Bar Bending & Concreting Level II

Learning Guide-13

Unit of Competence: carry out measurements and calculations for building structures

Module Title: carrying out measurements and calculations for building structures

LG CODE: EIS BBC2 M04 1019LO$_4$ -LG 13

TTLM CODE: EIS BBC2 TTLM 1019V1

LO4: Estimate approximate quantities

Instruction Sheet	Learning Guide # 13

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Material requirement calculations
- Formulas for calculating quantities.
- Estimating quantities from the calculations taken.
- Calculating, confirming and recording Material quantities

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

- Taken Calculations for determining material requirements
- select Appropriate formulas for calculating quantities
- estimate Quantities from the calculations taken
- calculate confirm and record Material quantities for the project

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below
3. Read the information written in the information below
4. Accomplish the “Self-check 1, Self-check 2, 3 and Self-check 4 and key answer below
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 in page -15.
6. Do the “LAP test”

Information sheet 1	Material requirement calculations

4.1 determining material requirements

Is a system for planning material requirements suitable for managing components needed to produce finished product. This technique is now widely used to plan production and procurement orders, taking into account market demand, bill of materials and production lead times.

This is all very well as long as demand is “regular”, but what happens when this is not the case?

What happens if demand is concentrated into certain periods (when the finished product is placed into production) but then drops off entirely? The error is a basic one: demand for these materials cannot be predicted but must be calculated on the basis of demand for the finished product. Production must be scheduled according to the quantity of finished products to be produced, and from this quantity you can arrive at the actual requirements for materials that go into them.

4.1.1 Methods of calculation requirement

- **Calculating gross requirements**: Gross first-level component requirements are calculated using orders to be issued (or launched) for finished products that they contain. This calculation is cascaded down through to the end of the bill of materials: from the first-level component orders to be issued we obtain the gross requirements for second-level components, and so on.
- **Calculating net requirements:** you now need to calculate net requirements for each finished product, component, assembly and sub-assembly, taking into account how many of each of these you already have in stock. The net requirement is therefore obtained by subtracting stock in hand at the end of the previous period from the gross requirement. Gross and net requirements must be accurately linked to a point in time: the date on which the finished products have to be available comes from the production plan, whilst the dates for components must be calculated backwards taking into account production or procurement lead times.

Self-Check -1	Written Test

Directions: multiple choose item

Instruction choose the correct answer

1. Gross first-level component requirements are calculated using orders to be issued (or launched) for finished products that they contain.

   A. Calculating gross requirements B. Calculating

   C. Calculating net requirements D. material requirements

2. you now need for each finished product, component, assembly and sub-assembly, taking into account how many of each of these you already have in stock.

A. the gross requirement B. calculate net requirements

C. product D. none

Note*:* Satisfactory rating –above 3 points Unsatisfactory - below -3 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer Questions

1._____

2._____

information sheet 2	Formulas for calculating quantities.

4.2 Formulas for calculating quantities.

The formulas & equations are essential for construction professionals to work out the quantities as well as cost & subtotals of building material. These formulas can be used in a wide array of construction projects and design applications which range from reinforced concrete, bridge construction, highway design etc.

A formula refers to equation demonstrating one variable as an amalgamation of other variable(s) with the use of algebraic operations like add, subtract, multiply, divide, raise to a power, apply the natural logarithm as well as the cosine, or other mixture of operations.Various issues related to construction can be easily resolved with proper application of these formulas.

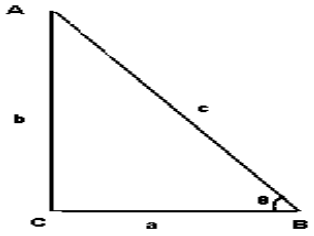
This content takes you through some formula basics, including constructing simple arithmetic are :-**Masonry work :** determining 1) number of concrete hollow blocks used and 2) number of cement volume of sand for mortar.

Concreting work: determining volume of concrete (number of cement bags, etc.) for footings, wall footing, floor slab, concrete columns (circular, rectangular), concrete beams, concrete and stairs**Steel reinforcement:** determining 1) number of bars in for footings, floor slab, columns (circular, rectangular), beams, and stairs

Carpentry: determining 1) total board foot of a lumber, understanding the all-important topic of operator precedence, and moving worksheet formulas.

