

ARCH 416
Building Construction II

2. BUILDING SYSTEMS

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Lecture Objectives

Upon completion of this lecture, the student will be able to:

1. Differentiate between structural and non-structural building systems.
- 2- List 4 types of structural systems.
- 3- List 4 types of non-structural systems.
- 4- Explain & discuss the building systems.



Lecture Content

- Introduction.
- Types of Building Systems.
- Foundation Systems.
- Floor Systems.
- Wall - Column Systems.
- Roof Systems.
- Enclosure & Protection Systems.
- Mechanical Systems.
- Finishing Systems.
- Fixtures & Furniture.
- Lecture Activity.
- Summary.



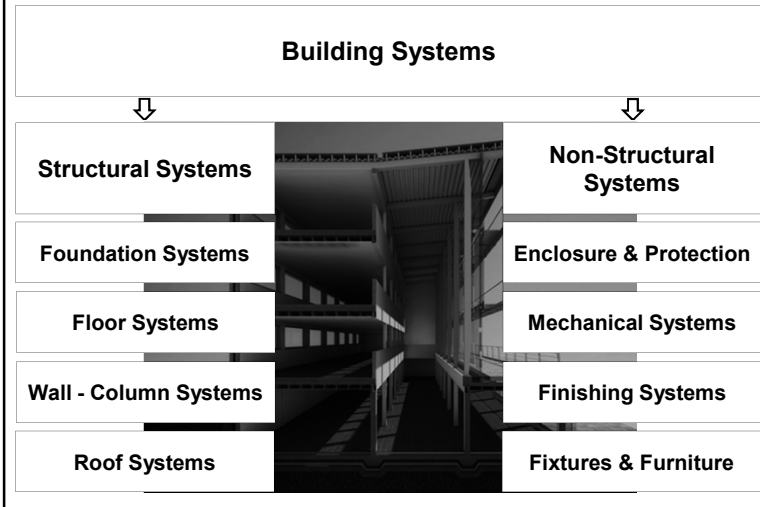
Introduction

Architecture and building construction are not necessarily one and the same thing. An understanding of the methods for assembling various materials, elements, and components is necessary during both the design and the construction of a building. A working knowledge of building construction is only one of several critical factors in the execution of architecture.



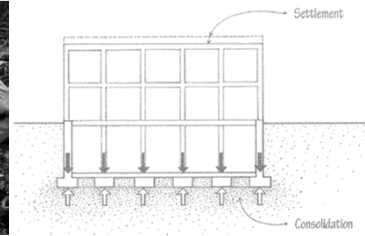
A system can be defined as an assembly of interrelated or interdependent parts forming a more complex and unified whole and serving a common purpose. A building can be understood to be the physical embodiment of a number of systems and subsystems that must necessarily be related, coordinated, and integrated with each other as well as with the three-dimensional form and spatial organization of the building as a whole.

Types of Building Systems



Foundation Systems

The foundation is the lowest division of a building (its substructure) constructed partly or wholly below the surface of the ground. Its primary function is to support and anchor the superstructure above and transmit its loads safely into the earth. Because it serves as a critical link in the distribution and resolution of building loads, the foundation system must be designed to both accommodate the form and layout of the superstructure above and respond to the varying conditions of soil, rock, and water below.



Foundation Systems

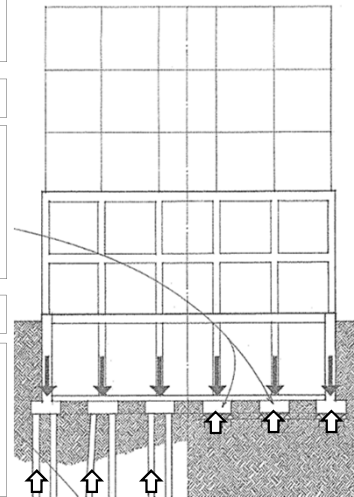
We can classify foundation systems into two broad categories—shallow foundations and deep foundations.

1- Shallow Foundations

Shallow or spread foundations are employed when stable soil of adequate bearing capacity occurs relatively near to the ground surface. They are placed directly below the lowest part of a substructure and transfer building loads directly to the supporting soil by vertical pressure.

2- Deep Foundations

Deep foundations are employed when the soil underlying a foundation is unstable or of inadequate bearing capacity. They extend down through unsuitable soil to transfer building loads to a more appropriate bearing stratum of rock or dense sands and gravels well below the superstructure.

