

ADDIS ABABA SCIENCE &TECHNOLOGY UNIVERSITY

SCHOOL OF CIVIL ENGINEERING &COTM

DEPARTEMENT OF COTM

BUILDING CONSTRUCTION - I

CHAPTER-1

1. INTRODUCTION



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1. INTRODUCTION

1. 1 GENERAL

- **A construction** is a process of constructing something by man for one purpose or another. It may be a road, bridge, a dam, a dwelling place, an airport, a commercial building, etc.
- **A building** can be generally considered as a structure consisting of floors, walls and roofs erected to provide covered space for different uses such as residence, business, entertainment, workshop, etc.
- Buildings come in a wide amount of **shapes** and **functions**, and have been adapted throughout history for a wide number of factors:

  - building materials available
  - weather conditions
  - land prices
  - ground conditions
  - specific uses
  - aesthetic reasons

Cont.....

- Buildings serve several needs of society – primarily as shelter from weather and as general living space, to provide privacy, to store belongings and to comfortably live and work.
- The first shelter on Earth constructed by a relatively close ancestor to humans is believed to be built 500,000 years ago by an early ancestor of humans.

- The initial causes which forced man to look for shelter were:

  - ✓ Fear of wild animals
  - ✓ Seeking protection against the cold and the heat
  - ✓ Seeking shelter against the rain and wind
  - ✓ The desire for a place where everything belonging to the family could be gathered

Cont.....

- The main considerations in architectural design of buildings for all purpose are:
  - Climate and its effect
  - People and their requirements
  - Materials for construction and method of construction
  - Regulations and building codes
- Requirements which must be satisfied for the construction of a modern house are:
  - A plot of land
  - Permission from local authorities
  - Materials for building
  - Skilled labourers for the erection
  - Finance
  - Professionals, such as architects and engineers

1.2. DEFINITION OF TERMS

Building: is an assemblage that is firmly attached to the ground and that provides total or nearly total shelter for machines, processing equipment, performance of human activities, storage of human possessions, or any combination of these.

Building design: is the process of providing all information necessary for construction of a building that will meet its owner's requirements and also satisfy public health, welfare, and safety requirements.

Building construction: is the process of assembling materials to form a building based on the building design.

1.3. BUILDING CLASSIFICATIONS

- Buildings can be generally classified in different groups depending upon their occupancy of use or types of construction

Classification Based On Occupancy
• Residential buildings • Educational buildings • Assembly buildings • Business buildings • Mercantile buildings • Industrial buildings • Institutional buildings • Storage buildings • Hazardous buildings

Classification Based On Types Of Construction
• Type1: Fire-resisting construction • Type 2: Non-combustible construction • Type 3: Heavy timber construction • Type 4: Ordinary construction • Type 5: Wood frame construction

CLASSIFICATION BASED ON OCCUPANCIES







1. **Residential buildings:** include houses occupied by persons where living accommodations are provided.

   Ex. private residences, apartments, dormitories, hotels, etc.

2. **Educational buildings:** include any building used for educational instructions.

   Ex. schools

3. **Assembly buildings:** include any building where group of people gather for amusement, recreation, social, political, religious and similar purposes.

   Ex. theatres, halls, places of worship, etc.

Cont.....







4. **Business buildings:** any building which is used for the transaction of business, for professional services and for keeping accounts & records for similar purpose.

   Ex. Garages, barbershops, city halls, court houses, public libraries, etc.

5. **Mercantile buildings:** any building which is used as shops, stores, market, and for display and sale of merchandise.

   Ex. Shopping malls

6. **Industrial buildings:** any building or structure in which products or materials of all kinds are fabricated, assembled, finished or processed.

   Ex. Assembly plants

Cont.....





7. **Institutional buildings:** any building which is used for purposes such as medical or other treatment or care or for penal or correctional detention.

   Ex. hospitals, prisons, etc

8. **Storage buildings:** any building which is used for storage or sheltering of goods, merchandise, agricultural products, raw materials etc.

   Ex. ware houses, barns, etc

9. **Hazardous buildings:** any building used for storage, handling, manufacturing or processing of highly inflammable, combustible or explosive materials.

   Ex. explosive storage

CLASSIFICATION BASED ON TYPE OF CONSTRUCTION

- Buildings are classified on the basis of resistance to fire of the elements of the buildings.



Type-1 Fire-resisting construction:

- Type of construction in which the elements of the building, which include the floors, walls, columns and the roof itself, are non-combustible.
- The building is sufficiently fire resistance that it with stands the effect of fire and prevents its spread to other rooms.

Cont.....

