excavation**	m^3	1	46.64	0.80	0.90	33.58	-	33.58
2.	**Hardcore (8cm) (broken Brick)**	m^2	1	.64	0.80	-	37.30	-	37.30
3.	**Plain Concrete for flooring**	m^3	1	46.64	0.80	0.30	11.20	-	11.20
4.	**Brick work Below D.P.C**	m^3							
	of width 0.48	m^3	1	46.96	0.48	0.25	5.64		
	of width 0.36	m^3	1	47.08	0.36	0.25	4.23		12.70
	of width 0.24	m^3	1	47.20	0.24	0.25	2.83 **$\sum$ =12.70**		
5.	**D.P.C Concrete of 15 cm thickness**	m	1	47.20	-	-	47.20		47.20
6.	**Brick work Above D.P.C**	m^3	1	47.20	0.24	2.75	31.20		
	Window W1 Reduction	m^3	2	2.00	0.24	2.00		1.92	
	Door D2	m^3	1	1.40	0.24	2.10		0.71	
	Door D1	m^3	1	0.80	0.24	2.10		0.40	
	Window W2	m^3	1	0.70	0.24	0.50		0.08	28.1

Item No.	Details	Unit	No.	Length (m)	Width (m)	Height (m)	Quantity (+)	Quantity (-)	Quantity (net)
7.	**Brick parapet**	m^3	1	49.44	0.12	0.60	3.56		3.56
					Total Brick work items 4,6,7 = 44.36 m^3				
8.	**R.C Lintel**	m^3	1	47.20	0.24	0.25	2.83		2.83
9.	**R.C Roof of 15 cm thickness**	m^3	1	14.48	10.48	0.15	22.76		22.76
10.	**R.C parapet 0.12 thick**	m^3	1	49.44	0.12	0. 35	2.08		2.08
						R.C items 8,9,10 = 27.67 m^3			
11.	**Roof-water proofing (with parapet skirting)**	m^2	1	14.24	10.24	-	145.80	$\sum =$	155.70
		m^2	1	49.44	-	0.20	9.88		
12.	**Roof soil & tiling (80x80cm)**	m^2	1	14.24	10.24	-	145.8		145.8
13.	**Outdoor plastering with cement mortar 1:3**	m^2	1						
	Plastering of brick wall below D.P.C (both sides)	m^2	2	47.08 (*)	-	0.75	70.62		70.62
	Plastering above D.P.C for walls	m^2	1	41.92 (**)	-	3.15	132.1		132.10

	Plastering for cantilever	m^2	1	2(14.48) 2(8.48)	1.0	-	45.92		45.92
	Plastering of parapet	m^2	1	49.92 (***)	-	1.10	54.92		54.92
	Reduction of 50% for doors & windows								
	W1	m^2	2	2.0	-	2.0		4.0	
	D2	m^2	1	1.14	-	2.10		1.2	
	W2	m^2	1	0.70	-	0.5		0.17	
					Outdoor plastering=$\sum = 298m^2$				
14.	**Gypsum plastering (Indoor)** **Roof** **Walls** **Reduction of 50% of windows & doors** W1 D2 D1	m^2 m^2 m^2 m^2 m^2 m^2	 1 1 2 1 1	 12.00 (8+12)2=40 2.00 1.14 0.80	 8.00 - - - -	 - 3.08 2.00 2.10 2.10	 96 123.20	 - 4.00 1.20 1.68	 96.00 123.0
					Gypsum plastering=$\sum = 212.00\ m^2$				
15.	**Emulsion painting (Indoor)**	m^2	1		Indoor painting =$\sum = 212.00\ m^2$				

16.	**Ceramic tiling for W.C (Walls)**	m^2	1	2(3+3)=12	-	3.08	36.96		
	Reduction 50%								
	W2	m^2	1	0.70	-	0.50		0.17	
	D1	m^2	1	0.80	-	2.10		0.84	
					Ceramic tiles =∑ = 35.95 m^2				
	Floor Ceramic	m^2	1	3.00	3.00	-	9.00		
					Ceramic tiles =∑ = 9.00 m^2				
17.	**Alum. Windows**								
	W1	m^2	2	2.00	-	2.00	8.00		8.00
	W2	m^2	1	0.70	-	0.50	0.35		0.35
					Alum. Windows=8.35 m^2				
18.	**Wooden door**								
	D1 (1.40*2.10)		1	1.40	-				
	D2 (0.80*2.10)		1	0.80	-				
19.	**Hardcore 8 cm (Broken Bricks)**	m^2	1	12.00	8.00	-	96	-	96
20.	**Plain Concrete 10 cm (C20 MPa)**	m^2	1	12.00	8.00	-	96	-	96
21.	**Mosaic tiles (40*40)**	m^2	1	12.00	8.00	-	96		
	Reduce (W.C) floor		1	3.24	3.24			10.5	
						Mosaic Tiles =∑ = 85.50 m^2			
22.	**Mosaic Skirting 10 cm**	m	1	2(8+12)	-	-	40	2.2	38

