Week 1 Lecture

Objectives

1.Apply the Standard Method of Measurement (SMM) to quantification of the works for simple buildings.
2.Measure quantities for groundworks; masonry (Brickwork); concrete/reinforcement and formwork; simple timber pitched timber roof; roofing, and finishes.
3.Describe a bill of quantities
4.Produce a bill of quantities for groundworks; masonry (Brickwork); concrete/reinforcement and formwork; simple timber pitched timber roof; roofing, and finishes.
5.Investigate and price measured building work items in a Bill of Quantities (BoQ).
6.Explain the application of computer software to measurement of building works.
7.Demonstrate understanding of the theory and practice of competitive tendering.
8.Explain the role of cost management of building works.

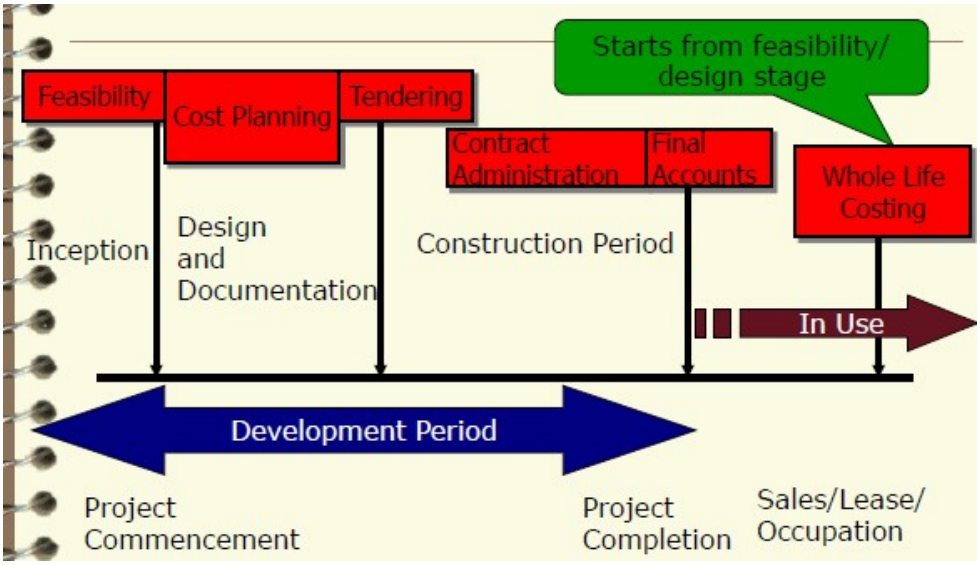
Measurement & Cost Management

- Cost = the expense that a business incurs in bringing a product or service to market
- Cost Management = from initial start through to finish (even design stage)
- Those responsible = quantity surveyors
- *Why* we do this = manage and measure risk, provide a figure for the client, to make a profit, assess completion (time estimate), to know how much to pay the builder

Trades & Elements

- *trade* = a **service** – e.g. concreting, painting, brickworkers etc.
  = done by a group of workers
- *elements* = the **actual component**/ material e.g. paint, timber, roof, window, upper floors etc.
  = any part of a building that performs a function
  = can combine many trades

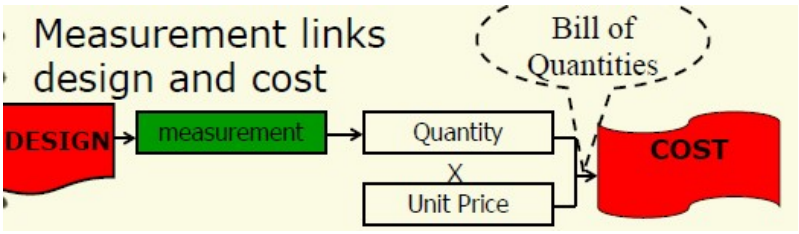
Development Cycle and Cost Management



Cost Management Process

- Budget setting – Cost Planning
  –Determining and Allocating Client's budget
- Tendering (Measurement and Pricing/cost estimating; selecting the right contractor).
- Contract Administration
  –Cost control: Variations - cost monitoring, checking, reporting, and remedial action
- Life Cycle Costing analysis

Pre-contract estimation of cost



Bill of Quantities

= should describe the materials and workmanship + be provisional for items that cannot be determined at that material time or cannot be measured accurately (the design is probably not complete/may have errors.

