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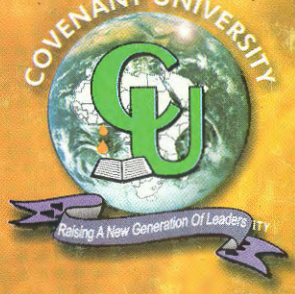

Public Lecture Series
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Building-Xray: Anatomy of the Structure and Process

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Public Lecture Series

Building Xray: Anatomy of the Buid\lding and Its Process

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1.1 Introduction

"Unless the Lord builds a house, its builders labour in vain" Psalm 127(1a)

We sometimes wonder how our world came to be. We know, however, that God created the universe and everything in it even though we may not fully understand the complexity of just how he did it. The story of creation is still subject of great debate today. Some say that God started the process and the universe evolved. Others say that there was a sudden explosion and the universe appeared. Whatever or whichever view we want to hold or accept the important thing is that the creation of the universe is complex and we all recognize and appreciate God for this.

The Buildings, which we all see around us today and have come to recognize and appreciate as central to our lives and our developments, are yet to be seen as complex structures involving complex processes, require appropriate technical skills to put things together. Apparently disturbed, surprised, embarrassed and disappointed by the level of awareness and understanding of the concept and complexity of building and the building process, authors of some previous articles have endeavoured to provide integrated information about building, fully signposted and cross-referenced. Yet with these efforts

the great debate is still on concerning the concept of building and the study of building. Questions are still being asked, conflicts still exist, and more mistakes are still being made, to the detriment of the building industry and the nation .All of these questions, conflicts and other unpleasant occurrences have provoked disquiet and unease.

Myriad press stories are available in our community sounding a cry to be heard. And whether all facts are as stated during each of the contemporary horrific occurrences of building collapse and other intrinsic evidence of defects on our buildings and other built infrastructures or civil suit for redress, the fact remains that the public, even for a moment, deserves to know what is the real truth and to appreciate the scale less challenges and complexities of the building industry. It is then and only then that associated drawbacks can be addressed, avoided and progress recorded. These drawbacks have kept our building industry and the nation in the underdeveloped category.

It has long been recognized that building and building process are complex issues for a man to handle and those who have read history of building or history of architecture are very much aware that building process became split into various interfaces of activities. The individuals at these various interfaces subsequently constituted themselves into the "Building Team" These interfaces became well defined boundaries of responsibilities for efficiency and effectiveness.

Today there is greater need for specialization and better integration as building and building process had grown in a more complex direction with the sophisticated owners ever demanding for higher level of performance. The building

industry sets great store by training and professional development. The building construction process and the relevant professionals involved throughout the complete spectrum of the industry's activities had all grown to include:

Planning stage

- Land Surveyor
- Minerals Surveyor
- Town Planner
- Architect
- Landscape Architect
- Civil Engineers (including specialist in highway waters, transportation etc.
- Structural Engineer
- Building Services Engineer

Design Stage

- Architect
- Landscape Architect
- Structural Engineer
- Building Services Engineer
- Quantity Surveyor

Tender Stage

- Estimator
- Buyer
- Project Planner
- Construction Manager

Construction Stage

- Construction Manager
- Project Planner
- Buyer

- Site Manager
- Estimator
- Building Services Engineer

Maintenance and Refurbishment Stage

- Building Surveyor
- Structural Engineer
- Building Services Engineer
- Construction Manager
- Estimator
- Buyer
- Site Manager

Restoration Stage

- Architect
- Building surveyor
- Structural Engineer
- Building Services Engineer
- Construction Manager
- Estimator

Since the building practice is a process, we therefore must turn to look at every stage in the process as tabulated above to understand how the stages relate and dovetail into one another. Basically the stages in the process, which should not be new to anyone in practice, include the planning, the design, the construction, the maintenance and refurbishment; and the restoration. Participation in the activities at the various stages by the professionals could be mutually exclusive or mutually inclusive. The important thing is that there should be definition of responsibility and a high degree of cooperation within and among the group of professionals at these stages.

Planning stage is where we must begin to look at the building practise from the point of view of the land use- that is the survey through to the planning of the land for building purpose.

The relevance of this stage and the group of professionals responsible for its activities is clear especially when we know that building and other infrastructural facilities are part of a sustainable environment. An aerial view of our towns and cities will reveal the chaotic situations we created and are still creating because we failed to appreciate or incorporate the inputs at this stage and in some cases we have failed to enforce the requirements identified and specified by this group.

Building and other construction projects arise in many ways. The need for a new school or community centre may arise. Government may see a demand for a new road. A company may want to build a new chemical plant, office blocks, power station, shopping centre or housing estate. The proposed site must be surveyed and ground conditions tested to see what loads can be carried by such proposals. A relationship must also be established between the proposed work and the existing ones. For this reasons the professionals in the group at the planning must collect process and manage, data about both the land's natural and its artificially constructed or artificially developed features, either to record them on maps (such as Ordinance Survey) or for use in decision on the sitting of construction projects.

The community will need houses, schools, shopping centres, recreation areas and places of work, but concern for the environment leads that a community to resist development. Town planners are right in the forefront, balancing these conflicting demands. They must look at proposals for new developments and decide what is best for both the people and the

environment. Town planning is a career for someone who wants to improve the quality of people's lives but accepts that solution may often have to be a compromise that inevitably won't please anyone. Town planners must know planning law and they must understand population trends and the consequent demands to be made on an area. They must be able to understand the roles of, and work with, architects, landscape architects, civil engineer, construction managers and surveyors, structural engineer building services engineer, and private quality and surveyor. The design is a creative process, which seeks to find the best approach in fulfilling the clients technical and other requirements and providing value for money while being in harmony with the environment. This is to say that today's architecture should no longer be just an articulation of tradition or a search for a new style. Architects are expected to design buildings that are pleasing to the eye, contribute something positively to environment, and function properly.

Whether they are palaces, factories, homes, office blocks or recreational centres, building must serve the purpose for which they are intended and be comfortable and convenient for the people who live, work or play in them. This requires impressive blend of skills by the architect to put into his design. The input of the structural engineer in the design process is to ensure that each element of a building structure can withstand the loads and stresses, which it is likely to be subjected. If a building is large and complicated, a structural engineer works with the architect from the outset.

To be fit for use, a building needs many services such as air conditioning, lighting and systems for fire, emergency, security and communication. The building services engineer works with the architect and structural engineer to arrive at an integrated design for the building.

The construction projects are translated into working drawings from which the private quantity surveyor draws up a list of all the materials required together with an initial calculations of construction costs. Potential builders are then invited to tender a price for which they will construct the project. The construction manager advises on the build ability of the design, provides extensive information for calculating tender figure, advises on the list and availability of equipment and materials as well as providing their competitive rates, and submits a scheduled programme of work so that the project can be completed in the shortest, most economic period, or to the clients specified time. The construction manager's inputs will require the contribution from an experienced estimator, a buyer, site and project planner are builders.

Until building and civil engineering projects are constructed they remain dreams and imaginations only no matter how beautiful or how well detailed. The physical construction of projects presents a major organizational challenge. The management construction team must coordinate subcontractors and use of plant, equipment, materials and people. The builder has the overall responsibility for the organization and profitability of a construction project. He uses his technical and managerial skills to construct the various elements of the building, and employs the management tools to ensure prompt delivery at the right cost. The site is a temporary factory of an assembly process therefore a builder is responsible for the coordination of the others in the assembly for quality standard and progress.