4.2.1 Basic trigonometric formula

Pythagoras formula $a^2+b^2 = c^2$

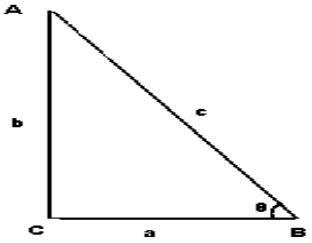


Sin θ = $\frac{b}{c}$ cosec θ = $\frac{1}{\sin \theta}$

Cos θ = $\frac{a}{c}$ sec θ = $\frac{1}{\text{Cos } \theta}$

Tan θ = $\frac{b}{a} = \frac{\sin \theta}{\text{Cos } \theta}$ cot θ = $\frac{1}{\tan \theta}$

- For any triangle
  - ✓ Cosine law



$a^2 = b^2 + c^2 - 2 * b * c * \cos A$

$b^2 = a^2 + c^2 - 2 * a * c * \cos B$

$c^2 = a^2 + b^2 - 2 * a * b * \cos C$

General formula for calculating construction material

4.2.2 Stone Masonry

a) 50cm thick basaltic or equivalent foundation wall bedded in cement mortar 1:4
   1. Stone = $1m^3/m^3$
   2. Mortar = $0.4\ m^3/m^3$
      2.1 Cement = $150\ kgs/m^3$
      2.2 Sand = $0.42m^3\ /m^3$

b) 50cm thick roughly dressed super-structure stone wall bedded in cement mortar 1:4
   1. Stone = $1.25\ m^3/m^3$
   2. Mortar = $0.4m^3/m^3$
      2.1 Cement = $150\ kgs/m^3$
      2.2 Sand = $0.42m^3/m^3$

c) 40cm thick dressed super structure stone wall bedded in cement mortar 1:4
   1. Stone = $1.50m^3/m^3$

2. Mortar = $0.40m^3/m^3$
   2.1 Cement = $150kgs/m^3$
   2.2 Sand = $0.42m^3/m^3$

4.2.3. Brick Masonry for Super-structure

a. ½ brick wall bedded in compo- mortar 1:2:9 both sides left for plastering

- Brick with 5% wastage = $58\ pcs/m^2$
- Compo-mortar (10mm joints) = $0.0353m^3/m^2$

15% wastage

- ✓ Cement = $5kgs/m^2$
- ✓ Lime = $14kgs/m^2$
- ✓ Sand = $0.034m^3/m^2$

b. One brick wall bedded in compo-mortar 1:2:9 both sides left for plastering.

- Brick with 5% wastage = $115pcs/m^2$
- Compo-mortar with 15% wastage (10mm joints) = $0.085m^3/m^2$

- ✓ Cement = $12.5kgs/m^2$
- ✓ Lime = $34kg/m^2$
- ✓ Sand = $0.081m^3/m^2$

4.2.4 Hollow Block Masonry for Super-Structure

A. 10cm thick hollow concrete block wall bedded in cement mortar 1:4

- Hollow block with 5% wastage = $13\ pcs/m^2$
- Mortar 10mm joints 20% wastage = $0.0135m^3/m^2$
  - ✓ 2.2 Cement = $5\ kgs/m^2$
  - ✓ 2.2 Sand = $0.014m^3/m$

B. 15cm thick hollow concrete block wall bedded in cement mortar 1:4.

- Hollow block with 5% wastage = $13\ pcs/m^2$
- Mortar 10mm joints 20% wastage = $0.020m^3/m^2$
  - ✓ Cement = $7.5kgs/m^2$
  - ✓ Sand = $0.022m^3/m^2$

C. 20cm thick Hollow concrete block wall bedded in cement mortar 1:4

- Hollow block with 5% wastage = 13pcs/m^2
- Mortar 10mm joints 20% wastage = 0.027m^3/m^2
  - ✓ Cement =10kgs/m^2
  - ✓ Sand = 0.028m^3/m^2

4.2.5 Concrete work

- **Basic data**
  - ✓ Density of cement - - - - 1400 kg/m^3
  - ✓ Density of Sand - - - - 1840 kg./m^3
  - ✓ Density of Stone Aggregate - - - - 2250 kg/m^3
  - ✓ Assume 30% Shrinkage and 5% wastage.