Type-2 Non-combustible construction:

- Construction in which the walls, partitions, structural elements etc. are non-combustible with less fire resistance than Type 1.

Type-3 Heavy timber construction:

- Exterior walls are out of masonry or other non combustible material.
- Interior structural members, floors and roofs are constructed out of timber either in solid or laminated forms.

Type-4 Ordinary construction:

- Exterior walls are out of masonry or other non combustible material.
- Interior structural members could be partially or wholly out of wood of relatively smaller sections unlike Type 3.

Type-5 Wood frame construction:

- Type of construction in which practically the whole of the building is out of wood or other combustible materials.

1.4. COMPONENTS OF A BUILDING

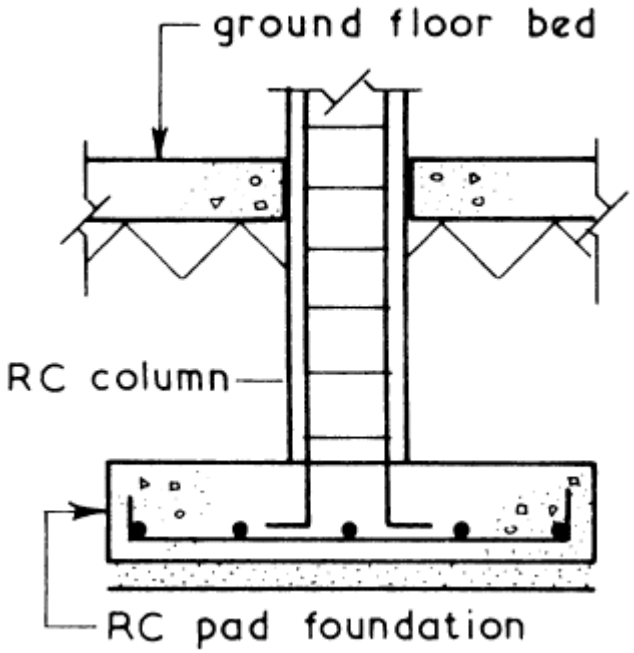
- A building has two basic parts:
  - Sub-structure
  - Super structure

Sub-structure: is the lower portion of the building, usually located below the ground level, which transmits the loads of the super-structure to the supporting soil.

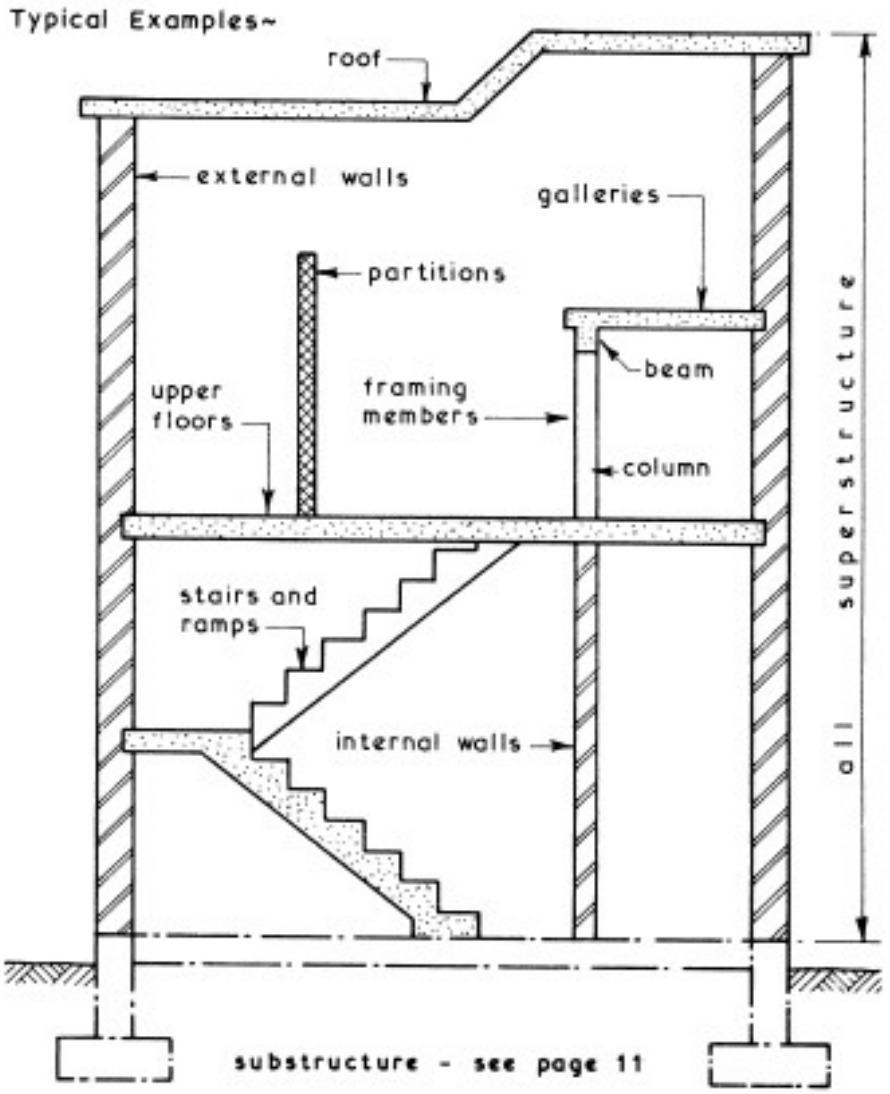
Super-structure: is the part of the structure which is above the ground level, and which serves the purpose of its intended use.