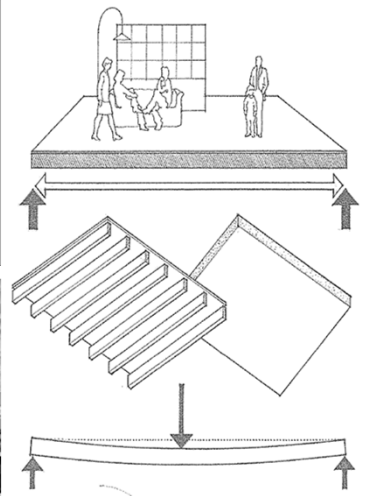
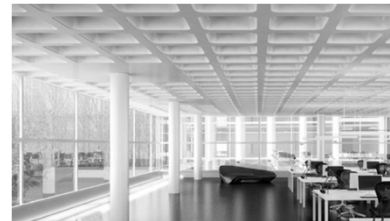


Floor Systems

Floor systems are the horizontal planes that must support both live loads (people, furnishings, and movable equipment) and dead loads (the weight of the floor construction itself).

Floor systems must transfer their loads horizontally across space to either beams and columns or to loadbearing walls.

Rigid floor planes can also be designed to serve as horizontal diaphragms that act as thin, wide beams in transferring lateral forces to shear walls.



Floor Systems

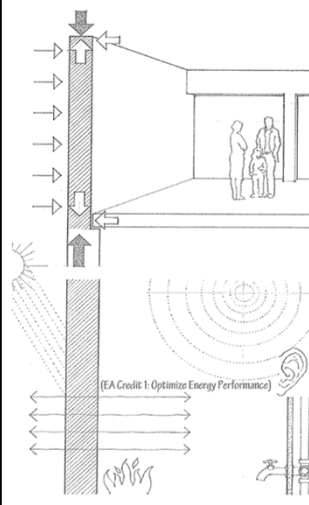
A floor system may be composed of a series of linear beams and joists overlaid with a plane of sheathing or decking, or consist of a nearly homogeneous slab of reinforced concrete.

The depth of a floor system is directly related to the size and proportion of the structural bays it must span and the strength of the materials used.

The size and placement of any cantilevers and openings within the floor plane should also be considered in the layout of the structural supports for the floor.



Wall - Column Systems



Walls are the vertical constructions of a building that enclose, separate, and protect its interior spaces. They may be loadbearing structures of homogeneous or composite construction designed to support imposed loads from floors and roofs, or consist of a framework of columns and beams with nonstructural panels attached to or filling in between them. The pattern of these load bearing walls and columns should be coordinated with the layout of the interior spaces of a building.



Wall - Column Systems

Columns are rigid, relatively slender structural members designed primarily to support axial compressive loads applied to the ends of the members. Relatively short thick columns are subject to failure by crushing rather than by buckling. Failure occurs when the direct stress from an axial load exceeds the compressive strength of the material available in the cross section. An eccentric load, however, can produce bending and result in an uneven stress distribution in the section.



Roof Systems

The roof system functions as the primary sheltering element for the interior spaces of a building. The form and slope of a roof must be compatible with the type of roofing (shingles, tiles, or a continuous membrane) used to shed rainwater and melting snow to a system of drains, gutters, and downspouts. The construction of a roof should also control the passage of moisture vapor, the infiltration of air, and the flow of heat and solar radiation. And depending on the type of construction required by the building code, the roof structure and assembly may have to resist the spread of fire.



Enclosure & Protection Systems

Partition Walls

A partition wall is a wall for the purpose of separating rooms, or dividing a room. Partition walls are usually not load-bearing. Partition walls may be constructed of steel panels, bricks or blocks from clay, terra-cotta or concrete, reinforced, or hollow. Glass blocks may also be used. They may also be constructed from sheet glass. Glass partition walls are a series of individual toughened glass panels, which are suspended from or slide along a robust aluminum ceiling track.



Enclosure & Protection Systems

Insulation

Building insulation refers broadly to any object in a building used as insulation for any purpose. While the majority of insulation in buildings is for thermal purposes, the term also applies to moisture insulation, acoustic insulation, and fire insulation. Often an insulation material will be chosen for its ability to perform several of these functions at once.