Assume:-

- ✓ Concrete Mix = 1:3:6
- ✓ Let volume of concrete = Zm^3
- ✓ Assuming 30% Shrinkage
  - 5% Wastage
- ✓ For: Mechanical mix Water/Cement = 0.4-0.5

Hand mix Water /Cement = 0.4-0.65

$$then \quad a)\ Cement = \frac{1}{10} \times Zm^3 \times 1400 kg/m^3 \times 1.30\ shrinkage \times 1.05\ wastage$$
$$= 191 kg\ Z$$
$$= 0.41 m^3\ Z$$

$$b)\ Sand = \frac{3}{10} \times Zm^3 \times' 1840\ kg/m^3 \times 1.30\ shrinkage \times 1.05\ Wastage$$
$$= 754\ kg\ Z$$
$$= 0.41\ m^3$$

$$c)\ Aggregate = \frac{6}{10} \times Zm^3 \times 2250\ kg/m^3 \times 1.30\ Shrinkage \times 1.05\ Wastage$$
$$= 1843 kg \times Zm^3$$
$$= 0.82 \times Zm^3$$

Self-Check -2	Written Test

Directions: multiple choose item

Instruction choose the best answer

1. are essential for construction professionals to work out the quantities as well as cost & subtotals of building material.

   A. formulas & equations B. material C. quality D. none

2. which of the following the density of cement is

A1600kg/m^3 B. 1400 kg/m^3 C. 1840 kg./m^3 D. 2250 kg/m^3

Note: Satisfactory rating –above 4 points Unsatisfactory - below -4 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer Questions

1._____

2._____

information sheet 3	Estimating quantities from the calculations taken

4.3 Estimating quantities from the calculations taken

4.3.1 introduction of estimating

Building construction estimating is the determination of probable construction costs of any given project. Many items influence and contribute to the cost of a project; each item must be analysed, quantified, and priced. Because the estimate is prepared before the actual construction, much study and thought must be put into the construction documents.

During the design process, the contractor prepares and maintains a cost estimate based on the current, but incomplete, design. In addition, the contractor may prepare estimates that are used to select between building materials and to determine whether the cost to upgrade the materials is justified. What all these estimates have in common is that the design is incomplete. Once the design is complete, the contractor can prepare a detailed estimate for the project.

4.3.2 Purpose of estimating

Is to give a reasonably accurate idea of the cost. .The **estimate** of a work and the past experience enable one to **estimate** quite closely the length of time required to complete an item of work or the work as a whole

The process of calculating the quantities (The quantity with reference to the measurement in the drawings, i.e. plans, elevation, section) and cost of various construction items i.e. excavation, concreting, masonry, plaster etc. of the project is called an “estimate”.

As the word suggests, it is an estimate of what the cost would be on completion. It can be based on “lump sum” i.e. thumb rule bases like plinth area or per sqft rate at the conceptual stage. Once plans are decided it has to be in details for its methodical & scientific planning and execution or say for right construction management and selection of materials. It will form the bases of so many decision and documents and will play an important role in the choice/selection of material as well as /construction technology.