Estimation of Materials

Cost Estimation for brick masonry:

1. Calculation for Brick Work (Masonry) Materials:

-

- Dimensions of the brick with mortar: $24\ cm \times 12\ cm \times 8\ cm$

Volume of the brick without mortar = $0.23 \times 0.11 \times 0.07$ = 0.001771 m^3

Volume of the brick with mortar = $0.24 \times 0.12 \times 0.08$ = 0.002304 m^3

Number of bricks in 1 cubic meter=$\frac{1}{\text{Vol.of the brick with mortar}} = \frac{1}{0.002304}$= 434 units

To consider the waste, we estimate 450 units

Volume of mortar in 1 cubic meter = $(0.002304\ -\ 0.001771) \times 434$ = 0.23 m^3

Amount of cement and sand in mortar:

Mortar = 0.75 (Cement + Sand)

Let C = proportion of cement in mortar (by volume)

For 1:3 mixing rate

0.23 = 0.75(C + 3C) → C = 0.0767 m^3

Cement amount = $0.0767\ m^3\ \times\ 1400\ kg/m^3$= 107.4 kg

$\frac{107}{50}$ =≈ 2 sacks

Sand = 3 (0.0767) = 0.23 m^3

This means that for each 1 m^3 of brick work we need 2 sacks of cement and 0.23 m^3 of sand.

1. Materials Cost:

Brick cost/m^3 = 450x150 = 67500 ID

1 Sack of Cement = 8000 ID

Cement cost/m^3 $= 2 \times 8000$ = 16000 ID

1 m^3 of sand = 20000 ID

Sand cost/m^3 = 20000x0.23 = 4600 ID

Total Material Cost of brick work/m^3 = 88100 ID

2. Labor Cost:

Each team includes 1 Mason (Builder) and 5 labors:

1 Builder Wage = 80000 ID/day

1 Labor Wage = 25000 ID → 5x25000 = 125000 ID/day

Average of 1 team product (1 Mason (Builder) and 5 Labors) = 6 m^3/day

Labor cost = $\frac{80000+125000}{6}$

Labor cost = 34000 ID/m^3

3. Total (Materials +Labor) Cost /m^3 of brick work:

Other costs (curing, scaffolds, and others) **≈ 10000 ID**

Total Cost = 88100 + 34000 + 10000 = **132100 ID/m^3**

Add taxes, insurance and overhead: Say 10% → $132100 \times 0.1 = 13210$ ID

Add an amount for contingency: Say 3% → $132100 \times 0.03 = 3963$ ID

Add an amount for profit: Say 15% → $132100 \times 0.15 \approx 19815$ ID

= ***170,000 ID/m³***

Calculations for brick partitions:

Partitions (12 cm thickness):

Example(1):

Estimate the number of bricks and mortar volume per/m^2 of 12 cm thick partitions.

Solution:

$No\ .of\ Bricks = \frac{1}{0.24 \times 0.08} = 52$ bricks/m^2

Volume of bricks without mortar = $0.23 \times 0.07 \times 0.11 \times 52 = 0.0921 m^3/m^2$

Volume of mortar = $(1 \times 1 \times 0.12 - 0.0921) = 0.0279\ m^3$

(H.W) Repeat Example (1) for:

1. 8 cm thick Partitions.

2. $(20 \times 15 \times 40)$ cm concrete blocks.

Estimation of the Concrete Constructions/m^3:

Let the Mixing proportion by volume be 1:2:4

1 = 0.67 (C+2C+4C)

ete.

Cement weight = $1400 \times 0.213 = 298.5\ kg/m^3$

No. of Sacks =$\frac{300}{50}$ =6 Sacks

Sand = 2C = 2(0.213) = 0.426 m^3

Gravel =4C = 4(0.213) = 0.852 m^3

Pricing:

1 Sack of Cement = 8000 ID → 6×8000 = 48,000 ID

1 m^3 of sand = 20000 ID → $20000 \times 0.426 = 8520$ ID

1 m^3 Gravel = 15000 ID → 15000×0.852 = 12,780 ID

Material Cost = 69,300 ID /m^3 of Concrete.

