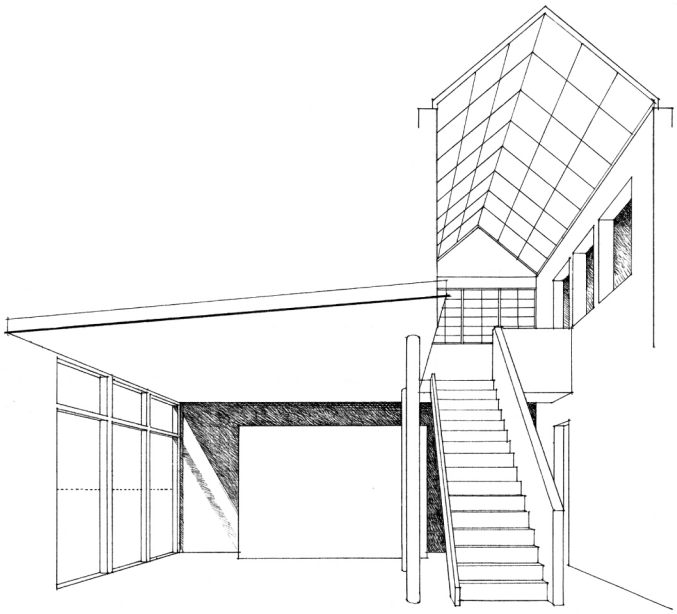

FRANCIS D.K. CHING

CORKY BINGGELI

INTERIOR DESIGN ILLUSTRATED

THIRD EDITION

CHING

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ILLUSTRATED

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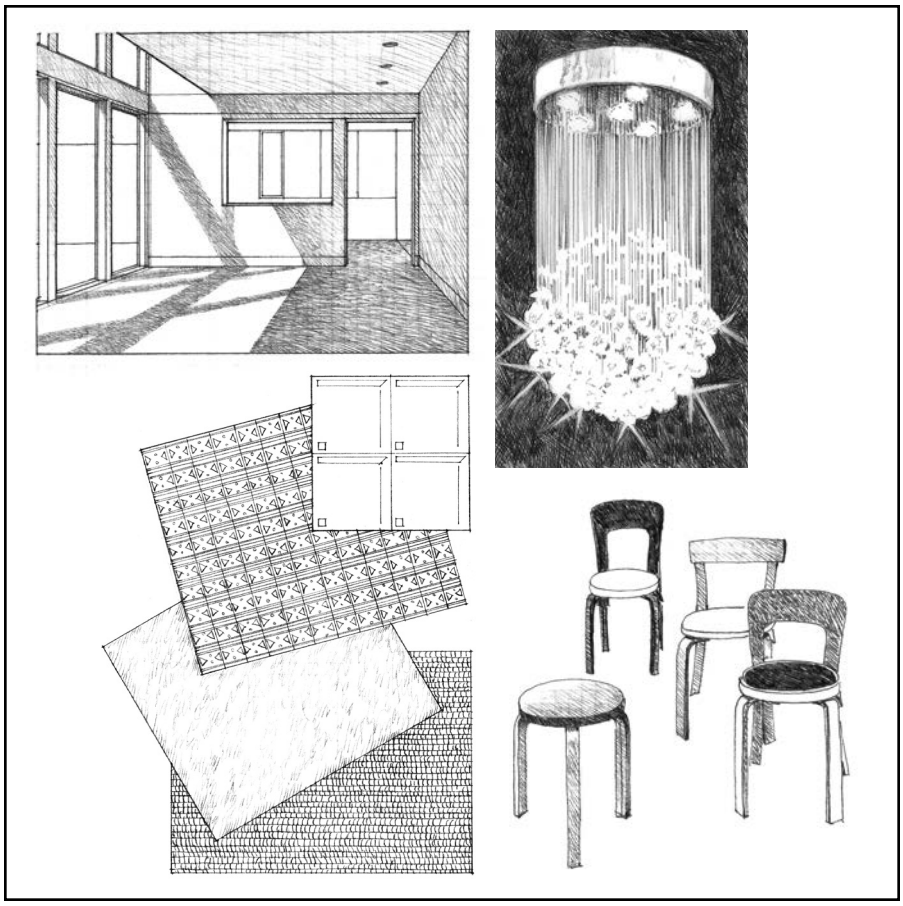

Francis D.K. Ching • Corky Binggeli

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CONTENTS

PREFACE

We spend the majority of our lives indoors, in the interior spaces created by the structures and shells of buildings. These spaces provide the physical context for much of what we do, and give substance and life to the architecture that houses them. This introductory text is a visual study of the nature and design of these interior settings.

The purpose of this primer is to introduce to students of interior design those fundamental elements that make up our interior environments. It outlines the characteristics of each element and presents the choices we have in selecting and arranging them into design patterns. In making these choices, emphasis is placed on basic design principles and how design relationships determine the functional, structural, and aesthetic qualities of interior spaces.

This third edition retains the organizational scheme of the second edition, with text and illustrations updated and added to cover sustainable materials, water and energy usage, indoor air quality considerations, and recent developments in computer technology. The section on lighting reflects current design practice, lamp and fixture styles, and energy conservation. The coverage of furnishings responds to changes in the work environment and bariatric design. New residential topics include aging in place and visitability. Standards and codes incorporate current International Code Council (ICC) and Americans with Disabilities Act (ADA) requirements. Finally, the Bibliography has been updated and a Glossary added.

This exploration of the ways and means of developing interior spaces begins with space itself, for it is the prime material with which the interior designer must work.

Chapter 1—Interior Space proceeds from a general discussion of architectural space to the particular characteristics of interior space in three dimensions and introduces the components of a building.

Chapter 2—Interior Design outlines a method for translating programmatic needs and requirements into three-dimensional design decisions.

Chapter 3—A Design Vocabulary explores the fundamental elements and principles of visual design and applies each of them to the unique field of interior design.

Chapter 4—Interior Building Elements describes the major categories of interior elements and discusses how each affects the functional and aesthetic development of interior spaces.

Chapter 5—Interior Environmental Systems outlines the environmental control systems that must be integrated with a building's structure and the layout of the interior spaces.

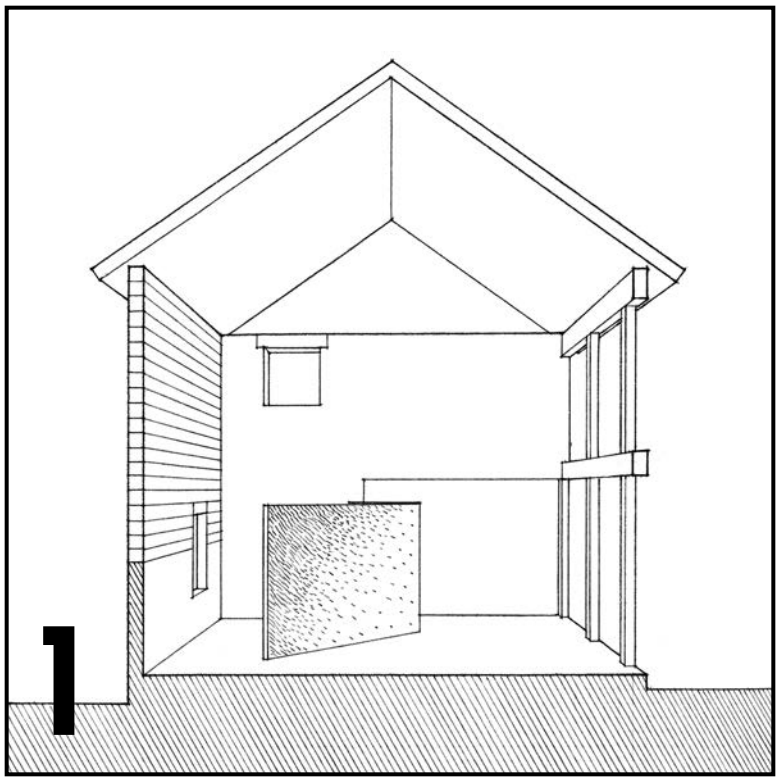
Chapter 6—Lighting and Acoustics addresses the lively and ever-present interaction of light and sound with the interior environment.

Chapter 7—Finish Materials introduces the palette used by interior designers to modify the architectural elements of interior spaces.

Chapter 8—Furnishings discusses basic types of movable and built-in components within the built environment.

Since interior design is to a great extent a visual art, drawings are used extensively in this book to convey information, express ideas, and outline possibilities. Some of the illustrations are quite abstract; others are more specific and particular. All of them, however, should be viewed essentially as diagrams that serve to demonstrate design principles or to clarify the relationships existing among the elements of a design.

The goal of interior design education is to prepare students to be responsible, well-informed, skilled professionals who make beautiful, safe, and comfortable spaces that respect the earth and its resources. The field of interior design encompasses both visual and functional design, as well as basic knowledge of building materials, construction, and technology. This introduction to interior design is therefore broad in scope. The intent, nevertheless, is to treat the subject with clarity, make it as accessible as possible, and stimulate further in-depth study and research.

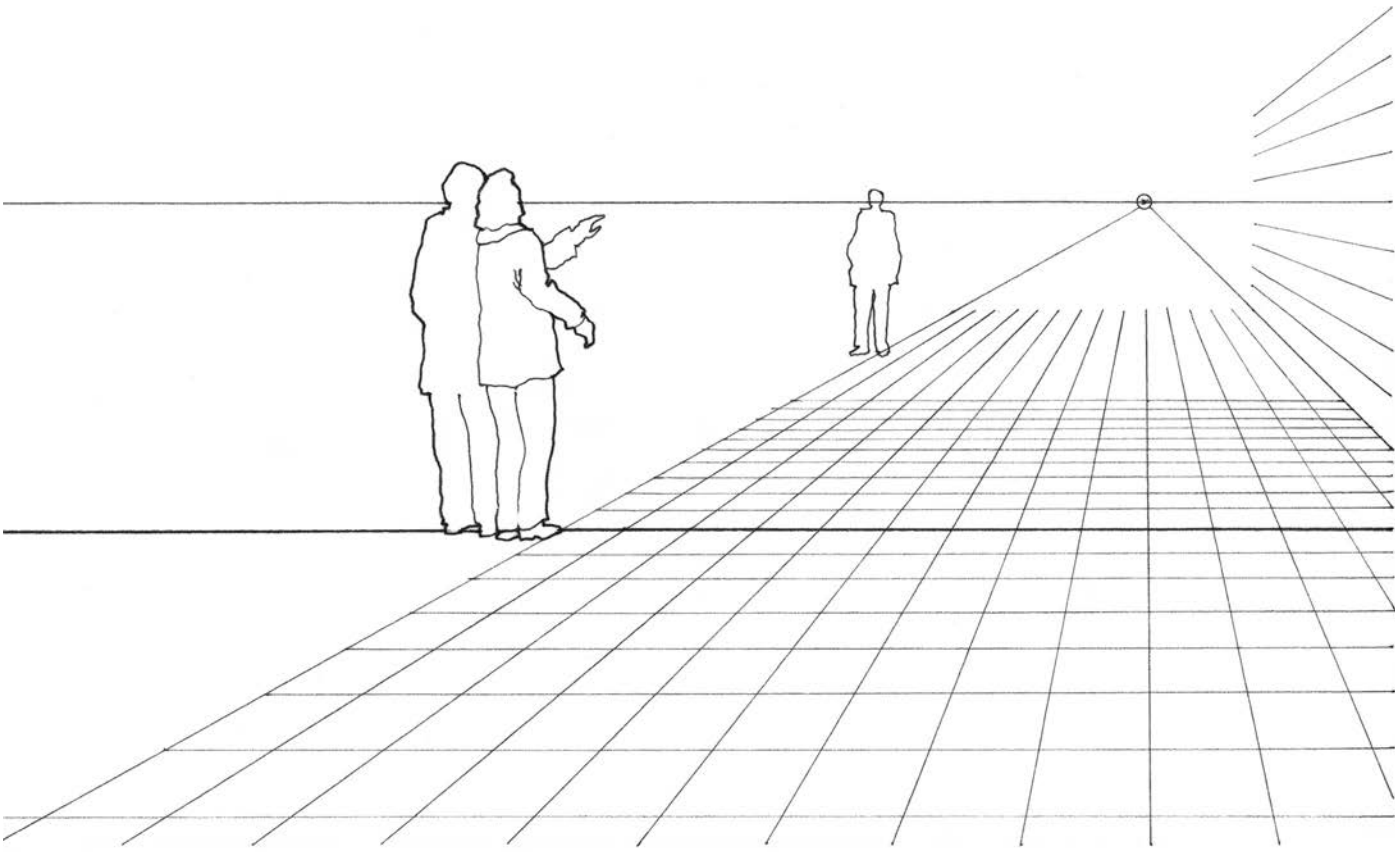


1 Interior Space

Space

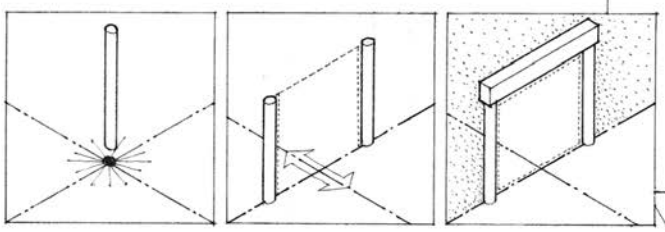
Space is a prime ingredient in the designer's palette and the quintessential element in interior design. Through the volume of space we not only move; we see forms, hear sounds, feel gentle breezes and the warmth of the sun, and smell the fragrances of flowers in bloom. Space inherits the sensual and aesthetic characteristics of the elements in its field.

