UNESCO-NIGERIA TECHNICAL &
VOCATIONAL EDUCATION
REVITALISATION PROJECT-PHASE II

NATIONAL DIPLOMA IN QUANTITY SURVEYING

PRINCIPLES OF CONSTRUCTION ECONOMICS 1

COURSE CODE: QUS 207

YEAR 2- SE MESTER 1

THEORY

Version 1: December 2008

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WEEK 1

1.0 AN OVERVIEW OF ECONOMIC ACTIVITIES WITHIN A NATION AND THE NATURE AND SCOPE OF THE CONSTRUCTION INDUSTRY

The National Income -1/2

(c) **Measurements of total amount of Economic activity in a country**

- **Gross Domestic Product (GDP)**
  Value of all goods & services produced within a country over the year.
- **Gross National Product (GNP)**
  Value of all goods & services produced by a country's owned resources whether home or abroad
- **Net National Product (NNP)**
  Value of all goods & services as GNP less depreciation

These are related but differing measurements of economic wealth of a country over a 12 month period

THE NATIONAL INCOME - 1 (page 2):

1 - **Measuring the creation of Economic**

THE NATIONAL INCOME - 1 (page 1):

1 - Measuring the creation of Economic Wealth

(a) **Who creates Economic Wealth**

- **People/organisations who <u>spend</u> money to buy goods**
- **People who <u>earn</u> the wealth by the provision of**
  - ***Labour***
  - ***Land***
  - ***Capital***
  - ***Entrepreneurial skills***
- **Firms/Govt departments or corporations which <u>produce</u> goods/services in the National Economy**

(b) **Theoretical concept**

<u>All</u> measurements should be equal:

If a car is bought for £10k, there is <u>Expenditure</u> of £10k

(d) **National Income**

What is it?

An aggregation of all the enterprises within a society

The National Income -1/1

Why is it important ?

By purchasing in exchange for <u>Production</u> which is worth £10k, the producer receives an <u>Income</u> of £10k which is shared out to workers, shareholders + suppliers

(e) Importance of National Income Statistics

- **It represents an aggregate of personal incomes**
- **↑er National Income = ↑er average earnings of its inhabitants**
- **↑er income = ↑er spending**
- **↑er income = ↑er output of goods + services**

Formulation of Govt policy

What are the implications for Construction?

THE NATIONAL INCOME - 1 (page 3):

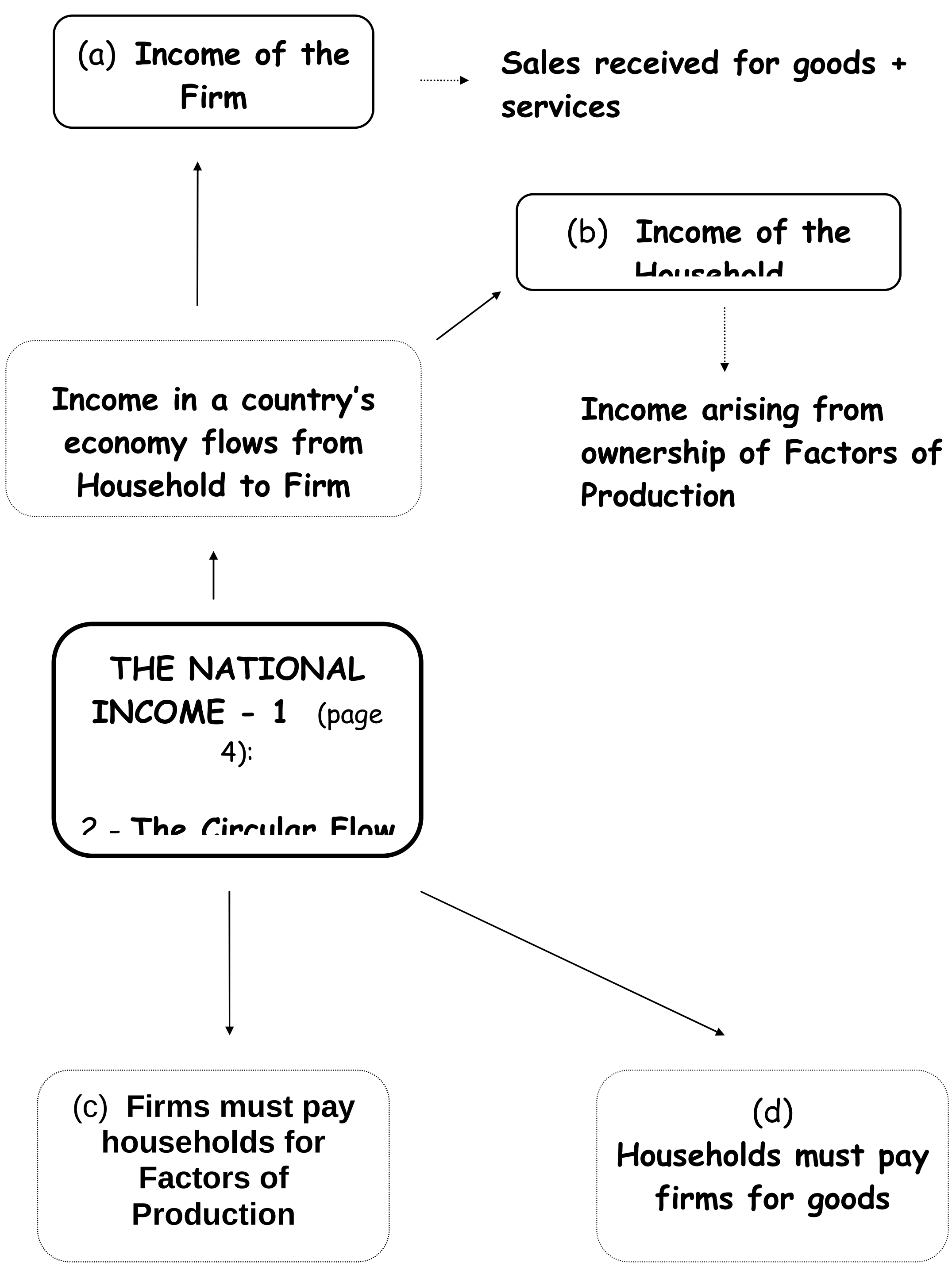
1 - **Measuring the**

(f) What use are the Statistics?

They provide the Government with essential information in the formulation of the following macro-economic objectives:

* ***Full employment***
* ***Economic growth***
* ***Stable prices / low inflation***
* ***Satisfactory Balance of Payments***

The National Income -1/4



This creates a circular flow of Income and Expenditure

(e)
Withdrawals &
Injections

Withdrawals

Movements of funds out of cycle

Injections

Movements of funds into cycle

THE NATIONAL INCOME - 1 (page 5):

2 - **The Circular Flow**

Withdrawals

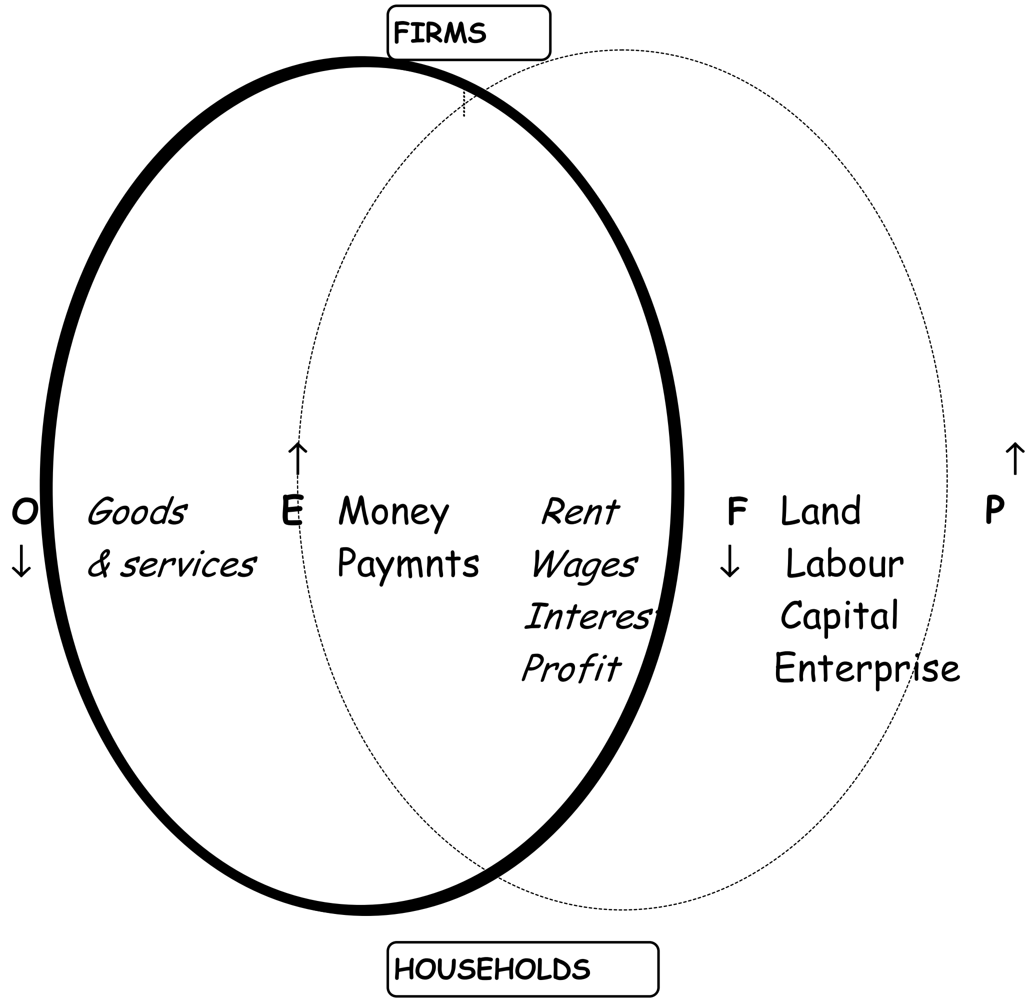
- **Savings (S)**

Injections

- **Investment (I) in capital goods**

- **Taxation (T)**
- **Govt spending (G)**
- **Imports (I)**
- **Exports (X)**

The National Income -1/6



CIRCULATORY FLOW OF INCOME & EXPENDITURE

Where:

O	**denotes**	**Output/Bought**	**}**	**Firm ➧**
F	**denotes**	**Factor incomes paid by firms**	**}**	**Household**
E	denotes	Expenditure on Goods & Services	}	Household ➧
P	denotes	Productive resources	}	Firm

<u>NOTES re DIAGRAM</u>

(1) Total sales value of goods produced ***(output)*** should equal total expenditure on goods, assuming that all goods produced are sold.

(2) Amount of expenditure should also equal total income of households - it is households that consume the goods and they must have income to pay for them.

(3) Households earn ***income*** - because they provide factors of production to enable firms to ***output*** goods and services.

(4) The income earned is used as ***expenditure*** on the goods and services produced.

(a)
The Expenditure Approach

Amount of expenditure on goods & services produced by the Nation's economy

- *Incurred by consumers, governments & foreign buyers*
- *Expenditure by firms excluded to avoid double counting*

THE NATIONAL INCOME - 1 (page 6):

3 - Measuring the

All three approaches will in theory result in the same total amount for economic wealth created in the period, which we call Gross Domestic product (GDP)

(b)
The Income Approach

Measures income from individuals; from employment & self-employment; profit & rent

(c)
The Output Approach

Measures the sales value of output by firms & other organisations in the given period

THE SIGNIFICANCE of NATIONAL INCOME STATISTICS

Income per capita (based on 1988 statistics)

Country	Population (million)	Annual income/ head (US$)	Male life exp (ave)
Brunei	0.23	21,000	70
Kuwait	1.99	15,770	68
Switzerland	6.51	14,066	74
Luxembourg	0.37	11,800	71
United States	241.00	11,695	70
Denmark	5.10	11,436	73
Canada	25.65	10,275	73
Japan	121.40	9,684	74
Australia	15.85	9,518	72
W Germany	61.01	9,341	71
France	55.30	8,850	73
Netherlands	14.52	8,599	74
Belgium	9.86	7,870	71
United Kingdom	**56.40**	**7,550**	**71**
Austria	7.54	7,377	69
Hong Kong	5.58	5,965	73
Italy	57.32	5,512	72
Ireland	3.63	4,355	71
Spain	38.82	4,200	72
Greece	10.00	3,600	71
Brazil	104.65	2,100	62
Mexico	81.65	2,090	64
Potugal	10.10	2,010	70
Turkey	52.34	1,100	60
Nigeria	94.30	740	48
Pakistan	89.83	354	51
Kenya	21.04	315	54
China	1,050.00	223	66
India	778.52	217	52
Ethiopia	42.58	126	39
Bangladesh	104.25	117	47
Chad	5.38	100	42

WEEK 2

1.2 Explain the Nature of the Construction Industry and its Scope of Activities

Construction industry has a number of characteristics common to both manufacturing and service industry. Certainly, as in other manufacturing, there are physical products, and often times these products are of mind bogging size, cost and complexity. In other ways, construction is more like a service industry because it does not accumulate significant amount of capital when compared with industries such as steel, transportation, petroleum and mining.

The construction is essentially an assembly of industry assembling the products of other industries, the designers intentions are portrayed in drawing and other documents and skilled operatives guided by high level management undertake the work of construction and assembly of components of the site. Thus the construction industry embraces a wide range of loosely integrated organizations that collectively construct, alter and repair a wide range of different building and civil engineering structures.

The construction industry cannot significantly influence the demand for its output or control the supply. A wide range of economic factors influences the extent of activity in the industry, and these include the general economic climate, interest rates, credit availability and extent of control of public sector spending. The demand fluctuates largely with natural needs and the state of the economy.

Construction site

CLIENTS OF THE INDUSTY

Two sets of clients can be identified for the construction industry which includes;

a. public sector (federal, state and local governments, nationalized industry, public corporations etc)

b. Private sector (developers, financial institutions, industry and commerce, building societies and individual promoters).

Construction products are often built for a price established through tendering. Also, unlike manufacturing, construction does not operate at a fixed location it moves from site to site wherever work is available.

There is also variability of the product (project) site firms undertakes range of discrete projects of relatively long duration often tailored to meet clients requirement.

Construction entrepreneurs must face a daunting array of risk some of which are inherent (arising from assumptions made at the time of building) some insurable (damage to property, health and life etc) and yet others transferable (conveyed to others such as sub contractors by contractual arrangement)

The construction industry in Nigeria today can be subdivided into three major sectors of activities:

SCOPE OF ITS ACTIVITIES

BUILDING WORKS

1. **Building Works-** this generally satisfies man's need for shelter and includes such diverse buildings as houses, flats, schools hospitals, shops, offices, factories and warehouses.

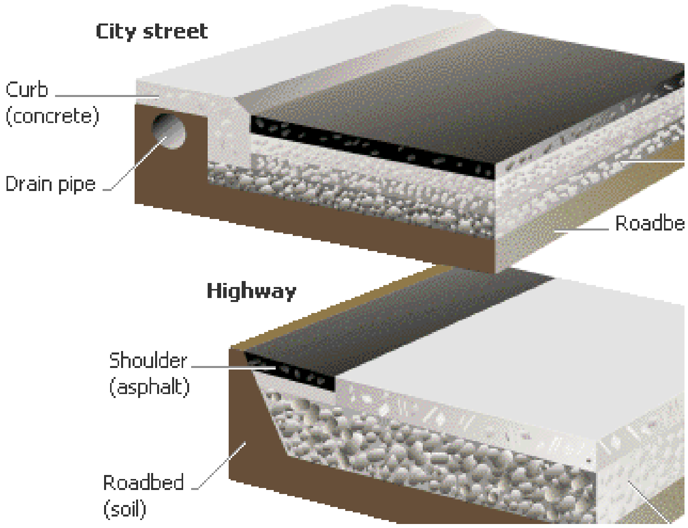
CIVIL ENGINEERING WORKS

2. **Civil Engineering Works** - this encompasses the essential services needed to make the building operative. They include roads, bridges, reservoirs, waste water systems, railways, power stations, harbors, dams and airports. The scope size and extent of civil engineering work is usually considerably more substantial than building works. Civil engineering works is more method related than with building works and bills of quantities comprise large quantities of few items while building works comprise a small quantity of a large number of items.