- Everything has a code
- Summary page at the end
- If you have to make a guess of price for a potential client – USE A COMPARIBLE PREVIOUS PROJECT

❖ Quantities are measured to facilitate estimation of cost, payment of work done, payment of work due to be carried out later and evaluation of design alternatives.

❖ Quantities are used for tender, feasibility studies, comparative study of material selection and decision making.

❖ Quantities measured can be read and understood by others.

❖ Order of measurement and sequence of measurement are important.

Measurement and Contract Arrangement

- Lump Sum Contract with Drawings and Specifications
  - measurement is done only to value variations
- Lump Sum Contract with Firm Bill of Quantities
  - Quantities form the basis of the contract: must be accurate
  - Quantities not subject to re-measurement
  - re-measurement is done only for provisional quantities items and for valuing variations
- Re-measurement Contracts with Approximate Bill of Quantities.
  - Quantities are approximate, and are subject to re-measurement upon completion of works on site – common in civil engineering projects (capital projects)
- Schedule of Rates Contracts: commonly used where accurate measurement of quantities is not possible (e.g. Maintenance/refurbishment works).
- Design and Build Contracts

Pre-requisites

- Interpretation of drawings
- Familiar with SMM
- Sound knowledge of construction methods and technology
- Building regulations, bye-laws and code of practices

'Taking Off'

= The process of measurement of quantities and booking them in specific order and method in accordance with the rules and principles of the Standard Method of Measurement.

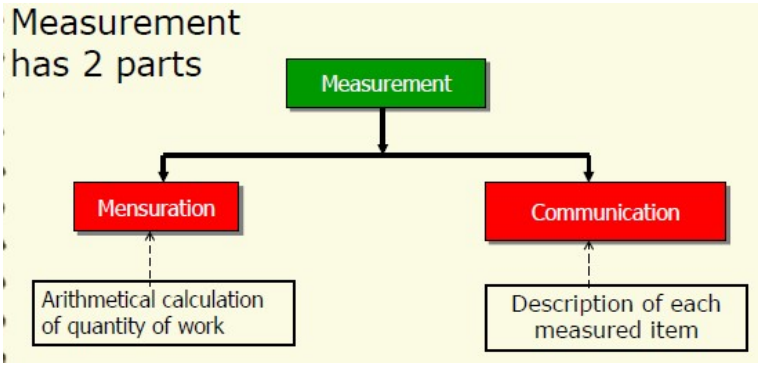
= The procedure by which dimensions of the works are calculated or scaled from drawings and entered onto dimension paper specific order and method in accordance with the rules and principles of the Standard Method of Measurement (SMM) ..

SMM (standard method of measurement) & Taking Off

- Measurement of building quantities are done in accordance with the *guidelines* stated in the Standard Method of Measurement of Building Works.
- Current edition is ASMM 6th Edition (2015) (Australian Standard Method of Measurement of Building Works)

Objectives of measurement for cost estimation

- To help define the scope of work.
- To enable quantitative comparison of alternative methods of construction.
- To highlight the cost significant items and facilitates cost monitoring.