- The basic component of a building include:
  - Foundations
  - Walls
  - floor
  - structures
  - Roof structures
  - Building finishes
  - Doors, windows and other openings
  - Vertical transportation

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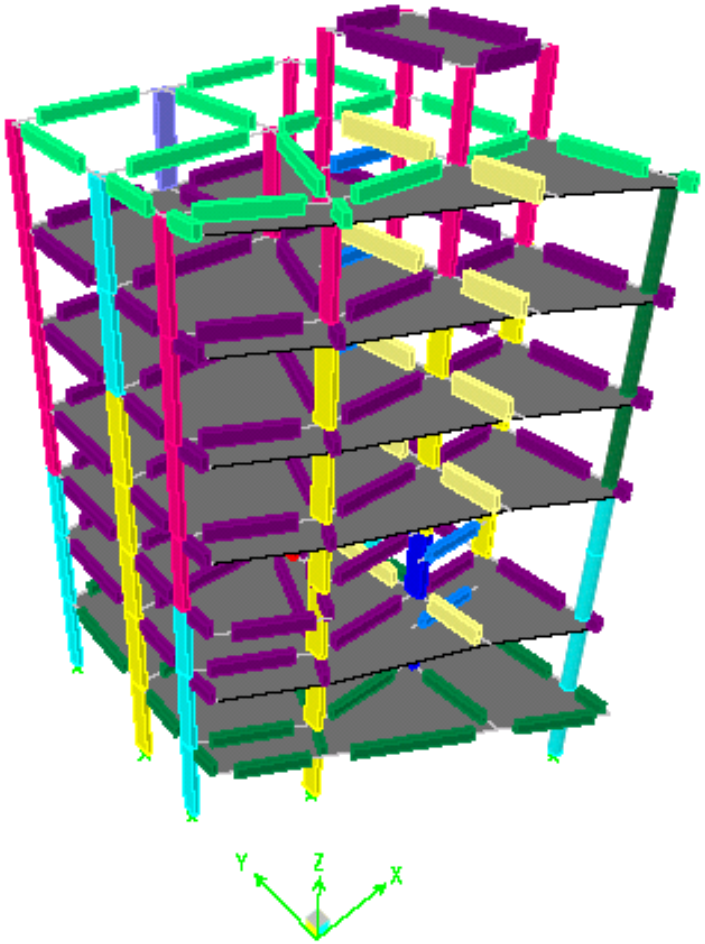