Building projects, once completed have to be maintained. This can range from routine repainting to assessing the effects of natural and man-made process on the completed work, and

carrying out repairs. The areas of professional service required will involve building surveyor, quantity surveyor, estimator, buyer, construction manger, and site engineer. Of all these professionals, only the scope of work of the building surveyor is yet to be discussed. In recent years the scope of building surveying has greatly increased. This is due to the current interest in renovating and conserving old buildings. Building surveyor is responsible for all aspects of the structural condition of buildings. He supervises the work carried out in repairing, maintaining or altering existing structures, and in the construction of new ones. He is involved as the client's representative, in monitoring the progress of the work against the design and cost specifications. Being in-charge of the technical and legal aspects of the construction work on an existing building, he also has to ensure that the work does not infringe planning permission and local bylaws. From time to time buildings may need to be restored to their original stage. The professionals at this stage as listed above have the responsibility to carry out restoration work.

The job of the professionals at the restoration stage is to preserve buildings of historic value in their original form or as near as possible to the originals. It may involve the use of traditional crafts and skills. It is a challenging work, and the professionals must appreciate the enormous task involved. This includes, the analysis and assessment of the structure, and the methodology of blending new materials with the old structure, the assurance of the safety of workers etc.

The construction industry is vast and therefore it requires the support of many professionals and technicians. It involves not only the core activities already mentioned and discussed, but a range of other professional and non-professional services. These include:

Clerk of works,
employed to be the eyes and ears of the clients on site, ensures compliance and adhesion to specifications. The clerk of works carries out regular inspection of all construction work being done and reports any substandard work. He maintains records of all drawings and contract documents, and keeps a diary of any delays. He ensures compliance with health and safety requirements. He ensures that variation orders are received and carried out by the builder/ contractor.

The Safety Adviser
has the responsibility to advise the management on all matters related to safety, health and welfare of those employed within the organization, those self-employed who are involved at the work place, and members of the public who may be affected by the work activities. This advice extends to senior and middle management in the preparation of safety policy, safe systems, and methods of works and their implementation for which management has responsibility. Other responsibilities include development of accident investigation and reporting systems and the introduction of emergency procedures including fire evacuation

Plant Engineers are in charge of plant need for construction works such needs includes cranes and mechanical diggers etc, to achieve better and greater output. The plant engineers are responsible for the design and manufacture of plant and deals with its purchase, hire and use on construction sites and are involved in deciding on the best plant to be on site at the right time and organizing maintenance programmes for the plant.

Estates Managers are responsible for the management of the property. Both land and building need managing and

administration. Estates managers are responsible for managing property assets, which could be land and buildings, owned by governments, a bank, retail organization etc.
The main part of an estates manager's work is valuation, which involves surveying and valuing buildings. He also liaises with architect, to obtain planning permission in case of new buildings or extensions. He promotes and sells properties for his employer.

Business managers
are in the category of supportive professional managers of the non-technical aspects of construction practice such as accounting, sales and marketing. This support service is important and helpful to a successful contracting business, particularly in the area of home building. They are responsible for procurement of land suitable for building and they arrange for market research to establish types of homes required in what area. They advertise and administer sales of property. Their efficient administrative capability also enhances site production and prompt delivery of construction works.

The above subsets of building process as earlier listed will be a very useful guide in projecting and planning man-power development for the industry. There had been over-sub-scription to professional need in certain areas. The student enrolments in our universities can attest to this statement. It is therefore necessary to revisit our policies on education. Most unfortunately too, quite a substantial number of those who opted for certain professions in the industry did so for what they can get rather than what they can give. Today for example, enrolment into applied sciences is by far in excess of enrol-ment into pure sciences such as Physics, Mathematics etc and yet, these are subject areas needed by applied sciences. Many

cases of square pegs in round holes exist at the expense of poor workmanship.

Implicit in this scenario are the dangers of drifting from one area of professional practice to another for survival. As a consequence there is under-performance, under-development and an uncontrolled process. The symptoms of these conditions exist in our building industry today. We need to introduce cultural adjustment and formulate policies that will help to discriminate between aptitude and attitude when selecting trainees.

Each of the programmes of study for the professional cadres in the building industry normally runs separately for upward of five years to ensure good coverage and depth. There should be no excuse for poor or shoddy performance and no explanation for drifting from one professional area to another even where subjects of study are known to have overlapped considerably. It is in this regard that regulations and regulatory bodies are set up to effect control of building practice at each stage to develop and review their academic programmes, for the improvement of personnel and practice.

The table below shows the statistics of institutions in the UK offering programs of study in the relevant areas of construction process.

	Degree	HND	HNC	ND	NC	Professional Exam.
ARCHITECTURE						
University	37					
Polytechnics		6		3	3	
Professional Inst.						13
BUILDING CONSTRUCTION MANAGEMENT						
University	44					
Polytechnics		57	123	105	113	
Professional Inst.						99
CIVIL ENGINEERING						
University	30					
Polytechnics		29	60	10	70	
Professional Inst.						13
QUANITY SURVEYING						
Universities	34					
Polytechnics		7	16	2	2	
Professional Inst.						11
STRUCTURAL ENGINEERING						
Universities	32					
Polytechnics		30	40	40	10	
Professional Inst.						13
SURVEYING						
Universities	20					
Polytechnics		4	2	1	2	
Professional Inst.						11
TOWN PLANNING						
Universities	15					
Polytechnics		3	3	3	5	
Professional Inst.						2
GENERAL SURVEYING						
Universities	2					
Polytechnics		5	2	4	7	
Professional Inst.						3

Our institutions of higher learning should take a cue from the above table and develop programmes of study as seen being done in the UK for balanced manpower development for our construction industry. Going by the stages of construction process on page 2 above, the ratio of one professional to another can easily be seen to justify this claim.

Professional bodies play an important role in establishing and maintaining standards as well as promoting their par-

ticular profession to the public at large. They set standards in their role as qualifying bodies for their members and maintain an ongoing concern with level of professional competence and conduct. Members are bound by a code of professional conduct. Professional membership therefore, infers a certain level of ability to the public, employers and clients. It confirms professional competence and ability, which can be an advantage in career development. It is vital for those who want to work anywhere in the world.

Membership of a professional body not only signifies a recognized level of competence but also provides ongoing benefits in terms of helping members maintain and improve their standard and in representing their interest. Professional bodies should have a large pool of resources to enable members keep in touch with latest professional practice- libraries, publications, technical reports, discounted text books. They should also have a job vacancy service, which will keep members informed about career opportunities as well as a service to help students find job experience.

Each construction profession is expected to have a representative body recognized by the granting of professional charter by the government. Each body usually offers several levels of membership according to the applicant's own particular qualifications and experience. This implies that to become member of a professional body certain criteria have to be satisfied which will vary according to the professional body and the level of membership. Normally, there will be three elements, an approved academic qualification, a period of work experience; and a formal professional assessment or review. A specified amount of Continuing Professional Development (CPD) must also be undertaken.

Most professional bodies will normally employ perma-

nent staff to provide member service as well as to represent member's views to local and national government and to achieve ever-widening recognition of their qualifications.

In the Nigerian construction Industry, the number of professional bodies is still scanty and therefore the necessary improvement is yet to be achieved and the extent of the construction activities is restricted leaving the Nigerian construction industry in the back burner of international recognition. It should be noted that today in Nigeria, both giants and menial construction activities are contracted out to expatriates businesses and hardly can any Nigerian construction business attest to such opportunities in other parts of the world where we have diplomatic presence.

Apart from the Nigeria Institute of Architect (NIA), the Nigeria Institute of Building (NIOB), The Nigeria Institute of Quantity Surveyors, The Institute of Town Planning, there are no other distinguishable institutions to perform specific functions as highlighted above in the interest of quality performance of the building industry. The omission of Nigerian society of Engineer is deliberate for the fact that the membership is too broad based to address specifics in the construction industry.