HEAVY ENGINEERING AND PROCESS ENGINEERING.

3. **Heavy Engineering and Process Engineering** – this are special construction projects such as steelworks, aluminum smelter plants, cement plants, sugar plants, offshore steel platforms, shipyards, energy centers, nuclear processing and production facilities, onshore and offshore oil and gas, petrochemical projects and other similar industrial engineering complexes.

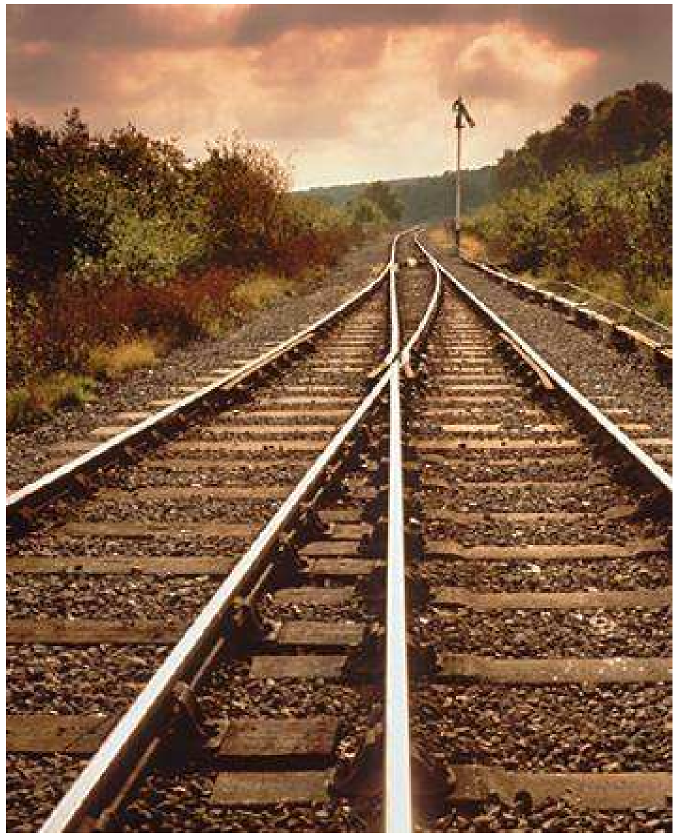
Motor way



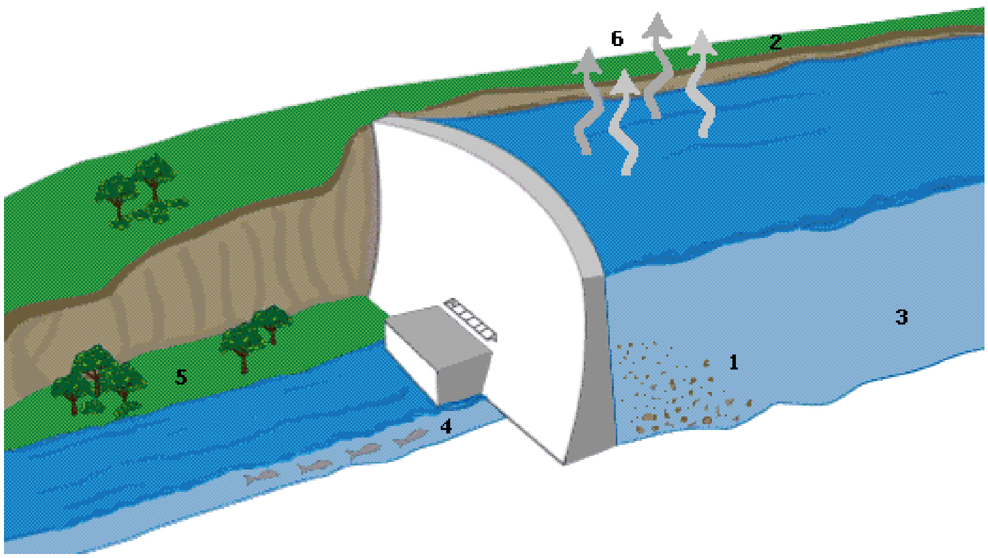
Road construction

Road Surface Cutaways

Flexible and rigid pavements each contain several different layers of materials. The layers below combine to support the traffic moving along on the surface layer, which is known as the wearing course. Asphalt makes up the wearing course of flexible pavement and is often found on residential streets in cities. Rigid pavement made of concrete is more durable and is a popular choice for highway construction.



Rail track



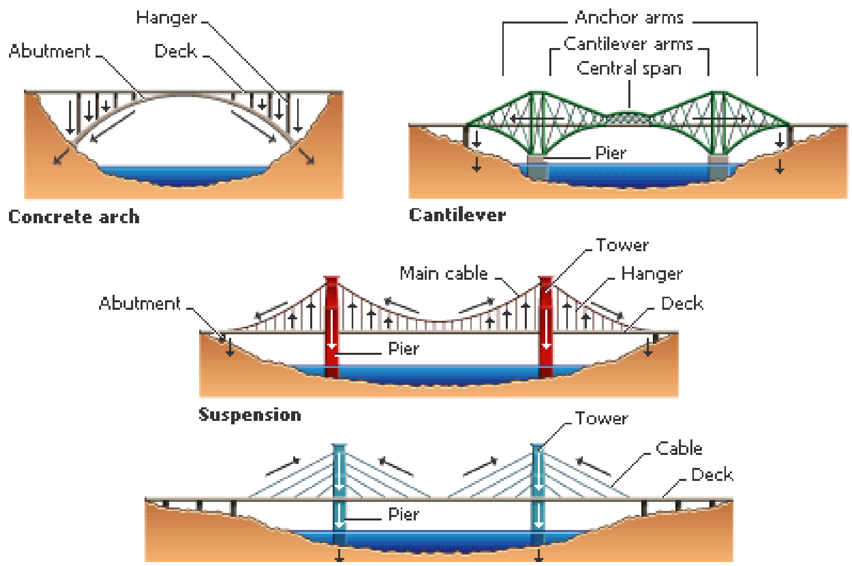
Dams and the Environment

Dams provide water for irrigation and municipal use, help control floods, and produce hydroelectricity. However, damming a river can also have serious environmental side effects. For example, (1) dams block sediment, which can lead to increased erosion downstream; (2) reservoirs inundate marshes and previously dry land; (3) cold water released from deep within the reservoir changes the downstream temperature of the river, preventing some types of fish from breeding; (4) dams can block migratory fish, such as salmon, from reaching upstream spawning grounds; (5) dams alter flood cycles, allowing riverside vegetation to grow unchecked and disrupting the river's ability to reshape the riverbed; and (6) water is lost due to evaporation and seepage into the banks of the reservoir, a phenomenon known as "bank storage."

1.3 CHARACTERISTICS OF THE PRODUCTS OF THE CONSTRUTION INDUSTY.

The construction industry has certain characteristics as a result of the physical nature of the construction products and its demands.

Bridge



Bridge Construction

- No two projects are identical, most projects are one-off designs and even with prototype construction, site characteristics and location will vary, making them un-identical.
- The products of the construction industry are manufactured on the clients property i.e. construction site.
- Construction work is carried out on the site where the product will be consumed
- Production is not carried out under controlled factory conditions. Construction activities are therefore affected by the vagaries of weather and also of ground conditions.
- Construction products take a long time to produce and last for many years.
- Construction work is capital intensive.
- Its processes include a complex mixture of different materials skills and trades.
- The construction industry is more of a service industry than a manufacturing industry.
- Throughout the world, the industry includes a small number of relatively large construction firms and a very large number of small firms.

Building construction is the product of a diverse group of sub industries, with many individuals and organizations involved in the construction of a single structure, from the manufacture of necessary components to final assembly. As a general rule, state laws require a registered architect or engineer, or both, to execute the design and to make sure that the design complies with public health, zoning, and building-code requirements. The design must at the same time conform to the requirements of the owner. The architect or engineer converts these requirements into a set of drawings and written specifications that usually are sent to interested general contractors for bids. The successful bidder or bidders in turn subcontract plumbing, painting, electrical wiring, structural frame construction and erection, and other jobs to firms specializing in these crafts.

Contractors ordinarily carry out their work under the observation of an architect or engineer, who acts as agent of the owner. State and local inspectors review the work for general compliance with the local building code. The immediate responsibility of the contractor, architect, and engineer ends when the local authorities approve the building for occupancy and the owner accepts the building. However, the contractor, architect, and engineer are legally responsible for any deficiencies in the construction or design for a period of several years after acceptance, the time depending on the terms of the contract and local laws.

CONSTRUCTION EQUIPMENT

EARTH MOVING EQUIPMENT

Earth-Moving Machines, equipment used in heavy construction, especially civil engineering projects, which often require the moving of millions of cubic meters of earth. The removal of earth or material from the bottoms of bodies of water is performed by dredges.

The primary earth-moving machine is the heavy-duty tractor, which, when fitted with endless tracks to grip the ground and with a large, movable blade attached in front, is called a bulldozer. Bulldozers are used to clear brush or debris, remove boulders, and level ground. A scraper is a machine that may be pulled by a tractor or may be self-powered. It consists of a blade and a box or container. Dirt is scraped by the blade into the container; the dirt may then be released so as to form an even layer of a predetermined thickness, or be carried off for disposal elsewhere. Scrapers are used to level and contour land, as in road construction.

Somewhat similar to scrapers are graders, self-propelled, wheeled machines with a long, inclined, vertically adjustable steel blade. Graders are primarily finishing equipment; they level earth already moved into position by bulldozers and scrapers. Lightweight tractors fitted with wheels in place of tracks are used for comparatively light construction jobs. Equipped with a backhoe, which is an open scoop attached rigidly to a hinged boom, such a vehicle can dig shallow trenches; equipped with a front-end loader, a scoop shovel affixed to the front of the tractor, it can lift and carry gravel, stone, sand, and other construction materials.

Draglines and power shovels are the primary forms of excavation equipment. A dragline is fitted with an open scoop supported from the end of a long boom by a wire cable. The scoop is dragged along the ground by the cable until it is filled with earth, which is then dumped elsewhere. Draglines are used primarily to excavate deep holes. Power shovels are fitted with buckets called clamshells, which dig into the earth and shovel it up. The bottom of the clamshell opens to dump the dirt into a truck for removal.

Grader

Graders are used to level the earth for construction projects. This John Deere grader has a laser leveling unit mounted on its blade; the leveling device constantly adjusts the height of the blade to ensure that the ground is made precisely flat.

Mobile Derrick Crane

A crane lifts materials for the construction of a research center at the South Pole in 1992. The derrick crane moves heavy objects through the use of a motor, which winds cable around a winch, and a system of pulleys.

Dump Truck

Dump trucks have large open beds for hauling loose material such as gravel or soil. To empty the bed's contents, a hydraulic lift inside the truck tilts the bed, dumping the contents behind the truck. Dump trucks are common at busy construction sites, where large amounts of building materials are frequently moved.

WEEK 3

2.0 PRINCPLES OF APPROXIMATE ESTIMATING AND METHODS AND USES OF APPROXIMATE ESTIMATES

2.1 Purpose of Approximate Estimating

Approximate estimates enables the client get the first idea of how much a proposed building will cost and it's this amount the client will always remember.

The primary function of approximate or preliminary estimating is to produce a forecast of the probable cost of a future project before the building has been designed in detail and contract particulars prepared .

In this way the building client is made aware of his financial commitments before extensive design work is undertaken.

The entry of quantity surveyors with adequate techniques into the estimating field was of considerable significance in the early development of a professional role.

To extend this role into that of a building economist, required the development of a professional role. To extend this role into that of a building economist required the development of understanding and techniques of a kind that deal not just with the items which go into the accountancy of a particular building, but with the economic and other force, which have determined the nature and relationship of those quantities and costs, and which determine the trends they show.

Indeed, economies are the study of all the forces which determine the present functioning and probable future trends of a whole industrial or financial system.

The quantity surveyor performs an extremely important role in cost assessment,

- Giving advice as to the probable cost of a particular design proposal and variations to it and

- Suggesting how similar objectives can be achieved more economically.

It must however be emphasized at the outset that no approximate estimate can be better than the information on which it is based. Indeed, a realistic approximate estimate can be achieved only when there is full co-operation and communication with the architect , quantity surveyor and building client from the inception of the scheme.

It is advisable to dissuade the architect from reporting forecasts of costs to the building client until some drawings probably no more than preliminary sketches have been prepared and an inspection made of the site .

There is a distinct possibility that the building client will endeavor to obtain an independent check on the preliminary cost figures and it is accordingly unwise to supply a high cover figure.

On the other hand, the submission of too low a figure can lead to recriminations as the first figures is the one that the building client will always remember.

The quantity surveyor should always emphasize that an estimate based on inadequate information cannot be precise and in such a situation he would be well advised to give a range of prices, as an indication of the lack of precision that is available.

The choice of method employed will be influenced by

- The information and time available ,
- The experience of the surveyor and
- The form of cost data available to him.

It is essential to carry out a detailed site survey before a preliminary estimate is prepared as it would be quite unrealistic to assume that the site is

- Leveled and free from obstructions,
- Free from fill and contaminations of any kind
- Has a ground water level well below any foundation and
- The soil has an average load bearing capacity

Similarly, old drawings of existing buildings scheduled for adaptation need checking.

2.2 Forms of Approximate Estimating

- UNIT METHOD
- CUBIC METHOD
- SUPERFICIAL OR FLOOR AREA METHOD
- STOREY ENCLOSURE METHOD
- APPROXIMATE QUANTITIES METHOD

A. UNIT METHOD

This method produces a total single price for the project and is based on cost per unit or person to be accommodated. This technique is based on the fact that there is a close relationship between the cost of construction and the number of functional units it accommodates. Total estimated cost is equal to number of functional unit multiplied by unit rate. e.g. Schools, hospital accommodation, car parks etc.

UNIT METHOD

The unit rate is normally obtained by a careful analysis of the unit cost of a number of fairly recently completed buildings of the same type after making allowances for difference of costs that have arisen since the buildings were constructed and any variations in site conditions, design, form of construction and materials. Variations in rates stemming from difference in design and constructional methods are difficult to assess and frequently there is insufficient information available to make realistic estimates

<u>EXAMPLE</u>

⇒ Hospital ward accommodation	N2million per bed space
⇒ Church hall	N 500,000 per seat
⇒ Primary school	N 250,000 per space
⇒ Car park	N 1,500,000 per car space

ADVANTAGES

ADVANTAGE

- It is simple and quick to use
- It has the advantage of speed of application

DIS ADVANTAGES

DISADVANTAGES

- Lack of precision
- It is advisable to express cost within a range of prices

B**. CUBE METHOD**

CUBIC METHOD

In this method, the external plan area of a building is multiplied by a height to get the volume of the building. The height is measured from the top of the concrete foundation to half way of the e roof if pitched is to 600mm above the roof, if flat. If the roof space is occupied, the height is taken up to ¾ (0.75) way up the roof.