Sub-structure

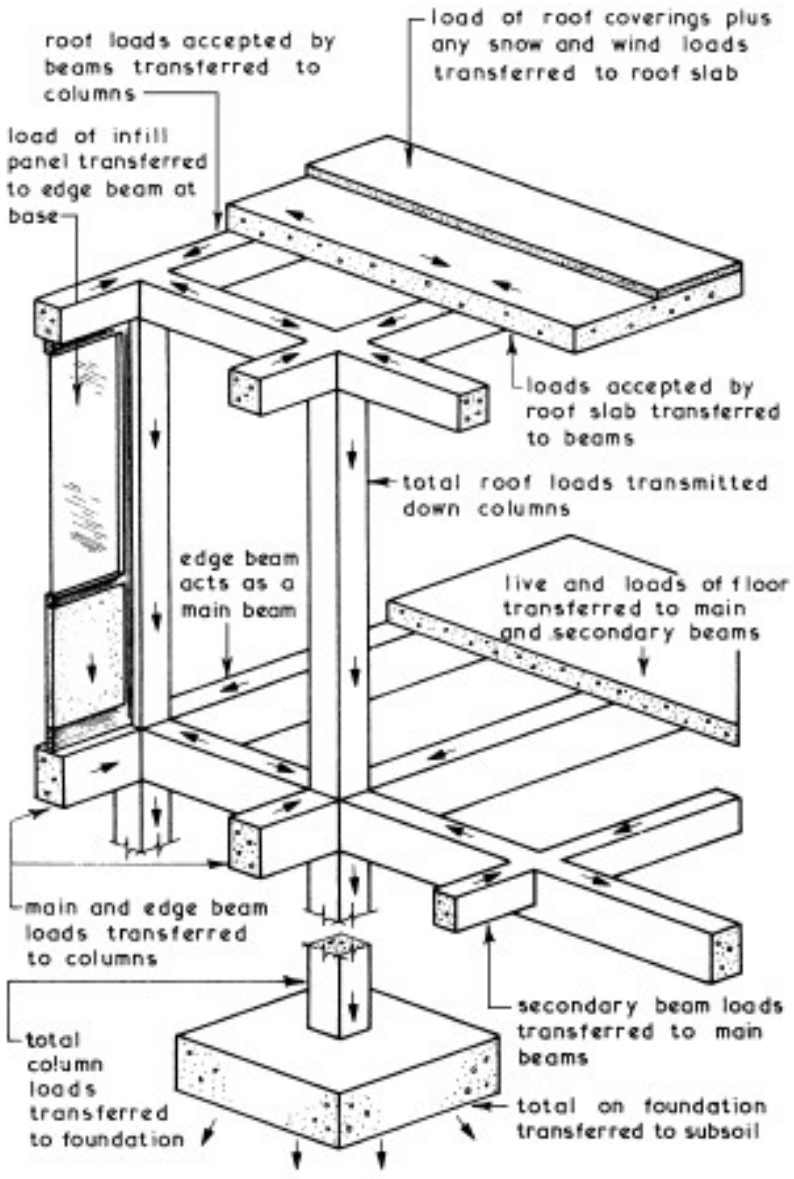


Super-structure and sub-structure

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3D-model



1.5. DESIGN AND PERFORMANCE REQUIREMENTS

- A building structure should satisfy the following basic design and performance requirements

A. The structure should have adequate ***margin of safety*** (factor of safety) in addition to that necessary to support its normal loading.

B. It must have ***sufficient stiffness*** so that its distortion does not offend the eye or reduce the efficiency of the structure for its normal purpose.

C. The building should be planned to provide sufficient ***comfort and convenience*** to the occupants of the building.

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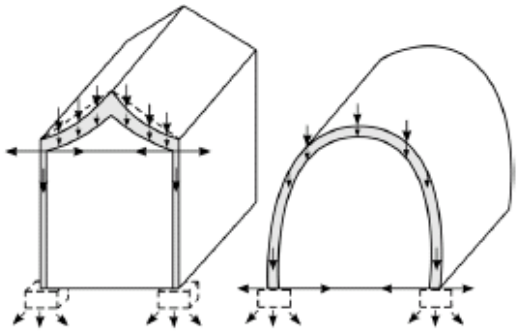
- To accommodate the basic functional requirements, a building should satisfy the following requirements in its design and construction works:

1. Strength and stability

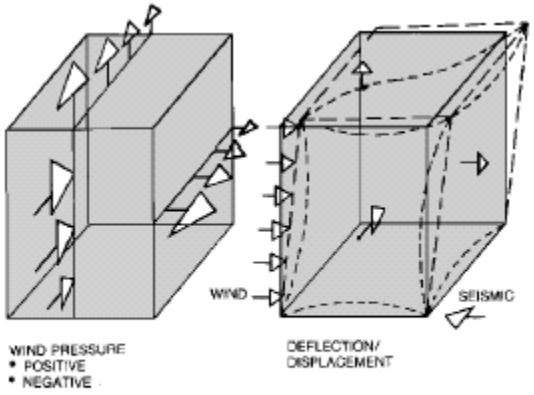
- ✓ Any structural component of a building should be strong enough to carry or support all possible types of loads to which it is likely to be subjected.
- ✓ The Loads in a building are commonly classified as: dead loads, super imposed or live loads and wind loads.

Dead loads: are static loads due to the weight of the respective structural members, i.e. The wall partitions, roofs, slabs and all other permanent fixtures in the building.