Measurement Process Principles:

- *Entering dimension*

	Length Width Depth		Order of booking a dimension

- *Spacing of items*
  •Leave sufficient space between all items on the dimension sheets. Why?:
  – easier to follow the dimensions
  – When items are left out they can easily be inserted without making the take off sheet untidy.
  • Take note of this point as it may affect the neatness of your work and, your mark.
- *Use of symbols and abbreviations*
  - Standard abbreviations are often used to reduce the length of description.
  - Repetitive terms are often abbreviated.
  - With the computer functions of copy and paste this has made the use of abbreviation less desirable.
  Standard symbols are also used to reduce the length of description.
  Examples: m (metre); m² (sq.m); m³(cu.m); mm (millimeter); nr (number), kg (kilogram); t (tonne); < (less than), >(exceeding); ≤ (not exceeding) ; ≥ (equal to or exceeding); – (hyphen; used to denote range of dimensions)
- *Timesing and Dotting on*

4/	4.20		**Timesing** 16 Ø HT reinf bars in grd beams
2•4/	4.20		**'Dotting on'** 16 Ø HT reinf bars in grd beams

Figured/ Given/ Specified Dimensions

QUANTITY SURVEYING DIMENSION PAPER

A4 Size (210mm x 297mm)

1	2	3	4	1	2	3	4

= what quantity surveyors use to calculate the quantities

= 4 columns (2 sets of tables per page)

Column 1: Timesing

Column 1 is called the 'timesing' column in which multiplying figures are entered when there is more than one of the particular item being measured. (Don't want to repeat dimensions that are the same)

3	4.00 3.60		35mm thick hardened cement and sand (1:3) on floor (store 1, 2 &3)

Column 2: Dimension Column

•Actual dimensions, as scaled or taken direct from drawings, are entered in Column 2.

•There may be one, two or three lines of dimensions in an item depending on whether it is **linear (1)** – e.g. skirting boards, **square (2**) – e.g. bricks, or **cubic (3)** – e.g. concrete footing, measured m³

- UNIT = METRES!

- if 3 dimensions:
  - 1st = length
  - 2nd = width
  - 3rd = depth

			Linear Dimension
	4.20		16 Ø HT reinf bars in grd beams
			Square dimension
	4.00		230 wall in comm bks
	3.60		renderd b/s (m/s)
			(garage
			Cubic dimension
	4.20		Reinf conc 25 Mpa
	0.50		in strip footing
	1.00		(garage

Column 3 – Squaring Column

In column 3 the length, area or volume obtained by multiplying together the figures in columns 1 and 2 is recorded.

To 2 decimal places!

	4.00		230 wall in comm bks
	3.60	14.40	renderd b/s (m/s)
			(garage

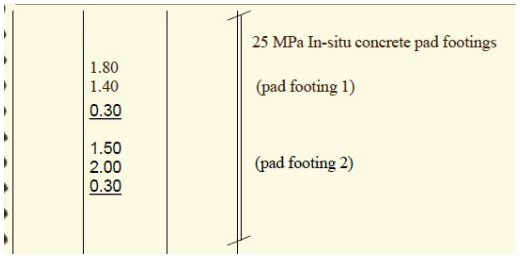
Column 4 = Description Column

- The second part of measurement is communication
- Communication involves description of measured items
- The description of each item is entered in column 4 – once all written, put a bracket/line below
- It describes the item of work taken-off in the most precise manner including all essential information relating to material and workmanship.

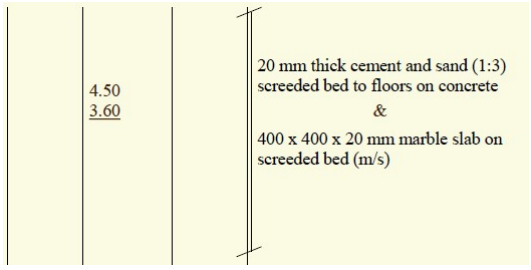
The **right hand side of description column** is referred to as '**WASTE'**

- Waste is where preliminary calculations, build-up of lengths, explanatory notes, location of measured work, and the like are written.
- Waste shows how a dimension was arrived at - workings
- Waste allow checking

- *Grouping of Dimensions and Bracketing*
  - Grouping of several bookings of dimensions under one description with the use of bracketing
  - To embrace several sets of dimensions with one descriptions →



