NORZAIHASRA BINTI SAABA | HAZLINA BINTI MARWAN | SALMIAH BINTI HUSAIN

Preliminary Estimating IN BUILDING CONSTRUCTION

Preliminary Estimating IN BUILDING CONSTRUCTION

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NORZAIHASRA BINTI SAABA

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PREFACE

This eBook can be used by all institutions of higher learning such as Polytechnics and Colleges as well as private and public universities.

The purpose for this eBook was written is to make it easier for students and readers to gain knowledge and review the topic of preliminary estimating in a simpler and more concise way. The examples of questions are included in this eBook with detailed steps of solution. In addition, students and readers will also be able to improve their understanding through the included practice questions.

The authors hope that this eBook can benefit all students and readers as well as educators around the world in the field of Civil Engineering.

Thank You So Much.

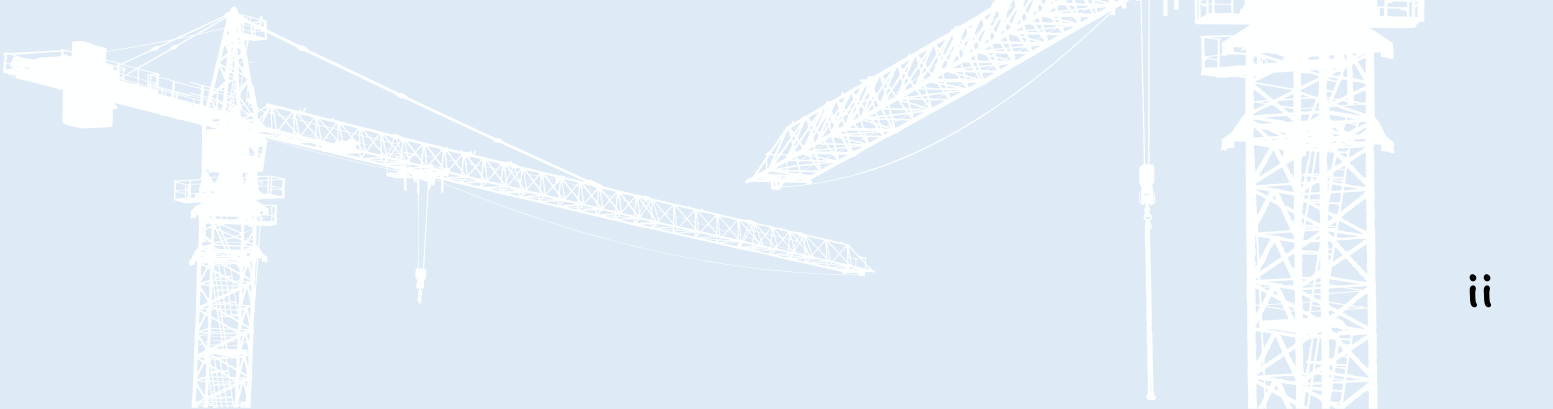
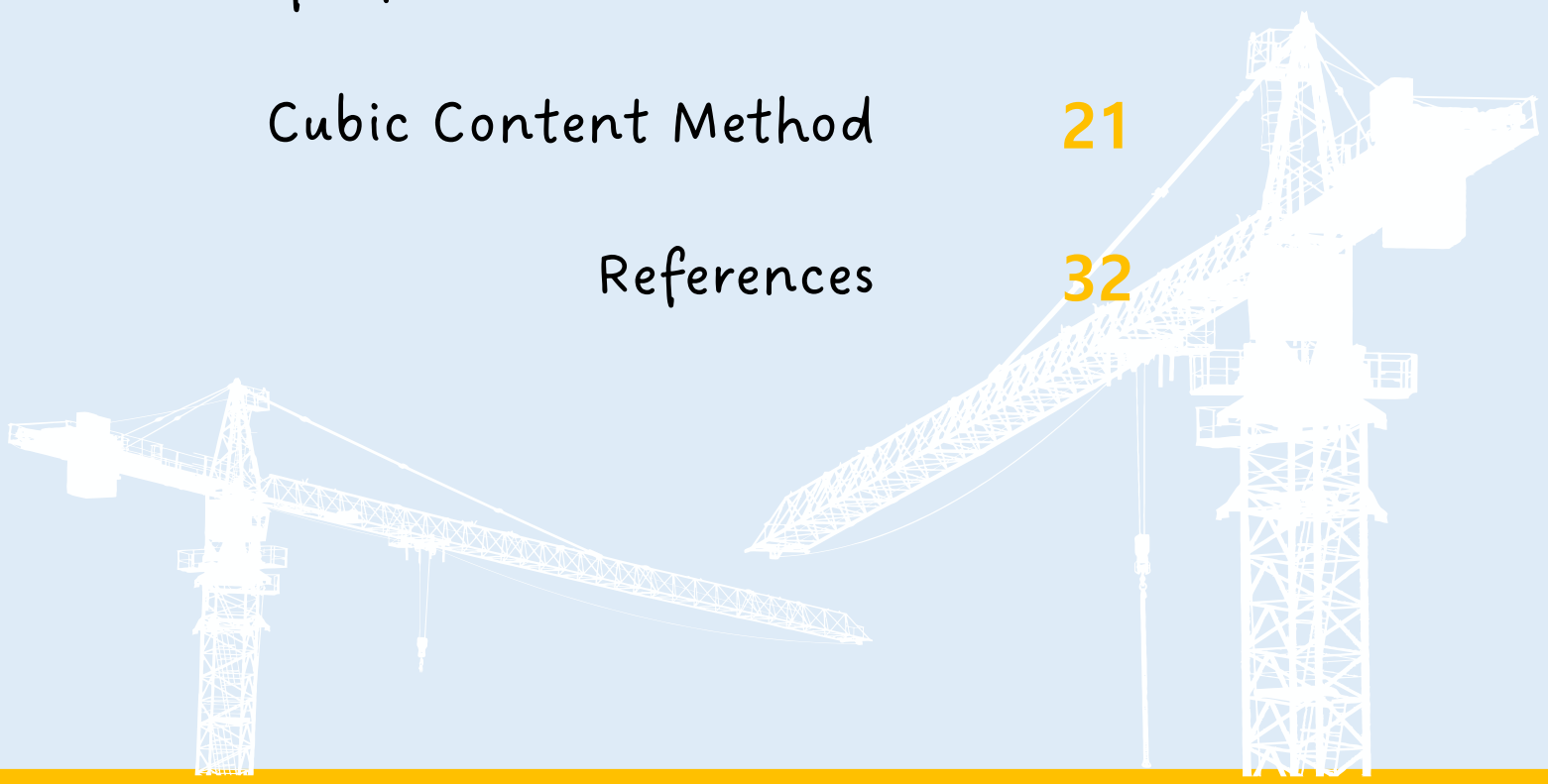


TABLE of CONTENT



Definition Of Preliminary Estimating Methods

A technique for predicting the possible cost of a particular building or construction project by a systematic calculation using a specific method is prepared at an early stage of the project.

The art of approximating the probable worth or cost of an activity based on information available at the time. (Stewart 1982).

The process of looking into the future and trying to predict project costs and resource requirements (Halpin 1985).

Why Preliminary Estimating Is Important ?

Insight into the costs of the project before detailed plans are drawn up.

Performed as a part of the project feasibility analysis (to assess the economic feasibility of continuing the project).

To determine costs for budget control.

Raise awareness of the likely costs to obtain an early financial commitment.

Inform the architects and engineers of the cost of the project and the commitments required.

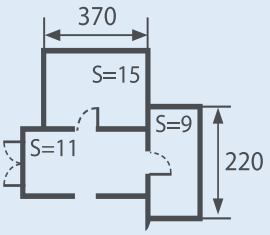
The Importance Of Preliminary Estimating To :

CLIENT	- To prepare a forecast of the probable cost or budget of a proposed project. - To be aware of cost forecasts and financial commitments. - Provide the financial input required to prepare a cash flow curve. - Determine the actual construction costs, hence the percentage of profit. - To assist the clients getting the most competitive tender.
ARCHITECT	- As a guide in designing a proposed project within a budget limit. - To assist in creating the most economical design for the required building project.
PROJECT MANAGER	- As a guide in controlling the cost of a project, especially during design and construction stage.
CONTRACTOR	- To prepare tender pricing during the tender process. - To ensure the amount of tender pricing is reasonable. - To obtain the accurate information on materials, labor and plants (avoid waste).
FINANCIAL INSTITUTION	- As a reference for the financing the project, such as term loan, overdraft, bridging finance etc. - To know whether the proposed project is eligible for project financing : competitive and viable, profitability, repayment capacity.
BUILDING MANAGER	- Easy to allocate of budget for maintenance and repairing or making good.