Space is not a material substance like stone and wood. It is inherently formless and diffuse. Universal space has no defining borders. Once an element is placed in its field, however, a visual relationship is established. As other elements are introduced into the field, multiple relationships are established between the space and the elements, as well as among the elements themselves. Space is formed by our perception of these relationships.

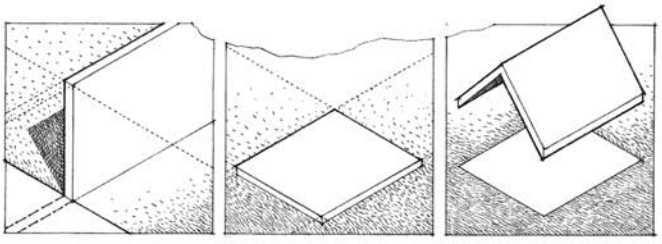


The geometric elements—point, line, plane, and volume—can be arranged to articulate and define space. In architecture, these fundamental elements become linear columns and beams, planar walls, floors, and roofs.

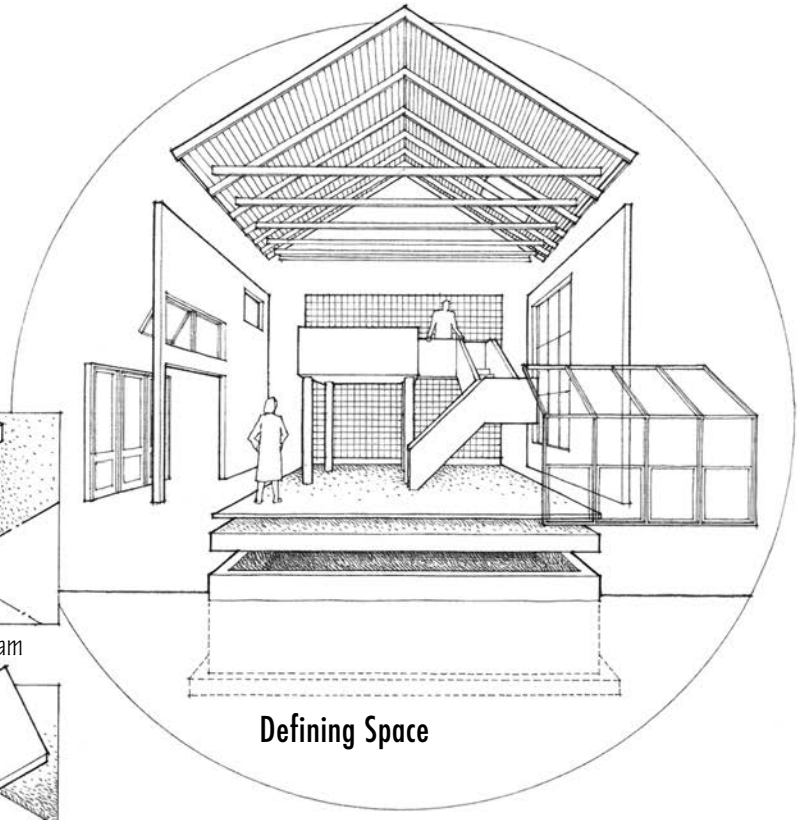
- A column marks a point in space and makes it visible in three dimensions.
- Two columns define a spatial membrane through which we can pass.
- When supporting a beam, the columns delineate the edges of a transparent plane.
- A wall, an opaque plane, marks off a portion of amorphous space and separates here from there.
- A floor defines a field of space with territorial boundaries.
- A roof provides shelter for the volume of space beneath it.



Column | Two columns | Columns and beam

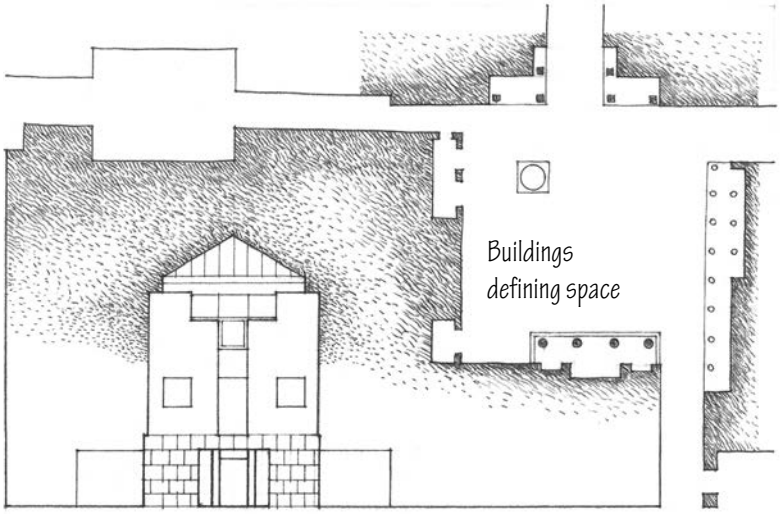


Wall | Floor | Roof



Defining Space

In architectural design, these elements are organized to give a building form, differentiate between inside and outside, and define the boundaries of interior space.



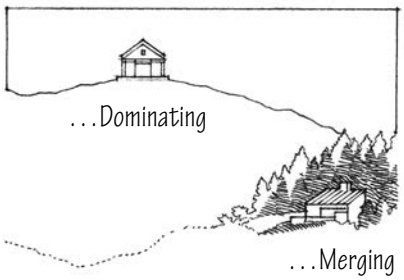
A building in space

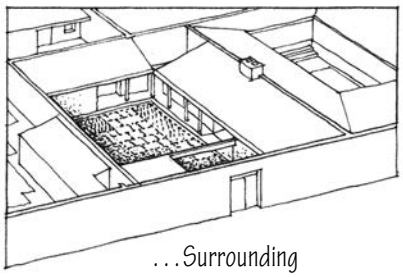
A building's form, scale, and spatial organization are the designer's response to a number of conditions—functional planning requirements, technical aspects of structure and construction, economic realities, and expressive qualities of image and style. In addition, the architecture of a building should address the physical context of its site and the exterior space.

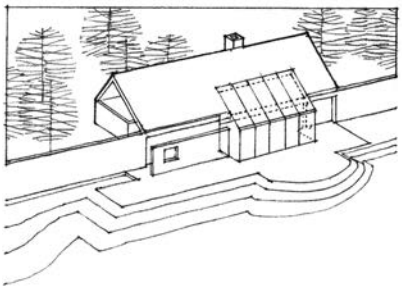
A building can be related to its site in several ways. It can merge with its setting or dominate it. It can surround and capture a portion of exterior space. One of its faces can be made to address a feature of its site or define an edge of exterior space. In each case, due consideration should be given to the potential relationship between interior and exterior space, as defined by the nature of a building's exterior walls.

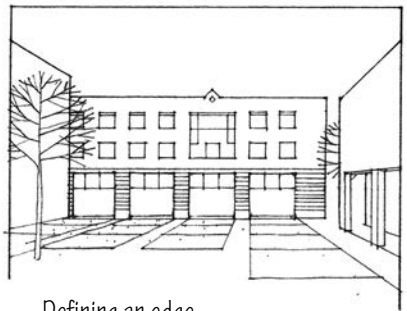
Buildings affect and are affected by conditions of their sites and the wider environment. Selecting and developing sites to reduce site disturbance, stormwater runoff, heat island effects, and light pollution contribute to *sustainable design*.

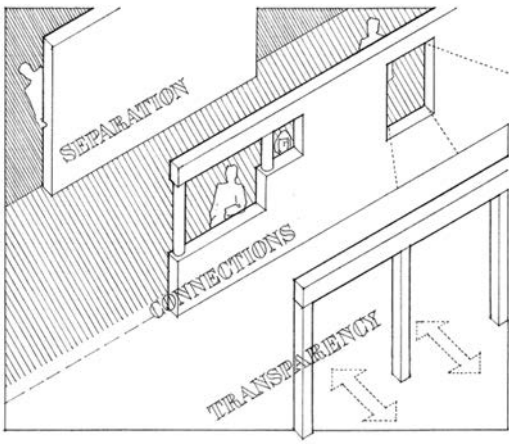
Buildings




. . . Surrounding


. . . Fronting


. . . Defining an edge



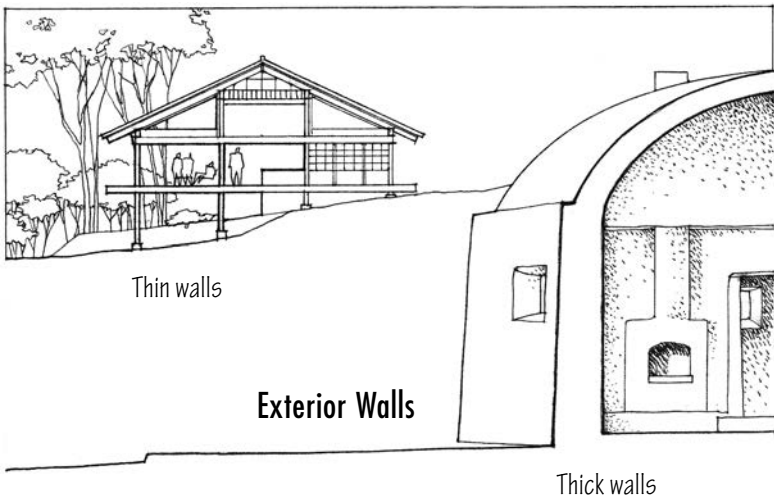
Exterior Walls

A building's exterior walls constitute the interface between our interior and exterior environments. In defining both interior and exterior space, they determine the character of each. They may be thick and heavy, expressing a clear distinction between a controlled interior environment and the exterior space from which it is isolated. They may be thin, or even transparent, and attempt to merge inside and outside.

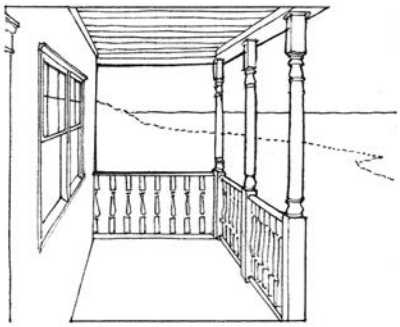
Windows and doorways, the openings that penetrate a building's exterior walls, are the spatial transitions between exterior and interior space. Their scale, character, and composition often tell us something about the nature of the interior spaces that lie between them.

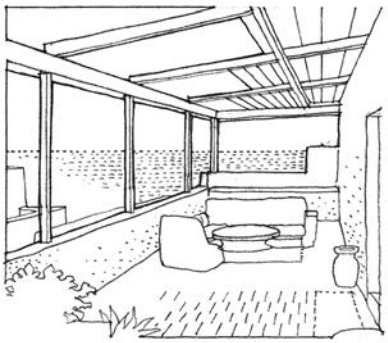
Special transitional spaces, belonging to both the outside world and the inside, can be used to mediate between the two environments. Familiar examples include a porch, a veranda, or an arcaded gallery.

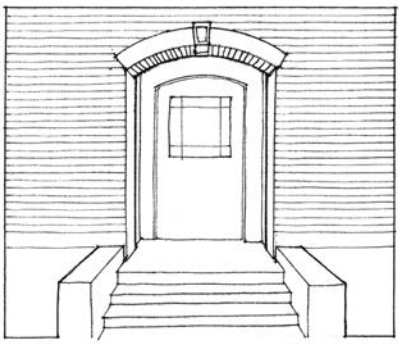
Many single-family residences have steps at all entrances that present barriers to people with physical disabilities. *Visitability* is a movement to construct new homes so that they can be readily lived in and visited by people with mobility impairments.