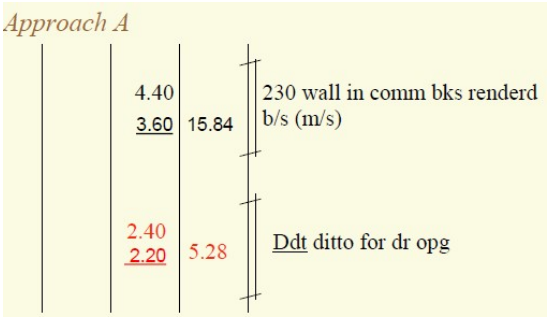
To embrace more than one description for one set of dimension →

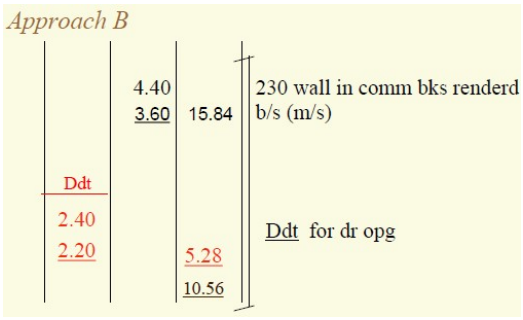


- *Deductions*

=Ddt

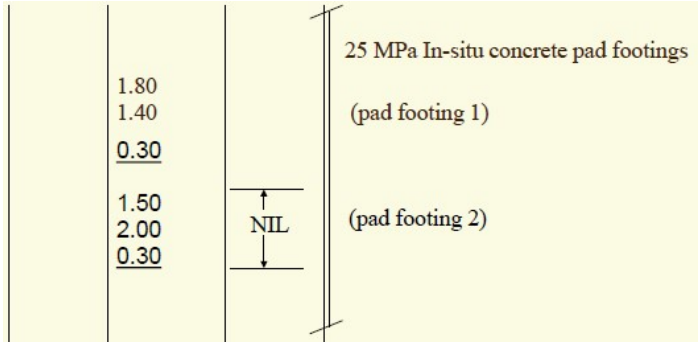
e.g. describe wall and it's measurements & deduct space for windows





(abstracting ↑??)

- *Altering Dimensions*



- *Extra Over Items*
  - When measuring certain types of work they are described as being extra over another item of work which has been previously measured.
  - This would mean that additional cost will be allowed for the second item as compared with the first.
  - Example: E.o. common bricks for fairface brick work. = more aesthetic that common bricks (joints)
    = "extra over common bricks for fairface bricks"

= measure everything + add extra things/materials needed e.g. excavating groundwater

- *Adjustment of Opening and Voids*
  - Measure from whole to part
  - Measure full area and then adjust for any voids or openings

Figured/Given/Specified Dimensions

- Specified dimensions on drawings should always be used whenever possible.
- Use scale rule when no dimension is specified.
- Where drawing is not to scale use figured dimension of other items and pro-rate it for the item to be measured.

Query Sheets

= Used by the QS to clarify issues or discrepancies with the architect

= not as common, nowadays use computers/email

QUERY SHEET

Questions (Benson, AA, 1st March 2010)	Answers (Raymond, P. 12th March 2010)
(1) What is the mix of concrete in Foundations	1:2:4
(2) Is Door 2 a Fire rated Door?	Yes
(3) What is the width of the cavity in foundation wall ?	60 mm

Mensuration

= arithmetical calculation of quantity of work

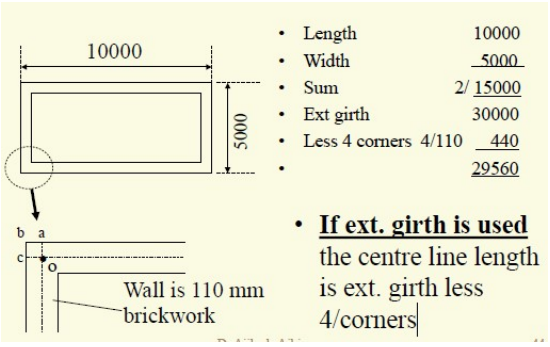
Accuracy of Dimensions

- All dimensions should be as accurate as possible.
- Accepted **limit of permissible error is ±1%** based on full working drawings.
- Working in waste calculation should be to the nearest millimetre