Type Of The Preliminary Estimating

Unit Valuation Method

Superficial Area Method



Cubic Content Method

Factors Influencing the Selection of the Preliminary Estimating Method

1. Information and **time** available.
2. The **complexity** of the calculation.
3. **Experience** of the Quantity Surveyor.
4. The **accuracy** of the estimate is required.
5. **Cost data** is available.

Video time !

Introduction to Preliminary Estimating Method

https://www.youtube.com/watch?v=jYqWYpYi9kA

Introduction Of Unit Valuation Method

- Known as the cost per functional unit method.
- Obtained unit rate of a completed building of the same type.
- Make adjustment for differences in site condition, design, construction method and quality of materials.
- Determine the number of units.
- Multiply the proposed number of units by the unit rate.
- It consists of choosing a standard unit of accommodation and multiplying this by an approximate cost per unit.

The standard units may represent, for example :

Schools, universities, colleges

→ – **costs per student**

→ – **costs per desk**

Hospitals

→ – **costs per patient**

→ – **costs per bed place**

Car parks

→ – **cost per car space**

Restaurants, cinemas, stadiums

→ – **cost per seat**

UNIT VALUATION METHOD

Total Estimated Cost (RM) =

Number of units (proposed)

x

Unit rate (cost per unit)

Cost per unit is obtained from past projects.

Advantages & Disadvantages

Advantages	Disadvantages
It can **be done quickly** where a rough figure is required instantly	This is **not a reliable method** (rough figure)
The estimate can be done even if there are **no drawings or specifications**	**Large deviation** from the accurate value
It is useful for buildings where **standard units** (desks / beds) occupy most of the space	It is **not based on drawings or specifications**
Little information is required from client (i.e. the number of units), but getting a lot of information from the client will be helpful for the estimator	It is **difficult to make allowances** for shape, size, construction method, quality of material, etc

EXAMPLE 01

With reference to the data below, calculate the construction cost for the hall to accommodate 2000 audiences.

Hall	Construction Cost (RM)	Audience
Hall A	550,000	1000

SOLUTION :

Cost per accommodation = RM 550,000 / 1000

= RM 550

Total Estimated Cost = No. of units (proposed) x

Unit rate (Cost per accommodation)

= 2000 x RM 550

= **RM 1,100,000** #

EXAMPLE 02

Based on the information given, prepare the rough cost estimate of a hostel building which accommodate 2,000 student, taking into consideration the rising cost of 20% due to changes in material and labor cost.

Type	Construction Cost (RM)	Number of student
Hostel A	2,500,000.00	1500
Hostel B	2,000,000.00	1000

SOLUTION :

Cost per unit (Hostel A) = $\frac{\text{RM } 2500000.00}{1500}$ = RM 1666.67

Cost per unit (Hostel B) = $\frac{\text{RM } 2000000.00}{1000}$ = RM 2000.00

Average cost per unit = $\frac{\text{RM } 1666.67 + \text{RM } 2000.00}{2}$ = RM 1833.34

Rising cost of 20% = RM 1833.34 x 20% = RM 366.67

Total cost per unit = RM 366.67 + RM 1833.34 = RM 2200.01

Total cost of new hostel = RM 2200.01 x 2000 student

= RM 4400020.00 #

EXAMPLE 03

With reference to the data below, find the construction cost for parking lot at Idaman Suria Apartment. The construction cost in 2024 will increase to 5% per year.

Location	Construction Cost (RM)	Number of parking	Year of construction
Senawang Jaya Apartment	3 million	500	2014
Asia Condominium	3.5 million	350	2014
Idaman Suria Apartment	?	450	2024

SOLUTION :

Interval period = 2024 – 2014 = 10 years

Senawang Jaya Apartment = $\frac{\text{RM } 3000000.00}{500}$ = RM 6000.00

Asia Condominium = $\frac{\text{RM } 3500000.00}{350}$ = RM 10000.00

Average cost per unit = $\frac{\text{RM } 6000.00 + \text{RM } 10000.00}{2}$

= RM 8000.00

Material cost = RM 8000.00 x 5% x 10 years

= RM 4000.00

New price rate = RM 8000.00 + RM 4000.00

= RM 12000.00

Cost of parking lot (Idaman Suria Apartment)

= RM 12000.00 x 450 parking lot

= RM 5400000.00#

QUESTION 1

Answer :
RM 8542975.00

According to the following data in Table 1, estimate the construction cost of hostel in Port Dickson Polytechnic which can accommodate 3500 students. Construction will start in 2016 (taking into consideration that will be additional 20% cost for changes in material).

Table 1 : Construction cost of others hostel building in 2008

POLYTECHNIC	LOCATION	CONSTRUCTION COST (RM)	NUMBER OF STUDENT
PUO	IPOH	7,800,500	4,000
POLISAS	KUANTAN	8,850,200	5,500
PSMZA	TERENGGANU	8,900,000	3,500

QUESTION 2

Answer :
RM 11250000.00

Based on the Table 2, calculate the construction cost for School C which can accommodate 1500 students (taking in consideration cost of 20% changes in materials). The new building will be constructing in 2017.

Table 2 : Construction Project in 2009

Hospital	Construction Cost	Total Patients
School A	RM13,500,000.00	2000
School B	RM14,375,000.00	2500

QUESTION 3

Answer :
RM 25987020.00

Based on data in Table 3, estimate the construction cost for new hospital in year 2014 to accommodate 3000 patients by using the valuation method. Construction cost is expected to increase 15% per year.

Table 3 : Construction Project in 2007

Hospital	Construction Cost (RM)	Number of patient	Year of construction
A	10,500,000	2,500	2007
B	9,500,000	2,300	2007
C	11,300,000	2,600	2007

Introduction Of Superficial Area Method

This method also known as the **floor area method,** uses as a single-rate technique (cost per square meter) of estimation to calculate the cost of building (Smith 1998).

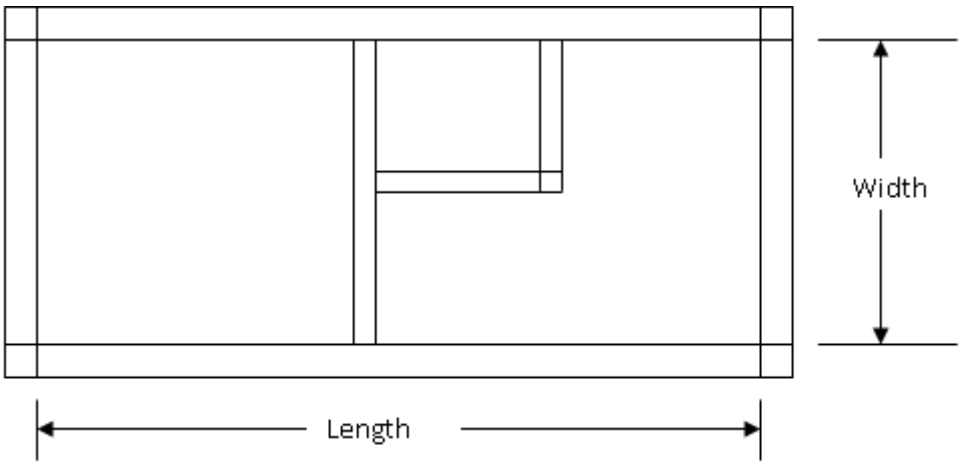
It is the first estimate that will be prepared when initial sketch drawings are produced by the architect.

The gross internal floor area of a building is measured and multiplied by the cost per square meter (per m^2) to determine the total cost of the building.

Method Of Use

The calculation of floor area is subject to the following measurement rules :

- Length and width is **measured between inside faces of external wall**.
- Different construction types or finishing standard are measured separately.
- The area of all **unclosed covered area** (which are not totally enclosed by full-height wall, such as corridors, verandahs, car porches, balconies) shall be **multiplied by ½**.



Total Estimated Cost (RM) =

Internal gross floor area (m^2)

x

Unit rate (cost per m^2)

Cost per m^2 is obtained from past projects.

Advantages & Disadvantages

Advantages

- More accurate than the unit valuation method.
- It relies on the architect's sketch drawings.
- It relies on the gross floor area of the building plan.
- Estimates are based on previous similar projects.
- Easier to understand for all parties.
- Easy to calculate and cost are expressed in a way readily understood by an average construction industry client.