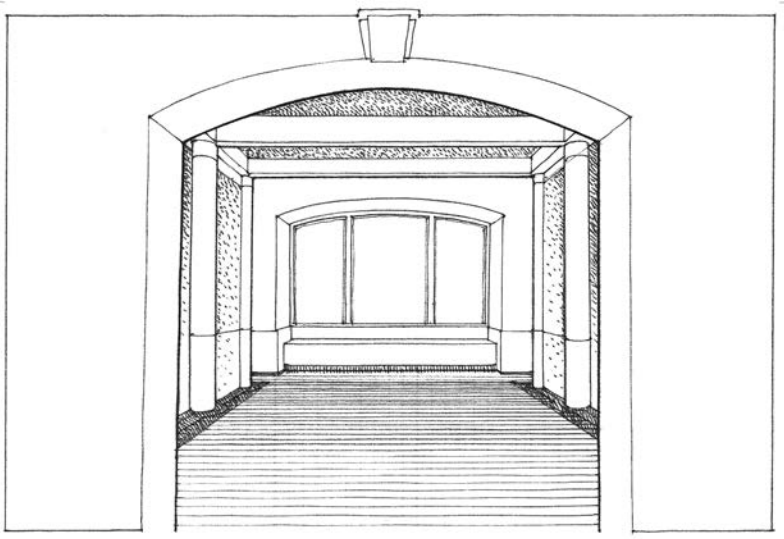


Spatial Transitions





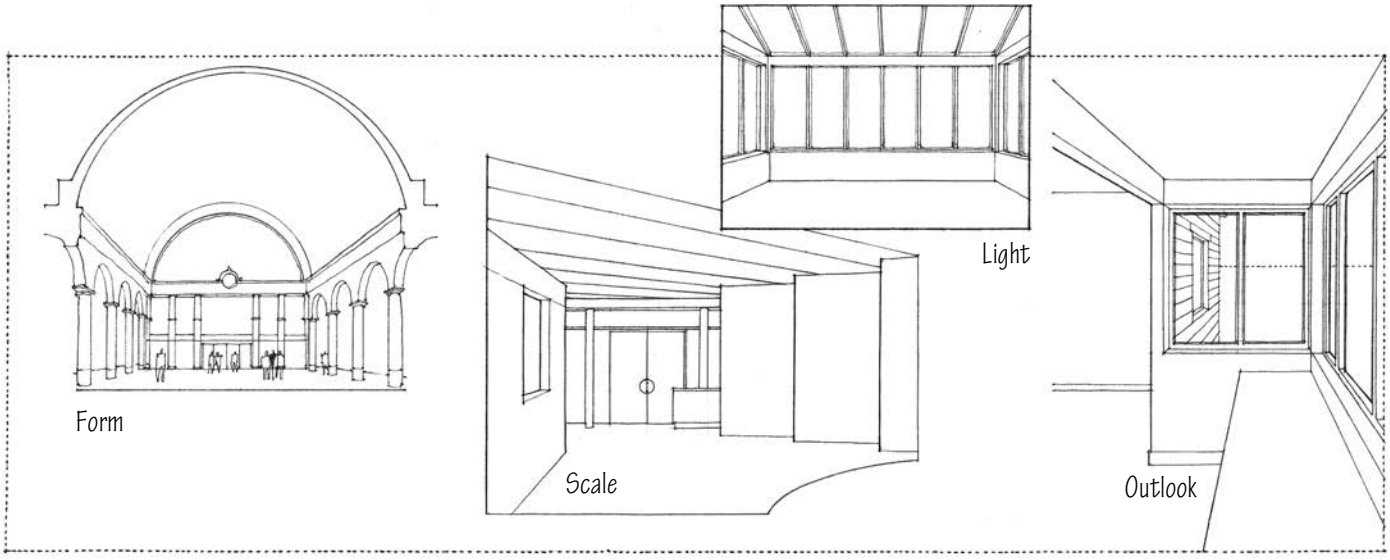




Entrances mark the transition from here to there.

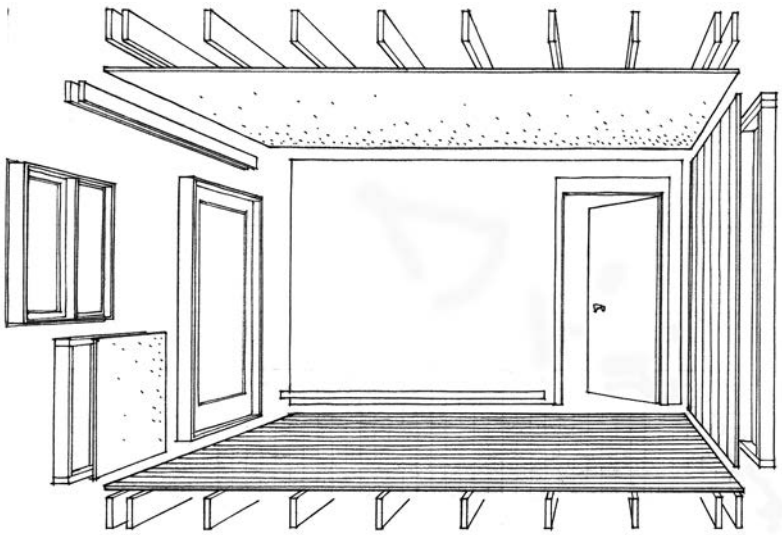
Upon entering a building, we sense shelter and enclosure. This perception is due to the bounding floor, wall, and ceiling planes of interior space. These are the architectural elements that define the physical limits of rooms. They enclose space, articulate its boundaries, and separate it from adjoining interior spaces and the outside.

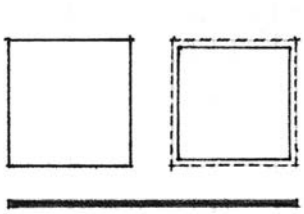
Floors, walls, and ceilings do more than mark off a simple quantity of space. Their form, configuration, and pattern of window and door openings also imbue the defined space with certain spatial or architectural qualities. We use terms such as grand hall, loft space, sun room, and alcove not simply to describe how large or small a space is, but also to characterize its scale and proportion, its quality of light, the nature of its enclosing surfaces, and the way it relates to adjacent spaces.



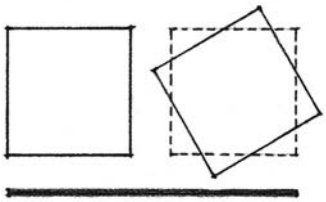
Spatial Qualities

Interior design necessarily goes beyond the architectural definition of space. In planning the layout, furnishing, and enrichment of a space, the interior designer should be acutely aware of its architectural character as well as its potential for modification and enhancement. The design of interior spaces requires, therefore, an understanding of how they are formed by the building systems of *structure* and enclosure. With this understanding, the interior designer can effectively elect to work with, continue, or even offer a counterpoint to the essential qualities of an architectural space.

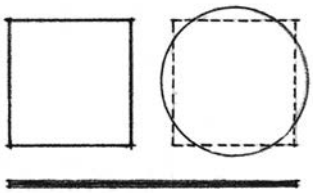




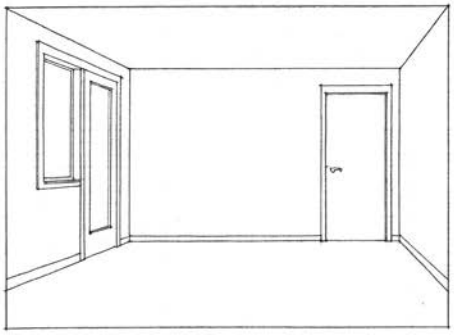
Continuation



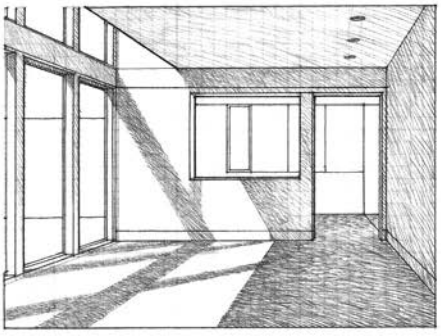
Contrast



Counterpoint



The basic shell



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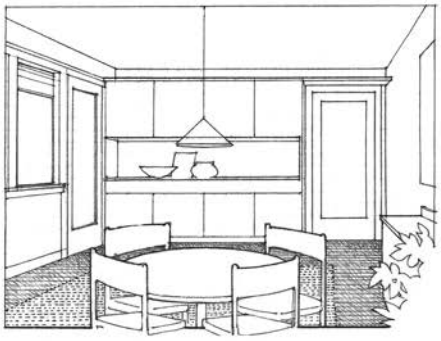
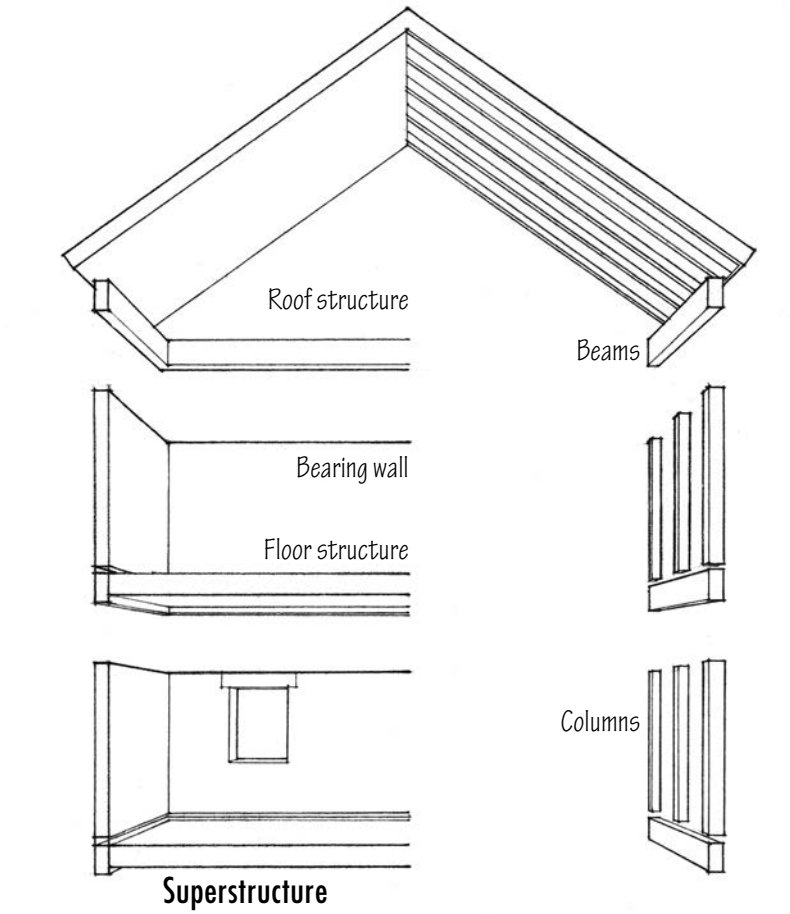
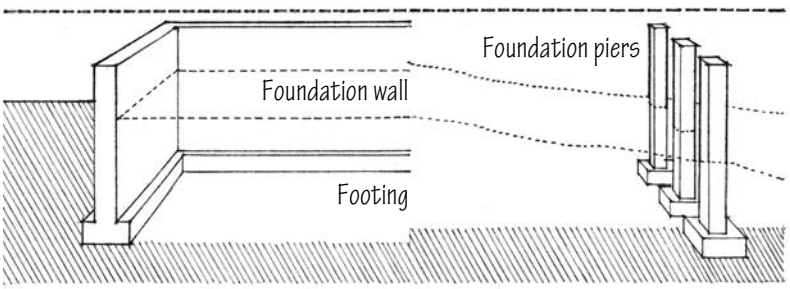


. . . or through interior design

Interior Space



Superstructure



Foundation

Buildings typically consist of physical systems of structure, enclosure, and building services equipment.

Structural Systems

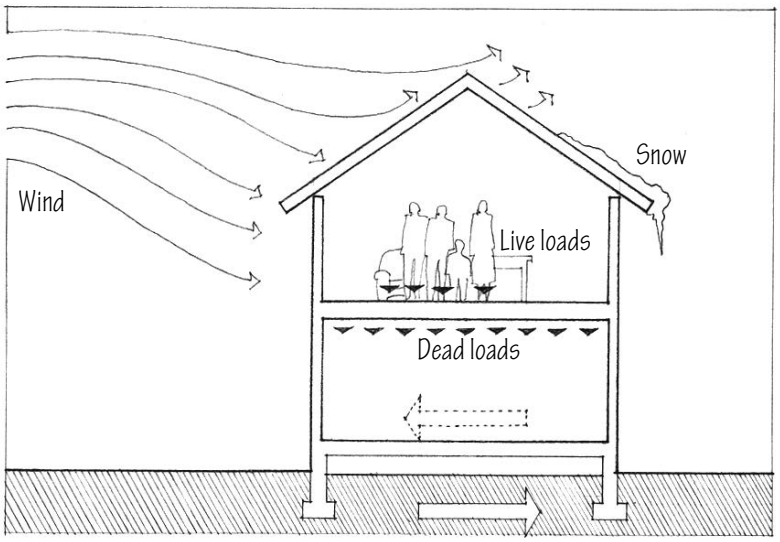
- The *superstructure* is the vertical extension of the foundation system and consists of the columns, beams, and load-bearing walls that support the floor and roof structures.
- The *foundation* system is the substructure that forms the base of a building, anchors it firmly to the ground, and supports the building elements and spaces above.

These systems must work together to support the following types of loads:

Dead Loads: How a building is constructed determines its dead load, which is a static vertical load comprising the weight of its structural and nonstructural components, including any equipment permanently attached to the structure.

Live Loads: How a building is used determines its live load, which is a movable or moving load comprising the weight of its occupants and any mobile equipment and furnishings. In cold climates, collected snow and water impose an additional live load on a building.

Dynamic Loads: Where a building is located determines its potential loading from the dynamic forces of wind and earthquake.