In the UK, the list of professional bodies effecting control and helping to develop aspects of building and building industry appears endless. Routes to Corporate status in the building in the UK are:

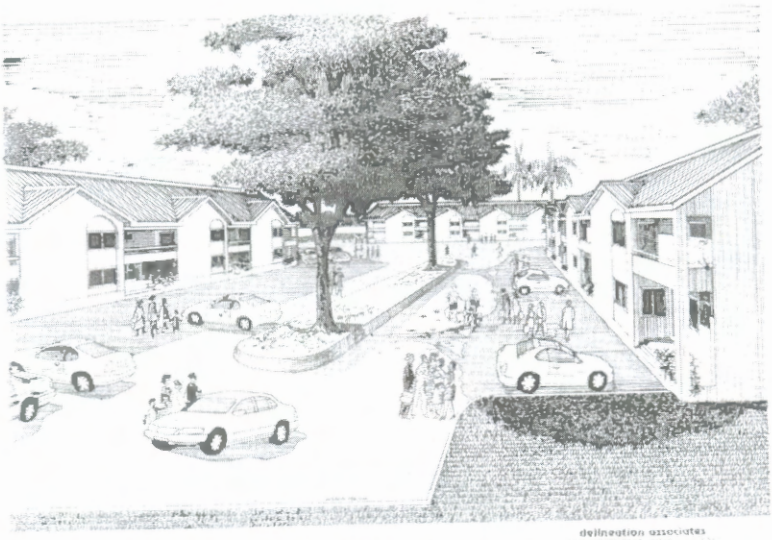
- Chartered Institute of Building (CIOB)
- Chartered Institute of Building Services Engineering (CIBSE)
- Institute of Structural Engineering (I Struct E)
- Institute of Civil Engineers (ICE)
- Royal Institute of British Architects (RIBA)
- The Royal Institution Of Chartered Surveyors (RICS)

- Royal Town Planning Institute (RTPI)
- Architects and Surveyors Institute (ASI)
- British Institute of Architectural Technicians (BIAT)
- Board of Incorporated Engineers and Technicians (Institution of Civil Engineers) (BIET)
- Incorporated Association of Architects and surveyors (IAAS)
- Institute of Building Control (IBC)
- Institute of Construction Managers (ICM)
- Institute of Clerks of Works (ICW)
- Institute of Plumbing (IOP)
- Institute of Civil Engineering Surveyors (ICES)
- Landscape Institute (LI)
- Society of Surveying Technicians (SST)

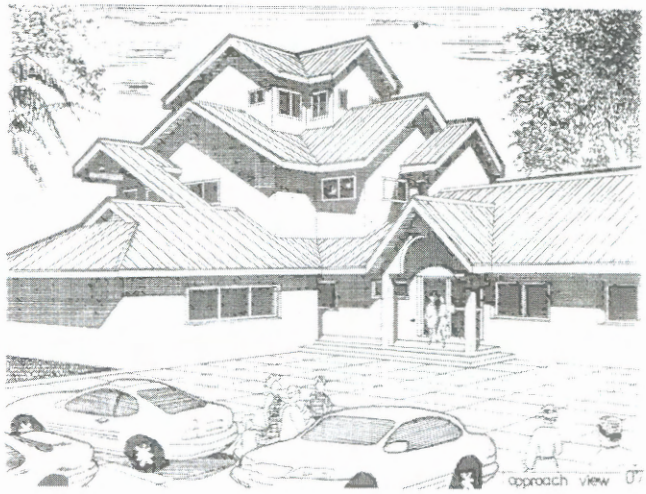
The concepts of what building and the study of building is and what it is not, or who does what and what not had been propagated a long way back but in a society such as ours where certainty is uncertainty, it is desirable to flog the matter further so as to highlight answers to so many of the challenges facing the industry and the society at large.

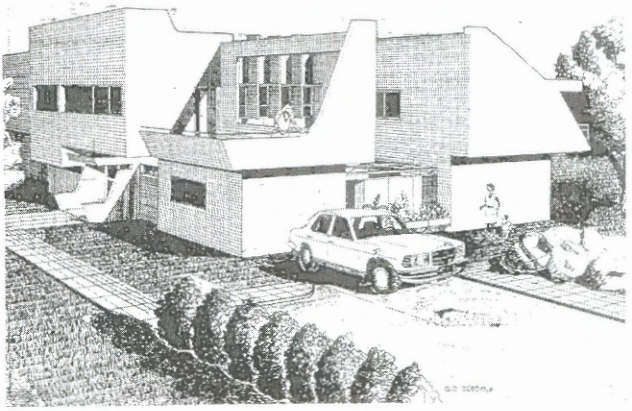
Justice would not have been done if this lecture will end at just to tell and not show how complex is the building structure and the building process. Those who have been engaged in just telling of the complexity must have been thoroughly disappointed, worn-out and sick with exhaustion. Therefore a complex panorama, veritable ethnographic details in the X-ray of building is here displayed to reveal what had been shrouded, for reasons of prudery, in plaster and paint to provide intimate glimpses into the customs and practices of building technology which ensure the quality of the buildings we see around us.

The series of presentations that follow are the architectural and building drawings to show how we **perceive** buildings and how we **actualise** a building project. While the architectural presentations are the forms based on the preference of the individual architects, the building drawings show the nuts and bolts of what it takes to achieve the forms.