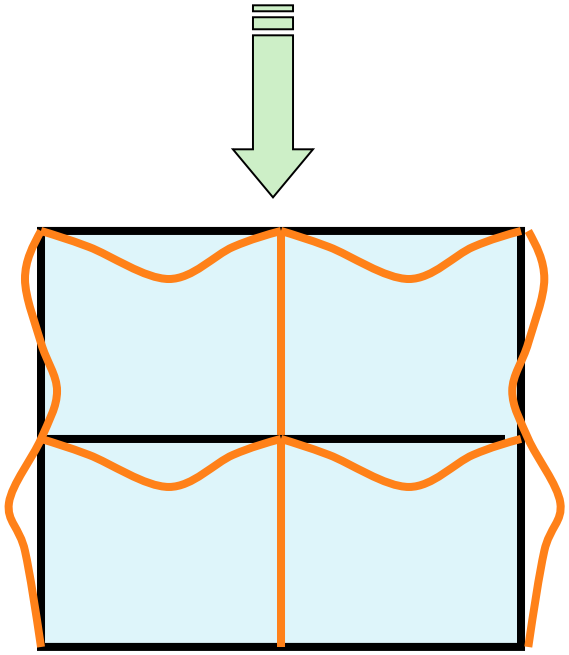
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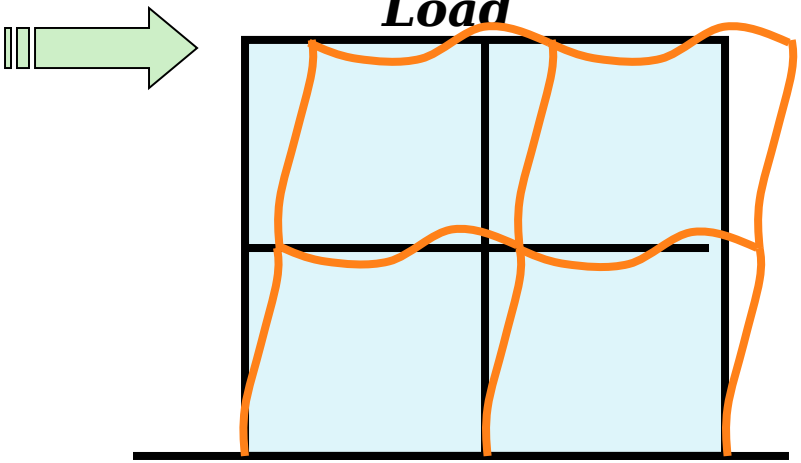
GRAVITY LOADS



WIND / SEISMIC LOADS



Gravity Load



Lateral Loading

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Live loads: also called as super-imposed loads, consist of moving or variable loads, due to people or occupants, their furniture, temporary stores, machinery, etc.

Wind loads: are loads, which can cause uplift on a building and reduce the pressure on the foundation on the windward side and increase pressure on the leeward side. The effect of wind pressure increases with the height of the building.

2. Dimensional stability

- Refers to the resistance to dimensional changes in building materials and structures caused due to:
  - elastic and plastic deformations as a result of applied loads
  - expansion and contraction due to changes in temperature and moisture content.

Cont.....

3. Comfort and convenience

- Should be satisfied by proper planning of the buildings and its units.
  - Optimum utilization of space
  - Lighting considerations
  - Orientation

4. Resistance to moisture penetration

- The presence of moisture in any building structure deteriorates the materials strength, reduces durability and could cause partial or total failure of the structure.

5. Fire protection

- A building structure should not ignite easily
- A building should provide means of fire escape
- A building should be designed to reduce the spread of fire

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6. Heat insulation

- The building should be designed in such a way to maintain fairly constant temperature of the internal environment independently of the varying climatic conditions externally.

7. Day light and ventilation

- Day lighting is essential to promote the activities carried in the building and to create pleasant inside environment.
- Ventilation is essential to prevent undue concentration of odours, fumes, dust, etc and maintain suitable condition for the user of the building.

8. Sound insulation

- The insulation of noise is a very important requirement for buildings such as hospitals, educational institutions, offices and residential building located in noisy areas.

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9. Durability

- The durability of a building is defined as the time over which a building remains serviceable and depends mainly on
  - Type of building materials
  - Environmental exposure
  - Quality of workmanship
  - Degree of maintenance, etc