Mixing and Placing Cost:

1 mixer with operating team cost about 500,000 ID/day

Maximum production ≤ 50 m^3/day → Average production = 25 m^3/day

Mixing and Placing Cost = 500,000/25 = 20000 ID/ m^3

Total Cost = 69,300 + 20,000 = 89,300 ID/m^3 (without reinforcement and molds)

Estimation of Plastering Items:

i. Interior plastering:(of 2 cm thickness)

$1 \times 1 \times 0.02 = 0.02$ m^3 per 1 square meter of plastering

$0.02 \times 1275 \times 1.1 = 28.05\ kg$

Labor cost (two layers):

6000- 8000 ID/m^2 (High quality)

Total Cost of plastering Say 10,000 ID

ii.**External plastering:**

Average thickness of plaster = 3 cm

$1 \times 1 \times 0.03 = 0.03$ m^3 per 1 square meter of plastering

Mixing rate (1:3)

0.03=0.75(C+3C) $\longrightarrow$ C=0.01m^3/m^2

Cement weight=1400$\times\ 0.01 = 14\ kg$ /m^2

Sand=3C=0.01*3=0.03 m^3/m^2

Material Cost=$\frac{14}{50} \times 8000 + 0.03 \times 20,000 = 2840$

Say 3000 ID

Total Cost of exterior plastering=3000+10000=13,000 ID

Estimation of Tiling:

Average Width of joints=3 mm

(30×30) cm tiles $= \frac{1}{0.303 \times 0.303} = 10.89 = 11$ unit/m^2

(40×40) cm tiles $= \frac{1}{0.403 \times 0.403} = 6.15$ unit/m^2

mixing rate of mortar 1:3

for example (30×30) cm tiles

Volume of mortar between joints $=(1-(0.3 \times 0.3 \times 11)) \times 0.03 = 0.003$m^3

For the previous example:

Item No.	Details	Unit	Quantity	Price per unit ID	Item cost (I.D)
1.	**Total Brick work**	m^3	44.36	170,000	7541200
2.	**Reinforced concrete**	m^3	**27.67**	89,300 *	2470931
3.	Interior (Gypsum)plastering	m^2	**212.00**	10,000	2120,000
4.	Exterior plastering	m^2	**298.00**	13,000	3874000
5.	Ceramic tiles Wall (15*30) Floor(30*30)	m^2	**35.95** **9.00**	30,000 **	1078500 270,000
6.	**Mosaic tiles** (40*40)	m^2	**85.5**	30,000 **	2565,000

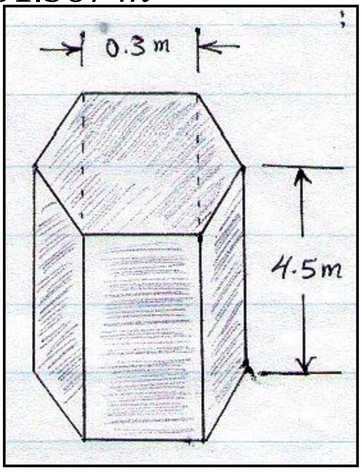
*without reinforcement and molds
** Assumed. It depends on the type of tiles and labor cost.

Example (1):

Estimate the quantity of cement in tons, gravel and sand in cubic meters required to pour 30 columns with mixing rate 1:1.5:3.

Solution: **Area**=$\frac{3\sqrt{3}}{2} \times a^2$

$$Volume\ of\ hexagonal\ column = 30 \times 3 \times \frac{\sqrt{3}}{2} \times 0.3^2 \times 4.5 = 31.567\ m^3$$



31.567 = 0.67(C+1.5C+3C)

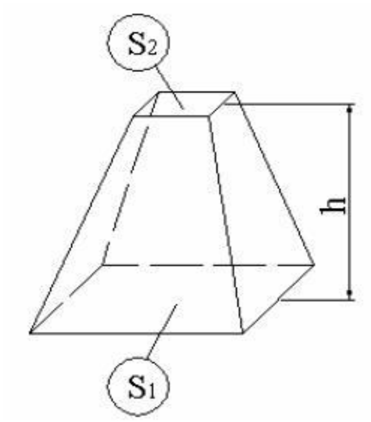
C=8.567 m^3

Cement = $\frac{8.567*1400}{1000}$=11.99 ton

Sand = 1.5C = 1.5*8.567 = 12.85 m^3

Gravel = 3C = 3*8.567 = 25.69 m^3

Example (2): Estimate the quantity of cement, sand and gravel required to pour ten pyramidal frustums with mixing rate 1:2:4



Note that S_2=60cm, S_1=120cm, h=120 cm

Solution:

$$\text{Vol} = 10 \times \frac{h}{3}(A_1 + A_2 + \sqrt{A_1 \times A_2})$$

$$\text{Vol} = 10 \times \frac{1.2}{3}(0.6^2 + 1.2^2 + \sqrt{0.6^2 \times 1.2^2}) = 10.08\ m^3$$

Cement= $10.08 \times \frac{300}{1000} = 3.024\ ton$

Sand= $2C\ =\ 2(0.213) = 10.08 \times 2(0.213) = 4.294\ m^3$

Gravel=$4C\ = 4(0.213) = 10.08 \times 4(0.213) = 8.588 m^3$