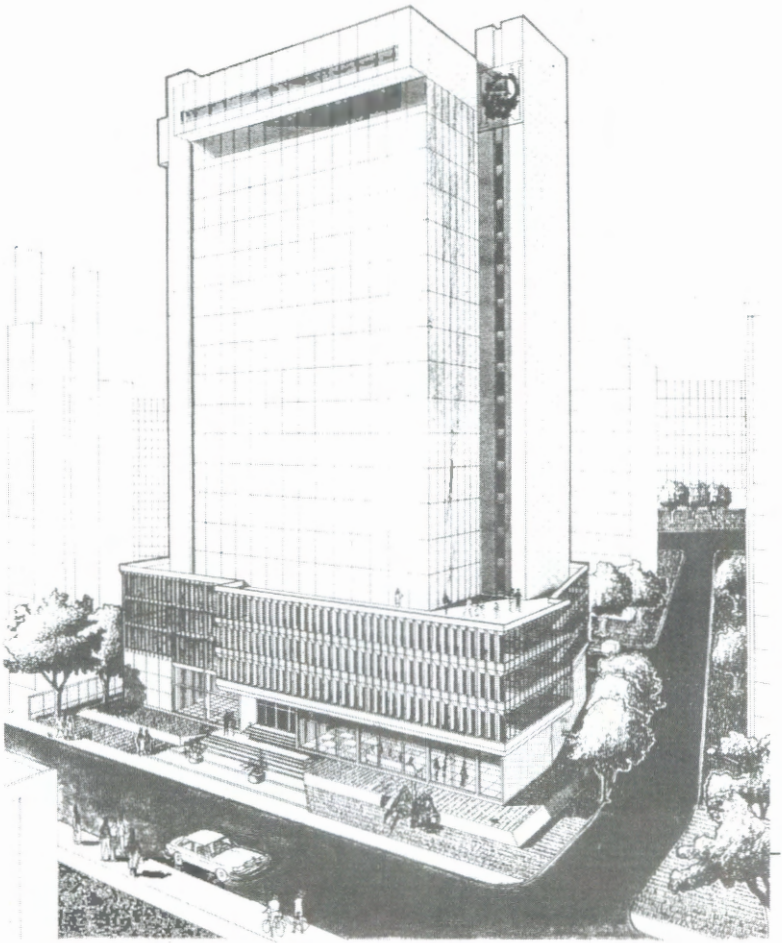
TERRACE HOUSES, OFF JOSEPH SHYNGLES CLOSE, SURULERE, LAGOS


approach view

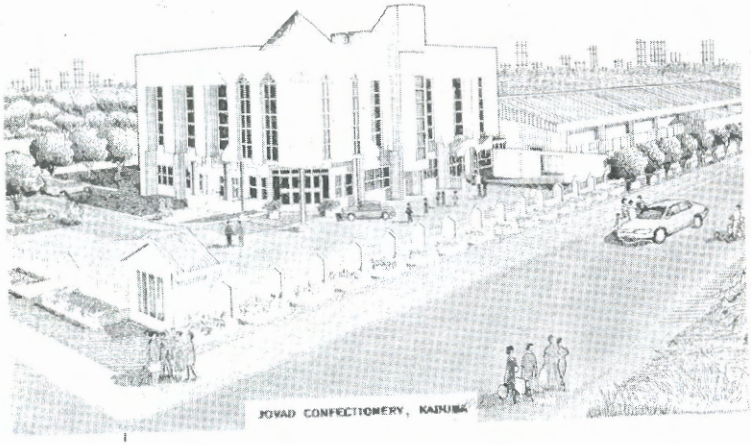


RESIDENTIAL PRIVATE DUPLEX, ABUJA

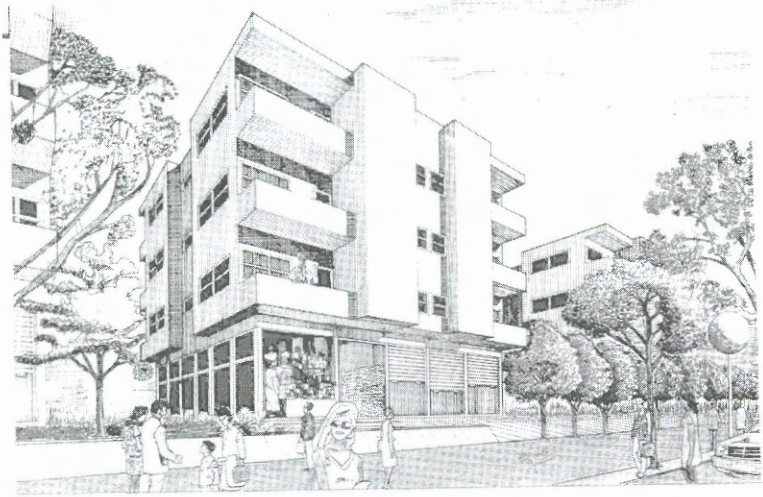
LIVING FAITH CHURCH, KADUNA



PROPOSED HEAD OFFICE FOR NIGERIAN BANK FOR COMMERCE & INDUSTRIES, LAGOS, NIGERIA.

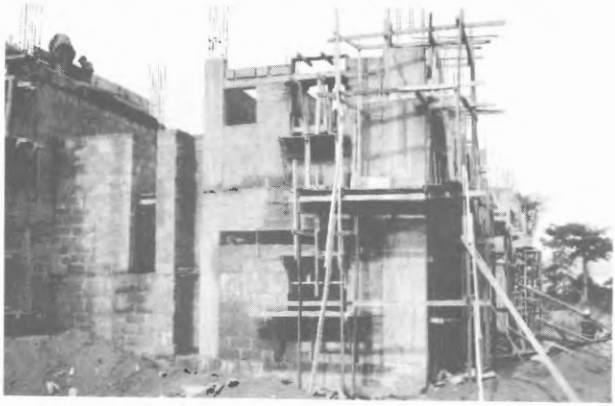


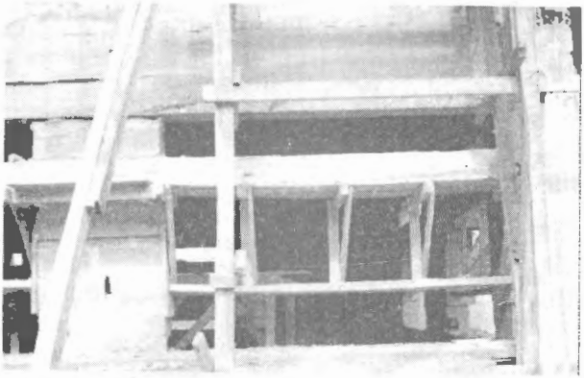
JOVAD CONFECTIONERY, KADUNA

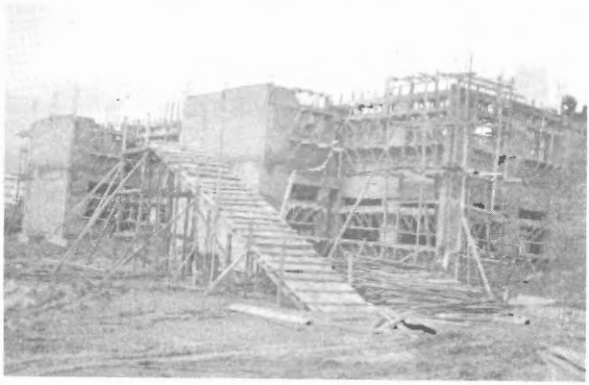


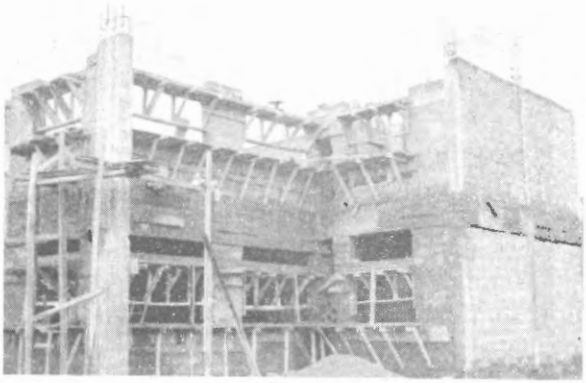
BLOCK OF FLATS, KADUNA

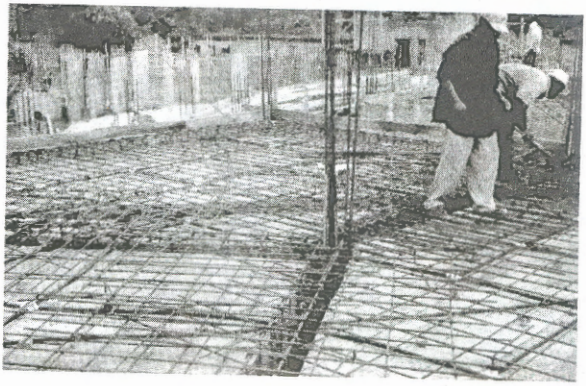
Building by definition, is a product in form of a structure. And structure by definition is arrangement of parts in construction, building, and so on or simply a form. Building therefore derived its authority, proportional and compositional, from our body, and in a complementary way the building acts to confirm and establish the body - social and individuals- in the world. The body, its balance standard of proportion, symmetry and functioning, mingling elegance and strength, was the foundation myth of building.