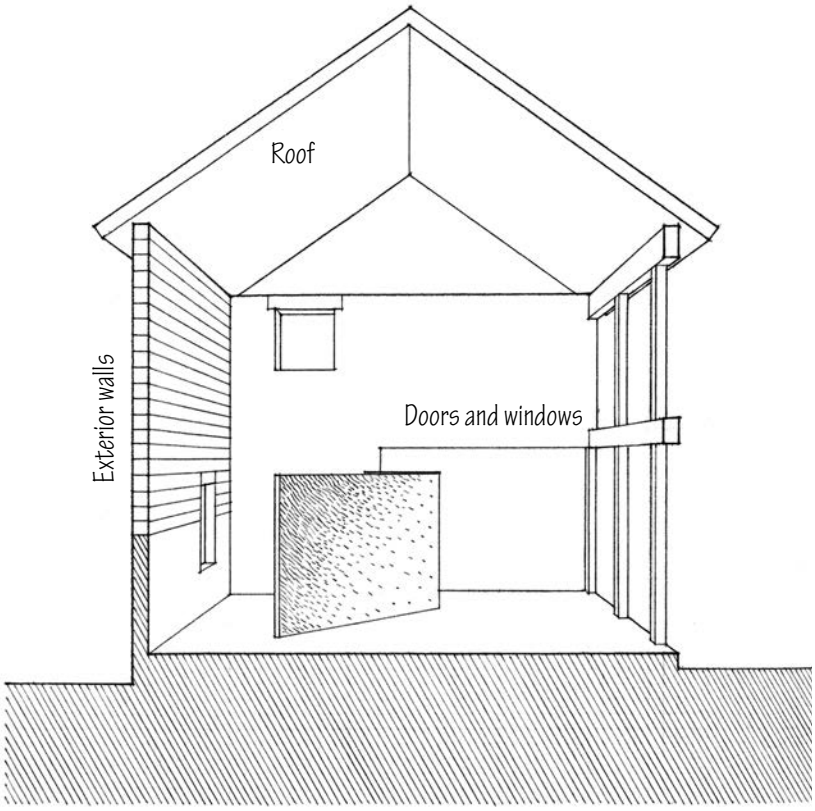
Building Loads

Enclosure System

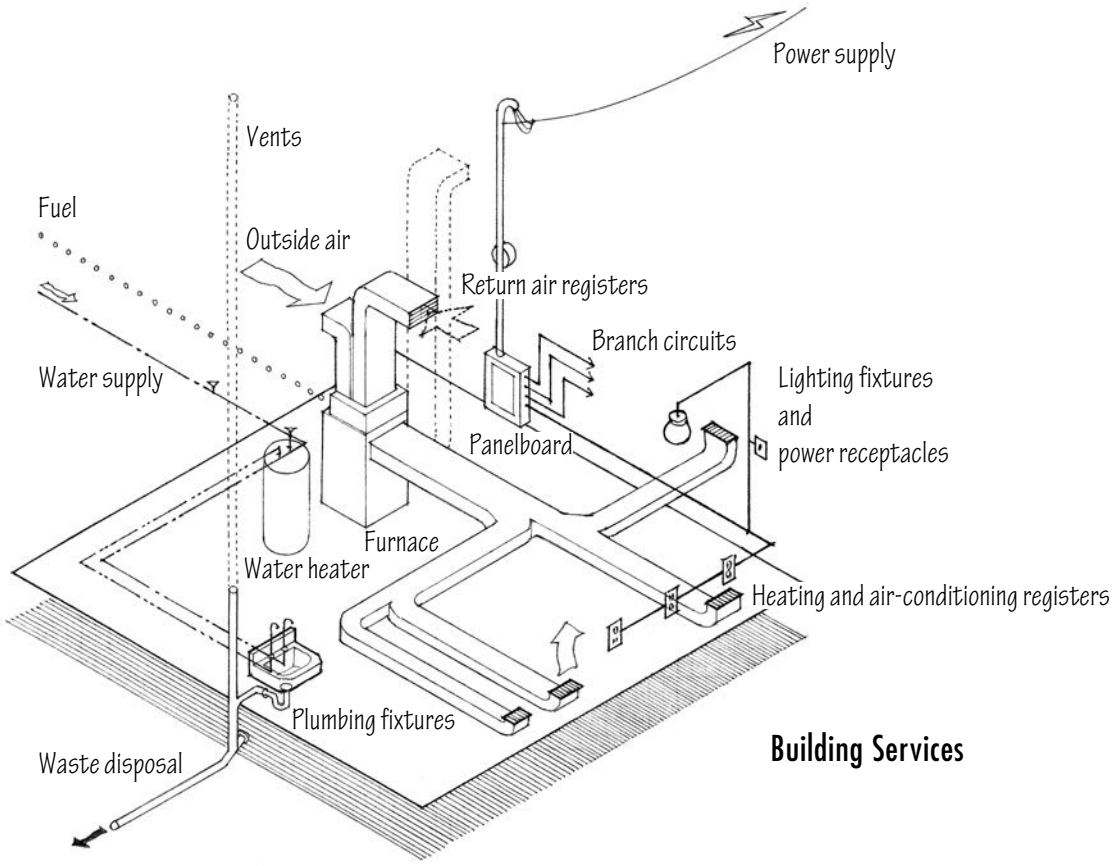
- The *building envelope* consists of exterior walls, windows, doors, and roof, which protect and shelter interior spaces from the exterior environment.
- Interior walls, partitions, and ceilings subdivide and define interior space. Many of these components are nonstructural in nature and carry no loads other than their own weight.

Building Services

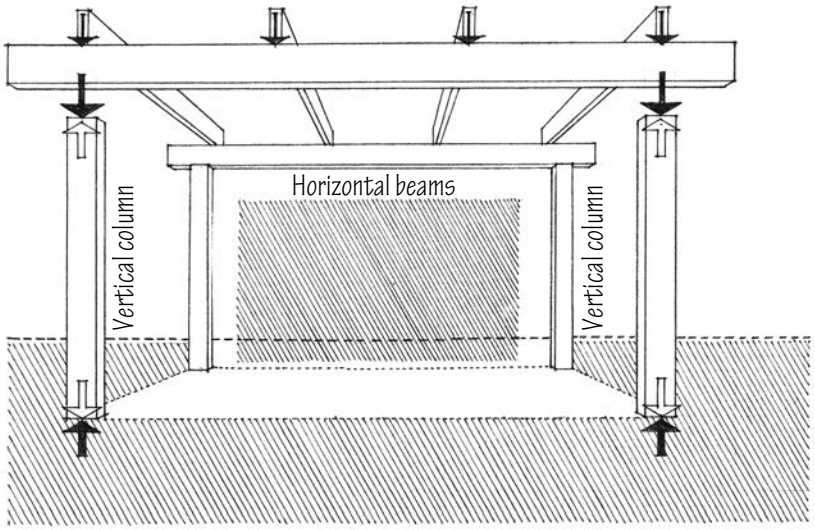
- Mechanical systems provide essential services to a building, such as the heating, ventilation, and air-conditioning of interior spaces.
- Plumbing systems supply water suitable for consumption and firefighting and dispose of sanitary waste.
- Electrical systems control and safely distribute power for lighting, equipment, security, communication, and vertical transportation.



Building Envelope



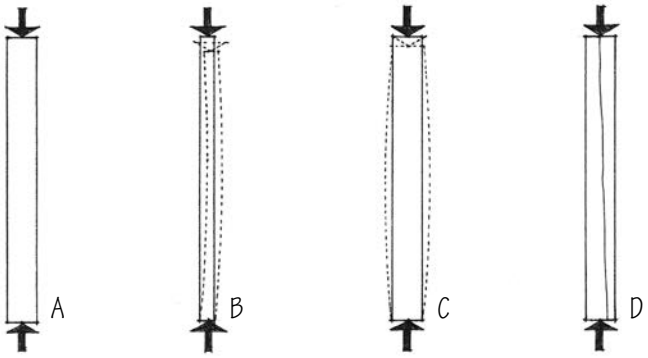
Building Services



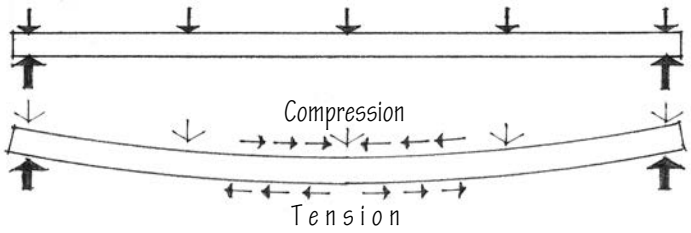
A building's structural system is formed according to the geometry of its materials and the way they react to the forces applied to them. This structural form and geometry, in turn, influence the dimensions, proportion, and arrangement of the interior spaces within the building volume.

The two basic linear structural elements are the column and the beam. A *column* is a vertical support that transmits compressive forces downward along its shaft. The thicker a column is in relation to its height, the greater its load-bearing capacity and its ability to resist buckling resulting from off-center loading or *lateral forces*.

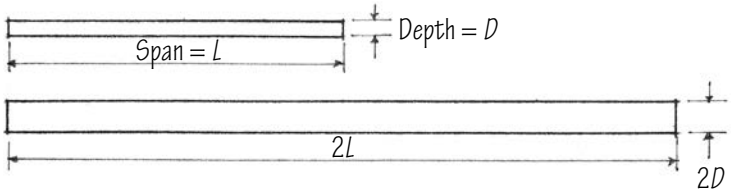
A *beam* is a horizontal member that transmits forces perpendicular to itself along its length to its supports. A beam is subject to bending and deflection, which result in an internal combination of compressive and tensile stresses. These stresses are proportionally greater along the upper and lower region of a beam's cross section. Increasing depth and placing material where stresses are greatest optimize a beam's performance.



A. Columns are subject to compression.
B. Slender columns are susceptible to buckling.
C. Thick columns may compress, or
D. In the case of timber or concrete, they may split or fracture.



Beams are subject to bending.

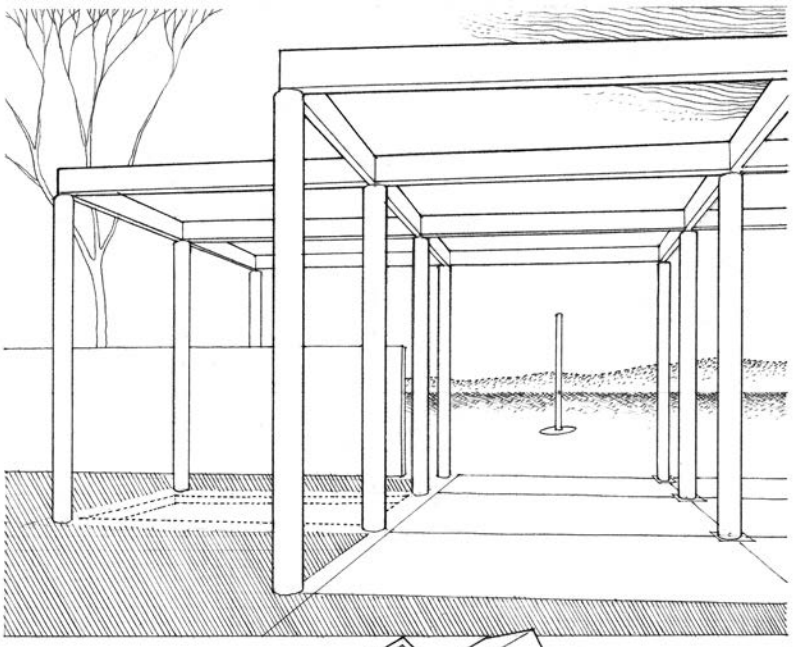


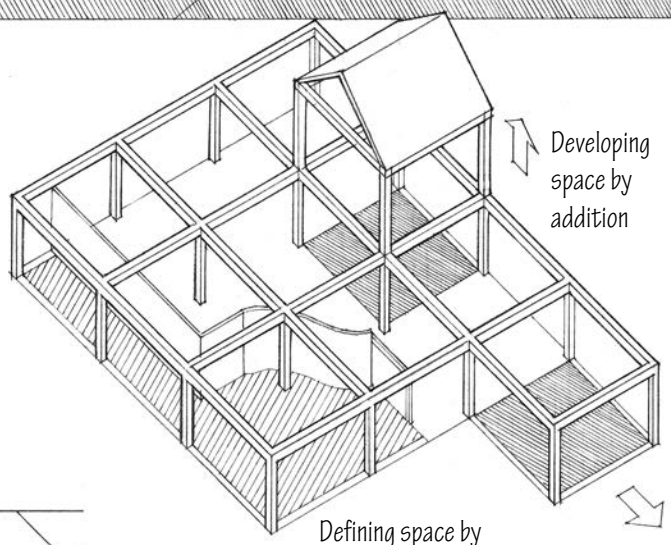
Increasing a beam's depth enables it to span greater distances.