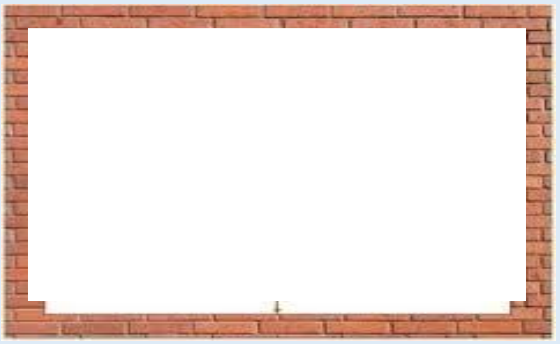
Disadvantages

- Does not consider changes to the floor plan, storey height, or overall height of the building, as these factors affect the building cost.
- Other work that is not related to the floor area must be calculate separately.
- It is difficult to calculate and allocate costs for different site conditions, the quality of materials, the condition of contract, etc.
- It doesn't take into account :
  - the total perimeter of the walls.
  - the floor-to-ceiling height of the building.
  - the area and type of wall finishes.

EXAMPLE 01

Figure 1 shows a simple rectangular single store (20 m x 5 m) with 230 mm external brick walls and no open space. The building rate is RM 8,000 per m².

Figure 1



SOLUTION :

Calculate the inside length of external walls (measured from inside face) :

Length = 20.00 m – (0.23 x 2) m = 19.54 m

Width = 5.00 m – (0.23 x 2) m = 4.54 m

Total Cost = (19.54 x 4.54) m² x RM 8,000

= 88.71 m² x RM 8,000

= **RM 709,680** #

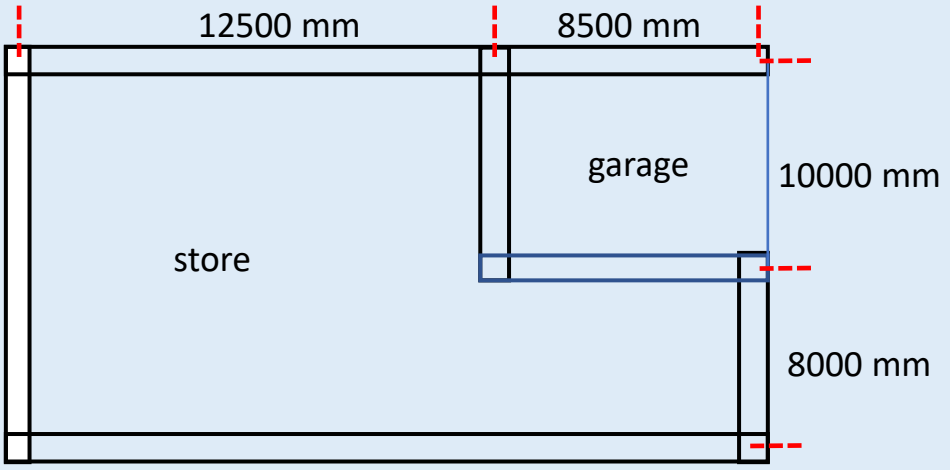
EXAMPLE 02

En Amin decided to build a store and garage. Based on Figure 2, estimate the construction cost for the store by using the superficial area method.

Given :

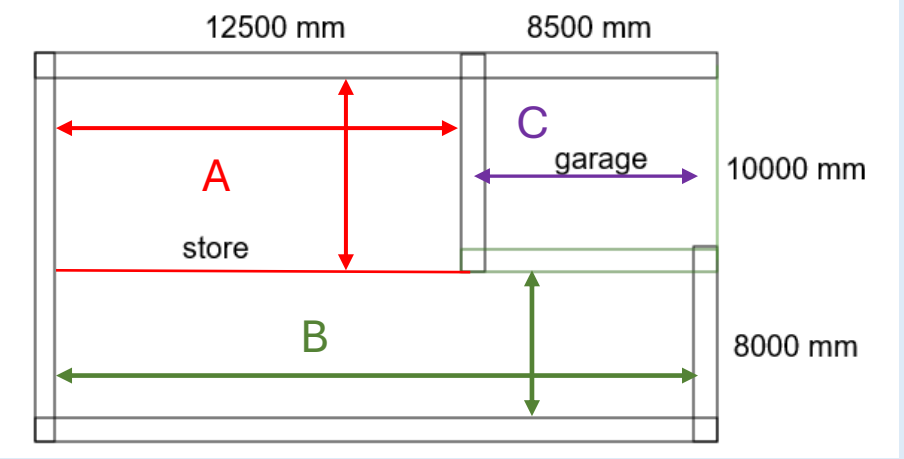
- All the dimension is measured from center line to center-line of wall
- Wall thickness is 230 mm
- Price rate/m^2 is RM 650

Figure 2



SOLUTION :

1) Define the space/area.



2) Calculate each area.

	Area A	Area B	Area C (Uncovered area)
Length (m)	12.5 – 2(½ x 0.23) = 12.27	21.0 - 2(½ x 0.23) = 20.77	8.5 - 2(½ x 0.23) = 8.27
Width (m)	10.0 – [(½ x 0.23) + (½ x 0.23)] = 10.0	8.0 – 2(½ x 0.23) = 7.77	10 - 2(½ x 0.23) = 9.77
Floor Area	= 12.27 x 10 = 122.70 m²	= 20.77 x 7.77 = 161.38 m²	= ½ [8.27 x 9.77] = 40.40 m²

3) Calculate total cost.

Total estimated cost :

= (122.70 + 161.38 + 40.40) m² x RM 650

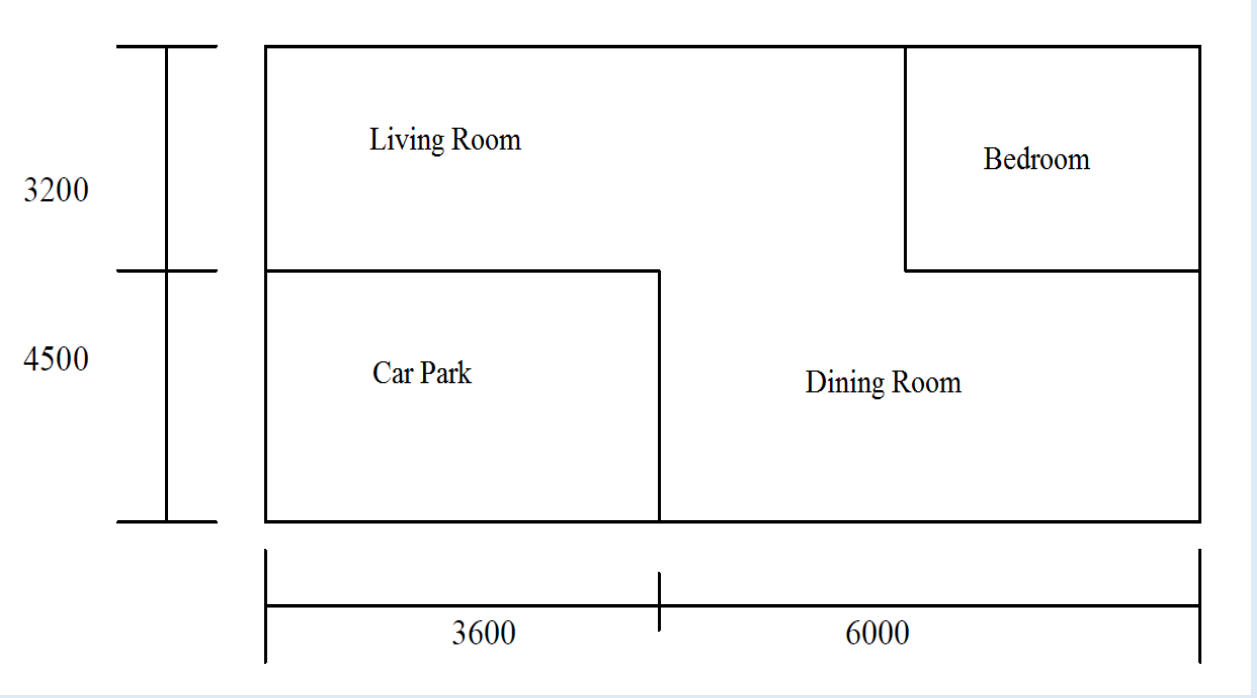
= 324.48 m² x RM 650

= **RM 210,912.00** #

EXAMPLE 03

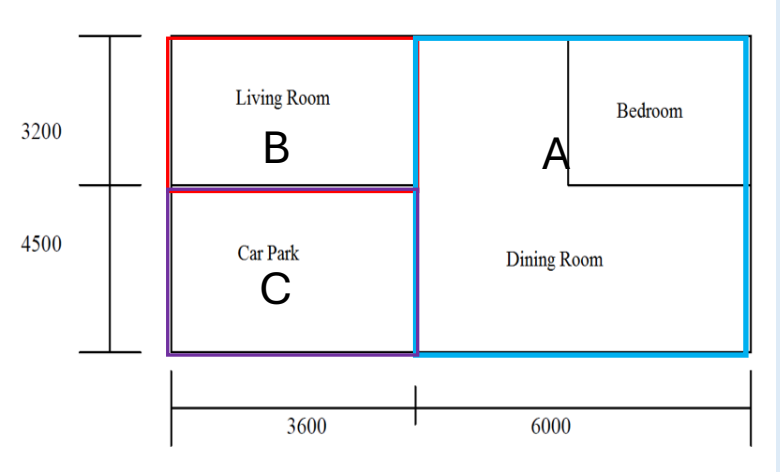
Based on the Figure 3, estimate the cost of proposed building by using Superficial Area Method. Assume price rate/m² is RM 250.00

Figure 3



SOLUTION :

1) Define the space/area.