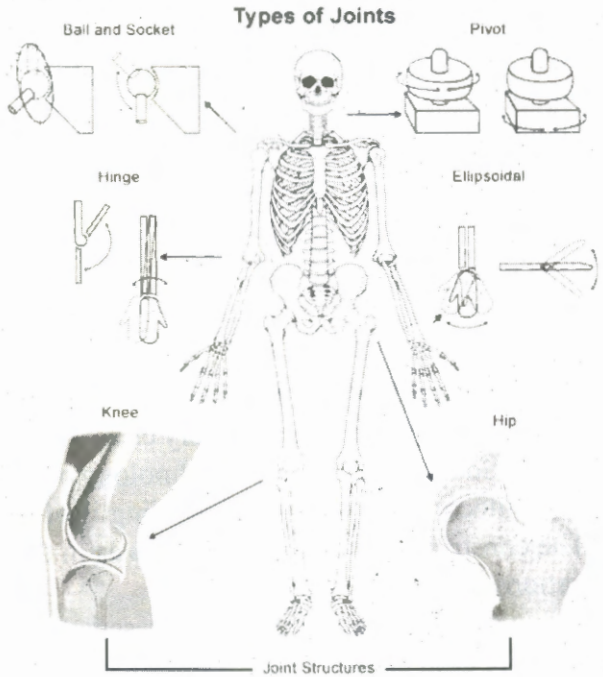






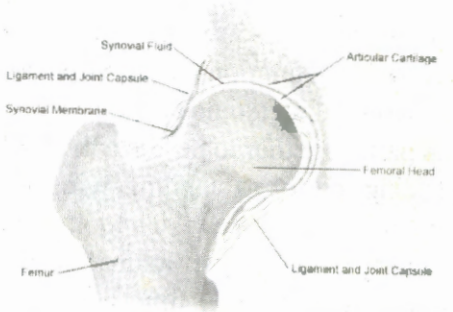


In deed, like the complex anatomy of the body or the individuals in the world, buildings are of various shapes, sizes and height- designed and personalized for each client based on requirements and the function to perform. Only those in the medical field would understand and appreciate what God did to put human parts together to perform the complex functions we human beings perform- standing, lying, sitting, squatting, running, or walking. We can take a look at the structure of human body to appreciate the structure and how the various parts and joints perform their functions and still maintain balance and stable condition.

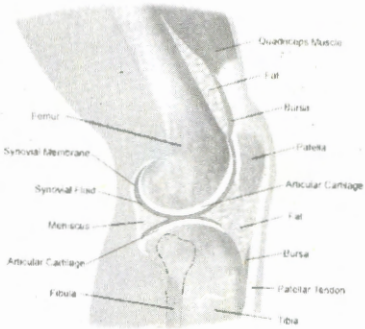


! Examples of the hip and knee joints follow: pivotal movements

Hip Joint



Anatomy of the Knee

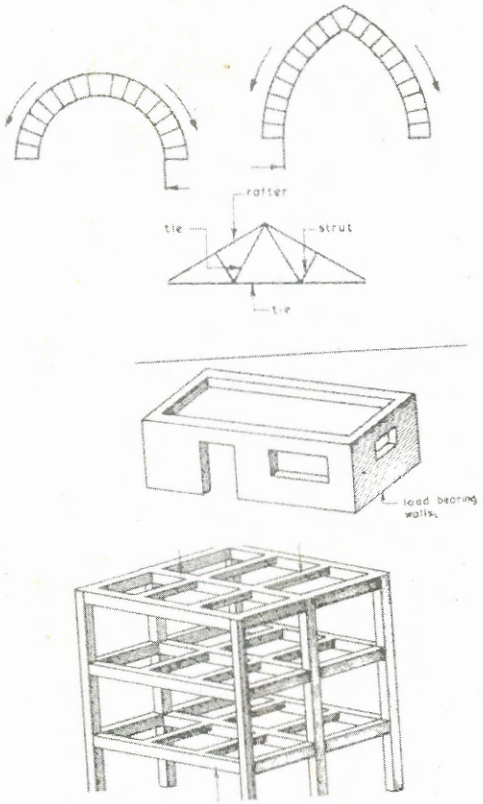


Understanding the behaviour of parts of building and the technology of assembling the parts is very crucial in erecting a stable and functional building. If the technology of erection is faulty the architectural values of the building is of no consequence. The construction of each element is as in the following illustrations

In other words, architectural design presentation remains a dreamed desire until properly built, unlike the building joints required to express specificities which nonetheless not mechanical imitation of one another. All the elements of building

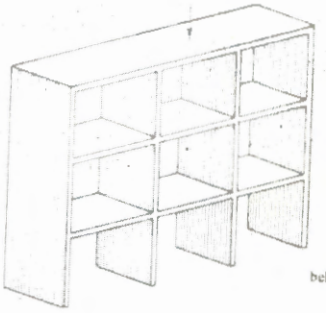
irrespective of their form or shape, with 'K- leg or bow leg', oval or circular, square or rectangular shapes, high rise or low rise have to be put together using specific and appropriate technologies, to be able to perform the required functions.
The common joints in building to connect the various elements include rigid, flexible, bolts and nuts, rivet, welded, expansion, scarf, dove tail joints and so on.

The skeletons of the basic types of structure of buildings are as illustrated below:



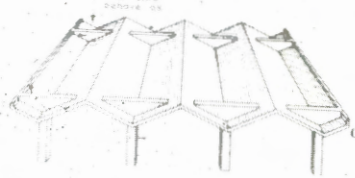
A structure consists of a series of interconnected plates forming structural walls and floors

Structure Consists of a Series of interconnected plate forming structural wall and floor



Panel or Box construction.

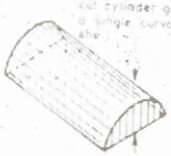
Flat slab folded so that roof will behave as a beam spanning fold.

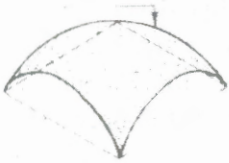


Folded Plate Construction

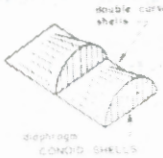
Shell Roofs
curved skin covering a given plan shape and area

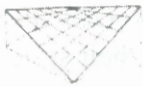
these are formed by a structural



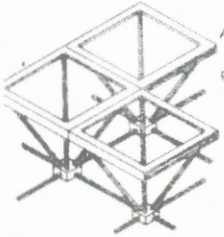


TRANSLATIONAL DOME



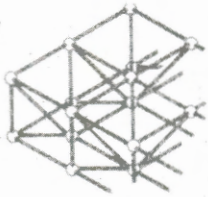


HYPERBOLIC PARABOLOID



A series of pyramids grids

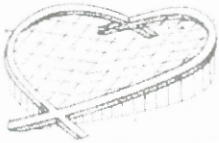
Space Deck



interconnected inverted
a series of interconnected

Space Frame

Tension Cables



Compressive Arch system

- tension cables to support coverings

TENSION CABLE STRUCTURE

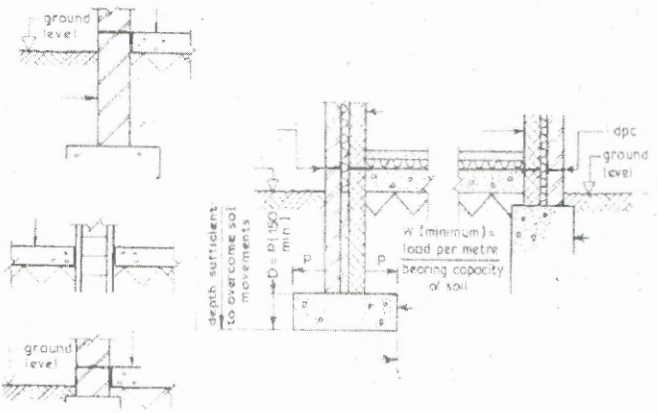
net of cables
forming tension Membrane

Pendentive Dome

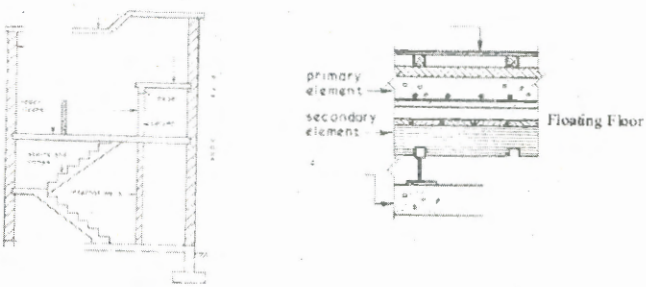
Vertical cut Plane
Tension membrane Structure

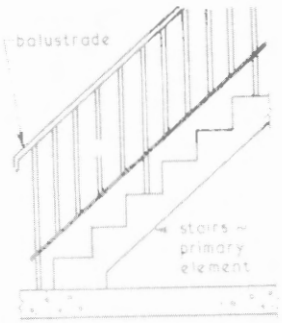
Each part of the body is uniquely constructed and joined together to perform its function. Building parts are uniquely constructed and joined together to be able to perform required functions.