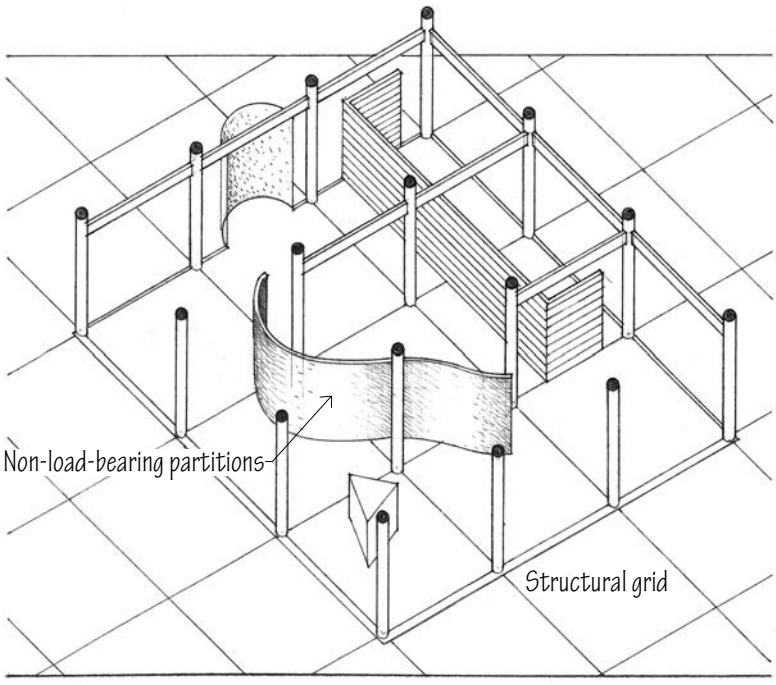
Columns mark points in space and provide a measure for its horizontal divisions. Beams make structural and visual connections across space between their supports. Together, columns and beams form a skeletal framework around interconnected volumes of space.

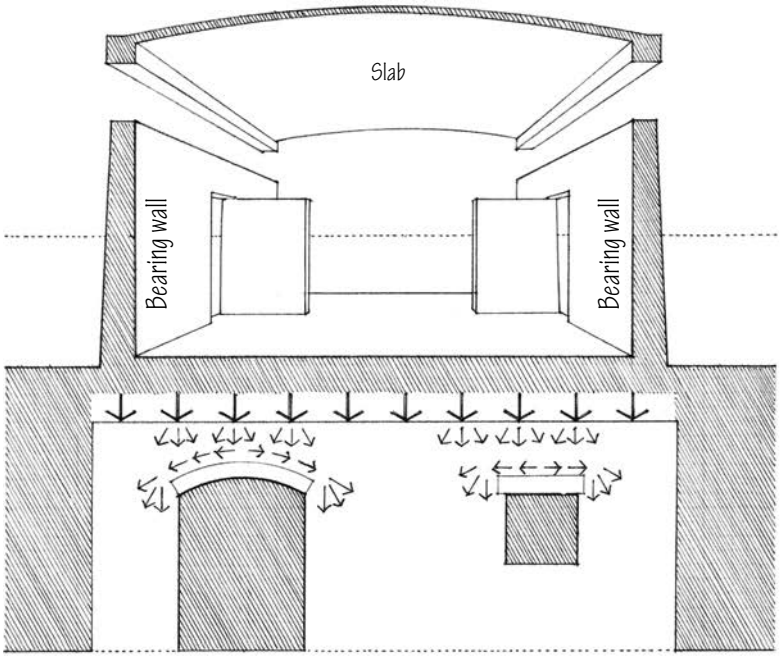
A linear structural system may suggest a grid layout of repetitive spaces, but floor, wall, and ceiling planes are necessary for the support and enclosure of interior space. Floor and ceiling planes, which define the vertical limits of space, may consist of planar *slabs* or a hierarchical arrangement of *girders* (large primary beams) and beams and *joists* (a series of smaller, parallel beams). Walls and partitions need not be load-bearing and do not have to be aligned with the columns of a structural frame, except where serving as *shear walls* and providing for lateral stability. They are free to define the horizontal dimensions of space according to need, desire, or circumstance.

Linear structural systems are cumulative by nature and eminently flexible. They allow for growth, change, and the adaptation of individual spaces to their specific uses.









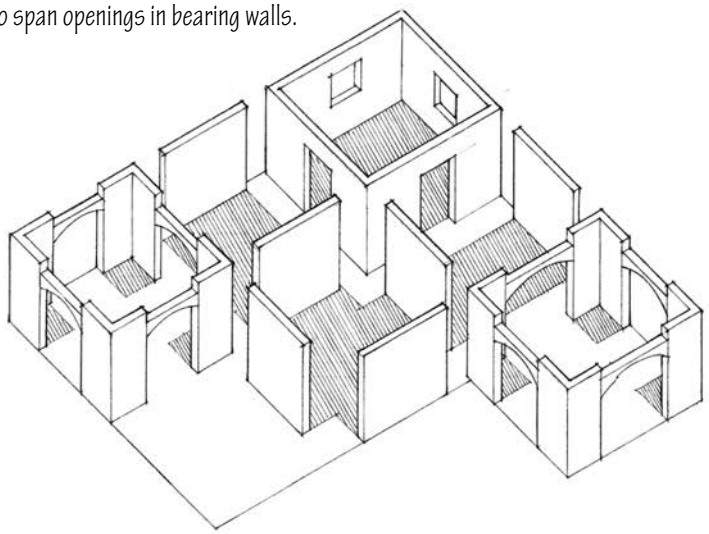
Small beams or lintels are required to span openings in bearing walls.

The two principal types of planar structural elements are the *load-bearing wall* and the horizontal slab. A bearing wall acts as a long, thin column in transmitting compressive forces to its support or foundation.

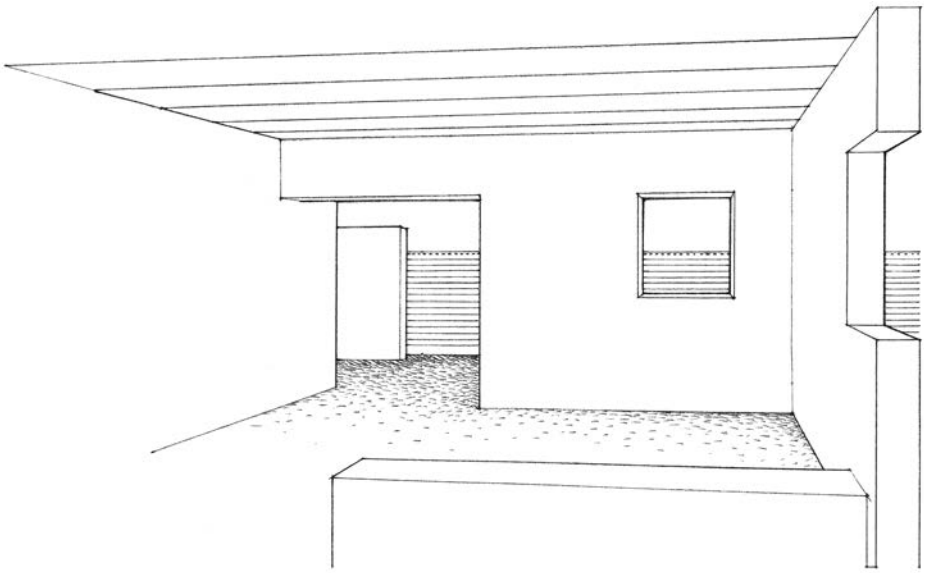
Window and door openings within a bearing wall tend to weaken its structural integrity. Any opening must be spanned by an arch or a short beam called a *lintel* to support the wall load above and allow compressive stresses to flow around the opening to adjacent sections of the wall.

A common pattern for bearing walls is a parallel layout spanned by floor joists and roof rafters, or by horizontal slabs. For lateral stability, *pilasters* and cross walls are often used to help brace bearing walls.

While linear structural elements outline the edges of spatial volumes, planar elements such as bearing walls define the physical limits of space. They provide a real sense of enclosure and privacy as well and serve as barriers against the elements.



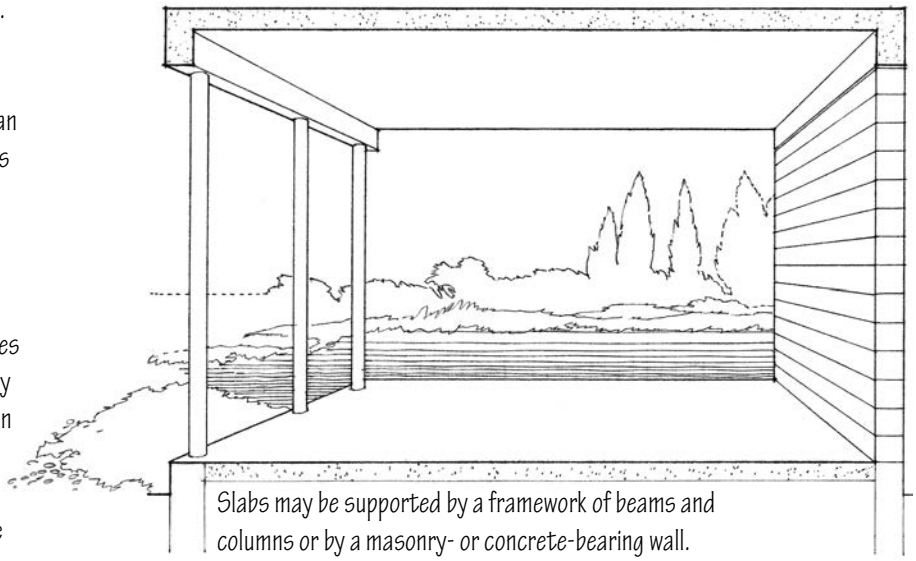
Varying degrees of spatial enclosure are possible with walls, depending on the size and location of openings within their planes.



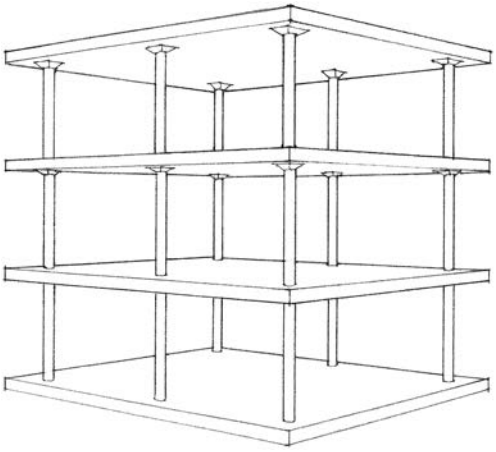
A slab is a horizontal, rigid, usually monolithic plate. A common example is a reinforced concrete slab. A slab is able to support both concentrated and distributed loads because the resulting stresses can fan out across the plane of the slab and take various paths to the slab supports.

When supported along two edges, a slab can be considered a wide, shallow beam extending in one direction. Supported along four sides, a slab becomes a two-way structural element. For greater efficiency and reduced weight, a slab can be modified in section to incorporate ribs.

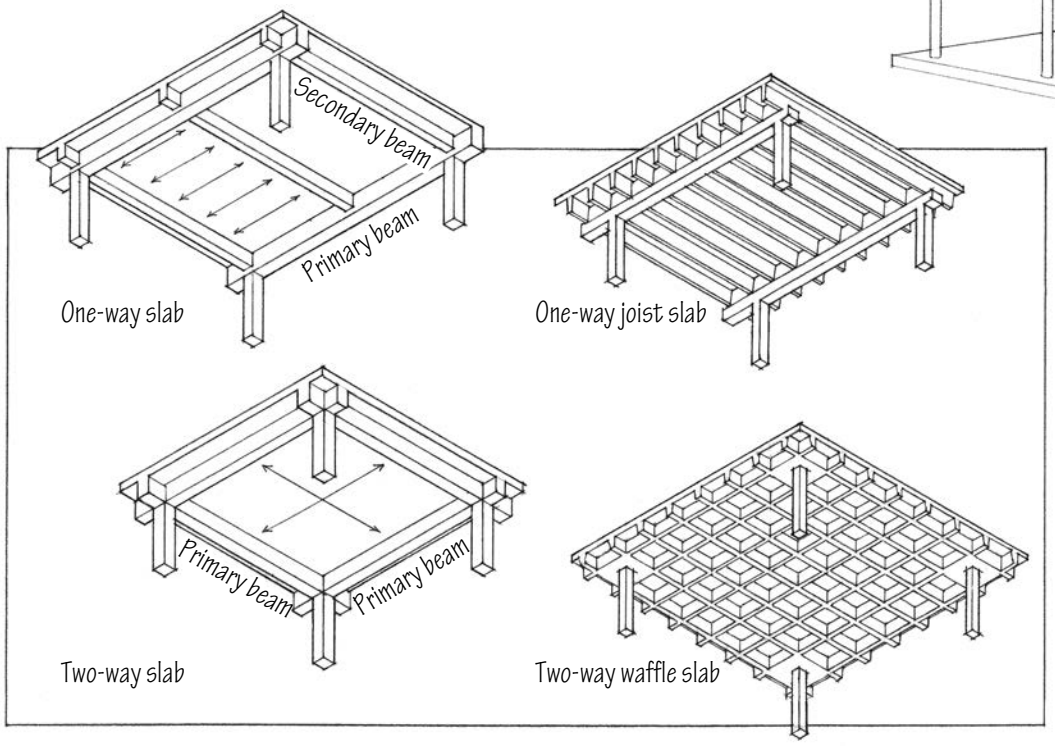
When integrally connected with reinforced concrete columns, flat slabs can be supported without beams. They form horizontal layers of space punctuated only by the shafts of the supporting columns.



Slabs may be supported by a framework of beams and columns or by a masonry- or concrete-bearing wall.