If the flat roof has a parapet, the height is taken up to the top of the parapet or 600mm whichever is greater. Total estimated cost is equal to cubic content/m3 multiplied by cost/m3

Where different part of a building varies in character or function, such as workshop with an office block frontage, then the different parts should be separately measured and priced. Basements should also be cubed separately so that allowance can be made in the unit rate for the increased excavation and construction costs.

Features such as piling, lifts, external paving, approach roads, external services, landscaping and similar works which bear no relation to the cubic unit of measurement should be dealt with separately by the use of lump sum figures or approximate quantities.

EXAMPLE

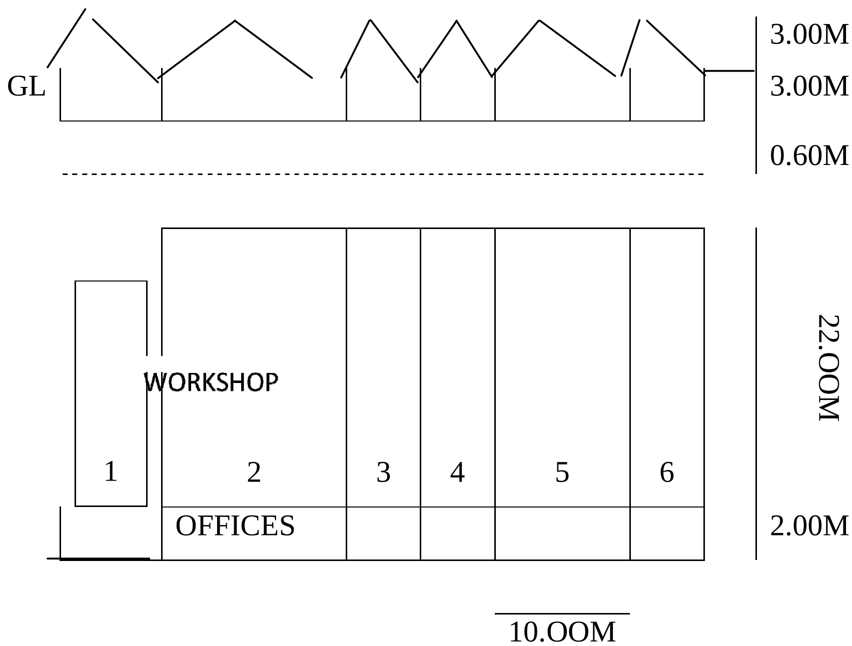


FIGURE 01

Figure 01 shows a block of six unit factories with an office in each unit . The effective height is 600mm (top of foundation to ground level) + 3.00m (ground level of roof) + ½ 3.00m roof = 5.100m

Volume of six workshops = 60m x 22m x 5.1m

= 6732m2

Volume of offices = 60m x 4m x 5.1m

= 1224m2

Estimated cost of block would be

6732@ 2500 = 16,830,000

Estimated cost of office would be

1224@ 2000 = 2,448,000

Total = 19,278,000.00

ADVANTAGE

- It is useful in estimating the cost of heating and air conditioning.

DISADVANTAGES

- It does not give the client an indication of the amount of usable floor area.
- It takes no account of no of stories or plan shape which is known to affect cost.
- It produces large cubic quantities that will increase the possibility of further inaccuracy in estimate.
- A primary weakness of the cube method is its deceptive simplicity.

WEEK 4

2.3 Approximate Estimating at Briefing Stage

The briefing stage essentially comprises of inception and feasibility stages of the RIBA plan of work.

2.4 Inception: inception is the first stage of the client's initial decision to build. The design team is not yet appointed so no cost control procedures are carried out. At the inception stage, the client's organization is set up for briefing. The client considers his requirement for the building and appoints a designer.

The brief: *preparing a detailed and comprehensive brief is very important. The brief starts precisely what the client wants. For example, with an airport building, it might be the proposed member of passengers to be handled or the number of aircraft movement to be coped with. A brief can be from a few pages to up to a very comprehensive document. The design team must interpret the brief to decide the type of project to be designed*.

B Feasibility: the second stage is the feasibility stage, where the design team provides appraisals and recommends regarding the form in which the project is to proceed.

An effective cost control system must then be set up, incorporating the three principles of cost control. The first principle to be incorporated to the system is principle. One, establishing a realistic first estimate, and deciding how to allocate this estimate among the elements.

Two approaches to setting a realistic first estimate can be considered. Firstly, the design team may be required to produce an estimate which defines the cost limit for the project. Alternatively, the design team may have to confirm that a building can be completed within the cost limit set by the client. In practice, an approach between these two extremes is usually adopted.

The information provided by the client will vary from project to project. However, whatever the approach, the function of the building is known, usually from the outset, and the location and description of the site is also available. The main factors for consideration are:

- Area (the floor area of the building)
- Quality (the standard of accommodation to be provided

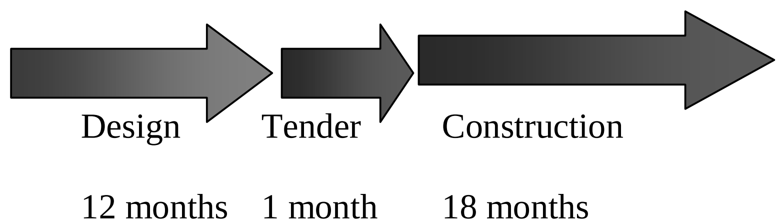
- ❖ Shape and aesthetic features
- ❖ The constraint imposed by the planning authority on the site
- ❖ The delivery time for the project when the client wants occupation)
- ❖ The balance between initial capital cost and the long term costs)
- ❖ Costs (the likely cost)

There are other factors which can come into consideration, but for ease of demonstration these are ignored here.

How the cost control system works

Step 1 when a project is completed, the final account is analyzed into elemental categories giving a cost per square meter for the overall project and the elemental categories. this is called a cost analysis.

Step 2 the cost analyzed is stored in files and on a computer for future reference. Remember, there is a time dimension for the analysis to be considered as demonstrated below.



The final account is the out-turn price.

***Cost planning** involves using information taken from cost analyses that have been updated.*

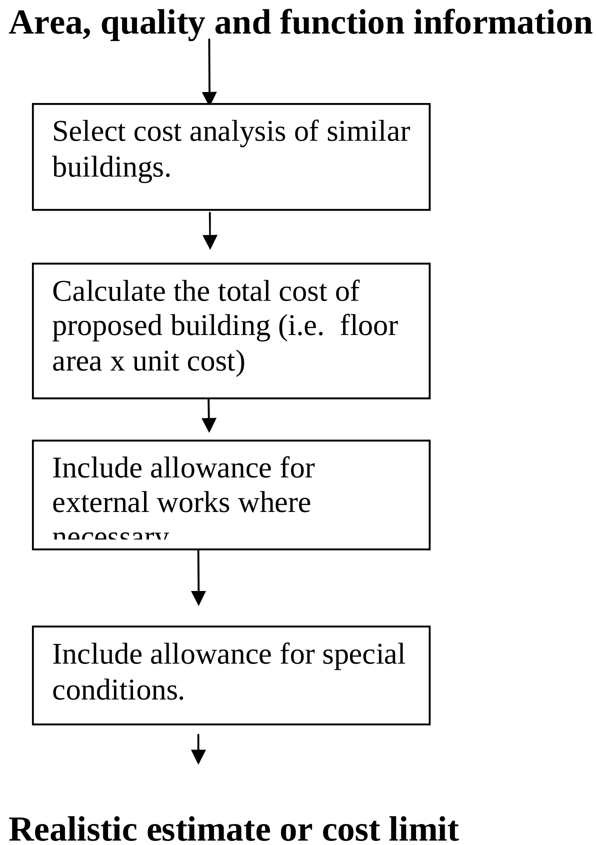
When either confirming or setting a realistic first estimate, consideration needs to be given to what is possible and probable. This can be done by a method of **interpolation.**

Beware of the pitfalls when using cost analysis of completed projects

- ❖ They relate to projects that were completed not necessarily within budget or on time.
- ❖ They relate to projects built anywhere in the UK, with possible regional cost differences
- ❖ The cost analysis may not reflect properly the quality of a project; quality can mean different things
- ❖ No two similar projects will cost exactly the same; there will always be a cost difference.

❖ No amount of work in the market will strongly affect the price level.

Interpolation method



The **interpolation method** is where cost analyses of buildings of the same type are studied. This method permits the differing sizes and standards which exist between buildings to be examined and taken into account when considering costs.

The total cost of each building is generally expressed in a common unit such as cost per square meter of floor area. Thus, the total cost of the building is the cost per square meter multiplied by the total area of the floor space.

An example of part of a typical range might be:

- ❖ Cost of building A (quality X, floor space 5000m2) is N 16,000 per m2 of floor area
- ❖ Cost of building B (quality Y, floor space 5500m2) is N 20, 0000 per m2 of floor area.

Special care needs to be taken with **external works** as published analysis may exclude costs associated with site works, drainage, external services and separate minor building. Consideration must also be given to any ***special conditions*** such as site problems, access, etc

From a range of costs of similar buildings and appropriate **cost limit** can be made, in calculating the cost limit, consideration needs to be given to differences in area. Quality and function and adjustments made for external works and any special conditions.

WEEK 5

2.4 Key Issues to Remember when Preparing Approximate Estimating

- ► There must be *a frame of reference* (cost limit and cost targets)
- ► There must be *a method of checking* (cost checking)
- ► There must be *a means of remedial action*(adjustment of cost targets)
- ► Establish a realistic first estimate
- ► Plan how the estimate is distributed among the building elements

(Note: A building element is not an abstraction - it is a part of a building that performs a specific function!)

2.6 Limitations on Cost Decisions during Stages A And B

Cost decisions must:

- ► Be based on functional requirements - not on a design solution
- ► Take account of limited amount of information available
- ► Impose minimal restrictions on subsequent design decisions

2.5 Information Available at Stage A: Brief Stage

- ► Function *(The use to which the building is to be put)*
- ► Accommodation *(The number of functional units or the floor area required - plus circulation areas in the latter case)*
- ► Quality *(Prestige v average v low)*
- ► Site *(Location, dimensions and soil conditions)*

2.6 Options Available

1. The Unit Method
2. Superficial Floor area Method
3. Superficial area method with Indicative cost by interpolation

The Unit Method

- The Simplest Technique
- Highly inaccurate
- Highly indicative only – use very wide ranges!!
- Example – Client wishes to build a new 35 bed hospital facility to meet in the increased demand being faced in the Private Healthcare sector in Preston.

Example using the Unit Method

- Price per functional Unit

District General	N16, 400,000.00 - N24, 600,000.00/Bed
Teaching	N22, 000,000.00 - N30,000,000.00/Bed
Private	N24,000,000.00 - N37,000,000.00/Bed

(Spons, 2006) Base = Tender Index 480 Location 481

Superficial Floor Area Method

- Total Floor area calculated
- Area from internal face of external walls
- Circulation space and internal walls measured over
- Multiplied by a cost factor.

Example using the Superficial Floor area Method

- Proposed floor area = 3800m2 over two storey's
- Hospital Prices:

Diagnostic/treatment 1,850 – 2,300

Acute services	1,700 – 2,250
Radiotherapy/Oncology	1,650 – 2,500
Community hospital	1,250 – 1,650
Trauma Unit	1,650 – 2,000
Private	1,180 – 1,800

(Spons, 2006) Base = Tender Index 480 Location 481

2.7 Indicative Cost by Interpolation Method

- ► Use data for buildings of same function
- ► Choose suitable source of data
- ► Isolate differences between analysed buildings and proposed building
- ► Make allowances for identified differences

Stage A: indicative cost major differences isolated

- ► Quality
  - Difference in standard of accommodation
- ► Quantity
  - Difference in number of functional units or in floor area
  - Additional or redundant features
- ► Price level
  - Difference in tender dates
- ► Site conditions

Adjustment for Differences – 1

- ► Quality

        - Standard of accommodation
            - Select suitable data or make a suitable allowance
- Quantity
    - Quantity of accommodation
        - This will be expressed in the calculation
    - Additional or redundant features
        - Make a suitable allowance

<u>Adjustment for Differences – 2</u>

- Price level
    - Apply an appropriate index
- Site conditions
    - Temporary access roads, difficult access and storage
        - Make a suitable allowance

WEEK 6

3.0 COST PLANNING PROCESS ILLUSTRATED

3.1 Feasibility Stage (JUNE 2008)

The information, available at this stage is normally very limited and, in this instance includes;

1. Initial brief identifying the use to which the building is to be put, the floor area required, and the indication of the desired quality.
2. Town planning policy
3. Details of the site.

In addition, the following data will be used.

- The histogram of average building prices; new office buildings generally.
- The detailed cost analysis of the office block given in appendix A
- Access to indices, for adjusting price level (not included here)

The above information and data has been assembled before we start to prepare our Feasibility stage estimate.

Initial Brief for Proposed Office Premises*

SPACE	A lettable area of at least 1850m2 and maximum permissible car parking. The parking provision is considered to be essential due to the congested city centre site, poor parking facilities and inadequate public transport. The tenants are likely to be professional services such as accounting and insurance.
PLANNING PERMISSION	Preliminary enquiries to the planning authority indicate that an office block three storey high would be permitted and

	that the stated amount of lettable area should be achievable as it is within the plot ratio.
USE	The premises will be offered for leasing as good- quality office accommodation at a rental which is in the upper market range
QUALITY	An above- average commercial quality is appropriate to this prime location site and will command a suitable return. Raised floors and suspended ceilings will need to be incorporated in to the new design in order to accommodate IT systems. An attractive facade is considered essential.
SITE	The site has been acquired and a site plan is available (it has not been included here as it is reasonably straightforward.) it shows that the terrace houses previously occupying the site have been cleared and the foundations grubbed up. Ground condition in the area is good.

Estimate

We must prepare our feasibility stage estimate so that the client can decide whether or not to go ahead with the project. This follows examination of the client's initial brief, an inspection of the site and local conditions, and agreement of quality standard between the design team and the client.

It is possible to gain an idea of the cost range by examining analyses of past projects for the same building type. This information may be obtained from in house records, or from published information. An information service, such as BCIS, published a wide range of suitable cost information.

Experience and knowledge is needed to interpret these cost ranges. For example, higher quality finishes and fittings to the ground floor reception or enhanced finishes and services for restaurants and computer suites may all increase the overall cost per m2 gfa. similarly, allowance must be made for the cost of any demolition and enabling works and the cost of site investigation, planning and building Regulations approvals and work to adjoining properties.#

Remember, costs will vary according to location, quality and size of development.

From this distribution, it appears that we should expect our estimate to b in the range of £450 to £850 per m2, which is fairly wide. This range is influenced by many factors including the exact quality desired (note that these prices do not include any allowance for external works.)

It is, therefore preferable to work from detailed cost analysis which provides some information about the building analysed. Ideally, a small, (between 4 and 10) of similar analyses should be selected. This will permit adjustments to be made for items where our brief or quality standard departs from those of cost analyses. We should obviously select analyses which are reasonably close to both our functional requirement and our standard of quality.

To keep this exercise within manageable limits we have selected just one analysis (given in appendix A) which is in our opinion suitable with regards to architectural style and quality. Ideally, in order to provide a good match for the new project, this cost analysis should have been a three-storey rather than an two-storey construction. Also the storey heights of the chosen analysis appear to be too low for our new project, nevertheless, this does allow us to consider some important design variables and their implications for project costs. The analysis has, therefore, been accepted for our purposes.