10. Security

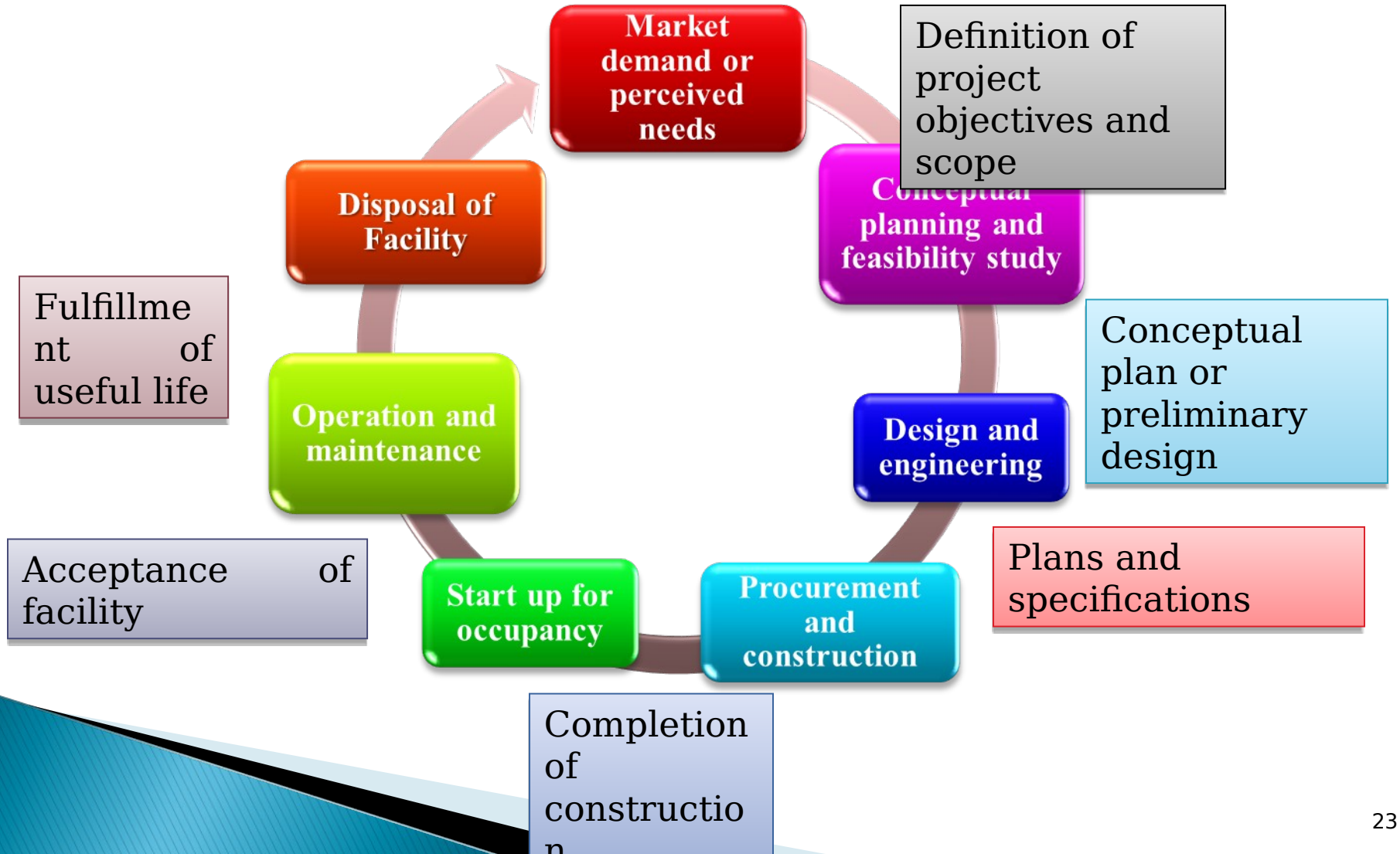
- Due considerations should be given in designing and constructing external walls and openings to protect a building against burglary or theft

11. Economy

- The designer must exercise economy at every stage of planning, design, construction, maintenance and operation.

1.6. THE PROJECT LIFE CYCLE OF A BUILDING

- The project life cycle of a building may be viewed as a process through which a building project is implemented from cradle to grave.



1.7. Main Parties in Building Construction Project

- The practice of **planning**, **designing**, **constructing**, and **operating** buildings is most usually a collective effort of different groups of professionals and trades.
- Depending on the **size**, **complexity**, and **purpose** of a particular building project, the project team may include:
  - A client or an owner: Individuals, government, real estate developers etc.
  - financial institutions or other investors that provide the funding
  - Local planning and code authorities
  - Consultants or Licensed architects and engineers who provide building design and prepare construction documents
  - Contractors who provide construction services and install building systems
  - Marketing or leasing agents
  - Facility managers who are responsible for operating the building.

Main Parties in Building Construction Project



Cont.....

I. Client

- The client is the most important party who is active from inception to completion and event to post-occupancy maintenance.
- Clients may be classified as ***Public sector clients*** and ***private sector clients***.

A. Public sector clients

- Central Government Offices (Ministries)
- Local Authorities (Regional or Town)
- Public Corporations

B. Private sector clients

- These are private individuals & private companies.

Cont.....