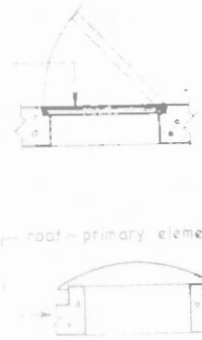
The process of constructing some of the elements of building in their structural forms is as illustrated below



The superstructure and primary element and secondary elements:

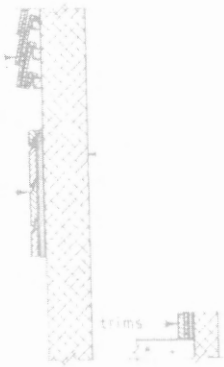






BALUSTRADES

Typical Example



Foundation Types and Selection

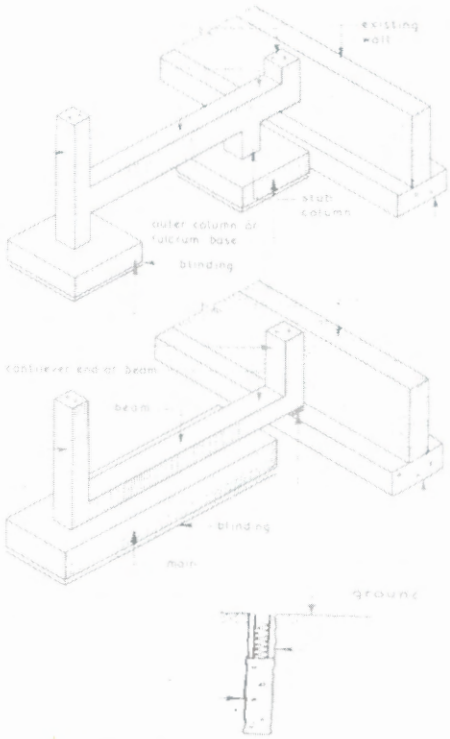
1.2 Strip Foundations

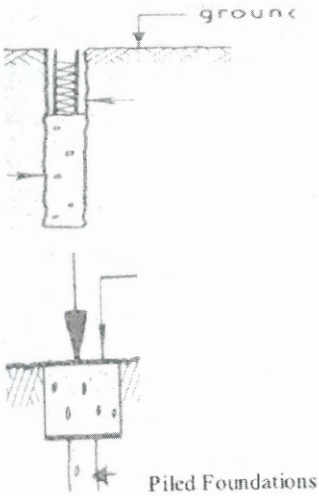
~ these are suitable for most sub soils and light structural loadings such as those encountered in low to medium rise domestic dwellings where mass concrete can be used. Reinforced concrete is usually required for all other situations.

1.3 Typical Strip Foundation Types ....

Reinforced Concrete Strip used where induced tension exceeds concrete's own tensile resistance

Continuous Column used for closely spaced or close to boundary columns





Piled Foundations

1.4 Piled Foundations:

These can be defined as a series of columns constructed or inserted into the ground to transmit the load(s) of a structure to a lower level of subsoil. Piled foundations can be used when suitable foundation conditions are not present at or near ground level making the use of deep traditional foundations uneconomic. The lack of suitable foundation conditions may be caused by: -

1. Natural low- bearing capacity of subsoil.
2. High water table - giving rise to high permanent dewatering costs.
3. Presence of layers of highly compressible sub-soils such as peat and recently placed filling materials, which have not sufficiently consolidated.
4. Subsoil, which may be subject to moisture movement or plastic failure.

Building, just as the anatomical structure of the human body, will break down through a gradual process due to patho-

logical state and subsequently collapse or at best, become incapable of fulfilling the purpose for which they have been designed and erected.

Numerous reasons are usually responsible for this poor pathological state of buildings, which may not be understood by most of us without appropriate and in-depth technical knowledge of building. Just like a patient, who had gone to a doctor to complain of headache may not understand why the doctor has to check the B.P and so on. Defects in building of various parts are caused by many things. For example cracking in wall may be as a result of movements of building parts such as foundation, floors or roofs, etc. All buildings move and in the majority of cases this will be for quite acceptable reasons and the amount of movement will not adversely affect the building performance.

Initial movement downward, of a newly constructed building, will be caused by the imposed loads on the subsoil beneath. While accepting that much building movement will be of a major nature in both extent and effort, there will still be occasions when the inspection of a building will reveal evidence of movement that causes concern. It is then necessary to determine the cause(s) of the problem and its implications. This may involve a wider range of defects than just unacceptable cracking/ movement, e.g. cracking of an external wall due to foundation failure may allow water penetration. There are many causes of foundation failure in buildings.

Movement in walls may be suffered throughout the life of a building. Often, it may not have its performance affected in any significant way. On the other hand, the movement may be so great, or happen in such a way, that performance is adversely affected.

The walls of newly constructed buildings commonly suffer cracking as a result of the initial drying out of the materials

used in the construction process and this can take up to 12-15 months after the completion of the construction.

Similarly, a building structure will be subject to normal and moisture movement caused by changes in climate and or internal living condition affecting building materials. This will result in expansion and contraction of both the materials and the elements of structure that they form. Mostly, the amount of movement will be insufficient to adversely affect the overall performance either the materials involved, the elements concerned, or the building as a whole. In practice modern buildings can suffer structural failure from these problems. Basic information on cracking should commence with the recording of basic data on each crack and should include:

- Identity of the element(s) affected
- Position within elements including whether it is above/below the DPC or pass through it.
- Length (including start and finish) point
- Width (this may vary along its length)
- Depth (is it through partial/full thickness of the wall)
- Pattern (vertical, horizontal, diagonal, stepped)
- Alignment (are surfaces on either side level or side proud)
- Age (often indicated by the amount of dirt/dust in the crack)
- Relationship with other evidence of movement.

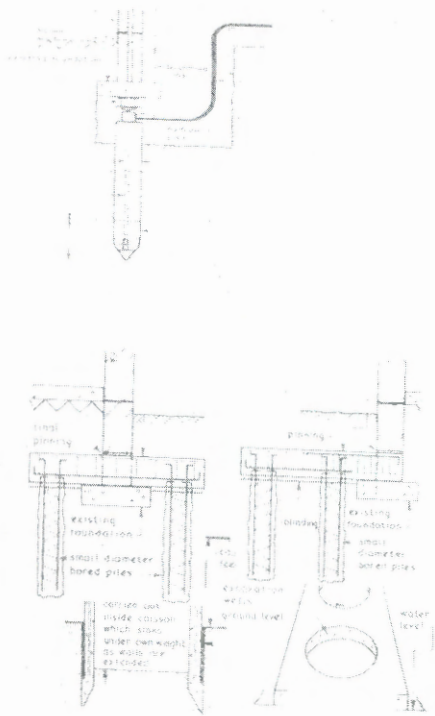
All elements of building, from foundation to roof, may be affected by one thing or the other and can be investigated and corrected if found to constitute hazard. The programmes of study in building construction and maintenance are designed

to provide basic information and technical knowledge in this regard.

Defects in buildings have to be corrected or rectified. The procedure for rectification may be elaborate or simple. For example we may need to transfer the load to a new level. In this case underpinning is used.

Box caisson

e.g. Box caisson



Failure of one building part may lead to rapid deterioration of other parts if appropriate action is not taken to put in check such a condition. For example rising damp in building will result in physical damage to the building elements and finishes as well as constituting health hazards. Rising damp in building may have been as a result of damaged or bridged DPC, and so on. Another example is the movement in walls leading to distortion such as bowing, bulging and buckling caused by foundation failure, poor floor joints, roof movement and so on.