2) Calculate each area.

	Area A	Area B	Area C (Uncovered area)
Length	6 m	3.6 m	3.6 m
Width	7.7 m	3.2 m	4.5 m
Floor Area	= 6 x 7.7 = 46.2 m²	= 3.6 x 3.2 = 11.52 m²	= ½ [3.6 x 4.5] = 8.1 m²

3) Calculate total cost.

Total estimated cost :

= (46.2 + 11.52 + 8.1) m² x RM 250

= 65.82 m² x RM 250

= **RM 16,455.00** #

TUTORIAL

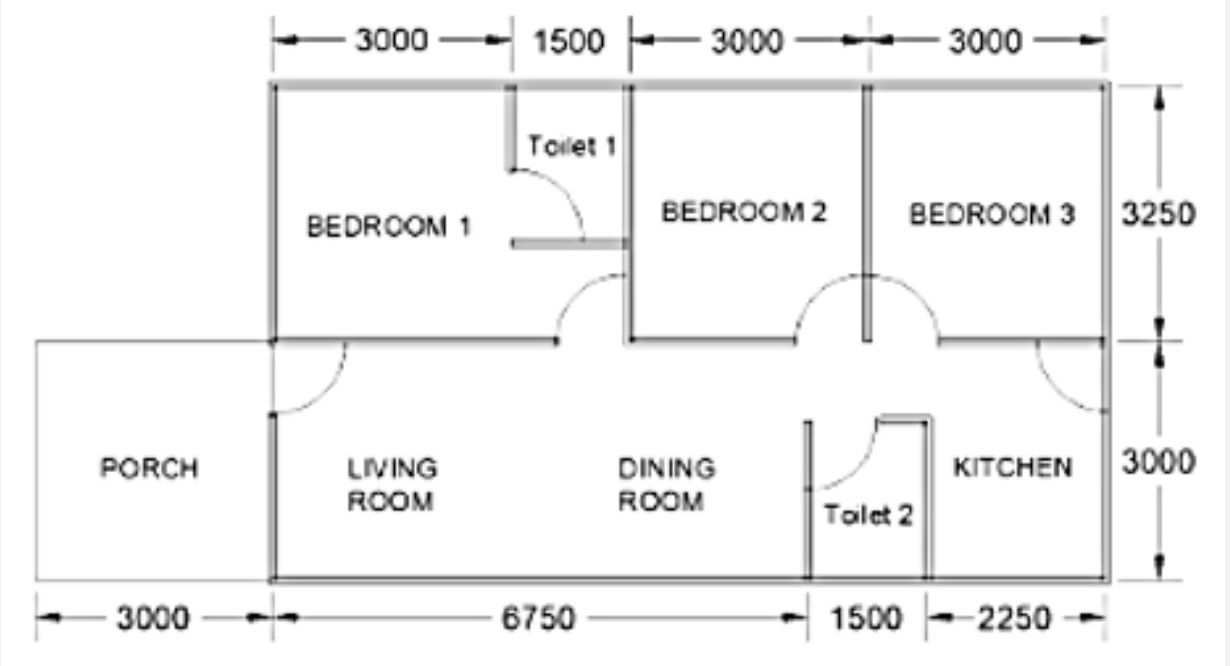
You've Got This!

QUESTION 1

Answer :
RM 35815.50

Based on Figure 4, calculate the construction cost for the building using the Superficial Area Method. Data for the previous project is RM525/m² and wall thickness is 115 mm. All the dimension is measured from center line to center-line of wall.

Figure 4



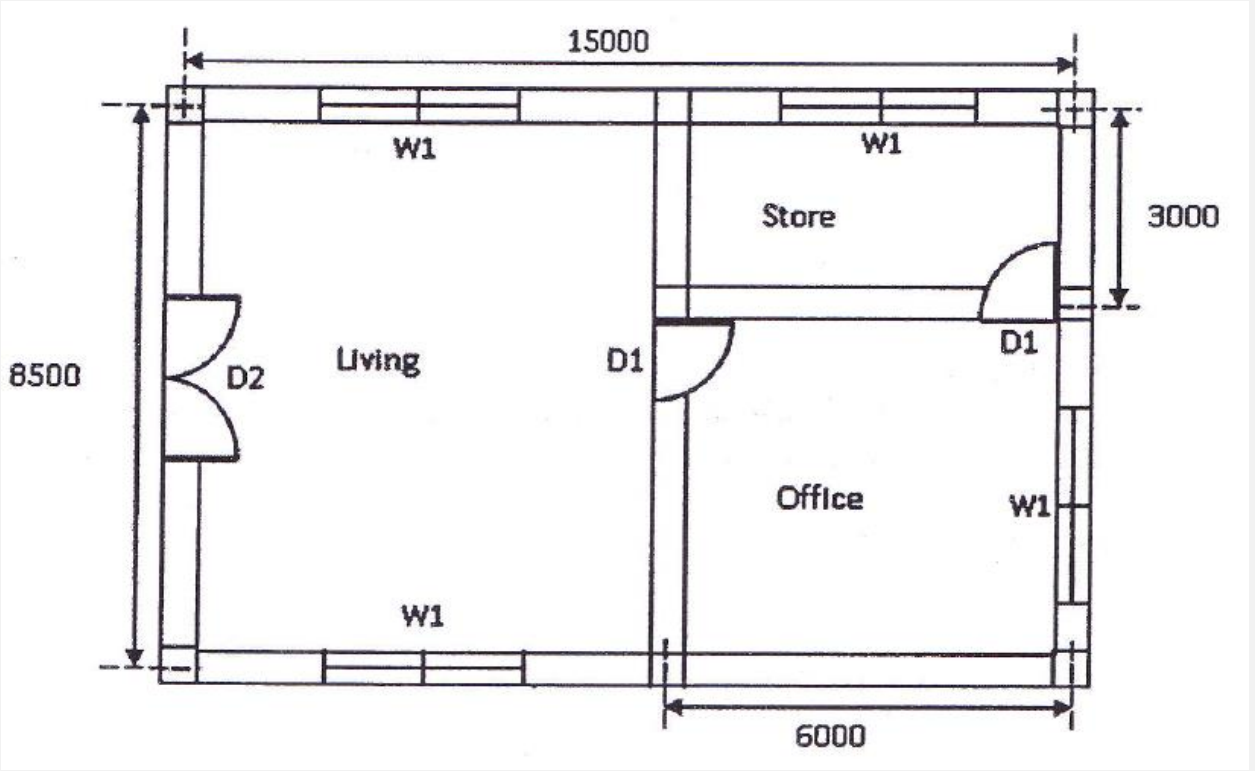
TUTORIAL
You Got This!

QUESTION 2

Answer :
RM 28094.50

Refer to Figure 5, using the superficial area method of estimating you need to show the calculation of the estimated cost for the construction. Data for the previous project is RM230/m². All the dimension is measured from center-line to center-line of wall. Wall thickness is 230 mm.