Duty of the Client

- Demand for the product. For example for the building project:
  - Availability and cost of land,
  - Location & accessibility
  - Price
  - Required Infrastructure
  - Legal constraints
  - Current & future development
  - Soil characteristics of land
  - Site preparation (right of way)
  - Permits

Cont.....

II. Consultant

- The main role of the consultant is to interpret the client's project requirement into a specific design.
- The consultants' team shall:
  - Ascertain, interpret and formulate the client's requirement into an understandable project.
  - Design the project to much requirements and constraints (imposed by statutory obligations, technical feasibility, environmental factors, site conditions, cost, etc)
  - Assess client's cost limit to decide on materials & the like.
  - Prepare contract documents.
  - Supervise the project and constantly inform the client on the progress
  - Approve payments
  - Resolve contractual disputes
  - Issue provisional and final acceptance certification

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III. Contractor

- These are groups established mainly as commercial companies, that contract to construct development projects.
- Responsibility of contractors:
  - Carry out a full site investigation prior to submission of tender,
  - Submit tender,
  - Plan, Program, Control the construction process.
  - Notify the consultant about delays, discrepancies,
  - Effect all payments to his employees, suppliers, subcontractors,
  - Rectify all defects on completion of works, etc
  - Provide post occupancy repair & maintenance if required.

CONT.....

IV. Public Sector Agencies

A. Statutory Authorities

- These bodies offer technical advice during design and construction in their respective areas.
- E.g. EEPCO, AAWSA, Fire Authority - requires meeting their specific requirements. Thus early information to these authorities is required.

B. Municipalities and Government Authorities

- These bodies offer the basic Land permit and building permit.

1.8. Resource for Building Construction

- The following resources are vital for construction industry:
  - Human Resources (Labor or Workmen)
  - Financial Resources (Fund)
  - Information Resources
  - Physical Resources (Materials, Equipment and Other Assets)
  - Services and Management

A. Human resource (Labour or Workmen)

- These include professional, skilled, semi skilled and unskilled laborers.
- Human resources can be understood in two values: **Capacity** and **Capability**.
  - **Capacity** - refers to the ***quantity*** of labor for the scope defined.
  - **Capability** - refers to ***knowledge***, ***technology*** ***know-how*** and ***skill*** as per the demands of the scopes ability.

Cont.....

A. **Human resource (Labour or Workmen)**

- Construction Managers need to be capable of:
  - Communication- Inter-personal, group interaction-skills
  - Problem solving / Conflict resolution / Negotiation Skills
  - Facilitating / Decision- making Skills
  - Writing skills for Proposals / Reports / ; and
  - Hard Skills- Planning, Implementing, Leading and Monitoring tools.

B. **Financial Resources (Fund)**

- Usually funds are available from among Governmental institution, Private institutions and Donors in the form of loan or assistance.

C. **Information Resources**

- Information can be understood in two terms: **data** whether processed or not; and its **technology**.

Cont.....

D. **Physical Resources**

i. **Materials**

- Material covers 55-70% of the total construction cost.

ii. **Equipments**

- Though their initial cost is high using equipments are far more better than using labor.

iii. **Other assets**

- Physical Infrastructures and Owned Land are assets which can be collaterals for capital base enhancement and credit facilities and are useful to develop the scarce financial resources and getting into business access.

Cont.....

E. Service and Management

i. Service

- Services such as acquisition of land, provisions of water supply, electric power, communication systems, etc., are very much necessary in the construction industry.

ii. Management

- Management has come to employ a disciplined approach to the use of available resources.

Drawing for building construction

- Construction drawings are prepared so that designers can communicate their requirements to the contractor in a **clear, concise** and **unambiguous manner.**
- They are also used:
  - to prepare bill of quantities
  - as part of contract document
- Building construction drawings:
  - Shouldn't be unnecessarily congested or complicated
  - Clarity is most important
  - Written descriptions should be as brief as possible
  - Should be Consistent with completeness
  - Should be well dimensioned and should be drawn to scale
  - The lettering used should be clear

Cont……

- **Construction drawings can be prepared**:
  - By hand assisted by various templates or
  - Computer software programs (Ex. AutoCAD)
- **The use of computer programs in building drawing**:
  - Enables users to produce any type of drawings quickly, precisely, and efficiently
  - Enables editing, adding or deleting texts to drawings
  - Enables printing to required sizes and color
  - It can easily be communicated via networks and e-mails and integrated with other programs
  - Enables to reduce contract time and eases communication between parties in construction.
  - Minimizes the need for storage space

Drawing for house construction

- Drawing for house construction shall include:
- Site plan
- Sketch drawings
- Working drawings
- Detailed drawings
- Construction drawings and
- Installation drawings

Drawing Equipment

- In order to produce construction drawings manually, items like drawing board, drawing paper, drawing pencil, ruler, ink, eraser, various time saving devices such as templates, protractor, t-square, setsquares, etc. are

Cont….