Before considering the major differences between the building analysed and our project, we need to estimate the total floor area which will be required for our project. From studies of other office blocks, it appears reasonable to allow 20% of lettable floor area for the additional area required for services and circulation space.

Lettable floor area required		=1850m2
Add		
Allowance for circulation space		
(I.e. corridors, toilets, stairwells, lift wells etc.).		
1850 X 20%		= 370m2
		=2220m2
	Say	2250m2

We will assume a gross floor area of 2550m2 for our project. Until the pre parathion of scheme design drawings, what is required now is a suitable all-inclusive rate to calculate our feasibility estimates. From our chosen analysis, the cost per m2 gfa (at September 1992) for the building subtotal is £612.22 per m2. Total cost (less contingencies) is £819.46 per m2. We cannot use this figures without first making some necessary adjustments for price level, quantity and quality. It is important to remember that at this stage we have very little information either in the form of information and design notes or as drawn information bearing this in mind we shall look at the adjustments.

3.1.1 Adjustment for Price Level

> **Remember:** the index has been updated to the time the estimate is being prepared – not to project completion.

Adjustment for time

Index at the analysis date	106(September 2005)
Index at preparation of first estimate	128 (June 2008)

Adjustment for location

Location factor for building analysed	1.00 (Kaduna)
Location factor for the proposed building	0.94(Zaria)

The adjustment for time and location may be combined into one Adjustment factor (AF) thus,

$AF = \frac{128}{106} \times \frac{0.94}{1.00} = 1.1351$ say **1.14**

These adjustments have been calculated as a normal routine approach, accepting without question published indices and factors. It should not be forgotten that this approach should be combined with professional judgement to reflect personal knowledge of local conditions and current trends. For our example the other factors previously discussed under price level do not apply

WEEK 7:

3.1.2 Adjustment for Quantity and Quality

To a large extent, size differences between the office block analysis and the new project will be catered for by considering the cost per m2 gfa. In addition we must make adjustments where major differences in the quantity or quality of an element can be found. At this stage, when considering quantity we must be alert to changes in **densities** as this is most important when considering cost in terms of £/m2 gfa. Similarly when examining quality, some thoughts should be given to the mix of individual items within an element. Given the limited information available, there is little to be gained by presenting the first estimates in an elemental format.

Inspection reveals a number of items in the analysis for which adjustments are required

1. **Office partitions**

The cost analysis includes demountable partitioning for office areas (see appendix A). In the new project, apart from WC cubicles, this will be the tenant's responsibility. The reduction is as follows:

Demountable partitioning = £14040

£14040 = £9.97 per m2 gfa
1408m2

(1408m2 is the gross floor area of the building analysed).

Update and adjust for location

£9.97 x 1.14 = £11.37 per m2 gfa

Floor finishes and suspended ceilings

The cost analysis shows that the carpet tiles were supplied under a separate contract and this supply cost is not included in the analysis (see appendix A) thus we must make the adjustment to the 'fix only' price for carpet tiles. We take the area of 1040m2 (the quantity shown in the analysis for carpet tiles). We decide, after looking through manufactures' catalogue, upon a current rate of £13 per m2 as an appropriate price for the supply of carpet tiles. We can calculate an appropriate addition per m2 gfa for this adjustment.

1040m2 x £13 = £ 9.60per m2 gfa
1408m2

With regard to ceiling finishes, the cost analysis shows that plaster board and skim coat on timber framing has been taken throughout the building analysed. For the proposed project, acoustic tiles in a suspended metal grid are required for the office areas. Plaster board and skim will be retained for toilet areas.

We find a current price for suspended ceilings to our specification of £29.54 per m2. The analysis shows the area of ceiling finishes to be 1380m2. From this we calculate the price per m2 gfa as follows.

<u>1380m2 x £29.54</u> = £ 28.95per m2 gfa
1408m2

To calculate the extra cost we must deduct from this figure the cost (after updating and adjusting for location) included in the analysis for the plaster board and skim finish (i.e. £14.04 x 1.14) . Thus £28.95 – (£14.04 x 1.14) gives an extra cost of £12.91. This will be slightly on the high side since suspended ceiling have now been allowed every where (including toilet areas). The additional cost is considered too small to worry about at this stage.

APPENDIX TO WEEKS 5 & 6: COST ANALYSIS SAMPLE

Source: Cost Control in Building Design by R. Flanagan & B. Tate

DETAILED COST ANALYSIS

Job Title: Office Units, Red Knights
Location: Reading, Berkshire
Client: Unipol Properties Ltd.
Date for receipt 10 September 1992 Date of tender. September 1992

INFORMATION ON TOTAL PROJECT

Project details:
2 storey office block with self contained units on 2f100rs with plant rooms in the roof voids together with external works including car parking, fencing, landscaping, services and drainage.

Site conditions:
Level demolition site with bad ground conditions but above water table. Unrestricted working space and access. Contaminated ground, approximately 400 mm'excavate and removed. All excavated material removed to licensed tip.

Market conditions:
Generally competitive overall but not keen. Lowest tender not accepted due to unacceptable qualification.

Project tender price index 106 (base: 1985 BCIS Index Base) Competitive

		Tender List
Tender documentation:	Bill of Quantities	£989,000*.
Selection of contractor:	Selected competition	£1,167,043
Number of tenders:	issued 6	£1,592,203
	received 6	£1,901,202
		£2,118,457

Type of contract: JCT private contract 1980 edition
Cost fluctuations: Firm

Contract period	stipulated by client	9 months
	offered by builder	9 months
	agreed	9 months

ANALYSIS OF SINGLE BUILDING

Accommodation and design features:

2 storey office building with 2 self contained units on 2 floors with plant rooms in the roof voids. Concrete stanchion bases and ground slab. Steel frame. Lightweight reinforced concrete upper floors on steel decking. Steel and timber roof with fibre cement slates. Facing brick/block cavity walls. Specialist curtain walls and external windows. Plasterboard ceilings and raised access floors. Air conditioning, electric installations, lightning protection.

Areas:		Functional units
Basement floors -		
Ground floor	704 m^2	1,195 m^2 usable floor area
Upper floors	704 m^2	
Gross floor area	1,408 m^2	Percentage of gross floor area
		2 storey construction 1 00%

Usable floor area	1,195 m2
Circulation area	75m^2
Ancillary area	74m^2
Internal divisions	64m^2
Gross floor area	1,408 m^2

		Storey heights:
Floor space not enclosed	3,872 m^3	Average below ground floor
Internal cube	835 m^2	at ground floor 2.75m
Wall to floor ratio	0.59	above ground floor 2.75m

BRIEF COST INFORMATION

TOTAL CONTRACT

Measured work	845,192	
Provisional sums	58,500	
Prime cost sums	150,000	
Preliminaries	100,101	being 9.5% of remainder of contract sums

(less contingencies)

Contingencies 13,250
Contract sum £1,167,043
*Lowest tender not accepted, see MC text

Element costs		CIl/SfB 320	Offices				
Gross internal floor area		1408 m2	Date of tender: 10 September 1992				
			Preliminaries shown separately		Preliminaries apportioned		
Element			Total cost Element (£)	Cost per m^2 (£)	Element unit quantity	Element unit rate	Total cost of element (£)	Cost per m^2(£)
1	SUBSTRUCTURES		45,243	32.13	704 m2	64.27	49,541	35.19
2A	Frame		45,366	32.22	1408 m2	32.22	49,676	35.28
2B	Upper floors		22,629	16.07	704 m2	32.14	24,779	17.60
2C	Roof		64,491	45.80	900	71.66	70,618	50.15
2D	Stairs		15,758	11.19			17,255	12.25
2E	External walls		27,069	19.23	304 m2	89.04	29,641	21.05
2F	Windows and external doors		172,555	122.55	531 m2	324.96	188,948	134.20
2G	Internal walls and partitions		26,295	18.68			28,793	20.45
2H	Internal doors		8,270	5.87	63 m2	131.27	9,056	6.43
	SUPERSTRUCTURES		**382,433**	**271.61**			**418,764**	**297.42**
3A	Wall finishes		18,930	13.44	904 m2	20.94	20,728	14.72
3B	Floor finishes		64,650	45.92	1301 m2	49.69	70,792	50.28
3C	Ceiling finishes		19,814	14.07	1380 m2	14.36	21,696	15.41
	INTERNAL FINISHES		**103,394**	**73.43**			**113,216**	**80.41**
4A	Fittings and furnishings		8,110	7.24			11,164	7.93
5A	Sanitary appliances		10,195	5.76			8,880	6.31
58	Services equipment							
5C	Disposal installations		5,477	3.89			5.997	4.26
5D	Water installations		26,921	19.12	56 nr.	480.73	29,478	20.94
5E	Heat source							
5F	Space heating & air treatment		185,081	131.45			202,664	143.94
5G	Ventilating systems							
5H	Electrical installations		80,721	57.33			88,389	62.78
5I	Gas installations							
5J	Lift installations							
5K	Protective installations							
5L	Communications installations							
5M	Special installations							
5N	Builder’s work in connection		14,432	10.25			15,803	11.22
5O	Builder’s profit & attendance							
	SERVICES		**320,742**	**227.80**			**351,212**	249.44

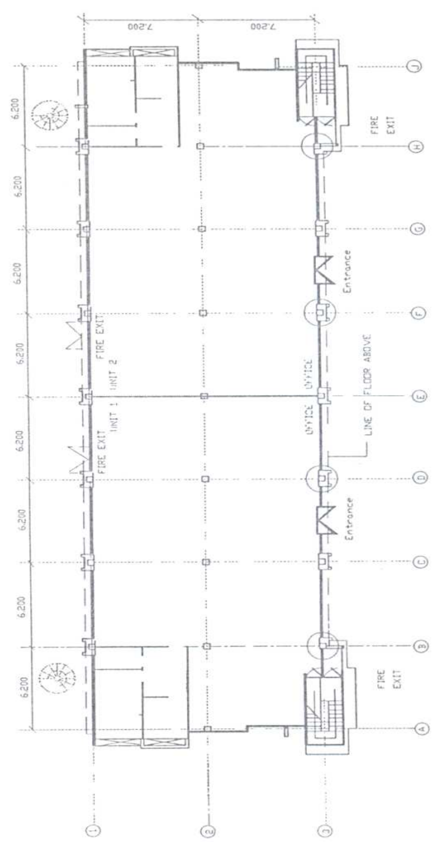
	BUILDING SUB-TOTAL	**862,007**	**612.22**			**943,898**	670.38
6A	Site works	141,532	100.52			154,978	110.07
6B	Drainage	41,816	29.70			45,789	32.52
6C	External services	8,337	5.92			9,129	6.48
6D	Minor building works						
	EXTERNAL WORKS	**191,685**	**136.14**			**209,895**	**149.07**
	Preliminaries	100,101	71.09				
	TOTAL (less contingencies)	**1,153,793**	**819.46**			**1,153,793**	**819.46**

	Specification and design notes				CI/SfB:32 0 Offices September 1992
			Unit quantity	All-in unit rate	Cost (£)
1	SUBSTRUCTURES	**Total**			45,243
	Plain concrete Grade 25 in stanchion bases, and strip foundations. Reinforced concrete Grade 30 in beds 150-300 mm thick		704 m^2	64.27	
2A	Frame	**Total**			45,366
	Traditional steel frame, galvanized 'Z' roof purlins, beams for plant rooms in roof space. Fire protective coating to first floor beams, fiire protective casings to exposed columns				
2B	Upper floors	**Total**			22,629
	Lightweight concrete reinforced with fabric on proprietary ribbed steel decking. Reinforced in situ concrete floors to plant rooms. Concrete casing to steel beams.				
2C	Roof	**Total**			64,491
	Artificial slates on battens on insulated metal decking over roof purlins to sloping root				
2D	Stairs	**Total**			15,758
	Main staircase of concrete with carpet finish to treads and risers, tubular steel open balustrades, PVC sheathed handrails. External escape stairs, galvanized steel spiral pattern.		2Nr 2Nr	4,253 3,626	8,506 7,252
2E	External walls	**Total**			27,069
	Decorative brick casing to steel columns forming piers between window bays. Bricked face hollow walls up to window sill level to both floors.		107 m^2 197 m^2	108.98 78.21	11,661 15,408
2F	Windows and external doors	**Total**			172,555
	Colour coated aluminium framed curtain walling with top-hung opening lights, tinted sealed double glazing units. Fire escape door, loading doors and pair of main entrance doors to each unit.		507 m^2 24m^2	329.49 229.29	167,052 5,503
2G	Internal walls and partitions	**Total**			26,295
	100 mm Blockwork division walls 200 mm Blockwork division walls One-brick walls Demountable partitions		162m^2 116m^2 123 m^2 112 m^2	19.80 30.12 45.15 125.36	3,208 3,494 5,553 14,040
2H	Internal doors	**Total**			8,270
	Teak veneered flush doors, generally half or one-hour fire resistance, stained hardwood frames, linings and architraves Satin anodised aluminium ironmongery		18 sgles 10 dbles	240 395	4,320 3,950
3A	Wall finishes	**Total**			18,930

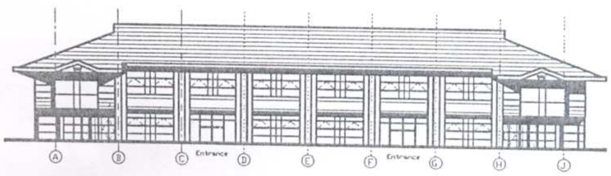
	Two-coat plaster to block walls Ceramic tiles full height toilet areas and splashbacks in kitchens		720 m^2 184 m^2	14.20 47.32	10,224 8,706
38	Floor finishes	**Total**			64,650
	Office areas: Pedestal access floors, hardwood skirtings. Stain and matt finish to skirtings. Lay only carpet tiles (supplied by client). Toilets and other areas: cement and sand screed, vinyl tiles and coved skirting.		1,040 m^2 261 m^2	55.51 26.51	57,730 6,920
3C	Ceiling finishes	**Total**			19,814
	Plasterboard and skim coat on timber framing. Emulsion paint.		1,380 rn2	14.36	
4A	Fittings and furnishings	**Total**			10,195
	Sundry fittings in entrance lobbies, including pinboards etc. Melamine faced chipboard vanitory tops in toilets Melamine faced chipboard duct cladding Grab rails etc. in disabled toilets Louvre blinds				1,400 1,600 795 1,200 5,200
5A	Sanitary appliances	**Total**			8,110
	Urinals Wash hand basins WC suites Cleaners' sinks Short connections to services) PVC overflows. Sundries)		6Nr 14 Nr 14 Nr 4Nr	171 171 190 210	1,026 2,394 2,660 840 1,190
5C	Disposal installations	**Total**			5,477
	PVC waste pipes and soil and ventilation pipes				
5D	Water installations	**Total**			26,921
	Mains supply Cold water service Hot water by electric water heaters		56 draw off points	375.38	21,021
5E	Heat source	**Total**			
	Included in element 5F and 5D				
5F	Space heating & air treatment	**Total**			185,081
	Four-pipe fan coil comfort cooling system Toilet extract ventilation				
5G	Ventilating systems	**Total**			
	Included in element 5F.				
5H	Electrical installations	**Total**			80,721
	Office and general lighting. Emergency and external lighting. Fire alarms. Office and general power supplies. Lightning protection.				
5N	Builder's work in connection	**Total**			14,432
	Normal builder's work in connection with service installations.				
6A	Site works	**Total**			141,532
	Macadam-surfaced car parking area. PCC block paving to pedestrian access.				