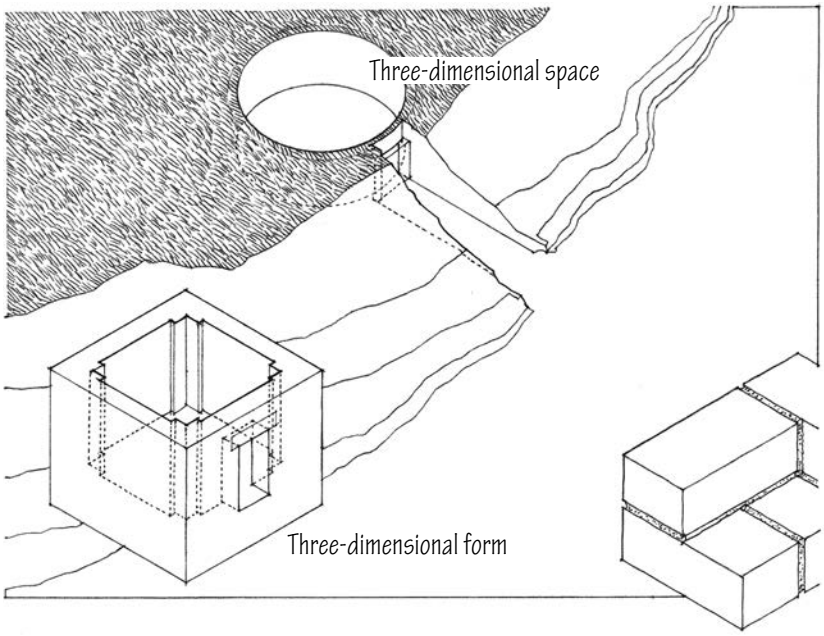


Two-way flat slabs thickened at their column supports define horizontal layers of space.

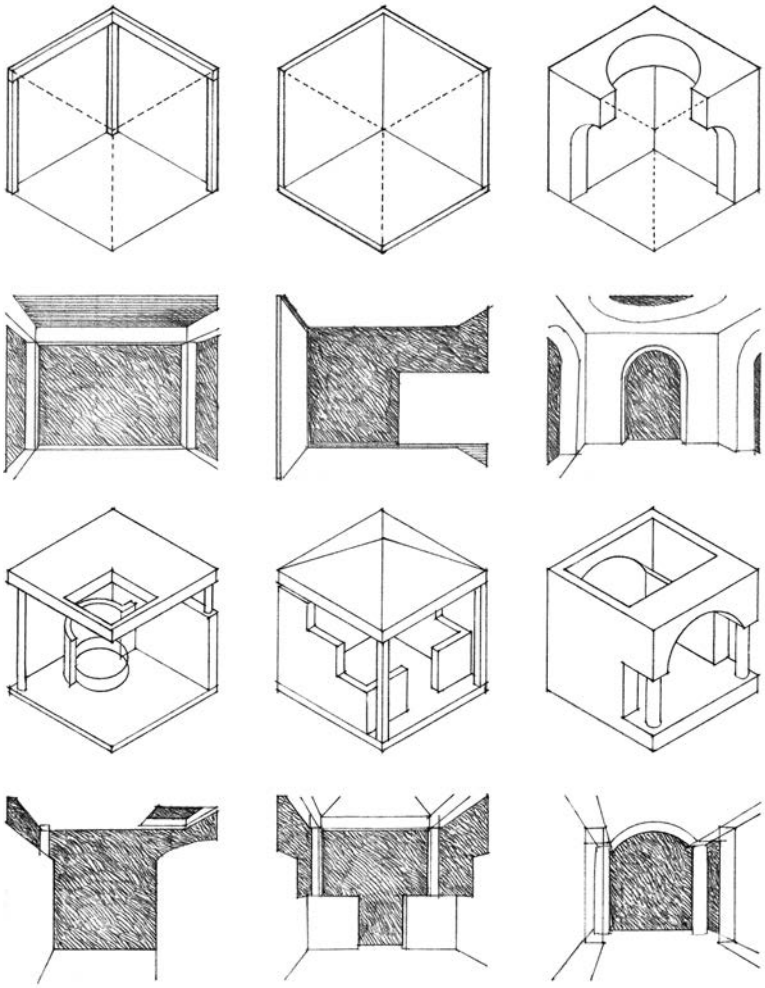


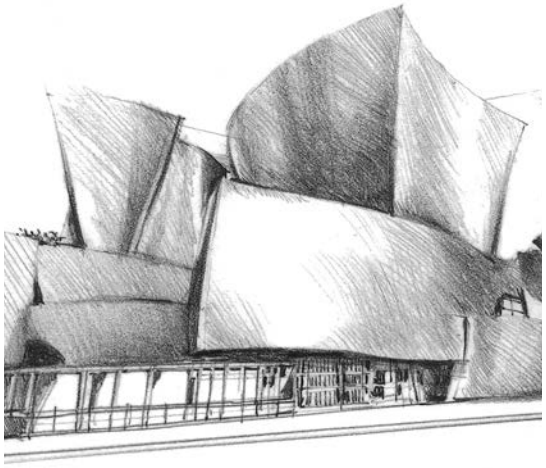
Types of Slabs

VOLUMETRIC STRUCTURAL SYSTEMS



A volumetric structural system consists of a three-dimensional mass. The mass of the material occupies the void of space. Out of the mass is carved the volume of interior space. The efficiency of engineering methods and the strength of modern building materials have limited the use of pure volumetric structural systems, although three-dimensional computer design is changing this. At a small scale, stone and clay masonry units can be seen to be volumetric structural elements. At a larger scale, any building that encloses interior space can be viewed as a three-dimensional structure that must have strength in width, length, and depth.

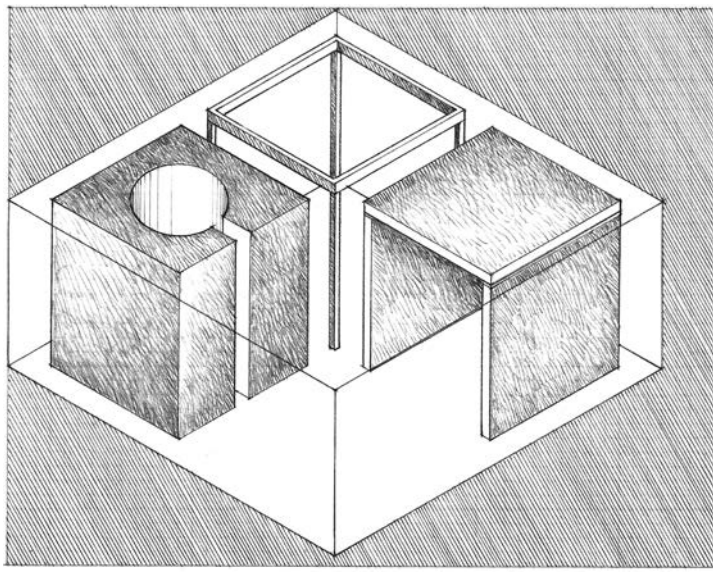


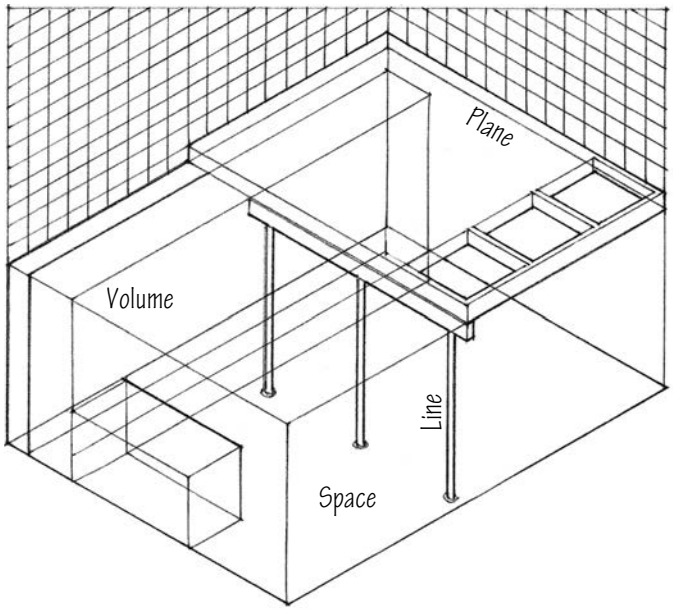


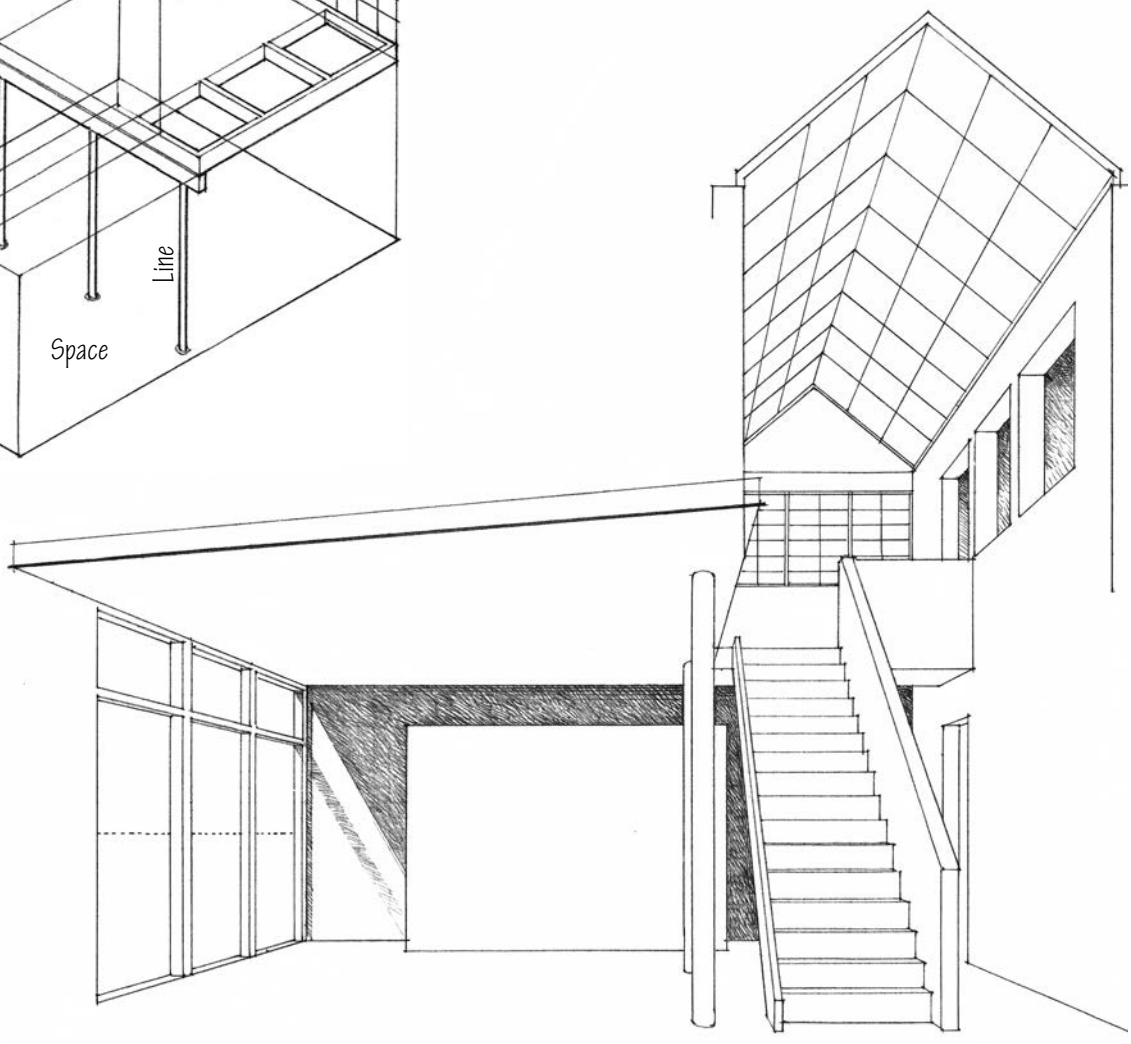
Walt Disney Concert Hall, Los Angeles, California,
Frank Gehry, 2003

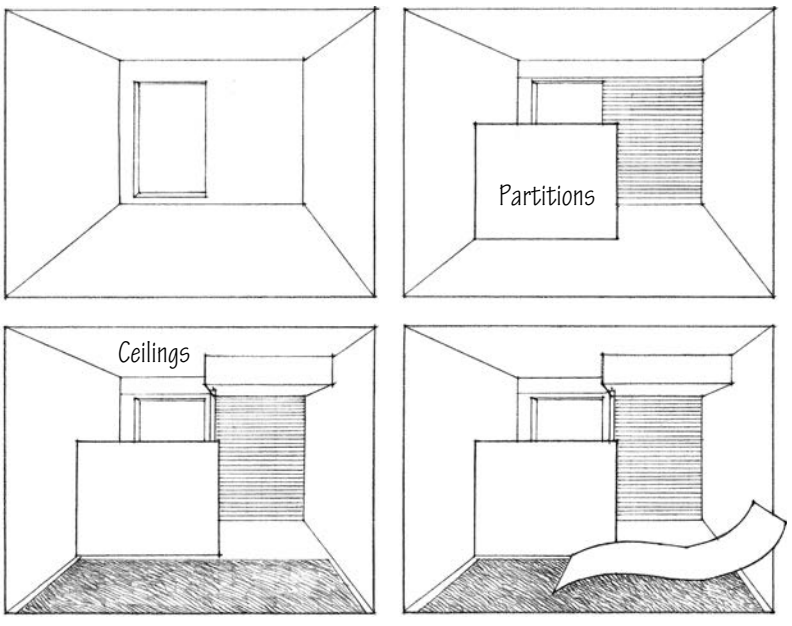
Composite systems combine linear, planar, and volumetric elements into three-dimensional compositions of form and space.