SITE PLAN

- A site is a parcel of land which is made up of one, two or more plots.
- A site plan is a drawing showing various properties in terms of their owners, locations, elevations, states of development and features such as roads, utility supply lines, etc.

Cont….

Components of a site plan

- **Survey beacon:** these are concrete pillars located at principal corners of the site and at every change in the direction of boundaries. They define the boundary and area of the site.
- **Elevations:** these are the different heights on the surface of the site in relation to a standard reference point known as the bench mark (BM).
  - Locations which have equal elevations are joined together using contour lines.
  - These lines help to define the topography of the land within a site.
- **Site orientation:** these refers to a system of defining the site in terms of its direction to the north, south, east and west.
  - Orientation is important in planning the building area to make into consideration such factors as the direction of rain, wind and sun within the site.

Cont.....

Components of a site plan (cont...)

- **Physical features:** these are permanent objects or features existing with in the site or adjoining sites which are used for referencing or identification of the site.

  Ex. Existing buildings, trees, roads, fences, etc.
- **Access road**: these shows the means of reaching the site.
- **Utilities**: A site plan shows utility supply lines such as for water, electricity and gas.

The scales used in drawing a site plan are:

- For small sites: Scales of 1:100, 1;200
- For large sites: Scales of 1:500, 1:1000, 1:2500

Sketch drawings

- Sketch drawings are preliminary drawings prepared for showing the general arrangements of buildings.
- They are often drawn free hand in pencils.
- They comprise plans of the most important storey, one or more elevations and a cross-section of the building.

Detailed drawings

- They are prepared to the extent necessary and depending on the complexity of the building.
- They can be prepared to a scale of 1:1, 1:5, 1:10, or 1:20.
- They usually show specific details, such as in stair cases, gutter to down pipe connections, wall to foundation connection, metal and wood joineries, etc.

Construction drawings

- They are prepared mainly for the foundation work, for construction in steel, concrete, roofing and wood works.
- They provide important information for the resident engineer and foremen in the execution of their day-to-day activities.

Installation drawings:

- Installation drawings comprise of drawings for water an drainage pipes, electrical installation as well as mechanical installation.
- For residential building a scale of 1:50 is normally preferred.

Working drawings

Working drawings

- They are prepared in greater detail with all dimensions given to avoid the need for taking measurements from scale.
- They comprise of all plans and elevations as well as an adequate number of cross-sections.
- The materials to be used for the various parts of the building should be indicated in different symbols.
- They are the most important components of building drawings since they provide detail information on the internal as well as the external view of a building.
- They are usually prepared using a scale of 1:50.

Floor plan drawings

- The floor plan is a drawing of the outline and partitions of a building that would be seen when the building was cut horizontally about 1.2m above the floor level.
- It provides more specific information about the design of the building than any other plan.
- It is used as the base for the projection of other drawings.
- The major steps in floor plan drawings preparation are:
  - Laying center line of walls,
  - Marking window and door openings,
  - Marking wall thickness,
  - Locating furniture positions,
  - Indicating material type,
  - Adding measurements and other details.

Elevation drawings

- Elevation drawings are orthographic drawings of the exterior of a building.
- They are prepared to show the design materials, dimensions, and final appearance of the exterior of a building.
- Elevation drawings are projected from the floor plan of an architectural drawing.
- The major steps in projecting elevations are:
  - Projecting vertical lines
  - Projecting horizontal lines
  - Locating roof lines
  - Adding elevation symbols
  - Providing elevation dimensions
  - Description of material used and finishing type

Sectional drawings

- Sectional drawings reveal the internal construction of an object.
- Architectural section drawings are prepared
  - For the entire structure (full sections) or
  - For a specific part(s) of a building (detail sections)
- The cutting plane is an imaginary plane, which passes through the building and divides it into sections.
  - Longitudinal section
  - Transverse section
  - Offset section
- Removed sections are frequently drawn for areas such as footings, window sill, cornice, gutter line and ridge sections.

Hatchings

- The main objective is to differentiate between the materials being used thus enabling rapid recognition and location.
- They must be used consistently throughout the whole set of drawings.
- In large areas it is not always necessary to hatch the whole area.

Symbols

- These are graphical representations and should wherever possible bed drawn to scale
- They must be consistent for the whole set of drawings and clearly drawn.

Thank you!