	Landscaping.				
6B	Drainage	**Total**			41,816
	Soil and surface water drainage systems in plastic or glazed clay ware pipes and fittings; granular beds and surrounds. Precast concrete and brick manholes.				
6C	External services	**Total**			8,337
	Builder's work only for water and electrical services (no cost allowed for service connection/supplies by local utilities authorities). Builder's work for telephone and lightning protection.				
7	Preliminaries	**Total**			100,101
	9.5% of remainder of Contract Sum (exc. Contingencies).				

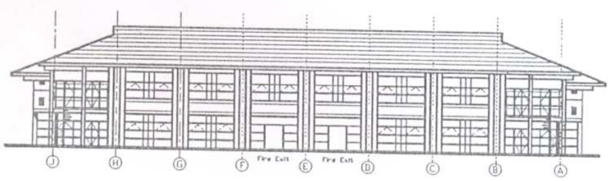
Proposed two-storey office block – ground floor plan



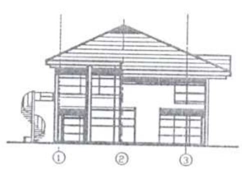
Proposed two-storey office block – elevations



Front Elevation

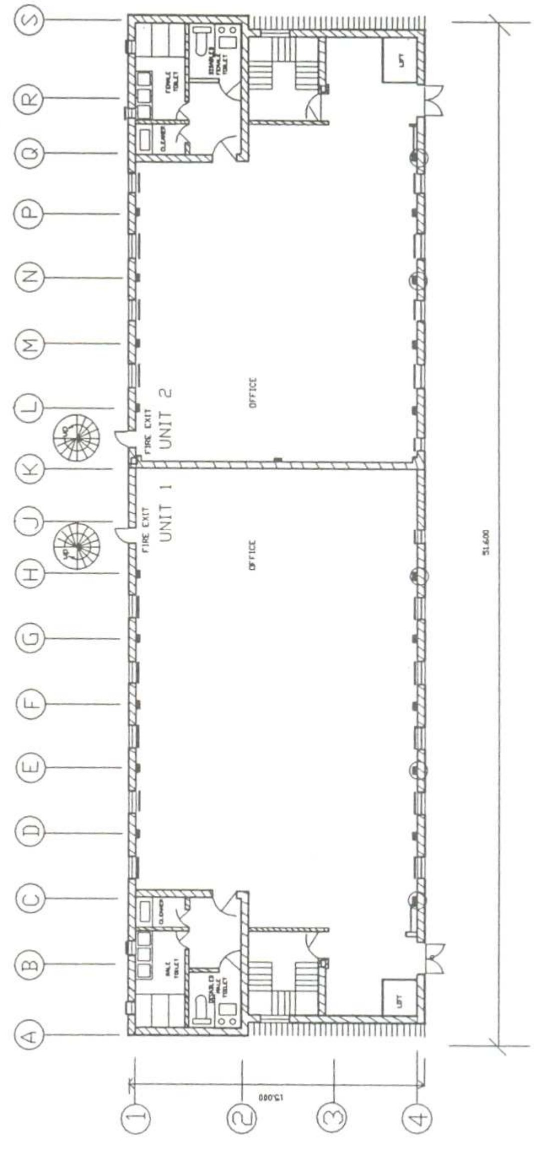


Rear Elevation

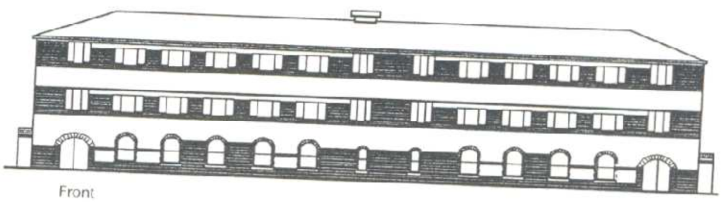


Side Elevation (handed)

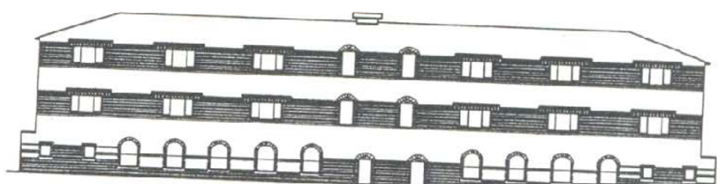
Proposed three-storey office block – ground floor plan



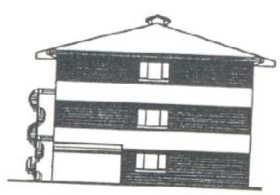
Proposed three-storey office block – elevations



Front



Rear



Side

WEEK 8

4.0 COST IMPLICATIONS OF DESIGN VARIABLES

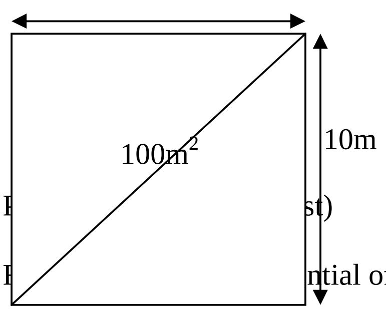
4.2 Effect of Design Variables on Cost of Construction

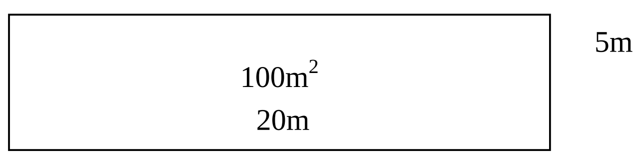
4.1.1 Plan Shape:

The plan of a building affects its cost to a large extent. Generally, the simpler the geometry of the plan the lower its unit cost.

Hence the more complicated the outline and partitions or the more irregular they are, the higher the unit cost for a numbers of reasons. The reason for the greater cost of narrow buildings has to do mainly with the greater perimeter for the same floor area than a more squarish outline.

The result is greater quantity of material, labour, & other inputs with the corresponding greater cost. In the same vein irregular or complex building outlines results in greater cost as a result of greater need (both qualitative and quantitative) of labour for setting-out site works, drainage and other services in addition to longer pipe/cable runs and greater number of manholes and lighting points.

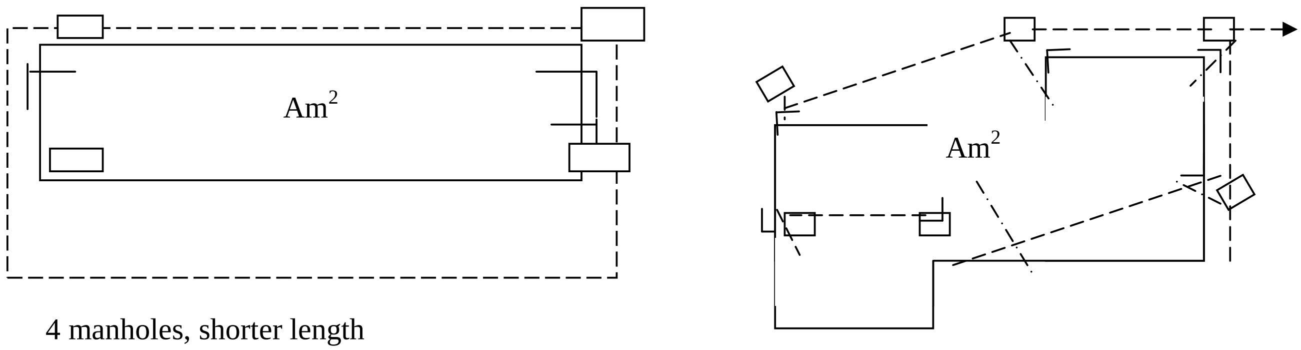




P st) Perimeter = 50m (higher cost)

P ntial of a square and Rectangular

Plan shape of equal floor Area.



4 manholes, shorter length of pipe

6 manholes, greater length

Fig. 1b. Drainage pipe/manhole differential of simple and complex plan shape of same floor area.

4.1.2 Size of Building:

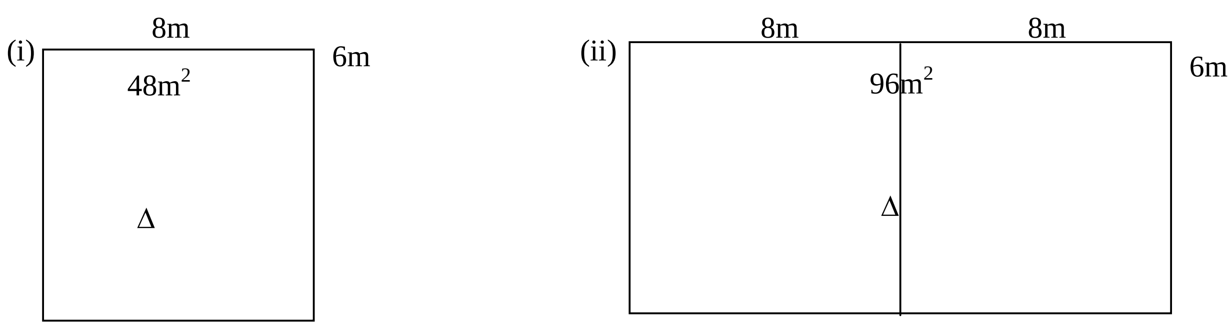
Unit cost normally decreases with greater size of buildings. With a larger project, on costs and overheads are normally a smaller proportion of total cost than for the small projects.

Some cost are almost fixed (especially the preliminaries) and as such are economical with the larger projects. Such costs as site offices, water supply and other statutory utilities on site, temporary roads etc, vary little with increase in the scope of the project.

Also and in most cases, the large sized buildings have less wall/floor ratio as the partitions and their accessories are correspondingly reduced. Similarly, with high rise structure the larger building has greater economy of lift and other equipments/services as same numbers may serve large floor areas than with smaller building.

For instance, the total cost of a lift in an office does not significantly with changes in the size order to reduce the sq meter price to a minimum. This also apply to a bathroom in a house, the same bathroom will serve a one apartment house just as well as a 2 apartment house. Therefore the overall cost of a bathroom per m2 will be less in 2 apartments than in one apartment.

Fig. 1c. Effect of doubling size of building on unit cost



Perimeter = 28m
Wall length/floor area = 28/48
Unit cost greater

perimeter=50m (including partition)
W.L/F.A = 25/48
Unit cost less,

Fig. 1c above is a simple illustration of economy gain of increasing the size of a building. The wall length/floor area of
(i) is greater than same ratio for
(ii) in spite of adding the partition wall which is normally cheaper than enclosing walls.

4.1.3 Perimeter/Floor Area Ratios:-

This is also known as wall/floor ratio. It involves dividing the perimeter of a building plan, taking as the area of the enclosing wall by the floor area. How economical a building is can then be determined from the value obtained. When calculating the ratio the external wall area must include the windows and doors.

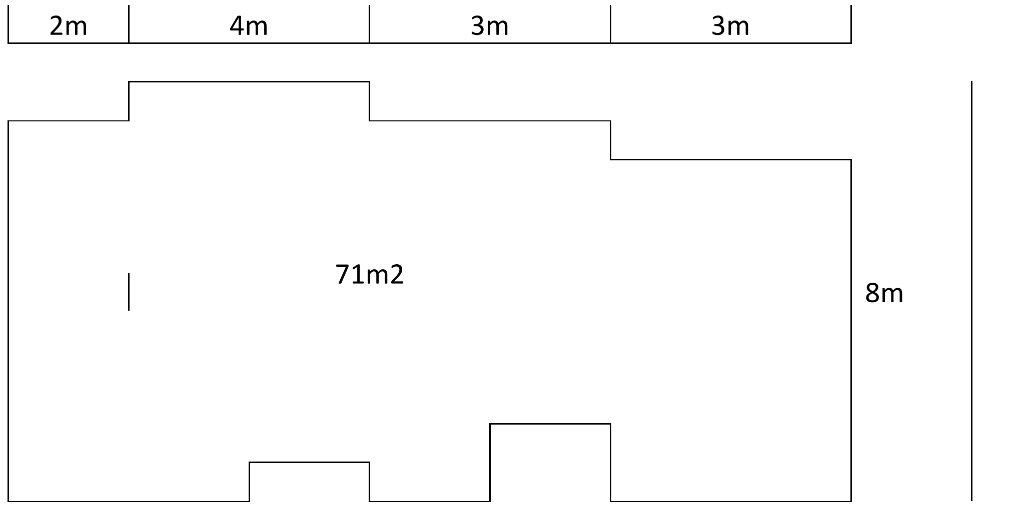
The lower the wall/floor area ratio, the more economical the proposal will be, but this may not be so in all cases, some other factors are to be considered. The wall floor ratio is a means of expressing the planning efficiency of a building, and this is influenced by the plan shape and size.

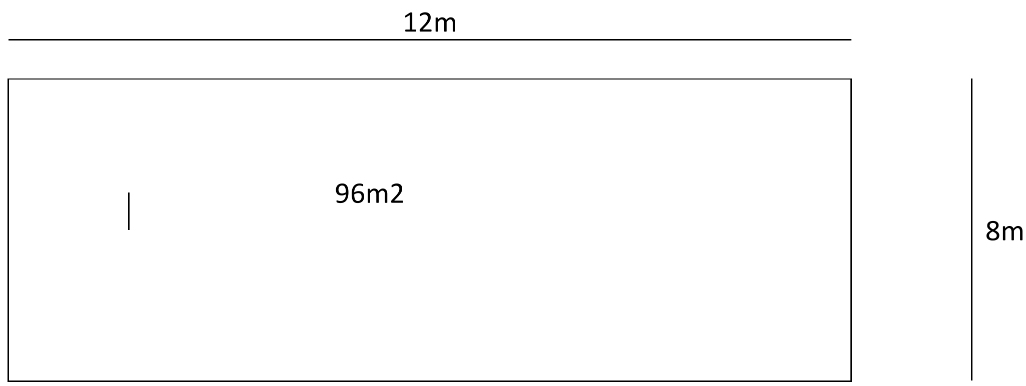
As discussed in the figures above under "size of building" factor, we can significantly reduce the cost of our building by reducing the ceiling height as doing so will reduce the overall area of the enclosing walls.

<u>Wall Area</u> Numerator

Floor Area Denominator

In principle, whatever increases the numerator in the above formula will increase the factor and hence the cost of the building. Conversely, whatever increases the overall floor area enclosed (the denominator) also increases the resultant factor and hence cost. An efficiently designed building which maximizes the floor area will reduce cost.


2m
4m
3m
3m
71m2
8m


12m
96m2
8m

WEEK 9

4.1.6 Storey Height

This is the height from finished floor to finished floor (depending) or from finished floor to ceiling or head room (bungalow).

Variations in storey height do not affect the cost of the horizontal components of the building e.g floors, roofs, but have a more or less direct bearing on the cost of vertical components e.g. walls, partitions and stanchions.

The vertical components of building of 2-storeys or more can account for roughly ¼ to 1/3 of the total cost. Therefore, variation in storey heights affects to a reasonable extent the cost of a building.

Naturally a greater storey height implies a greater cost although there may be exceptions like where the extra height is needed for some special functions like services, storage etc. Whose alternative provisions may be impracticable or too expensive.

The element most affected by storey height variations are the walls (enclosing/ partitions) and their accessories other effects of storey – height increases include:

- Increased volume for heating/cooling leading to a greater energy consumption and longer lengths of pipes and cables.
- Longer services pipes for water supply and waste disposal
- Increased cost of vertical circulation means/facilities
- General increase in labour cost in ceilings, roofs etc due to working at greater height.
- Possible increase in cost of substructure to support increased wall loading.
- Increased height and consequently cost of columns/stanchions for framed buildings.