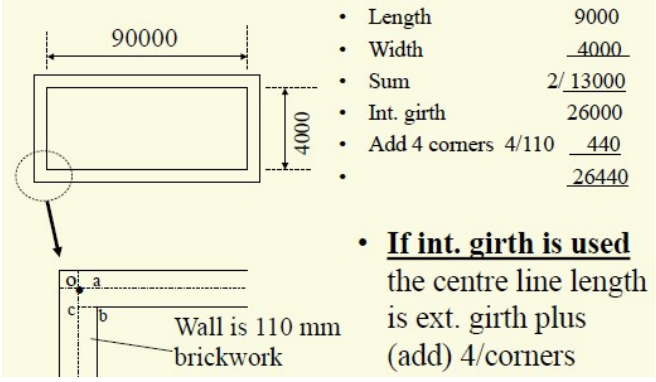
Mensuration is concerned with the **measurement of areas and volumes of triangles, rectangles, circles**, etc.
- when dealing with CURVED SURFACES = *keep separate from straight surfaces*

- GIRTH = the perimeter = 2(L+W)
- CENTRE LINE OF MEASUREMENT: To calculate the length of wall we can either use the external (ext.) girth or the internal (int.) girth

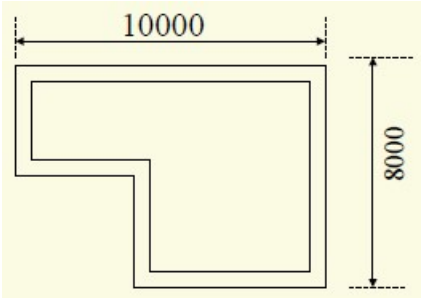
- If **ext. girth** is used the centre line length is ext. girth **less** (**minus**) 4/corners



- If **int. girth** is used the centre line length is ext. girth **plus (add**) 4/corners

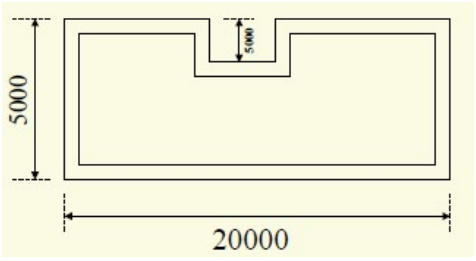


- building with **set-back:**



- Take external girth
- Ext. corners less Int. corners
- Girth less 4/corners will be the length of wall

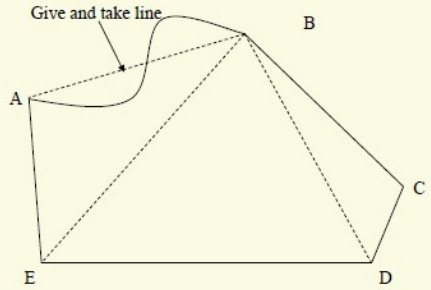
- building with **recess**



- Take the ext. girth
- Add twice the recess depth
- Less 4/corners

Measurement of Area

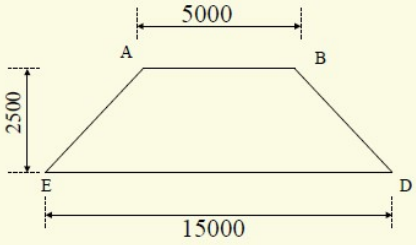
1. Irregular areas



Area = ΔEAB+ Δ EBD+ Δ DBC

Area of triangle = ½ (base x height)