Most structural systems are in fact composites of linear, planar, and volumetric elements. No one system is superior to all others in all situations. For the structural designer, each presents advantages and disadvantages, depending on the size, location, and intended use of a building. An interior designer should be aware of the character of the interior spaces each system defines.





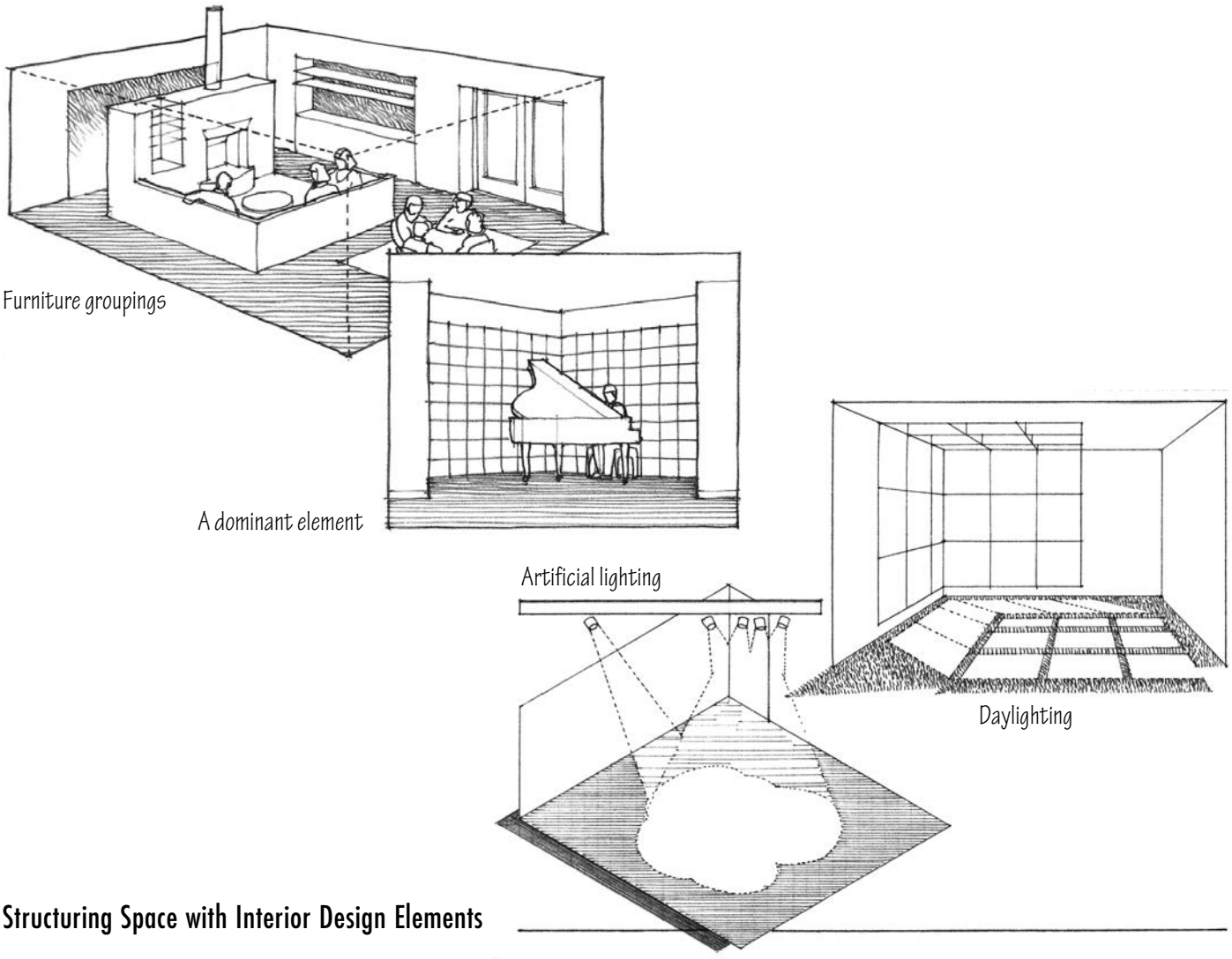




Although a building's structural system sets up the basic form and pattern of its interior spaces, these spaces are ultimately structured by the elements of interior design. The term "structure" is not used here in the sense of physical support. It refers to the selection and arrangement of interior elements such that their visual relationships define and organize the interior space of a room.

Non-load-bearing partitions and suspended ceilings are often used to define or modify space within the structural framework or shell of a building.

The color, *texture*, and pattern of wall, floor, and ceiling surfaces affect our perception of their relative positions in space and our awareness of the room's dimensions, scale, and proportion.



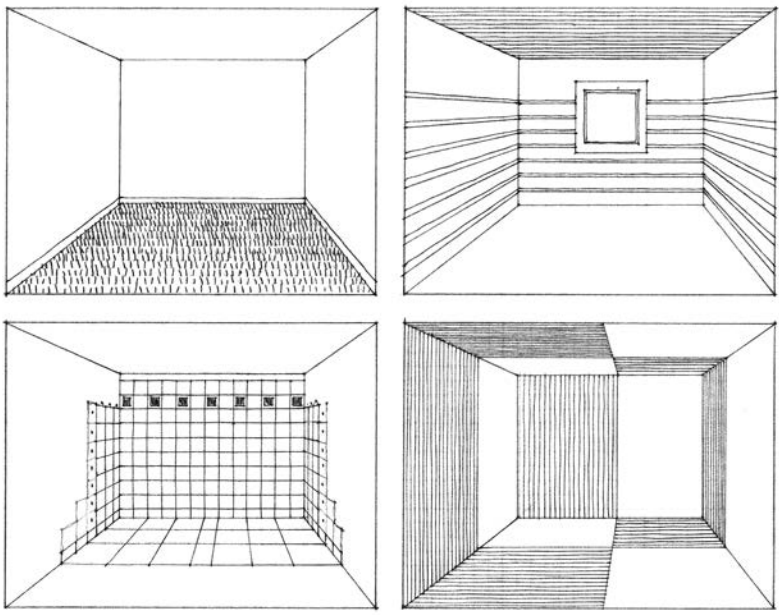
Structuring Space with Interior Design Elements

Within a large space, the form and arrangement of furnishings can divide areas, provide a sense of enclosure, and define spatial patterns.

Lighting, and the light and dark patterns it creates, can call our attention to one area of a room, deemphasize others, and thereby create divisions of space.

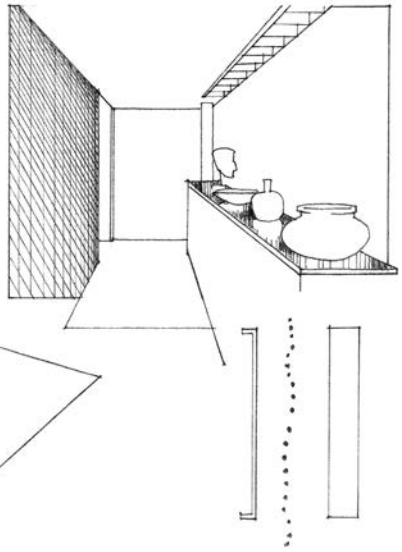
Even the acoustic nature of a room's surfaces can affect the apparent boundaries of a space. Soft, absorbent surfaces muffle sounds and can diminish our awareness of the physical dimensions of a room. Hard surfaces that reflect sounds within a room help to define its physical boundaries. Echoes can suggest a large volume.

Finally, space is structured by the way we use it. The nature of our activities and the rituals we develop in performing them influence how we plan, arrange, and organize interior space.