The process of constructing new buildings and the rectification of defects in existing building stock begins with the signing of formal building contracts. Typically, construction industry includes three parties: an owner, a designer (called the architect/ engineer), and the builder/constructor (called the contractor). Traditionally there are two contracts between these three parties as they work together to plan, design, and construct the project. The first contract is the owner-designer contract, which involves planning and design. The second contract is the owner- builder/constructor contract, which involves construction. An indirect third party relationship exists between the designer and the builder due to these two contracts.

Today, an alternative contract or business model is now in vogue, which replaces the two traditional contracts with three contracts, namely owner-designer, owner-construction manager, and owner-builder. The construction management company becomes an additional party engaged in the project to act as an advisor to all the parties. The construction manager's role is to provide construction advice to the designer, design advice to the constructor, and both construction and design services, such as materials and subcontracts as necessary, to the owner.

Agency Construction Management (CM) is also available as a fee-based service in which the construction manager is responsible exclusively to the owner.

Efficient construction management practice begins when the design team has made a proper design upon which a builder is invited to tender for a construction project. The word project technically refers to a plan and commitment for its fulfilment. It is important to place the concept of a commitment in the forefront of one's objective in the completion of a project. For with projects comes responsibility of keeping within the scope of a budget, a time frame, and a standard of quality. After all, the success of building project can mean different things to different parties but ideally a building project is successful if all the parties are pleased with the outcome.

Primarily, the design team is concerned with pleasing the owner who wants the project to be completed on time for the contracted sum and within a standard anticipated quality as specified on the drawings.

The builder is responsible for complying with the requirements spelled out in the plan and specifications. If the drawings contain omissions, errors, or inadequate space conditions to accommodate the required installation, both the plan and the specifications have to be modified. Under such conditions the builder is entitled to a change order and a modification of the contract sum. If the magnitude of such orders exceeds the expectations of the owner, the design team will incurs his displeasure.

Many contracts, usually between an owner and the builder contain a liquidated damage wherein the builder subject to a penalty if he is responsible for a delay in the completion of the contract. These delays are generally expressed in terms of a per diem penalty.

Conversely, if the owner, who is the party to the contract, and his agents- architects, engineers or construction manager, is responsible for delaying the completion of the project, the builder may be entitled to damages caused by these delays.

There are certain basic factors that influence the success of a project among which are good planning, scheduling, and forecasting, a sense of responsibility, and commitment by all parties, a spirit of cooperation, technical competence by the team, timely communication and decision – making, willingness to compromise, good management and adequate funding. There are other factors that can affect the success of a project but the emphasis here is on the controllable factors.

There is an element of wisdom necessary for effective project control and it is prudent to take advantage of the many cost engineering advances that have been made in recent years. However before considering how to use these advances, it is important to focus on the philosophy of the challenges from more than one perspective.

Obviously, the motive of builder is to make a profit and the completion of a project on time is advantageous particularly on fixed price contract. He needs to balance labour force with production rate. Production is defined as the quality of materials installed per given time period usually measured on monthly basis since the interval for interim payments for progress on the job is monthly. In some cases special materials already stored on a job site is credited toward job progress prior to installation, though production counts only when the materials are actually installed in its required place.

Since a builder's labour estimate is based upon projected unit productivity, the builder's labour cost will stay within budget if the unit productivity is efficient. But productivity can be efficient and the production may be poor if there is, an

insufficient number of skilled workers deployed at the project. A continuing lag in production could delay the completion of a project and the builder could be liable for liquidated damages for failure to comply with the schedule.

The construction of a project involves dependent interrelationships and the builder's lag in progress could affect other parties including the owner. The d velopment of critical p method as a tool to identify the interrelated and dependent tasks was therefore based on a situation such as this on a building construction site. There are instances when a contract document requires that the successful bidder furnish a critical path network of activities depicting the planned logic for the execution of the project.

It is important to be aware that many setbacks can occur on a project, but if the project is carefully monitored, timely corrective procedures can be implemented. Although, the complexity of a project has increased with the advent of technological progress and regulatory restraints, improvements in tracking systems have emerged but need to be properly and efficiently utilised.

There are usually three essential, M's to effective project control. They are Measurable, Manageable and Meaningful.

The elements of management of a construction project are:

Construction estimates

which can be utilized as a baseline for information to be used for the effective control of a project. The quality and accuracy of an estimate are extremely important to a builder as well as subcontractors as their common objectives are the successful completion of a project or at least covering the overhead. There are a number of different construction estimates such as limpsum, unit price, and cost plus. The commonly used is lumpsum estimates, as they constitute a risk to the builder.

The construction estimates has an estimating process – evaluating anticipated labour, expenditures, estimating indirect costs, interpreting sometimes ambiguous language, and rendering rapid decisions during periods of limited time available. The estimator has to contend with many unpredictable events and has to use value judgments to arrive at a sound estimates which must not be too high or too low to lose a contract. It must be just right.

Procurements,
which is the process of purchasing materials equipment and other items required in the execution of a construction contracts. The procurement process start from the time the builder receives the award of contract. The pricing of labour, material, and subcontracting amounts is performed during the bidding stage. The estimate serves as the baseline for determining the amount to be paid for a particular item. Obviously it is to the advantage of the builder making a purchase to try to accomplish a savings against the amount allowed in the estimate. These savings can serve as a cushion against labour overruns and material takeoff and pricing errors on other items.

The procurement or purchasing process should be consonant with the construction logic. A wise procurement practice will take into account source of supply, quality of supply, storage, placement, installation and final connections.
There is usually a close relationship between the procurement office, site, and the account department of an organization.

Planning
is defined as a scheme for a future accomplishment. Planning is the process of developing a scheme and outlining the steps necessary to accomplish the goals associated with the

scheme. Construction planning is concerned primarily with establishing the sequence order in which various operations will be carried out on the job sites. Planning is the most time-consuming and difficult phase as well as being the most important of the job management system. It requires an intimate knowledge of construction methods combined with an ability to visualize discrete work elements and to establish their mutual interdependencies. Most construction projects are involving large numbers of job activities whose interrelationships are intricate and complex. When job constraints such as equipments availability and material delivery time are also considered, job planning becomes an arduous management function.

Construction planning, may be said to consist of three steps:

- Determination of the job steps or activities that must be performed in other to construct the project.
- Ascertainment of the sequential relationships among these activities.
- The presentation of this planning information in the form of a network diagram.

In actual fact, however, these three actions usually proceed more or less simultaneously with one another rather than discrete and separate steps.

Critical path methods mainly used in this regards begins with a simple logical process of low one activity relates to the other.

This can become a very complex exercise requiring application of computer depending on the nature and complexity of the project.

Project time control is the concluding part of a project management and control. The earlier activities of project management are carried out to eliminate delays and time

conflicts. A plan and schedule have been devised, which if followed, will enable the work to be accomplished in an efficient and expeditious manner. Project now shifts its attention to implementing the job plan in the field and maintaining the established schedule as closely as possible.

It is axiomatic that no plan can ever be perfect nor can the planner anticipate every future job circumstance and eventuality. Contingencies arise everyday that could not have been foreseen. Adverse weather, delivery delays, labour disputes and numerous other conditions can disrupt the original plans and schedule. It is not unusual that activities additional to those included in the original plan prove to be necessary. As a result, it is normal that construction projects deviate from their developed schedules.

During the construction period, considerable time and effort are required to check the time progress of the job and to take whatever action is appropriate and necessary to bring the work back on schedule. These actions constitute the monitor and rescheduling phases of the job management system, the two been collectively referred to as project time control. The single objective of keeping the work on schedule is accomplished by the following actions:

- Report and record job progress
- Compare work actually accomplished with the planned
- Take appropriate action to correct scheduled slippages
- Update schedule of work yet to be done.

The following concluding remarks can be made from the content of this lecture.