Figure 5



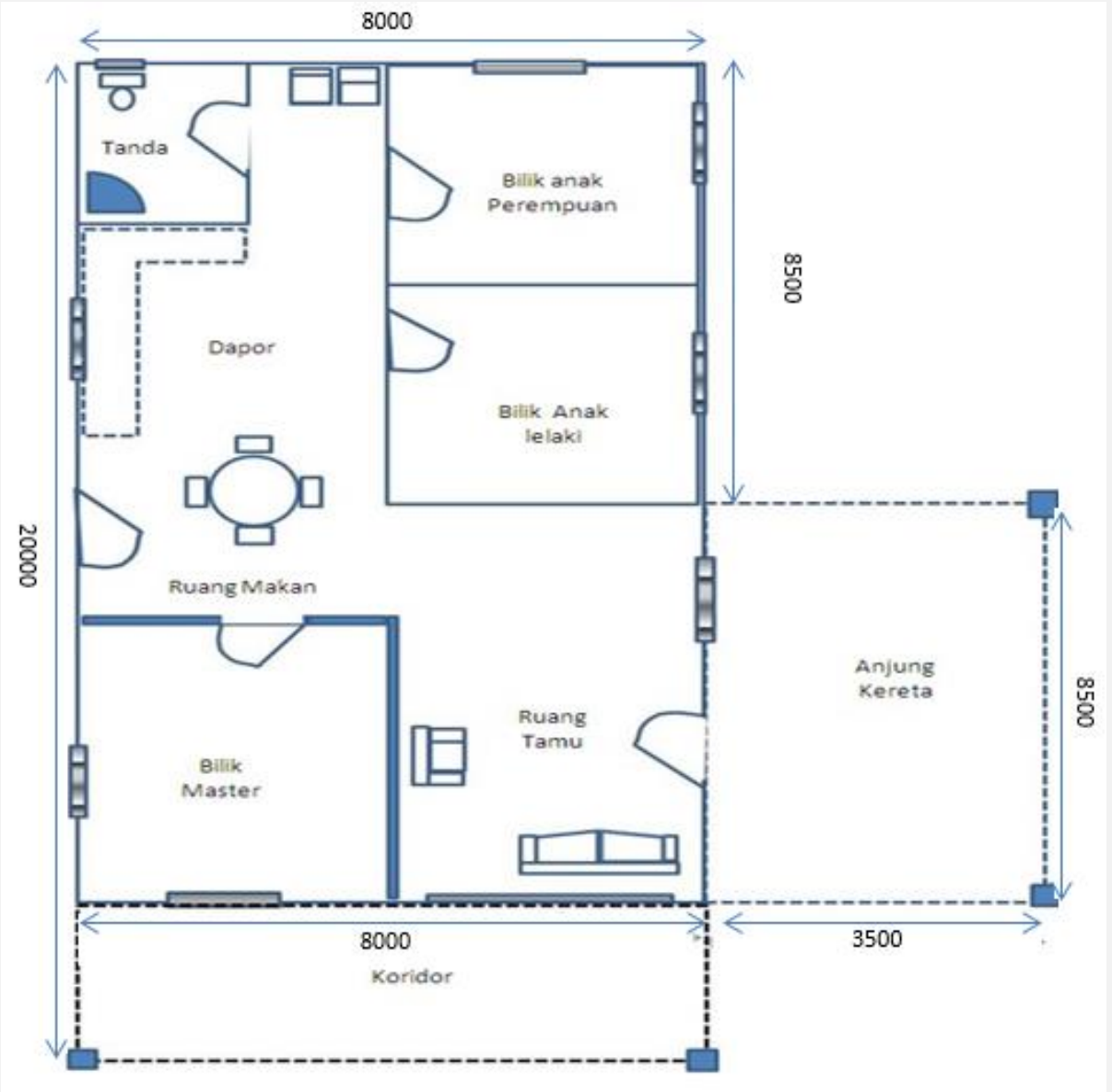
TUTORIAL
You Got This!

QUESTION 3

Answer :
RM 78135.00

Refer to Figure 6, using the superficial area method of estimating you need to show the calculation of the estimated cost for construction of a project with pitch roof. Data for the previous project is RM500/m². All the dimension is measured from center-line to center-line of wall.

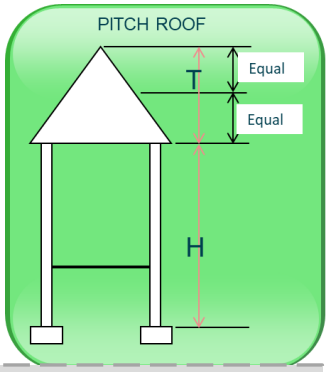
Figure 6



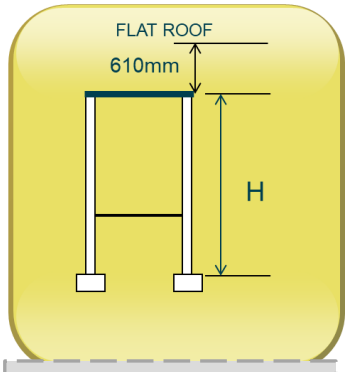
Introduction Of Cubic Content Method

This method is specific for building projects and aims to overcome the current criticism of the floor area method, which does not consider possible variations in the storey height.

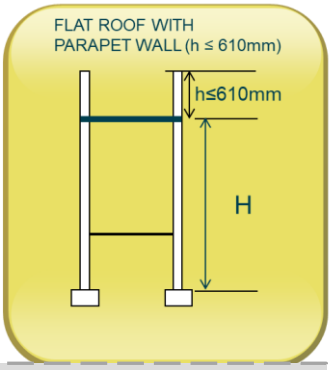
Method Of Use



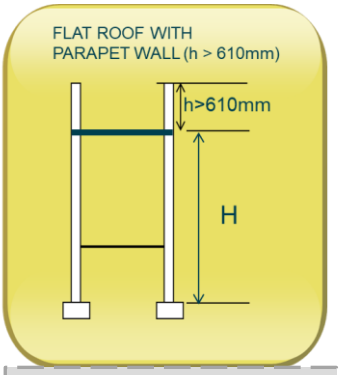
Total height = H + ½T



Total height = H + 610 mm



Total height = H + 610 mm



Total height = H + h

For pitch roof :

The height is measured from the top of foundation to a point midway between the ceiling and the apex of the roof and the intersection of wall and roof (half the height of the roof).

For flat roof :

The height is measured from the top of the foundation to 610 mm above the roof level.

For pitch roof with parapet wall (If the height of parapet wall is less than 610 mm) :

The height is measured from the top of foundation to 610 mm above roof level.

For pitch roof with parapet wall (If the height of parapet wall is greater than 610 mm) :

The height is measured from the top of foundation to the top of parapet wall.

Total Estimated Cost (RM) =

Total cubic content (m^3)

x

Unit rate (cost per m^3)

Cost per m^3 is obtained from past projects.

Advantages & Disadvantages

Advantages

It is more accurate than the superficial area method because it considers the height of the building.

A simple and quick method of estimation.

Suitable when the cubic content of a space or a building directly influences the cost of an element.

Easy to understand.

Simple mathematical process.

Disadvantages

The client is unable to anticipate the floor area of building.

Need higher skill to determine the unit rate :

- Do not express the actual cost of different parts of the building.
- Due to the large number of variables, it is difficult to adjust the unit cost.
- It doesn't provide any indication about the amount of usable space.
- Fails to take account of variations in plan, shape, storey height or total number of storeys, etc.

Experience is necessary to select an appropriate rate.

EXAMPLE 01

En. Ahmad Albab has decided to build a rest house. Refer to Figure 7, calculate the volume of the building. Given:

i. all the dimension is measured from centre-line to centre-line of wall

ii. wall thickness is 115 mm

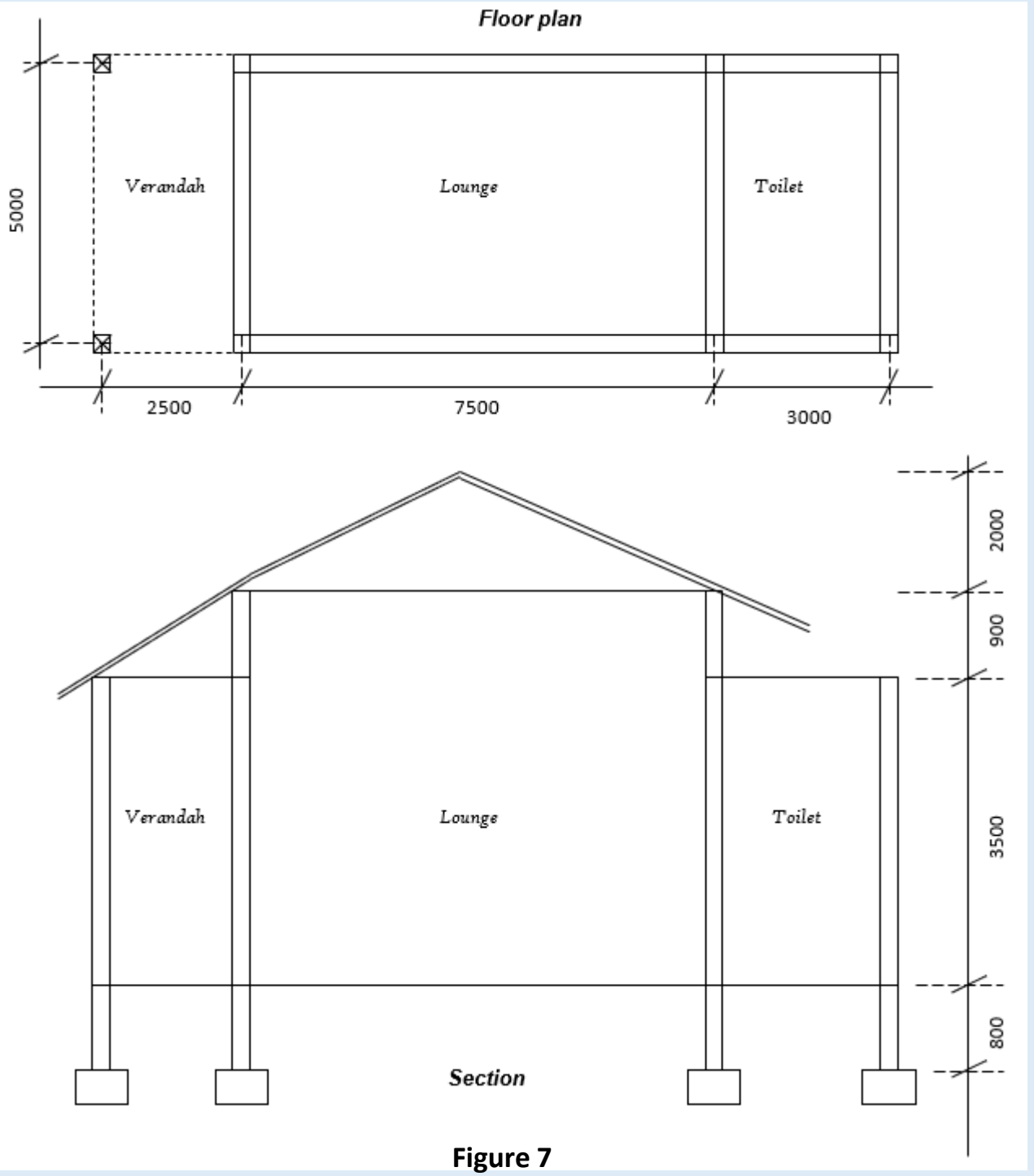


Figure 7

SOLUTION :

1) Calculate each volume.

	Verandah	Lounge	Toilet
Length (m)	2.5 + [(½ x 0.12) - (½ x 0.12)] = 2.5	7.5 + [(½ x 0.12) + (½ x 0.12)] = 7.62	3 - [(½ x 0.12) + (½ x 0.12)] = 3
Width (m)	5 + [(½ x 0.12) + (½ x 0.12)] = 5.12	5.12	5.12
Height (m)	0.8 + 3.5 + (0.9/2) = 4.75	0.8 + 3.5 + 0.9 + (2/2) = 6.2	0.8 + 3.5 + 0.61 = 4.91
Volume (m^3)	60.8	241.89	75.42

2) Calculate total volume.

$= [\ (½)\ (60.8) + 241.89 + 75.42\ ]\ m^3$

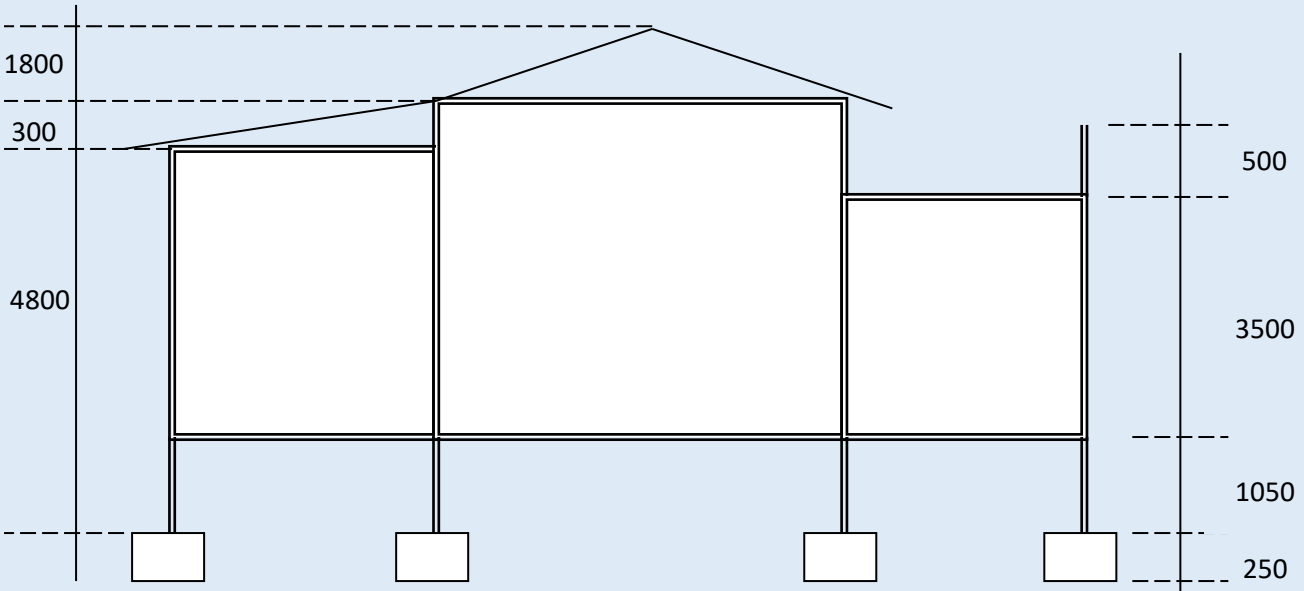
$= 347.71\ m^3$ #

EXAMPLE 02

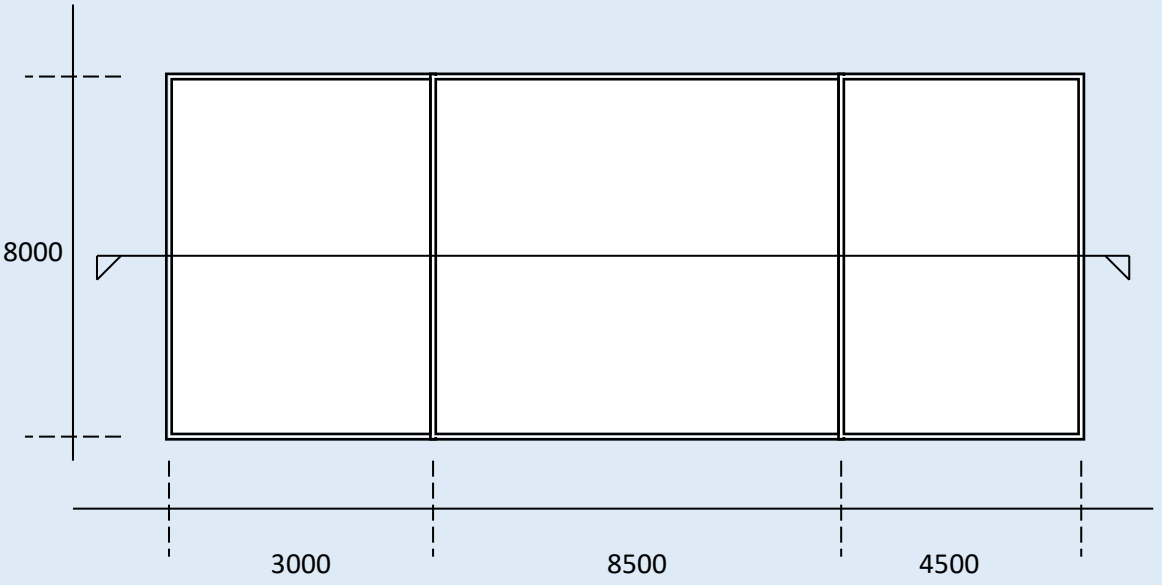
With reference to Figure 8, estimate the construction cost of the proposed building using the cubic method, if the data cost/m3 is RM450.00.

All the dimension is measured from center line to center-line of wall. Wall thickness is 230 mm.

Figure 8



SECTION A – A



FLOOR PLAN

SOLUTION :

1) Calculate each volume.

	A	B	C
Length (m)	3 + [(½ x 0.23) - (½ x 0.23)] = 3	8.5 + [(½ x 0.23) + (½ x 0.23)] = 8.73	4.5 - [(½ x 0.23) + (½ x 0.23)] = 4.5
Width (m)	8 + [(½ x 0.23) + (½ x 0.23)] = 8.23	8.23	8.23
Height (m)	4.8 + (3/2) = 6.3	4.8 + 0.3 + (1.8/2) = 6	1.05 + 3.5 + 0.61 = 5.16
Volume (m^3)	155.55	431.09	191.10

2) Calculate total cost.

Total estimated cost :

= (155.55 + 431.09 + 191.10) m^3 x RM 450

= 777.74 m^3 x RM 450

= **RM 349,983.00** #

EXAMPLE 03

Refer to Figure 9, calculate the estimated cost for construction of a project with flat roof. Data for the previous project is RM 350/m³. All the dimension is measured from center-line to center-line of wall. Wall thickness is 230 mm.