4.1.7 Total Height

Constructional costs of buildings rise with increases in their height, but these additional costs can be partly offset by the better utilization of highly priced land

and the reduced cost of external circulation works. Other effects of total height are:

- ❖ Foundations cost/m2 of floor area will fall with increases in the number of storey provided the form of the foundation remains unchanged.
- ❖ Beyond a certain number of storey the form of construction changes and unit costs usually rise. The change from load-bearing walls to framed construction is often introduced when building exceed four storeys in height.
- ❖ The affect of the number of storeys on cost varies with the type, form and construction of the building.
- ❖ As general rule maintenance costs rise with an increasing number of storey, as maintenance work becomes more costly at higher levels.
- ❖ Airconditioning costs are likely to fall as the number of storey increases and the proportion of roof area to walls reduces.
- ❖ Fire protection requirements increase with height as fire fighting equipment becomes more sophisticated, involving the use of wet or dry risers and possibly sprinklers.
- ❖ As the number of storey increases, both the structural components and circulation areas tend to occupy more space and the net floor area assumes a smaller proportion of the gross floor area, thus resulting into a higher cost per sq.m of usable floor area.
- ❖ Means of vertical circulation in the form of lifts and staircases tend to be increasingly expensive with high buildings, although fairly sharp increases in costs are likely to occur at the storey heights at which the first and subsequent lifts become necessary.
- ❖ Fees of specialist engineers will probably be incurred for the design of foundations and frame, mechanical and electrical services and fire fighting equipment.

WEEK 10

5.0 OTHER FACTORS AFFECTING DEVELOPMENT

5.1 Effect of Legislation on Project Cost

Legislation, generic term used to denote the body of laws enacted in various countries, chiefly in the 19th and 20th centuries, to correct specific social and economic maladjustments. In general, such laws are designed to raise the standard of living and the cultural level of the economically depressed. In recent times legislation has also been passed to aid segments of the general public affected by such economic vagaries as spiraling costs of living and increased unemployment.

LEGISLATION

5.1.1 Effect of Government Legislation on Building Development in Nigeria

The national fiscal policies have a great impact in influencing the made of the construction development if a boom period appears to the ahead investors will be confident, contractors will be wiling to execute project while if the future prospects appear glooming they will be far from being confident from investing their resources. Usually such factor will make a terrific difference to the type of investment into which investors are prepared to put their money apart from affecting the thinking of the investors the economic situation can also affect the amount of money in circulation at any particular time.

The government fiscal polices which imposes stringent credit restriction can prevent people from undertaking development purely and simply because they could not obtain the necessary finance and /or the cost of finance is very high, since there is non- to lend and the little available attracts high cost of finance. It is obvious then that there could be no scheme.

When the situation improves and adequate finance is available attracting low interest rate contractors will be undertaking competitively and investors will expand their activities thus making it possible for goods and services to be made available.

It is therefore important to not the effects of government policies which are extremely important to the growth of construction works. In many instance the government has given traffic on certain building materials, and set money into research for the development f materials for construction works.

Government has sunk in money for building factories i.e. cement, Iron and Steel industries as well as encouraged foreign investors for the establishment of building manufacturing and assembling of building component, in Nigeria such ventures includes tower aluminum, flag aluminum, crittal hope general metal products etc.

Such policies are aimed at providing leverage to the availability of building materials and hopefully at more affordable prices, this effect do only reduce the high cost and construction but as well as the time require for excursion and completion of projects while the quantity surveyor preserve this government measures in terms of construction cost, the valuers preserves this measures as enhancing developers and investors in construction this is because while government provide direct aid such as grants for various purposes. Grant is given to encourage the improvement and modernization of older residential building properties.

There is little doubt that such and influxes investment policies, as with the aid of a great a scheme which previously was un remunerative and unattractive may suddenly become a paying preposition, the resultant effect are t

The product cost produced are not only available at lower prices since there will usually very low interest rate or none and the grant consider the rate of building sacristies that provide building loans at lower interest rate.

Local Economy

The values will consider the state and trends in the local economy as a prime and important factor in investing. An investment in property in a depressed local area is hardly likely to be attractive as a similar investment in a thriving area unless the depressed area currently offers investment possibilities at a bargain prices and it is considered that future prospect for the area is good.

However, the Quantity Surveyor main concern is construction price, should the government policy for instance, is the construction of a brand new sport stadium and an entertainment canter, it will certainly cost more in a local area with a high unemployment rate.

The Quantity Surveyor attention should be geared towards:

- Source of available building materials and / or storage
- The provision of necessary security for the mats
- The recruitment of skilled and semi skilled labour the unskilled can be provided at the local level
- The provision of camps and / or transportation as well as welfare facilities at the local level.

There are many of such cost factors inching provision of hired plants at the site. It is sure that this will make the change more costly to construct relative to a similar one in the urban centre.

However, it is also important to note that land in the cities is available at a rather high premium (price) vis-à-vis the local area.

5.2 Effects of Government Action on The Construction Industries

Government has a crucial role in determining demand for the construction industry's output and its growth prospects. This is because both the public authorities buy over hall is output and because general economic measures have powerful influence on the demand for private housing and industrial and commercial building.

The reason being different monitory policies are introduced to check the economy as a whole, when government introduces restraints or stimulate cough-up in the process. When the policies of restrain operates there is usually a reduction in the volume of public building particularly housing such as motor ways and town centre developing scheme are likely to be cut-back or postpone. The adverse effect on contractors is not usually felt immediately as contracts in hand will normally be carried out to completion. However, in the long-term the result can be serious, resulting in some of the following situation:

(1) Unemployment of building operatives

(2) Smaller building firms are likely to be forced out of business

(3) Large constructions firms could be reluctant to invest large sum in new plants and equipment or to experiment with new techniques.

(4) Suppliers of materials and components will be unwilling for explanation for their existing plants.

(5) The recruitment of persons into the industry at all level will become more difficult.

(6) The lack of continuity of the construction work, causes higher cost due to fluctuation over the ………. as well as reduced efficiency.

We shall consider some of the repercussion of government policy:

a. **The Government As A Client**: The Nigerian government undertakes over 70% of the construction work, either through undertaking the construction or purchases form private developers (i.e. NNDC) many of this government projects (Capital Projects) that is modernization and electrification, motor ways, building of new and expanding of towns, housing for all programs and erection of local government houses as well as structures for political parties etc.

Thus a relatively small change in government policy may cause significant change in the construction industry's work load to which the industry will find difficult in adjusting itself due to the nature of its structure and project.

Government spending on capital investment such as schools, hospitals, roads and public housing, it curtail can have a serious impact on the construction industry. Also a change in priority by the government such as transfer of funds forming housing to other projects creates problems for the construction industry as these two activities are largely undertaken by different size all types of firm using subsequently different forms of plant. Hence it is not only the level or volume of construction activities which needs consideration but also its composition e.g. substantial increase in housing loan will result to a significant rise in the volume of work available to small builders.

b. **Public Control**: Government seems to influence the location of new works or industries through some certain ways:

   i. Location
   ii. Through grants
   iii. Construction subsides as well as tax incentives.

Therefore new industry is likely to be stiffed towards location where the government wishes to see industries development established as new capital, local government headquarters, even development policies, rural areas where there are surplus and construction impact. Also the same government action may not only influence level of construction, location but indeed the cost of the structure, for example certain standards are set for certain types of construction such as technical schools, hospitals etc which are aimed at securing minimum standard of construction in buildings at this standard influence cost as well as the demand for the building work and the type of contractors to handle such projects.

Note also that factory acts prescribes certain minimum requirement for temperature, ventilation and lightening in factories and this requirements will affects construction cost.

Sometimes social and political consideration can influence the form and pattern of a construction program e.g. the universal primary education scheme which gave more attention to the training of the primary school pupil, how about emergency teachers colleges, what about the genesis of school of basic studies. These decisions will affect the nature, scale and location of education buildings in a particular financial year or period.

c. **Monetary Policy**: The government uses various controls such as bank rates, open market operation and higher purchases restrictions to alter the level of interest rate and to control the amount of create available and the term on which it can be obtained. Create restriction affect the contractor both directly and indirectly through bank and landing institutions as through builder’s merchants who are always a ready source of trade credit and could be the mainstay of many small builders.

In the short term an increase in interest rate is unlikely to affect the demand for construction work.

In the term it will result in higher prices of building and this may cause some developer and other building client to retrain from investing capital in building projects, as their no longer as profitable, and the client themselves may experience difficulties in obtaining finance at a higher interest rate, hence, some projects are likely to be postpone or abandon, furthermore, contractors reducing on bank over draft as a main source of working capital may find their loans curtail and thus be compelled to reduce the output.

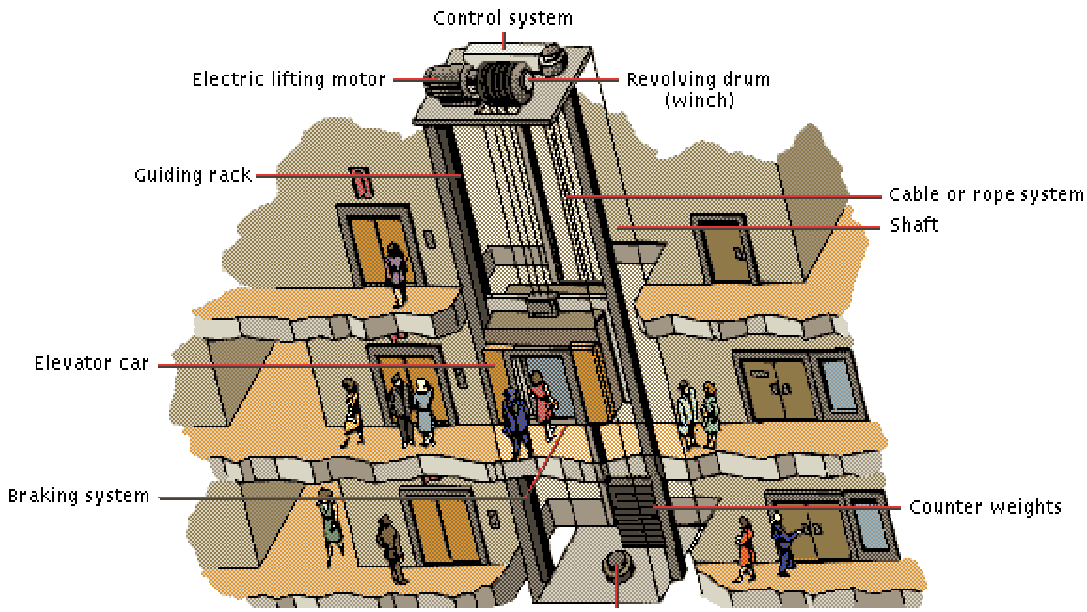
d. **Taxation**: Taxation is an important tool in the government fiscal policies and has important application stemming from the alternative uses to which the money would have been used had it not been taken as tax, and the wide spread distribution of tax. Taxes are levied on both capital and income, an increase in capital tax on the value of property or on gains made from the sales of buildings or land may result in decreased demand, while an increase on property income or used is likely to result to a result in crease demand for new buildings unless of cause it is off set by their rates or profit.

e. **Fiscal Policy**: Apart from taxation a government can influence the level of economic activities by regulating the amount of its spending but the level of spending on construction is very high. Generally, however, in times of deflation and rising unemployment an expansion of public works generate employment opportunities and investment to revive the economy.

WEEK 11

5.3 Effect of Equipment Installation on Project Cost

Special installation requirement



ELEVATORS / LIFTS

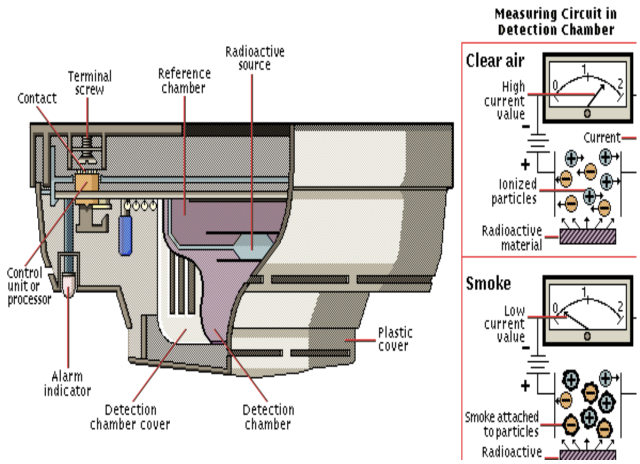
Elevators / Lifts: device for vertical transportation of passengers or freight to different floors or levels, as in a building or a mine. The term *elevator* generally denotes a unit with automatic safety devices; the very earliest units were called hoists. Elevators consist of a platform or car traveling in vertical guides in a shaft or hoistway, with related hoisting and lowering mechanisms and a source of power. The development of the modern elevator profoundly affected both architecture and the mode of development of cities by making many-storied buildings practical.

BURGLAR ALARM

Burglar Alarm: burglar alarm can initiate a considerable response by police or private security personnel, who may leave other important duties to race to the scene of the alarm. Therefore, it is important to prevent false alarms when designing and installing alarm systems. Modern burglar alarms make use of several different technologies to reduce false alarms.

FIRE FIGHTING EQUIPMENT

Fire Fighting: techniques and equipment used to extinguish fires and limit the damage caused by them. Fire fighting consists of removing one or more of the three elements essential to combustion—fuel, heat, and oxygen—or of interrupting the combustion chain reaction.



SMOKE DETECTOR

A house with central heating or air condition is invariably more valuable and expensive than a similar house which does not have these facilities. Again the use of heavy machine installed in factories requiring a more working weight due to the machines as well as more expensive foundations and machine bases to carry the heavy machine loads and absorb vibrations will affect the cost of construction. Similarly a house with special installations such as lifts, fire fighting equipment, fire and burglary alarm will be more expensive than a similar house which does not have these facilities

5. 4 Health and Safety Plan - Method Statement

GENERALLY

A **Construction Hazards** arising from the design of the project include those identified below. Common hazards which should be controlled by management and good site practice are not listed.

- Hazard: Working at height and in confined spaces

Precautions assumed: Dust masks and protective clothing. Scaffold where necessary

B **The Construction Phase Health and Safety Plan,** developed from the Pre-tender Health and Safety Plan must be submitted to the CA not less than 1 week before the proposed date for start of construction work. Do not start construction work until the Employer has confirmed in writing that the Construction Phase Health and Safety Plan includes the procedures and arrangements required by CDM Regulation 15(4). The plan must include:

- Detailed proposals for managing health and safety during the construction phase together with site rules and emergency procedures.
- Method statements related to the hazards identified in the pre-tender health and safety plan and/or statements on how the hazards will be addressed and other significant hazards identified by the contractor.

C HSE (Heath and Safety Executive) **Approved Codes of Practice**: Comply with the following:

- Management of health and safety at work.
- Managing construction for health and safety.

D **Security:** Adequately safeguard the site, the Works, products, materials, plant, and any existing buildings affected by the Works from damage and theft. Take all reasonable precautions to prevent unauthorised access to the site, the Works and adjoining property.

E **Stability**: Accept responsibility for the stability and structural integrity of the Works during the Contract, and support as necessary. Prevent overloading: details of design loads may be obtained from CA.

F **Occupied Premises**:

- Existing buildings will be occupied and/or used during the Contract as follows:

  All dwellings included in the schedule.
- Carry out the Works without undue inconvenience and nuisance and without danger to occupants and users.