Enclosure & Protection Systems

Curtain Walls

A curtain wall system is an outer covering of a building in which the outer walls are non-structural, but keep the weather out and the occupants in, therefore it can be made of a lightweight material. When glass is used as the curtain wall, a great advantage is that natural light can penetrate deeper within the building.

A curtain wall is designed to resist air and water infiltration, sway induced by wind and seismic forces acting on the building, and its own dead load weight forces. Curtain are designed to span multiple floors, and take into consideration design requirements such as: thermal expansion and contraction; building sway and movement; water diversion; and thermal efficiency.



Enclosure & Protection Systems

Openings

A door is a moving structure used to block off, and allow access to, an entrance to or within an enclosed space. Similar exterior structures are called gates. Doors normally consist of a panel that swings on hinges or that slides or spins inside of a space.

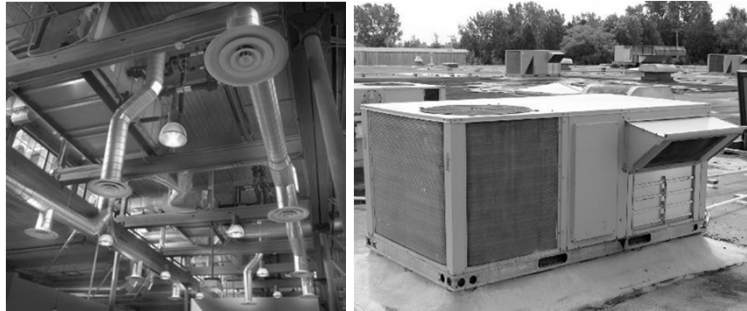
A window is an opening in a wall, door, roof that allows the passage of light and, if not closed or sealed, air and sound. Modern windows are usually glazed or covered in some other transparent or translucent material. Windows are held in place by frames. Many glazed windows may be opened, to allow ventilation, or closed, to exclude inclement weather.



Mechanical Systems

HVAC Systems

Heating, ventilating, and air-conditioning systems condition the interior spaces of a building for the environmental comfort of the occupants. A potable water supply is essential for human consumption and sanitation. The efficient disposal of fluid waste and organic matter is necessary in order to maintain sanitary conditions within a building and in the surrounding area. Electrical systems furnish light and heat for a building's occupants, and power to run its machines.



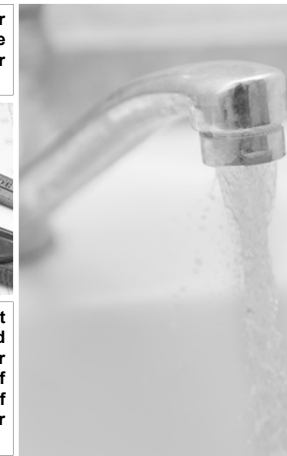
Mechanical Systems

Water Supply & Sanitation

The water supply system provides potable water for human consumption and sanitation, while, the sewage disposal system removes fluid waste and organic matter from a building.



Water must be supplied to a building in the correct quantity, and at the proper flow rate, pressure and temperature, to satisfy the above requirements. For human consumption, water must be potable and free of harmful bacteria. To avoid the clogging or corrosion of pipes and equipment, water may have to be treated for hardness or excessive acidity.



Mechanical Systems

Electrical & Lighting Systems

The electrical system controls, meters, and protects the electric power supply to a building, and distributes it in a safe manner for power, lighting, security, and communication systems.



The primary purpose of a lighting system is to provide sufficient illumination for the performance of visual tasks. Recommended levels of illumination for certain tasks specify only the quantity of light to be supplied. How this amount of light is supplied affects how a space is revealed or how an object is seen.

Mechanical Systems

Mechanical Transportation Systems

The mechanical transportation of people and goods is an energy-using service which needs the designer's attention at the earliest stages of building design. Standards of service rise with expectations of quality by the final user and with the provision of access for disabled people. Building transportation systems include: Elevators, Escalators & Travelators.



An Elevator



An Escalator

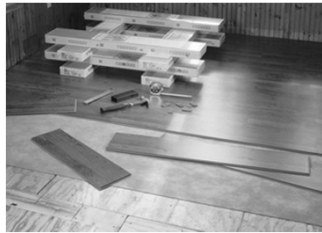


A Travelator

Finishing Systems

Flooring

Floor Finishing (Flooring) is the general term for a permanent covering of a floor. Materials almost always classified as floor covering include carpet, area rugs, and resilient flooring such as linoleum or vinyl flooring. Materials commonly called flooring include wood flooring, ceramic tile, stone, terrazzo, and various seamless chemical floor coatings.