Ever since the initiative by the man we all fondly refer to as the Master Builder to develop the concept of the Building Team' when he realized that the building process was too complex for one man, building process had become even more complex. Consequently the need for more professionals and deeper professional knowledge had arisen.

A common confusion is the distinction between architecture civil engineering and building /construction technology. In essence architecture is a component of the building and architects are responsible for the form and appearance of a building including the way in which people use and experience the space of the building, and they typically act as the leader of the design team. Similarly civil engineers are responsible for the designs of civil engineering infrastructural facilities such as water treatment plants, harbours dams, highway. The management of these facilities is the responsibility of the builder/constructor.

The academic field of construction management education encompasses a wide range of topics. These range from general management skills, to management skills specifically related to construction such as estimating of the actual construction cost, programming of construction activities and coordination of site activities to ensure prompt and quality construction product delivery.

Unfortunately the building industry in Nigeria is yet to keep in step with the above trend, which will enhance its image. Our building industry is still loosely controlled for sustainable development because of some challenges and roadblocks in the process.

The leaders of the various professions such as (APON) have failed to promote an integrated approach to project delivery by promoting procurement systems that ensure responsible professional practice. They are yet to formulate profes-

sional ethics that will discourage one being the player, the umpire and the judge at the same time. The negative effect of the situation is that client requirements as well as other stakeholder's interests are undermined. Also the professional knowledge and skills available are not harnessed and utilized to maximum efficient delivery.

The professionals should close ranks to exclude the outside stealers who are unwashed and unwashable, while getting the clients (largely government) to accept its regulatory role by stopping the massive patronage of non- professionals and in some cases foreign companies.

Though there had been the creation of legal frameworks in certain cases to regulate and provide the cast of full characters to underpin correct practice, the language of presentation has been market- oriented and as such contains loopholes to encourage bad practice. The government, the professionals themselves, and the general public at large, without much chance of seeking redress, had flouted regulations.

Obviously changes in building and building process will bring about professional transformation, which will be hurting those who lack flexibility or the skills to leave the decaying practice or the approach to their professions. The building industry has an important role to play in rebuilding and equipping its practitioners, who are adversely affected by these changes in manner of practice, to face new challenges. Increasing and improving the skills and capabilities of construction workers is a key to economic factor to succeed in increasingly integrated and competitive global trends. Developing nations must climb the quality ladder and move out of products based on unskilled labour.

Building team must take a cue from the challenges of building a winning team in the soccer pitch as illustrated by Prof M.A Ajayi last month. To do well every member of the

team must play his/her part according to the rules. Neglect of the rules is a recipe for failure. In a soccer team there are, a goal keeper, defenders, holding mid-fielder, attacking- mid-fielders and the strikers. Because of lack of cooperation among the building team, the coordination of building project and delivery has been difficult. We have created tension between the drawn and the built. We have unhomely homes, jerry buildings and an overall unfriendly environment.

The various professionals within the industry had proposed legislations, ethics and standard of improved performance and maintain ace, but not much had been achieved as the language of communication had been market- driven. Today, some of the professional charters already in place are being amended to emphasis what we want to do rather than what we should do. The building practice as of today is just gradually being brought under control by the recent approval of new building code. It should be noted that what can be achieved through a development programme is dependent upon what is inherited by administrative or institutionalized capacity. This must be taken into account for posterity.

In the construction industry today the professionals behave as if one has delegated powers to the other. In a team work there is no delegation of power, rather there is sharing of power and responsibilities. Construction as earlier illustrated has five distinct phases Planning- Design- Construction-Maintenance- Refurbishment.

Perhaps the least forgivable aspect of the constructional treason is the blatant refusal of members of the building industry to cooperate with one another but preferred to lend support to the ignorant society to undermine the efforts of instituting sanity in the industry.

The contemporary challenges in the building industry is building collapse, premature decay of our building stock and

uncanny appearances on our buildings are strong intrinsic evidence of ignorance, lack of understanding or blatant delight in undermining one another and professional jealousy.

If the series of building collapse has not served as an important trigger mechanism for us to become more sensitive and reasonable to improve our understandmg then nothing else would. What we are experiencing today in our built environment is a legacy of bad construction practice from planning, design, construction, maintenance and refurbishment stages. We are experiencing the symptoms of an industry operating in an atmosphere of poverty and under development.

There are a number of positive initiatives today from which our construction industry can borrow to impact positively on the individuals in the construction industry, the industry itself and the nation as a whole.

One of such initiatives is the activities of the Vision 21 Steering Committee set up by the building industry in Singapore. The committee was charged with the responsibility of formulating a vision for the Singapore's construction industry for the 21st century; "To be a World Class Builder in the Knowledge Age". The vision C 21 is to transform their construction industry from "the 3Ds to the 3Ps", that is from an industry which is Dirty, Dangerous, and Demanding to one which is Professional, Productive, and Progressive.

Under this vision, six strategic thrusts can be identified

- Enhancing the professionalism of the industry
- Raising the skill level
- Improving industry practices and techniques
- Adopting an integrated approach to construction
- Developing an external wing to challenge for world market
- A collective championing effort for the industry.

The above listed strategic thrusts will induce high level performance through training and retraining of professionals and technicians, encourage and develop research programmes, promote cooperation and acceptance among professional colleagues, and generate basis for international credibility and national economic stability and growth.

The development of construction industry should be an all embracing one including material development, project documentation and procedures: human resources, technology, institutions (both public and private)

Governments, and in deed the public, have thrown challenges to the industry on the use of locally developed construction materials. However research into the development of materials requires funding and therefore sponsorship, by the "challenger" that is the government and individual philanthropists, is very necessary.

This is not to say that through a well thought-out design or more innovative construction techniques and new material need cannot be evolved. Design team and the builder need further cooperation in this regard through feedback system in order to design out construction site challenges while the builder needs to be more innovative in translating design concepts and requirements into quality buildings. Lack of such exchange of feedback information will jeopardize cooperation and give rise to site difficulties and as a consequence, will lead to relaxed specifications and reduced standards.

Distinguished chairman, Ladies and Gentlemen, '**Building the beautiful Bride**' to be engaged and be married to, requires the cast of positive character, integrity, and finesse, and those who want to practice **building** must develop all the technical and managerial attributes of a builder. For the benefits of those who asked questions and those who expressed

fear, for whatever reasons, the sum total of what we all have heard and seen today, in the course of this lecture, is what it takes and what to gain by studying building and becoming a builder.

1.5 Acknowledgement

Let me first and foremost thank the Almighty God for the opportunity to serve in this unique environment at this point in my academic career. I want to thank the Chancellor, Dr. David Oyedepo immensely for receiving a wonderful Vision and allowing God to work through him to establish this wonderful place. I feel deeply honoured to serve.

I want to place on record my appreciation to the entire Management of the University especially the Vice Chancellor Prof. Aize Obayan, and the Registrar Mr. Yemi Nathaniel for the confidence reposed in me.

My warmest and deepest appreciation to my friend Dr. Daramola S.A, who knows the value of building and therefore initiated the establishment of a Department of Building at Covenant University the first of its kind in a private University in Nigeria. Can anyone of us imagine a Department of Architecture responsible for the design of building without a Department of Building that will build what is designed? I wonder.

To my long time friends Prof. E.A Adeyemi, who was very instrumental to my joining this great University, and Prof. O. Solanke who has been a very supportive colleague, and to those new friends that I have made since I came here particularly my 'sibling' Prof. C. Oluwafemi, Prof. C. Loto, 'my shadow', and a host of other wonderful colleagues, particularly my Departmental staff who have contributed immensely in collating this lecture note. It has, indeed, been wonderful experience working with you all. Finally, my thanks go to the members of my family for their moral support.

GOD BLESS YOU ALL
AND
THANK YOU FOR LISTENING

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