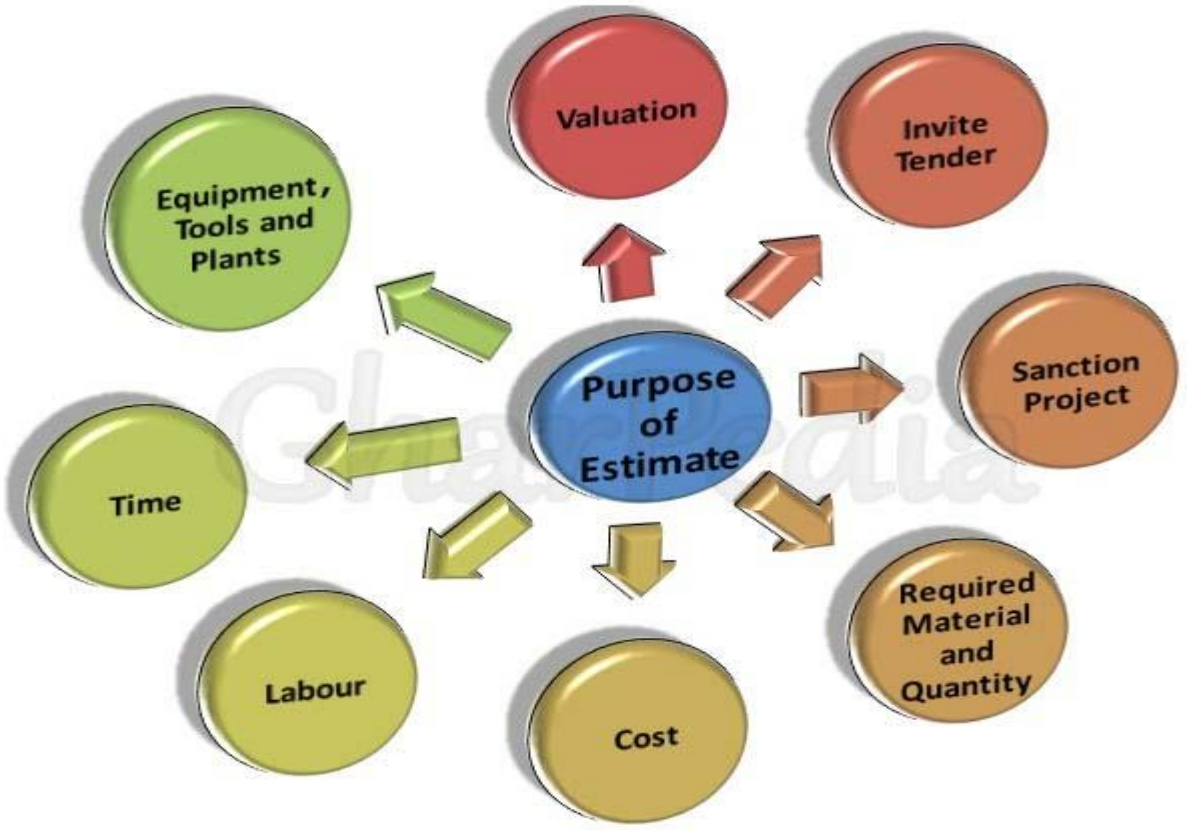


Figure 3.1 **Purpose of estimating**

4.3.3. Estimating methods

The required level of accuracy coupled with the amount of information about the project that is available will dictate the type of estimate that can be prepared. These estimating methods require different amounts of time to complete and produce different levels of accuracy for the estimate.

The different estimating methods are discussed below:-

- **Detailed Estimate:** - The detailed estimate includes determination of the quantities and costs of everything that is required to complete the project. This includes materials,

labor, equipment, insurance, bonds, and overhead, as well as an estimate of the profit. To perform this type of estimate, the contractor must have a complete set of contract documents. Each item of the project should be broken down into its parts and estimated

- **Assembly estimating: -** In assembly estimating, rather than bidding each of the individual components of the project, the estimator bids the components in groups known as assemblies. The components of an assembly may be limited to a single trade or may be installed by many different trades.
- **Parametric Estimates: -**Parametric estimates use equations that express the statistical relationship between building parameters and the cost of the building. The building parameters used in the equation may include the gross square footage, number of floors, length of perimeter, percentage of the building that is common space, and so forth. For an equation to be usable the parameters used in the equation must be parameters that can be deter-mined early in the design process; otherwise the equation is useless.
- **Square-Foot Estimates: -**Square-foot estimates are prepared by multiplying the square footage of a building by a cost per square foot and then adjusting the price to compensate for differences in the building heights, length of the building perimeters, and other building components. In some cases, a unit other than square footage is used to measure the size of the building. For example, the size of a parking garage may be measured by the number of parking stalls in the garage
- **Model Estimating: -**Model estimating uses computer models to prepare an estimate based on a number of questions answered by the estimator. Model estimating is similar to assembly estimating, but it requires **less input** from the estimator.
- **Project Comparison Estimates: -**Project comparison estimates are prepared by comparing the cost of a proposed project to a completed project. When preparing an estimate using this method, the estimator starts with the costs of a comparable project and then makes adjustments for differences in the project.