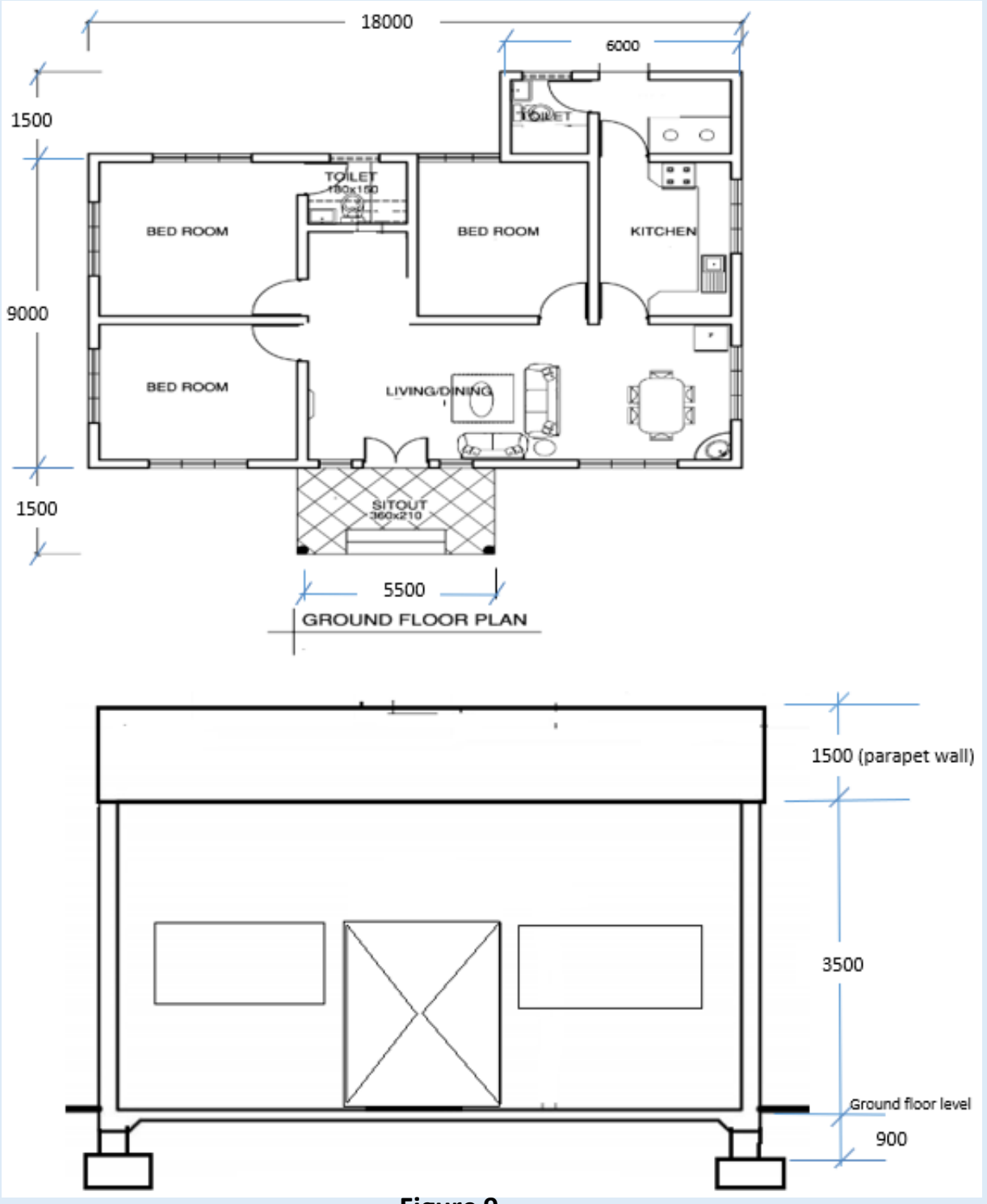


Figure 9

SOLUTION :

1) Calculate each volume.

	A (toilet)	**B** (main building)	**C** (sitout) unclosed cover area
Length (m)	6 + [(½ x 0.23) + (½ x 0.23)] = 6.23	18 + [(½ x 0.23) + (½ x 0.23)] = 18.23	5.5 + [(½ x 0.23) + (½ x 0.23)] = 5.73
Width (m)	1.5 - [(½ x 0.23) + (½ x 0.23)] = 1.5	9 + [(½ x 0.23) + (½ x 0.23)] = 9.23	1.5 - [(½ x 0.23) + (½ x 0.23)] = 1.5
Height (m)	0.9 + 3.5 + 1.5 = 5.9	5.9	5.9
Volume (m^3)	55.14	992.75	25.36

2) Calculate total cost.

Total estimated cost :

= (55.14 + 992.75 + 25.36) m^3 x RM 350

= 1073.25 m^3 x RM 350

= **RM 3,756,375.00** #

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QUESTION 1

Answer :
234.09 m³

Refer to Figure 10, calculate the volume of the building. Given :