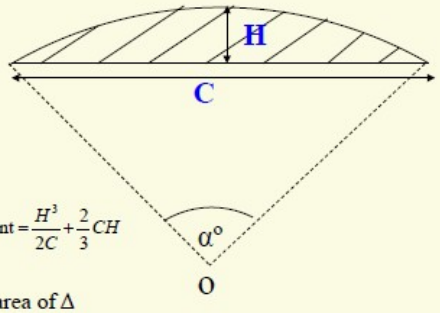
2. Trapezoids



Area = Average length x width

½ (ED + AB) x 2500

Segment (part of a circle bounded by an arc and chord)



area of the hatched segment $= \frac{H^3}{2C} + \frac{2}{3}CH$

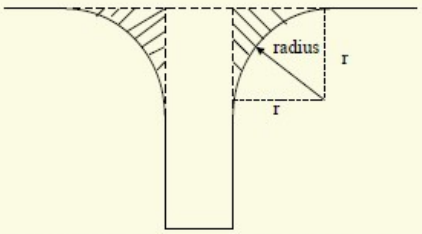
OR

= Area of sector – area of Δ

Area of sector = ½ (length of arc x radius)

Length of arc = $\frac{\text{(angle } \alpha\text{)} \times \text{(circumference of whole circle-2}\pi r)}{360^\circ}$

Bellmouths



Area of each segment = r^2 - ¼ (π r^2)

$$= r^2 - (\frac{1}{4})(\frac{22}{7})r^2 = \frac{3}{14}r^2$$

Measurement of Volume

- Suggest some aspects of a building that may require the measurement of volume?
- Volume = Area x height (or depth)
- Regular and irregular solids (prism, cube, pyramid etc.) – see Appendix for some of the formulae for measuring volume

Measurement of Reinforcement Bars

= Usually in tonne or Kg. calculated on the basis the mass of steel per metre length of bar.

Estimating

- Estimating is a continuous process and should be carried out at every stage of the design process to enable a check on the cost effectiveness of the design. Accuracy of estimates depends on Experience, Availability of cost data, Correctness of measurement

Week 2 Lecture – SMM & More Taking Off Rules

Recap of Lecture 1: Taking off and SMM

= **Taking-off** is the process of measurement of quantities and booking them in specific order and method in accordance with the rules and principles of the SMM.

Standard Method of Measurement (SMM)

= The Standard Method of Measurement provides a uniform basis for measuring building works and embodies the essentials of good practice but more detailed information than is required by this document shall be given where necessary in order to define the precise nature and extent of the required work. (Seeley, 1979)

- The Australian Standard Method of Measurement (ASMM)
- First Published in 1959 and now in its6th Edition, 2016
- Authors – The Australian Institute of Quantity Surveyors and The Master Builders Australia

Purpose of SMM

- It is a book of measurement rule. Does not instruct you how to measure quantities but lists principles and conventions that apply when measuring quantities.
- Forms the basis for the measurement of the bulk of building work.
- Provide a systematic structure of bill items thereby maintaining a uniform ways of describing and booking the quantities.
- Facilitate pricing by standardizing the layout and content of the BoQ. Enable the pricing of projects based on similar quantities.
- Standardised all rules pertaining to the measurement process. Avoid confusion (imagine individual quantity surveyor having their own method of measurement).

Terminology

Bill of Quantities

= Bills of Quantities (BQ) is a document that formed part of the contract. It provides a full description and accurate quantities of the works to be executed. Works which cannot be measured accurately shall be described as provisional or given in a bill of approximate quantities.

Purpose of a Bill of Quantities

- Main purpose of a BQ is to facilitate *tendering*.
- Provides a common base for *pricing* to all builders participating in the tender.
- Avoids *duplication* in quantifying work.
- Prevent *errors* in measurement by *different builders*.
- Provide database of *cost information* which facilitates cost analysis and cost planning.
- Cost control during construction:
  - Facilitates *interim payments*.
  - Enables a fair method for *valuation of variations.*

BQ & Risk

- consider a project where BQ forms are part of the project:
  - contractor's risk = **underestimated rates** are their risk, they have to get them as accurate as possible (the clients are paying what was agreed)
  - client's risk = could have **underestimated quantities**