G **Employer's Representatives Site Visits:**

Inform the CA in advance of all safety provisions and procedures (including those relating to materials which may be deleterious) which will require the compliance of the Employer or the Employer's representatives when visiting the site. Provide protective clothing and/or equipment for the Employer and the Employer's representatives as appropriate.

Protect Against The Following:

A Noise:

- Comply generally with the recommendations of BS 5228: Part 1, clause 9.3 for minimising noise levels during the execution of the works.
- Do not use or permit employees to use radios or other audio equipment in ways or at times which may cause nuisance.

B Asbestos Based Materials: Report immediately to the CA any suspected asbestos based materials discovered during work. Avoid disturbing such materials. Agree with the CA methods for safe removal or encapsulation.

C Fire Prevention: Take all necessary precautions to prevent personal injury, death, and damage to the Works or other property from fire. Comply with Joint Code of Practice 'Fire Prevention on Construction Sites' published by the Building Employers Confederation and the Loss Prevention Council.

D Fire Prevention: Smoking will not be permitted on the site except in designated areas which must be carefully controlled equipped with fire fighting equipment and receptacles for the safe disposal of smokers materials and inspected to guard against risk of fire.

E Waste:

- Remove rubbish, debris, surplus material and spoil regularly and keep the site and Works clean and tidy.
- Remove all rubbish, dirt and residues from voids and cavities in the construction before closing in.

- Ensure that non-hazardous material is disposed of at a tip approved by a Waste Regulation Authority.
- Remove all surplus hazardous materials and their containers regularly for disposal off site in a safe and competent manner as approved by a Waste Regulation Authority and in accordance with relevant regulations.
- Retain waste transfer documentation on site.

TEMPORARY PROTECTION:

F The Contractor shall allow for:-

a) providing temporary fencing, gates, hoarding, screens, fans, planked footways, guard rails, gantries and the like as may be necessary for protection

A Adjoining Property: Prevent trespass of workpeople. Take all reasonable precautions to prevent damage to adjoining property. Obtain permission as necessary from the owners if requiring to erect scaffolding on or otherwise use adjoining property, and pay all charges. Clear away and make good on completion or when directed. Bear the cost of repairing any damage arising from execution of the Work.

B EXISTING STRUCTURES:

- Check proposed methods of work for effects on adjacent structures inside and outside the site boundary.
- Provide and maintain during the execution of the Works all incidental shoring, strutting, needling and other supports as may be necessary to preserve the stability of existing structures on the site or adjoining, that may be endangered or affected by the Works.
- Monitor adjacent structures and immediately report excessive movement to the CA.

- Do not remove supports until new work is strong enough to support the existing structure. Prevent overstressing of completed work when removing supports.

WEEK 12

5.4 Effect of Site Condition on Project Cost

Each site has its own peculiar characteristics which can have a considerable influence on the total cost of development. Some of the important site factors are now examined.

LOCATION OF

The cost of building a site in the major cities can be as much as 30% more expensive than the cost of erecting a similar building on a provincial site due to higher wages, more costly materials and other operational costs. Some parts of the country are more exposed to rainfall than the others which can lead to loss of productive time.

A building on a remote country site may involve long lengths of bad road and lack of electricity. A site in a congested area can give rise to problem of delivery and storage of materials. An exposed site may make working conditions more difficult and costly and some locations may be vulnerable to vandalism and theft and so require more costly security measure.

A project located in the heart of a city centre location will attract substantially higher preliminary costs such as: insurances against damage to adjoining properties, restricted access to site and the concomitant reduced productivity, maneuverability problems with the use of plant and equipment and other planning permission restrictions.

And even within the same city, variation in cost of input exists. A project in the heart of Lagos Island will naturally be more costly than a similar one in the less dense district like Surulere. This is as a result of a number of factors like the higher cost of transporting large equipment and bulky materials to the project site, the greater cost of protection of adjoining properties and associated higher insurance premiums.

DEMOLITION AND SITE

One site may be clear of obstruction, whilst another may contain substantial buildings requiring demolition, heavy foundation and plant bases requiring removal. Extensive paved areas which need breaking up and a number of large trees which require felling, together with the grubbing up and disposal of their roots.

CONTOURS

Few sites are entirely level and the more steeply sloping the site, the greater will be the cost of foundation and earthwork generally. Most buildings require constant floor levels and this will involve considerable excavation and filling on a sloppy site.

GROUND CONDITION

Where the stratum is of low bearing capacity, it may be necessary to introduce piled or other more expensive types of foundation. Raft foundation on made up ground or in areas liable to mining may be three times as expensive as normal strip foundation, whereas piled foundation used to transmit loads to a deeper load bearing strata could be as much as five times as expensive.

Ground condition may affect choice of equipment, type of mechanical plant, transporting equipment, need for pumping equipment or costly de watering processes.

SITE ORGANIZATION

Site organization may affect progress of work, speedy completion being usually a reflection of an efficiently organized site. A well laid out and tidy site also assist the safety aspect.

PLANNING AND BUILDING REGULATIONS

The ratio of site value to cost of building should always be considered. In expensive central locations the aim must generally be to secure the most profitable permission to use, and coupled with this is the desirability of obtaining maximum site utilization. the shape and size of the building as well as probable cost, are affected by heights restrictions, building and road improvement lines, parking requirement, light and air restrictions, landscaping conditions, access requirement and similar consideration.

SERVICES

The position and capacity of existing services such as sewers, water mains, electricity cables, gas mains and telephone services are other important influences on site cost. The cost implication of combined separate and partially separate systems of sewerage must be appreciated. On occasions it is necessary to divert existing services which cross sites to improve and regrade watercourses which adjoin sites.

AVAILABILITY OF LABOR, MATERIALS

The availability of labor is an important factor to be considered in the contract area and the availability o f materials when preparing tenders, investigations into the availability of materials would include availability of sand, blocks etc. Contractors will have to make important decisions at the tendering stage each of which will influence cost.

- If all labor requirements can be met

- If mechanical or non mechanical plant owned by the organization is suitable or if it is necessary to purchase for the project
- If is desirable to sublet works to specialists.

OTHER FACTORS AFFECTING COST

A contractor can influence the cost of a project by his selection of construction methods (method statement) and by adjusting these methods to increase the effectiveness of the resources used. The free choice method is however constrained by the design of the building.

The availability of the members and types of resources needed for each method and by the relative cost of the building. Another important cost aspect is the quantity of materials wasted on building sites and the cost of these wastages which can be averted by effective planning and supervision. The existence of easement can also affect the design, construction and cost of the work.

WEEK 13

5.5 Effect of Use of Plant and Market Condition on Construction Cost

USE OF PLANT

With the continual rise in labor costs, many contractors are making greater use of plant. This requires an intimate knowledge of all types of plant. When each can be used most profitably and of the fullest possible use of plants.

Cranes are being used increasingly in building sites resulting in higher productivity. Examples of such plants are concrete pumps, batching plants tower cranes, crawler cranes, material and passenger hoists formwork systems and forklifts. A contractor sometimes has to choose between hiring or purchasing Plants and the decision will be influenced by demand

Grab-Bucket Dredge

A grab-bucket dredge collects underwater matter in a bucket at the end of a flexible arm. This type of dredge is especially useful for work in deep water.

ADVANTAGES OF OWNING PLANTS

- ✓ Plant is readily available at all times
- ✓ Plant may be retained on a site if circumstances make it desirable
- ✓ Plants can be transferred from one site to another without great difficulties
- ✓ In emergency situations, machines can be taken off less important work as the contractor has complete control of the plant

HIRING PLANT

Plant hire serves on the other hand serves a valuable function in that it offers a wide verity of plant types to the contractor free from the liabilities attached to the purchase of plant especially if the contractor is short of capital. Hiring plant often ensures maximum economy with full plant utilization and is an aid to quicker building.

FACTORS TO BE CONSIDERED

The main factors to be considered when evaluating the economies of buying or hiring plants are

- Forecasts of commitments to assess plant requirements
- Availability of workshop facilities for servicing plants
- Length of time for which plant is to be utilized. If utilization is less than 60% its better to hire than purchase.
- Adequacy of capital available for purchase
- Availability of personnel for controlling and operating plant holdings
- Cost of transporting plants to site.

PRINCIPAL METHODS OF CHARGING FOR

- Percentage of contract price
- Direct cost to the contract
- Hire charge.

In all these cases, an efficient costing system is necessary to ensure that realistic rates are charged for the use of plant.

EFFECT OF MARKET CONDITION

The level of prices submitted for a particular project may reflect the market situation at that point in time. This is governed by the volume of work in progress in the area and relative keenness of building prices, the situation can change quite dramatically over a comparatively short period of time.

In addition many unforeseeable and external factors can influence building costs, such as national and local shortages of labor/ materials. Other factors bearing on costs include time for completion and special requirement of the building owner. Such as phased completion of various sections of the work.

Tender prices can also be influenced by the way in which the contract documents are prepared and the amount adequacy of the information which is supplied to the contractor at the tendering stage. The method of tendering can also affect the price of a project and negotiated contracts are more expensive than competitive tendering. But factors other than cost may influence a decision on the method to be adopted.

Many cost aspects may need considering in the feasibility studies of projects. A common problem is to assess the relative merit of converting and modernizing existing buildings as against building new ones.

Probable trends in prices can be an important factor. Cost limits of development projects may be set by the rent obtainable and an important aim may be to maximize the areas available for use by occupants. The periods needed for both pre contract and construction stages may be of considerable importance to the building client.

WEEK 14

5.6 Explain the Impact of Building Use on Cost

LOW AND HIGH RISE BUILDINGS

Residential Buildings

The relative cost of low and high rise residential buildings were compared and reasons were sought for the much higher cost of the high rise development over two- storey housing. The more intensive use of highly priced land will offset to some extent the increased costs resulting from multi storey development. In addition there may be social benefits to be gained some occupiers through the erection of tall block of flats on central urban sites, such as a ready access to town center facilities and reduction in lengths of journey to work although these benefits are difficult to evaluate, and there is ample evidence of sociological problems. High rise flats often cost between sixty and eighty percent more per square meter of floor area than houses with superstructure. Cost influenced particularly by the cost of the frame and floors accounting for just over half of the increased cost and the cost of services including lifts taking up most of the remainder. Further more, the high block of flats show a greater range of costs than low flats or houses.

With low rise flats, the main sources of higher cost in this type of flats as compared with a house is in floors, landing , staircases, balconies and finishing. These cost could be as much as two to three times greater than corresponding items in two storey housing, while the majority of other components average from twenty to seventy percent higher in cost. Savings in roof and substructure cost were not particularly significant.

Apart from higher constructional costs, problems were also encountered through people not willing to live so far from the ground, difficulties experienced by young married couple as to raising young kids in high flats.

Industrial Buildings

Industrialists have a general preference for single storey premises but a variety of matters such as limitation on land available and increased demand for car parking space may justify re-appraisal. A wide diversity of loading occurs in factory buildings, in a specific case. The roads to be carried may affect the choice of site, influence the building design and if very heavy may have a considerable bearing on the choice between single and multistory construction.

Post war industrial development included some multistory factories but the majority has been single storey. In the new and expanding town almost all the factory buildings were single storey although possibly fronted with double storey office blocks.
In the nineteen eighties saw a significant demand for warehouse but the recession in the early 1900s severely affected manufacturing industry and resulted in a sharp decline in the numbers of new factories under construction. The main demand was for small units of the nursery of starter type which because they operated as “seedbeds” are subject to frequent changes of ownership and this concerns the institutions more than the lower units and higher construction costs compared with larger industrial buildings.

The design of factories is primarily concerned with two aspects “space requirements of the occupier and structural requirements. Most large industrial companies employ production and plant engineers who are capable of arranging plants and human, and make ample arrangement for parking and waiting space for long vehicles.
Most factories are roofed in such a way that allows roof lights by use of transparent sheets. The surface finish of the roof will depend on the type of work to be undertaken in the factory as some machinery might be attached to the roof.

Span and space play an important role in design cost. The fewer the intermediate upright the better but care must be taken to obtain optimum acceptable column positioning which will determine the structural grid. The fewer the column position, the greater the loading concentrated on a smaller number of points. Reconciliation is also needed between the number of columns required to keep the cost down and the number that will interfere with the production work in the factory.

Floors take a substantial load. Except in small or ancillary buildings. The external walls are unlikely to be load bearing. The type of external walling will also have a significant effect on the thermal and sound insulation provision.

Many other factors require detailed consideration such as the provision of closely controlled lighting levels. Distribution network of services (often overhead), adequate staff facilities and a satisfactory standard of materials, heating and ventilation.

Shops

The number of story incorporated into other types of buildings will often be influenced by the purpose for which the building is to be used and /or the value of the site. Shops are generally of single storey construction for the convenience of users while offices are often multi storey to make more intensive use of highly priced central sites and to enable the occupants to be as far removed as possible from traffic noises. An ideal approach is to build offices on top of shops in the center of large towns and cities. And flats or maisonnettes above shops in neighborhood centers.

Flexibility should be the prerequisite of every shopping complex based on the optimum structural grid.

Schools

Schools re of varying heights with predominated single storey buildings amongst primary schools. Secondary schools are often of two, three or four storey and technical colleges and colleges of further education are often of several storey except for single storey workshops and laboratories.

A study undertaken showed that a two storey building was the cheapest proposition and that both three and four storey buildings were significantly cheaper than a single storey building. Factors contributing to the higher cost of single storey buildings included the greater quantity of work below ground floor level and in roof and drainage work. More external doors which are relatively expensive and more pipe and cable run which are also costly.

The unit cost of three and four story blocks exceeded those of two storey blocks with the same total floor area for several reasons.

With certain elements such as roofs and work below ground level, the reduction in cost/s-m obtained between the single storey buildings diminishes as the floor area increases with the provision of additional storey.

The three and four story buildings must be provided with two staircases whereas one is sufficient for the two storey building.

As the height of building increases there is a marked increase in the need for wind bracing.

Offices

Tenant's requirements are an important aspect of the office development process. Developers must generally be prepared to provide good quality office buildings with high standard finishes and services. Higher rent demand or should demand higher standards. Tenants are basically looking for good simple and reliable services and an attractive approach to the offices, a good entrance hall and flexibility in the use of the space which they are renting. The spacing of columns across the width of the building will need determining at an early stage. A general arrangement is two rows of columns forming a corridor down the center of the building. This arrangement is flexible to be used either for individual cubical offices or if the whole floor is left open for a single department.

It is necessary to establish an economic structural grid for column spacing other wise the structural cost will be expensive in relation to overall building cost. Technically, it is possible to keep the floors completely free of columns to provide maximum flexibility but the cost of achieving this is usually great in relation to the potential advantage.

An office shell may have a life span of 60 to 100 years but the tenant could change every 10 to 15 years and internal office landscape every one to three years.

Office strips are connected by nodes, lifts, and stairs. Toilets, tea points, and similar fixed installations. They are intended to present a visual and environmental contrast to the office area.

WEEK 15

5.7 Specifications And Their Cost Implications.

Walling

Walls and partitions with associated doors and windows constitute a major item of expenditure of a building. In a municipal housing, these components can account for about one quarter of the total cost of blocks.

The curtain wall, the most common type of non load-bearing wall, may be assembled either on or off the site. It consists of an exterior skin backed with insulation; a vapor barrier; sound-deadening materials; and an interior skin that may be part of the curtain wall or may be attached separately. The exterior skin may be made of metal (stainless steel, aluminum, bronze), masonry (concrete, brick, tile), or glass. Limestone, marble, granite, and precast concrete panels are also used for facades.