i. all the dimension is measured from center-line to center-line of wall

ii. wall thickness is 230 mm

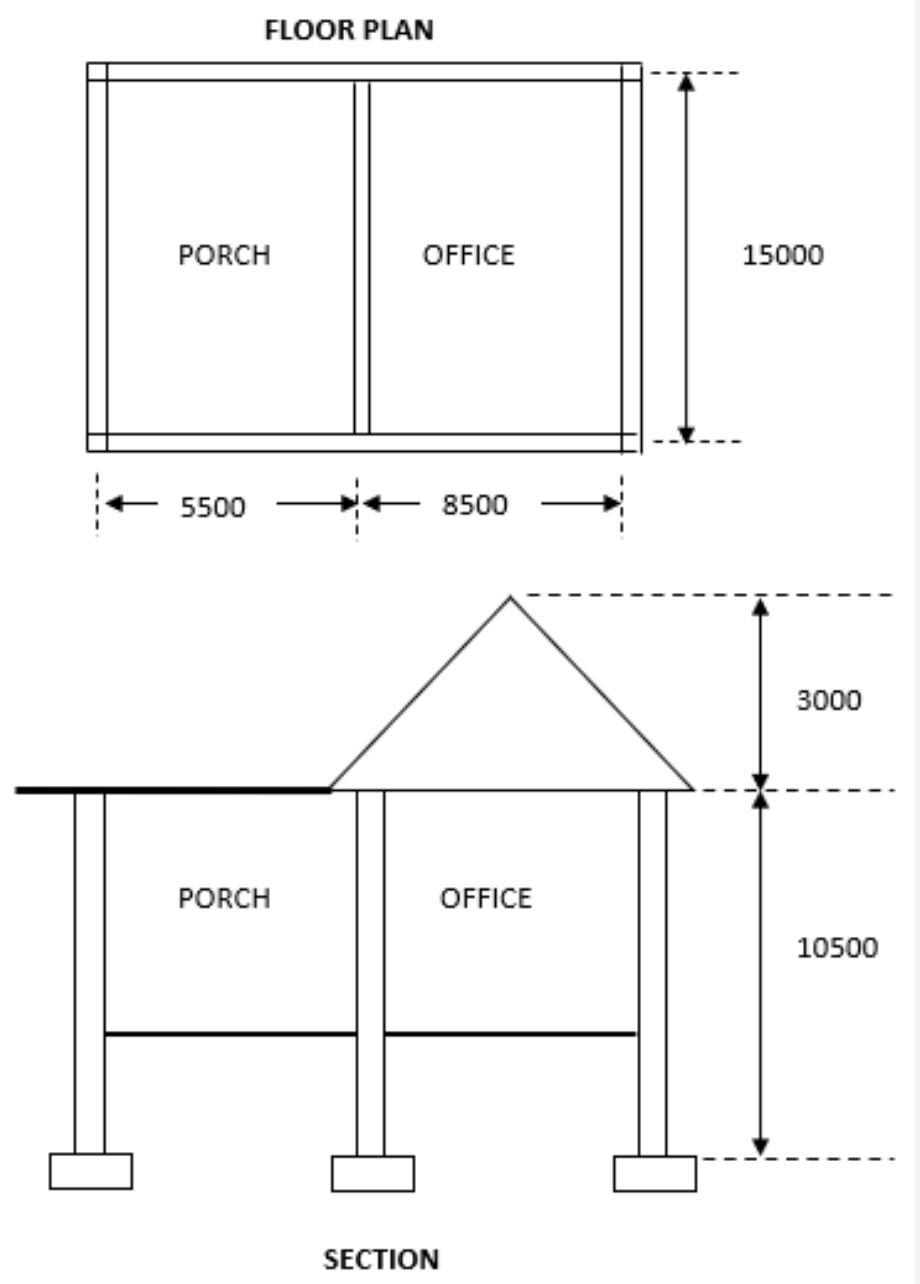

Figure 10

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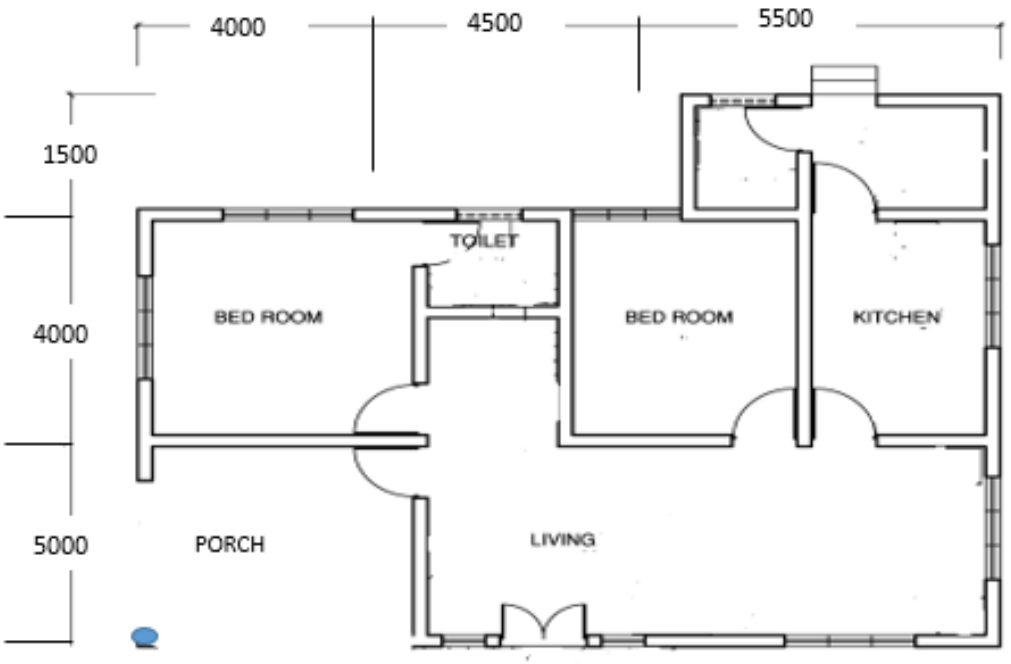
QUESTION 2

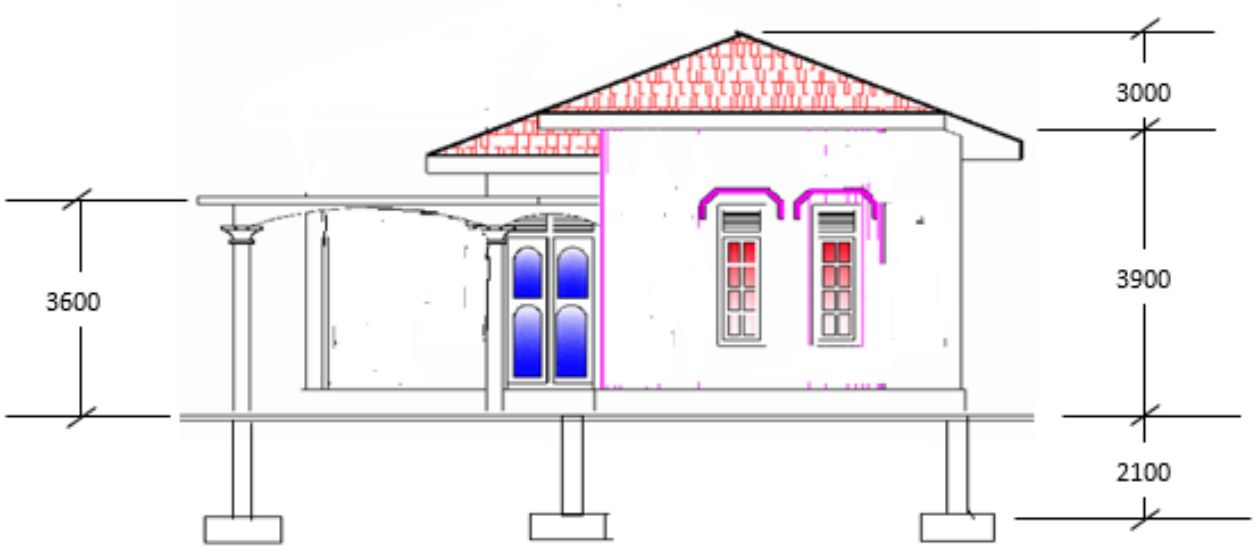
Answer :
790.34 m³

Based on Figure 11, calculate the volume of the building using the cubic content method. Wall thickness is 230 mm. All the dimension is measured from center-line to center-line of wall.

Figure 11



GROUND FLOOR PLAN



FRONT ELEVATION

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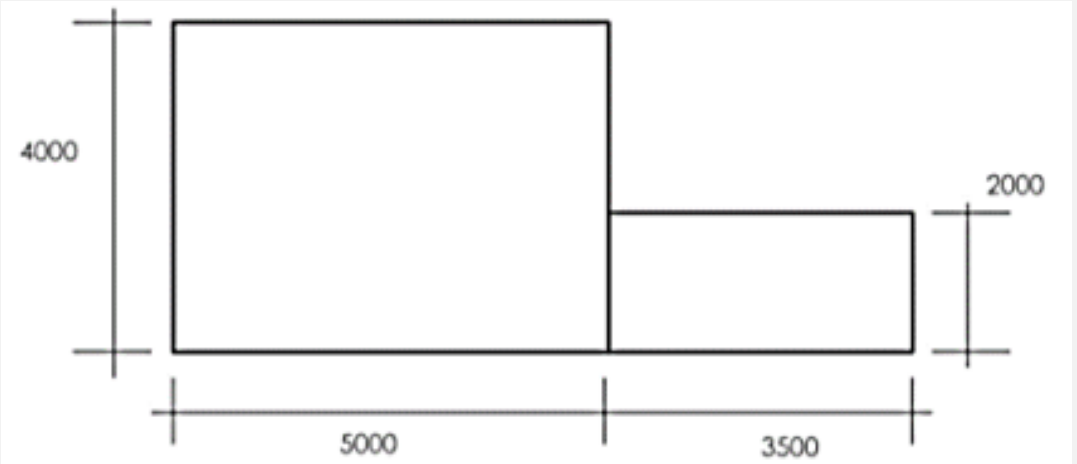
QUESTION 3

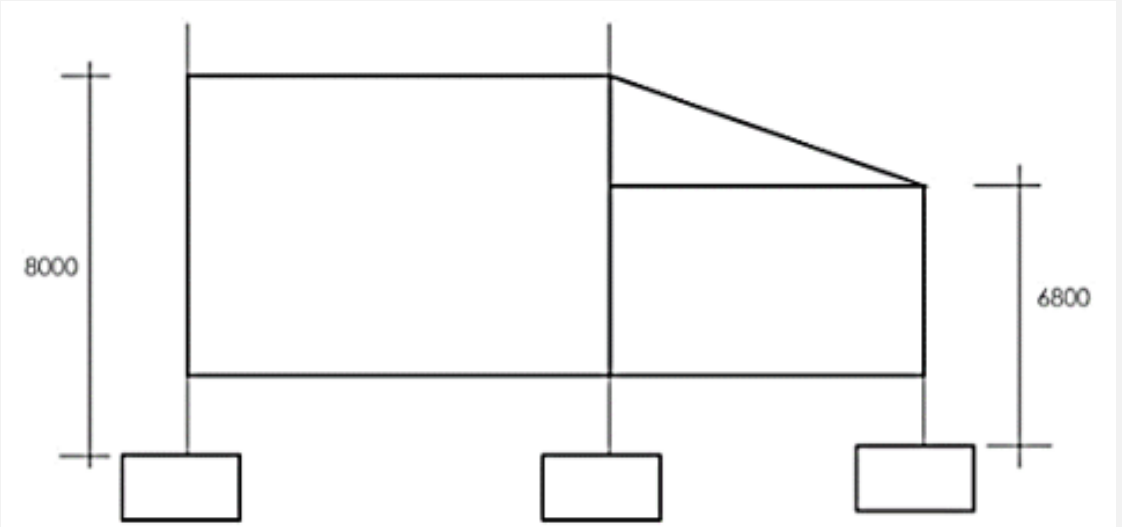
Answer :
RM 131040.00

According to Figure 12, calculate the cost of the building using the cubic content method. Assuming the price rate is RM 450/m³ and should be an additional cost about 30%. Ignore the wall thickness.

Figure 12



Floor Plan



Side View

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