Finishing Systems

Wall Finishes

Plaster Work

Plaster is a building material used for coating walls and ceilings. Plaster is manufactured as a dry powder and is mixed with water to form a paste when used. The reaction with water liberates heat through crystallization and the hydrated plaster then hardens.



Wall Paneling

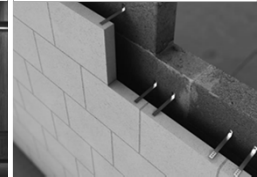
Paneling is a wall covering constructed from rigid or semi-rigid components. These are traditionally interlocking wood, but could be plastic or other materials.

Paneling was developed in antiquity to make rooms in stone buildings more comfortable. The panels served to insulate the room from the cold stone.



Wall Cladding

Wall cladding is a type of decorative covering intended to make a wall look like it is made of a different sort of material than it actually is. Some of the most common examples are on the outside of buildings, but cladding can also be an artistic element in interior decorating.



Finishing Systems

Suspended Ceilings

A Suspended ceiling is a secondary ceiling, hung below the main structural ceiling. It may also be referred to as a drop ceiling or a false ceiling. Suspended ceilings are staple of modern construction and architecture in both residential and commercial applications.

Suspended ceilings provide a concealed space for mechanical ductwork, electrical conduit, and plumbing lines. Light fixtures, sprinkler heads, fire detection devices, and sound systems can be recessed into the ceiling plane. The ceiling can be fire-rated to provides fire protection for the supporting floor and roof structure. Thus, the ceiling system is able to integrate the functions of lighting, air distribution, acoustical control, and fire protection.



Fixtures & Furniture



Lecture Activity

Each student is required to prepare a brief but informative internet-based research about one of the topics related to this lecture (Building Systems); i.e., new developments, successive and local case studies or important details. The research should be presented in Only TWO A4 sheets.



Summary

- Building systems can be divided broadly into two categories; structural and no structural.
- Structure is a necessary part of architecture; with reason being that it ensures the stability of buildings. Structural members should be designed to enable the resolution and transfer of forces to the ground. This can be achieved by various structural systems, depending on what kind of structure is to be built.
- Building structural systems can be divided into four categories as follows: foundation systems, floor systems, wall – column systems, and roof systems.
- Buildings include nonstructural systems such as partition walls, insulation, doors, cladding, electrical & HVAC systems.



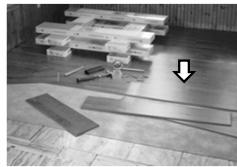
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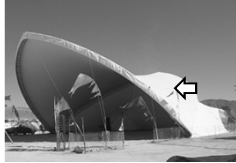

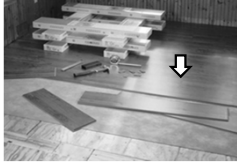
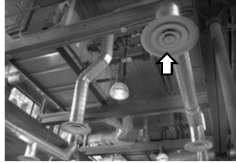

Exercise 1

The following table contains photos for building systems studied during this lecture, name the indicated system in each photo.

Exercise 1 (Answers)

The following table contains photos for building systems studied during this lecture, name the indicated system in each photo.

		
Floor System	Roof System	Wall - Column System
		
Finishing System	HVAC System	Furniture

Exercise 2

Identify correct (✓) and false (X) statements:

- Shallow foundations are used when the soil underlying a foundation is unstable or of inadequate bearing capacity.
- Wall cladding is a type of decorative covering intended to make a wall look like it is made of a different sort of material than it actually is.
- Thermal insulation is considered a structural building system.

Exercise 3

Choose the correct answer:

A is a wall for the purpose of separating rooms, or dividing a room. I) partition wall II) shear wall III) curtain wall

..... systems condition the interior spaces of a building for the environmental comfort of the occupants.

I) HDF II) BIM III) HVAC

..... systems must transfer their loads horizontally across space to either beams and columns or to loadbearing walls.

I) Foundation II) Floor III) Fire Fighting

Exercise 2 (Answers)

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- Thermal insulation is considered a structural building system. X

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I

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III

..... systems must transfer their loads horizontally across space to either beams and columns or to loadbearing walls.

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II