The traditional method of constructing a roof is to lay down, over a steel or concrete deck spanning the framing members, rolls of roofing felt laminated with tar and topped with gravel. Synthetic materials are also being used increasingly in place of felt and tar. New glasslike and rug like materials made of plastic enable recreation areas to be built on top of roofs at little expense.

Traditional methods of partitioning a building interior include the use of masonry walls 10 to 15 cm (4 to 6 in) thick made of concrete, gypsum, or pumice block, painted or plastered; or wood or metal frames covered with lath over which plaster is spread. Plasterboard and wallboard are increasingly used.

To provide for greater flexibility within buildings, movable or easily disassembled partitioning systems are used, the only restriction to their placement being the spacing of the interior columns. Such partitions may be metal, prefabricated plasterboard components, accordion like rolling curtains, or, if sound transmission is a problem, leaded curtains that move either horizontally or vertically. Lightweight materials usually mean an increase in transmitted sound and a loss of privacy. Nevertheless, the trend is toward lighter partitions and increased use of sound-absorbing materials. In many buildings, the only walls still made of masonry are fire walls, which enclose elevator shafts, stairs, and main corridors.

Roof

The majority of multistory flats have flat roofs. The need for lift motor rooms, tank rooms ventilating plant on each occasions, ducts and pipes add to the complexity of roofs and the economy of covering number of dwellings with one roof is partially offset by the costlier construction. Building ancillary structures on roof is both expensive and often aesthetically unsatisfactory.

Asphalt is the most common covering to flat roof.

Roof finishes

The range of roof finishes available is immense; among materials available is aluminium, zinc, clay, slate, concrete, metal, timber, synthetic or a combination of various types. The main factors to be considered in the selection of finishes are

The provision of an impregnable skin which does not change its characteristics on exposure

Reasonable capital cost in relation to function

Low cost and ease of maintenance and repair

Speed and ease of application

Long life expectance

Ready availability and

Suitable visual qualities such as color texture, scale and applicability to the required roof form

In Nigeria, aluminum/zinc account for ninety per cent of pitched roof coverings, presumably stemming from economy and suitability both technically and visually for low rise housing of medium to large frontage. For flat roofs there is no such clear cut market situation and the factors influencing choice are frequently more oriented towards the specialist skills of lying

Roofing Costs

One useful method of investigating the cost of alternative roof types is now outlined.

The general format and scope of the study is discussed

Details and a measured schedule for a basic design are prepared; these are discussed and the general principle settled.

Variations from the basic designs are considered

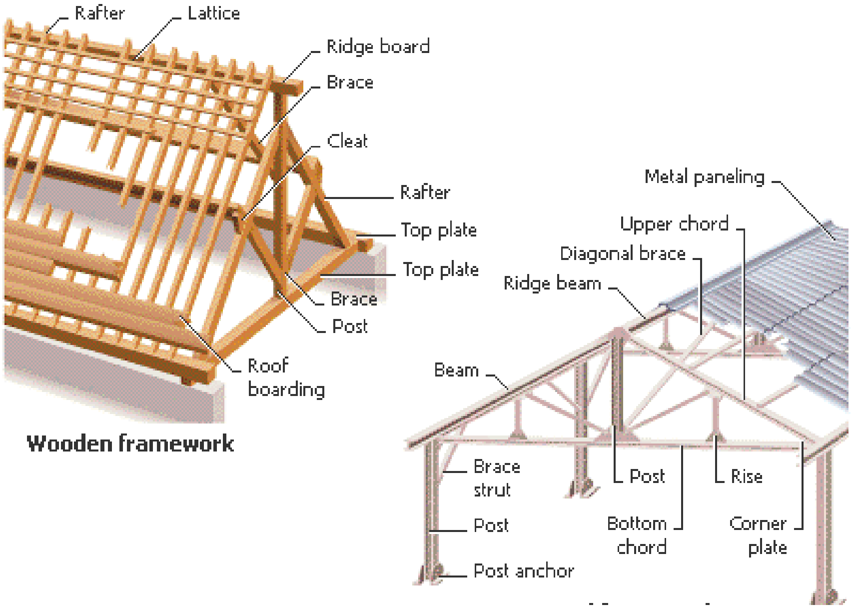
Details and measured schedules for variations are prepared; these are discussed and coordinated.

A schedule of rates is prepared based on an agreed price list of materials

Schedules of measurement are priced.

Cost relationship are examined

A report is prepared



Flooring

Floors and Floor Coverings, structures that, together with ceilings and walls, form the basic components of a building. When the first dwellings for protection and shelter were built, the ground served as the floor; branches, reeds, and wood logs were among the early materials also used as floors and floor coverings. Stone and brick floors appeared with the first stone building constructions during the 4th millennium BC in Egypt. Clay tiles (*see* Ceramics; Tile) were also used in Egypt, Mesopotamia, Crete (Kríti), Greece, and Rome. The ancient Greeks made extensive use of stone and marble, and the Romans used concrete; especially as a base for mosaic floors .

In early times floors became an important ornamental element in architecture. Mosaics, colored and glazed tiles, marbles of different colors, and inlaid wood have been used throughout history to create designs. Among famous examples of ornamental flooring are the mosaic pavements found in the ruins of a Roman villa near Piazza Armerina, Sicily. The mosaics, set around AD 300, cover an area of 3500 sq m (4200 sq yd) and are outstanding for their range of colors and their vigorous style. Tile floors appeared in European cathedrals during the 12th century. Terrazzo, flooring consisting of small marble and granite chips embedded in cement, became popular during the Renaissance and is still used today.

A wide variety of materials are used in modern floors. Concrete and wooden floors are usually covered with carpets, rugs, and other floorings for aesthetic reasons and to increase durability of the surface, absorption of sound, and ease of maintenance. Wood is still extensively used in residences, especially as parquets (short, hard pieces of wood assembled in geometric patterns). Wood tiles and prefabricated parquets can easily be installed on existing floors.

Tiles also play an important role in modern buildings and homes. Of all floor coverings, they are the most resistant to water and humidity, and they are easy to clean. Glazed ceramic tiles are used wherever highly sanitary conditions are required, such as in hospitals, laboratories, swimming pools, and public rest rooms. In the home, tiles are used on the floors and walls of kitchens and bathrooms. Synthetic, resilient floorings include linoleum, asphalt tiles, vinyl asbestos and pure vinyl tiles, and rubber.

Floor finishes also vary considerably in unit costs and thickness of the flooring can influence structural costs as thick finishes like wood blocks may produce a taller building than a thinner floor covering such as vinyl tiles spreading on the screed thickness. Cleaning and maintenance costs of floor finishes are other important considerations which should be taken into account in any cost appraisal.

A number of natural and synthetic materials are used as floor coverings. Each offers a range of advantages and disadvantages in terms of durability, comfort, ease of cleaning, and ability to take colors or form attractive designs.

Wood flooring has been used for centuries and still accounts for a large percentage of floors. In the United States, oak flooring is the most common because of its fairly high resistance to wear. Most wood floors are laid as planks, or strips, or a parquet tiles. Although they are attractive, wood floors need more care than do most other floors. Cork, treated with heat or linseed oil and sometimes coated with vinyl, can be used as tiles or carpeting; its ability to absorb sound is excellent, but its wear properties are inferior to those of other floor types. Kitchens, bathrooms, and entry areas, especially, often have floors of terrazzo or ceramic or quarry tile (*see* Tile). These floors are very hard, waterproof, and stain-resistant.

The most common resilient floorings are rubber tile and vinyl tile. The latter has largely replaced linoleum and asphalt tile because of its superior moisture- and chemical-resistance and its greater variety of colors and patterns. The most recent innovation is flooring that needs no waxing to retain its shine. Rubber tile is made of synthetic rubber combined with fillers and pigments; it is used in places where traffic is heavy, such as shopping malls, and is available in tiles and rolls. Vinyl tiles and rolls are made of polyvinyl resins containing binders, fillers, and pigments. Vinyl flooring is wear-resistant and easy to maintain.

Linoleum, the oldest synthetic floor covering, was invented by the English rubber manufacturer Frederick Walton about 1861. It is composed essentially of a mixture of solidified linseed oil and filler adhering to a fabric backing. In inlaid linoleum, the design permeates the entire material.

Asphalt tiles consist of fibers and mineral fillers that are bonded with asphalt or synthetic resins. Epoxy resins that are spread directly on concrete floors have also been developed; these are used mainly where resistance to chemicals is important.

Doors and Windows

Window (building), an opening, usually framed with wood or metal, built into a wall or roof. Windows are usually constructed with glass to admit light.

There is a wide range of choices available from timber to steel, aluminium to pvc. Even with the same class and size of window, there can be wide variation in price according to the particular design of the window and the number of opening lights. For instance, with 1200 x 1100mm steel windows the introdiction of two opening lights over and above a single fixed light can increase the total cost of the window by twenty five percent.

Until the 1970s the use of stainless steel windows was confined almost entirely to banks, insurance offices and large department stores on account of their high initial cost.

Finishes

The range of choices available for wall and ceiling finishing is probably greater than for any other components of a building and the choice is influenced considerably by the class and use of the building. In municipal housing, finishing to walls and ceilings can account for up to ten to fourteen percent of the total construction costs in varying situations. There are very large regional differences in the cost of internal decorations.

In industrial buildings, clients are generally not prepared to spend more than 4 to 6 percent of total construction cost on internal finishes with the majority allocated to floor finishes, the specification being influenced mainly by the function and profit.

The use of plaster board and similar sheet materials to form a dry lining to dwellings has become increasingly popular as t simplifies the work of the finishing trades and leads to earlier completion.

Decorative laminates offer a number of advantages,

Uniform coverage of large areas a

Attractive appearance,

Good durability,

Good resistance to wear biological and chemical attack, heat and moisture and low maintenance cost

They are particularly well suited for use in the communal parts of buildings where an attractive hardwearing and low maintenance cost surfacing is desirable.

The acoustic properties of finishes are becoming increasingly important and acoustic materials are manufactured in three major categories;
Porous materials for general sound absorption but with special reference to high frequencies
Resonant panels for abortion at low frequencies and
Cavity resonators which can be designed to provide maximum absorption at a particular frequency.

Ceiling, overhead surface of a room, opposite the floor. Usually the term refers to a flat, beamed, or curved surface that conceals the underside of the roof or the floor above, but it may also refer generally to the exposed underside

Service Installations

Building and their environmental services have become more complex and the range of choices continues to increase. Unfortunately the wide choice, lack of experience of new techniques and the need for assistance from more specialist skills have tended to act as constraints. In particular environmental requirements are often considered far too late in the design process for them to make a positive contribution to the final design. This is unfortunate when viewed against the high cost of service installations which may amount to as much as twenty five percent of cost on housing schemes.

Plumbing, system of piping that carries water into and out of a building. To protect public health, every inhabited building must have a supply of safe water for drinking and for the operation of the plumbing fixtures and appliances, and a sanitary drainage system for wastewater disposal. To provide the sanitary facilities required, local government authorities are responsible for establishing regulations known as *plumbing codes*, which govern design and installation requirements and the minimum number of fixtures needed, based on building use and the number of occupants.

Water Supply and Drainage Installations:

In developed communities, water under pressure is secured from street water mains and piped into the buildings. In other areas, water must be obtained from on-site wells or adjacent streams or lakes, in which case great care must be taken to ensure that the water is sanitary. Where available street pressure is insufficient to serve a building because of its height, equipment within the building, such as a pump that supplies a gravity tank above the roof, a pressure tank, or a booster pumping system must be installed. In hospitals and laboratories, in addition, special water systems such as distilled, dematerialized (deionizer), and reverse osmosis (RO) water systems are usually required

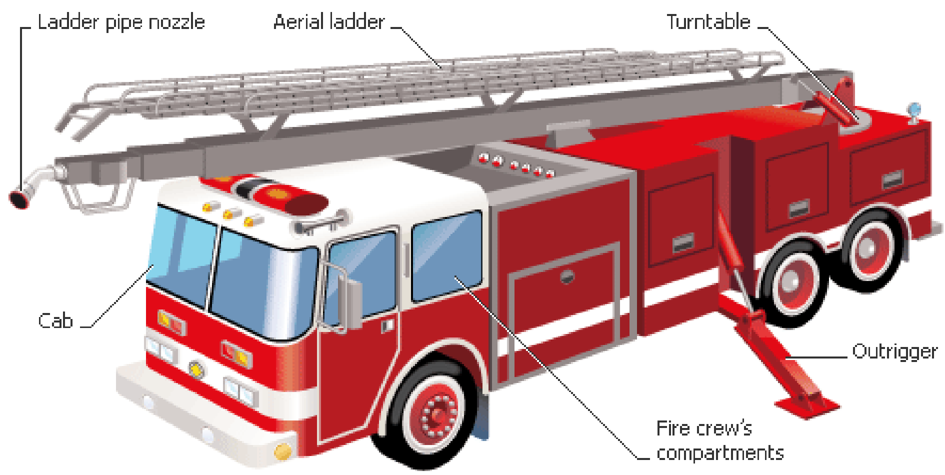
Drainage systems are of two basic types: sanitary and storm water. *Sanitary drainage systems* carry bodily and other wastes from the plumbing fixtures and appliances by gravity through a sewer to a sewage treatment facility outside the building. Sanitary drainage piping inside the building must be linked to a system of vent piping, to keep the pressures in all sections of the drainage piping equal. This prevents the siphoning or blowing of water in the traps (U-shaped dips in the piping), which in turn prevents the harmful sewer gases, which form as sewage material decomposes, from entering the building. *Storm-water drainage systems* carry rainwater from the roof by gravity through a sewer to a body of water or to a *dry well* (an area of the ground where wastewater can drain into the surrounding soil). Basement drainage usually needs to be collected in a sealed and vented pit or tank and pumped out of the basement. Hospitals and laboratories often require additional special drainage systems for removal of acid waste, radioactive waste, and infectious waste.

Sewage Disposal, or wastewater disposal, various processes involved in the collection, treatment, and sanitary disposal of liquid and water-carried wastes from households and industrial plants. The issue of sewage disposal assumed increasing importance in the early 1970s as a result of the general concern expressed in the United States and worldwide about the wider problem of pollution of the human environment, the contamination of the atmosphere, rivers, lakes, oceans, and groundwater by domestic, municipal, agricultural, and industrial waste.

Heating, Ventilating, and Air Conditioning (HVAC), related processes designed to regulate ambient conditions within buildings for comfort or for industrial purposes. Heating an area raises temperature in a given space to a more satisfactory level than that of the atmosphere. Ventilation, either separately or in combination with the heating or air-conditioning system, controls both the supply and exhaust of air within given areas in order to provide sufficient oxygen to the occupants and to eliminate odors. Air conditioning designates control of the indoor environment year-round to create and maintain desirable temperature, humidity, air circulation, and purity for the occupants of that space or for the industrial materials that are handled or stored there.

Heating

Fire Fighting, techniques and equipment used to extinguish fires and limit the damage caused by them. Fire fighting consists of removing one or more of the three elements essential to combustion—fuel, heat, and oxygen—or of interrupting the combustion chain reaction



EXTERNAL WORKS

It is interesting to break down the cost of site works on a housing contract to see the relative values of various works, although it is appreciated that their distribution will vary from site to site. This can be broken down into

Site preparation

Retaining walls

Screen walls and fencing

Paved areas

Drainage

External services

Landscaping

External works do therefore form a significant part of total building costs and justify taking steps to reduce cost by reducing the amount of earthwork and retaining walls, restricting paved areas to a minimum, reducing pipe runs of drains and other services and seeking materials and components which perform their functions satisfactorily and at the same time show favourable costs in use figures.