Self-Check -3	Written Test

Directions: multiple choose item

Instruction choose the correct answer

1.___ is the determination of probable construction costs of any given project. Many items influence and contribute to the cost of a project; each item must be analysed, quantified, and priced.

A. Building construction estimating B. quantity C. quality D. all

2. determination of the quantities and costs of everything that is required to complete the project. This includes materials, labor, equipment, insurance, bonds, and overhead, as well as an estimate of the profit.

A Model Estimating B. Detailed Estimate C. Parametric Estimates D. none

Note: Satisfactory rating –above 3 points Unsatisfactory - below -3 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer Questions

1._____

1. _____

information sheet 4	Calculating confirming and recording material quantities

4.4 Calculating confirming and recording material quantities

4.4.1 introductions of material quantities

Construction Materials quantitiesseeks to publish original research and practice papers of the highest quality on procurement, specification, application, development, performance and evaluation of materials used in construction and civil engineering. Papers are particularly sought on metals, timbers, glass, ceramics, bricks, terracotta, stone, rubber, finishes, plastics, sealants, adhesives, bitumen and fabrics. Papers on innovative and recycled materials and novel applications of other materials such as concrete and cement are also encouraged. All aspects of a material's life are addressed including embodied energy, environmental impact, service life, refurbishment, recycling and reuse.

Records to be maintained at construction sites play important role in construction activities. It is a document required to prove any construction activity has taken place at site during billing or any other claims.

These records have all the data of various construction activities carried out at site. If any additional work has been carried out and it is claimed during billing, these documents need to be produced as a proof.

Maintenance of records also helps during audits of construction projects at any point of time. These documents helps to defend any claims such as liquidated damages or false claims or violations of any guidelines by authorities or clients.

4.4.2 Records at Construction Site

The following are the various records that need to be maintained at construction site,

1. Drawings: First and foremost import records to be maintained on site are the working drawings approved by the clients and design engineer, based on which all the construction

activities takes place on site. There are different types of drawings required for construction; some of the basic required drawings are,

- Architectural drawing
- Structural drawing
- Plumbing & sanitary drawing
- Electrical drawing
- Finishing drawing etc.

2. Contract Agreement: Contract agreement documents including all sets of drawings, including amendments, a co estimating of approval of municipality, corporation or urban development authorities need to be maintained at construction sites till the completion of construction projects. These documents provide permission and guidelines for all the activities carried out at the construction site.

3. Work Orders Book: All the orders given by clients to the contractors need be maintained with serial numbers, signatures and dates. These orders should be specific for works. This order should also have a compliance column.

4. Works Diary: Works diary of a construction project should indicate contract agreement number, name of work, amount of contract, date of commencement of work, date of completion and extension time granted.

All the relevant details need be entered daily in the works diary. This diary serves as an authentic record.

Self-Check -4	Written Test

Directions: multiple choose item

Instruction choose the correct answer

1. the basic required drawings are :(**3 points)**
   A. Architectural drawing
   B. Structural drawing
   C. Plumbing & sanitary drawing
   D. All are correct
2. All the orders given by clients to the contractors need be maintained with serial numbers, signatures and dates. These orders should be specific for works. This order should also have a compliance column.
   A. Work Orders Book B. Works Diary C. Contract Agreement D. all

Note Satisfactory rating – above 3 points Unsatisfactory - below -3 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer Questions

1. _____
2. _____

Operation Sheet 1	Select Appropriate formulas techniques

Techniques for select appropriate formulas:

Procedure:-

Step 1: Prepare your self before the calculation

Step 2: prepare calculation instrument and A4 size paper.

Step 3: prepare calculation format on the A4 paper

Step 4: calculate brick, block and mortar materials for $3m^2$.

Step 5: collect your calculation result and summit your teachers.

- **by using the above procedure do the following LAP test**

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks with in 2 hour.

Task.1. Select appropriate formulas

Self check 1

Key answer

1.A 2.B

Self check 2

Key answer

1.A 2.B

Self check 3

Key answer

1.A 2.B

Self check 4

Key answer

1.D 2.A

Reference

- https://www.youtube.com/watch?v=l7K2Vl9GZ3I
- https://www.youtube.com/watch?v=l7K2Vl9GZ3I
- https://www.youtube.com/watch?v=KEvHwvrkwbU

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