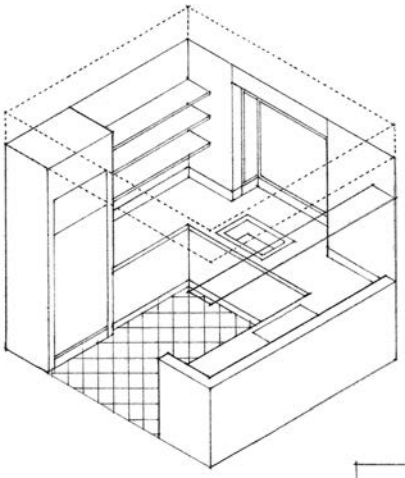


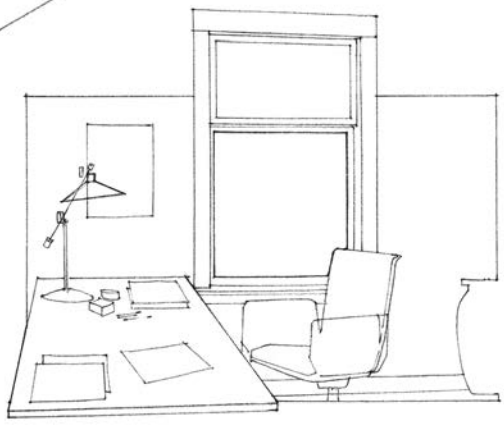
Color, texture, and pattern

Communication

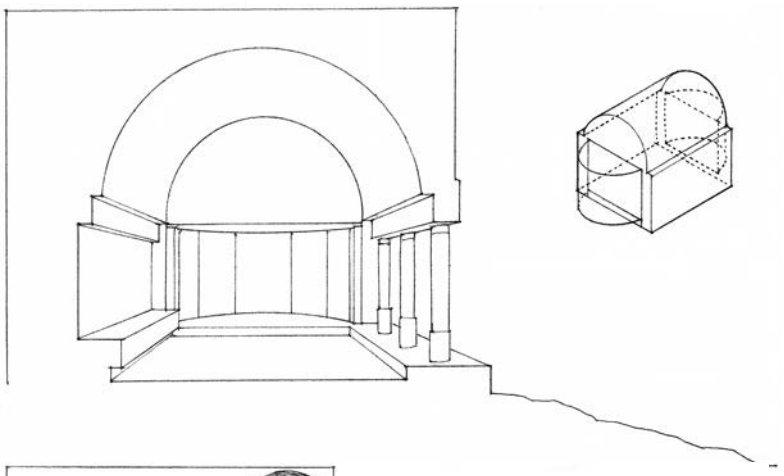


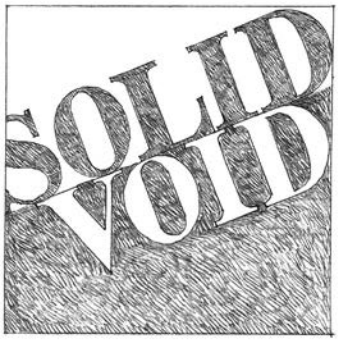
Movement

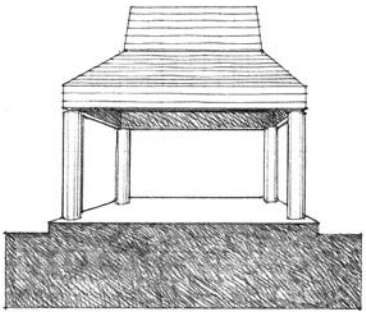


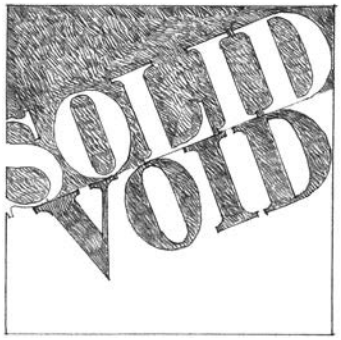


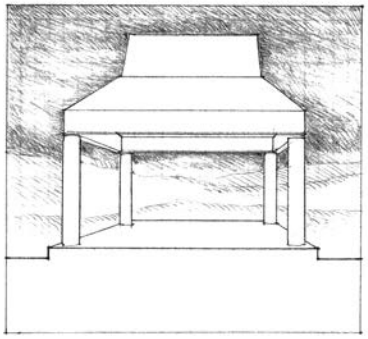
Individual and group activities

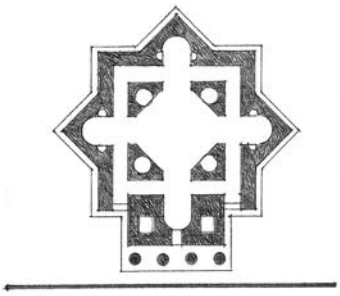


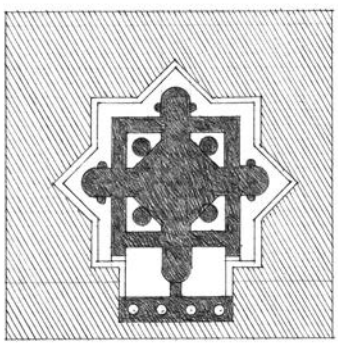


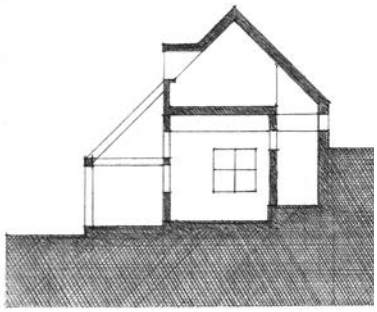












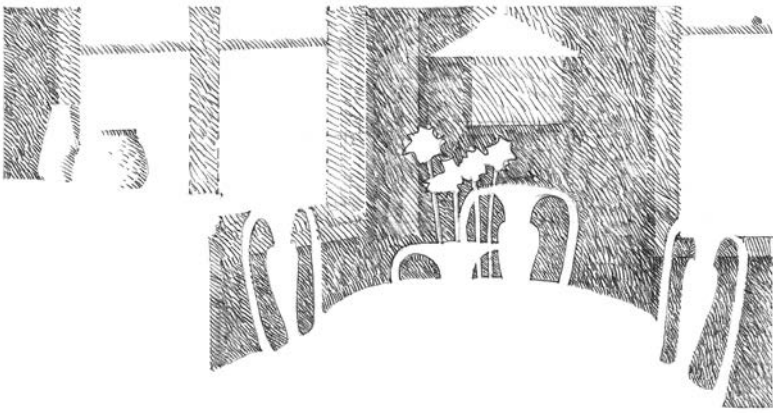
Interior spaces are formed first by a building's structural system, further defined by wall and ceiling planes, and related to other spaces by windows and doorways. Every building has a recognizable pattern of these elements and systems. Each pattern has an inherent geometry that molds or carves out a volume of space into its likeness.

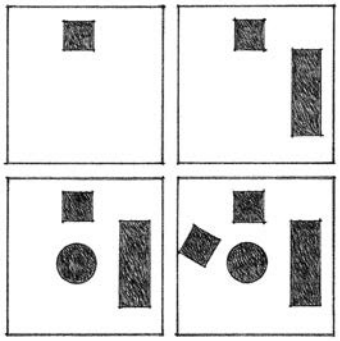
It is useful to be able to read this *figure-ground* relationship between the form of space-defining elements and that of the space defined. Either the structure or the space can dominate this relationship. Whichever appears to dominate, we should be able to perceive the other as an equal partner in the relationship.

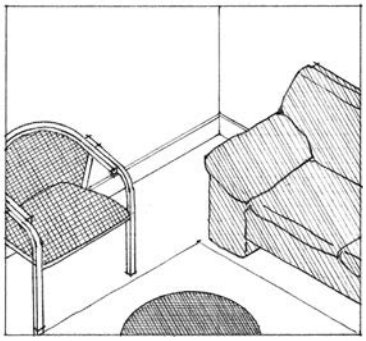
It is equally useful to see the alternating figure-ground dominance occurring as interior design elements, such as tables and chairs, are introduced and arranged within an interior space.

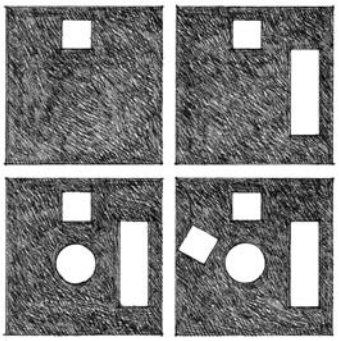
When a chair is placed in a room, it not only occupies space, it also creates a spatial relationship between itself and the surrounding enclosure. We should see more than the form of the chair. We should also recognize the form of the space surrounding the chair after it has filled some of the void.

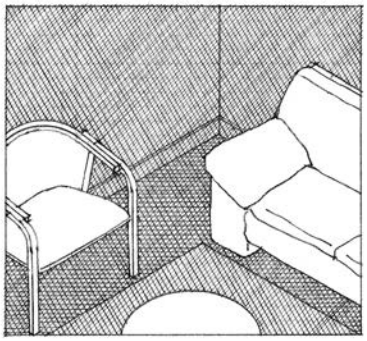
As more elements are introduced into the pattern, the spatial relationships multiply. The elements begin to organize into sets or groups, each of which not only occupies space but also defines and articulates the spatial form.

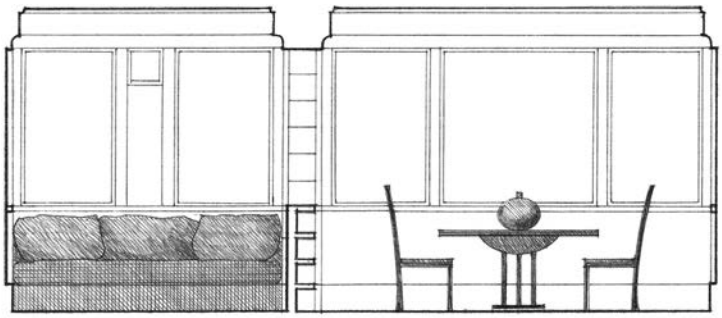


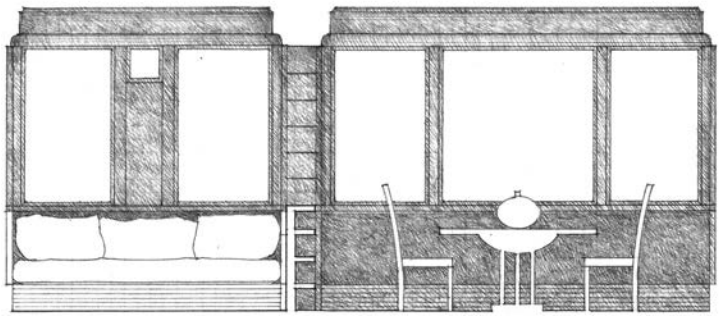


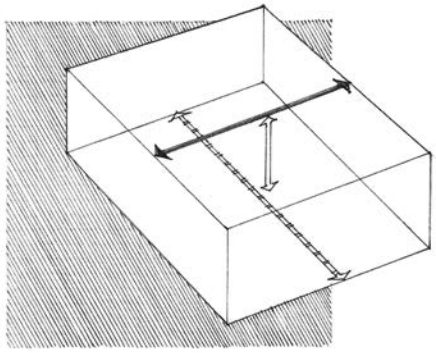


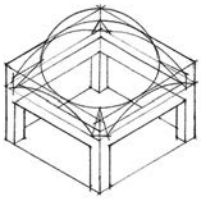


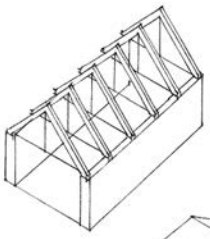


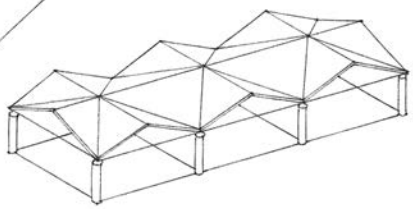


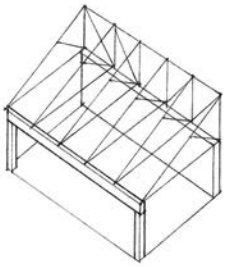


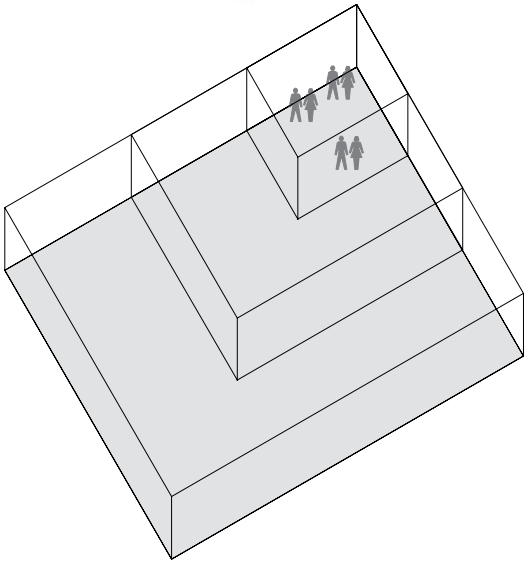










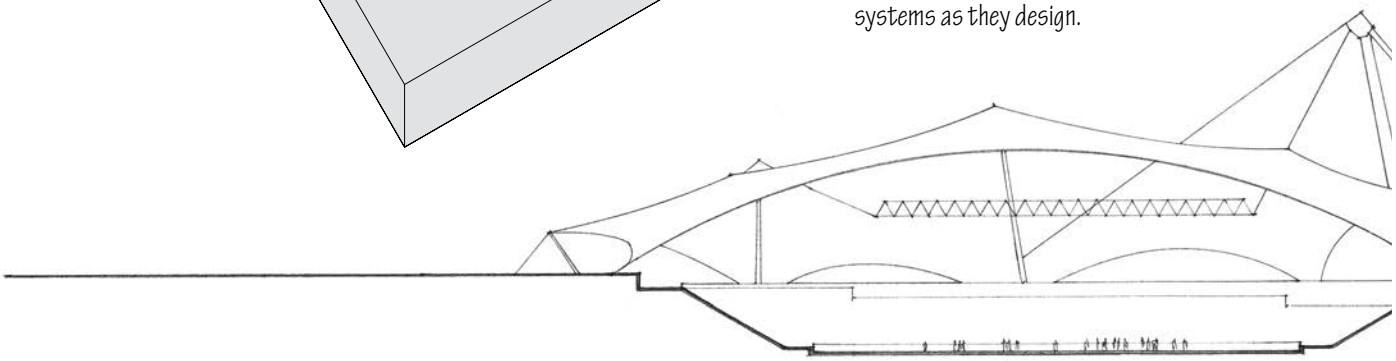


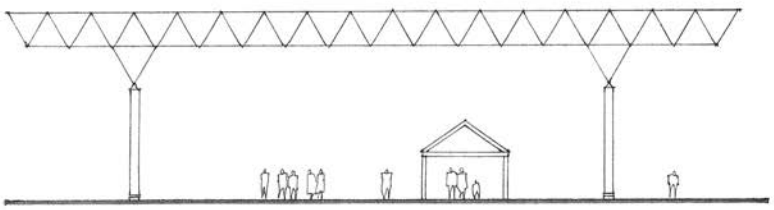
The dimensions of interior space, like spatial form, are directly related to the nature of a building's structural system—the strength of its materials and the size and spacing of its members. The dimensions of a space, in turn, determine a room's proportion and scale and influence the way it is used.

One horizontal dimension of space, its width, has traditionally been limited by the materials and techniques used to span it. Today, given the necessary economic resources, almost any architectural structure is technically possible. Wood or steel beams and concrete slabs can span up to 30 feet (9 m). Wood or steel trusses can span even farther, up to 100 feet (30 m) or more. Longer roof spans are possible with space frames and a variety of curved structures, such as domes, suspension systems, and membranes supported by air pressure.

Within the bounds of structural necessity, the width of an interior space should be established by the requirements of those who use the space and their need to set boundaries for themselves and their activities.

Building designers have traditionally developed spatial relationships by sketching and model building. *Computer-aided design (CAD)* and *building information management (BIM)* software systems are changing the way that building designers work. These computer technologies allow designers to build interactive three-dimensional computer models of buildings, and to coordinate building systems as they design.

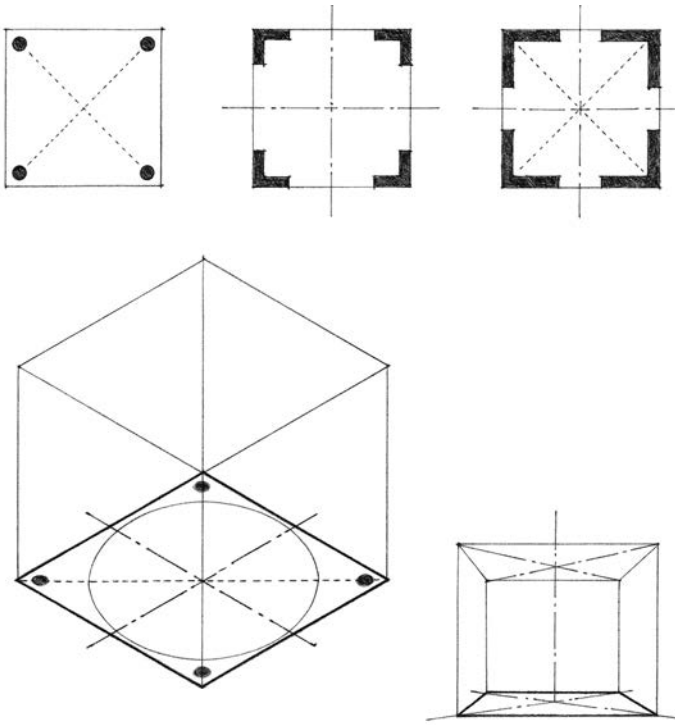


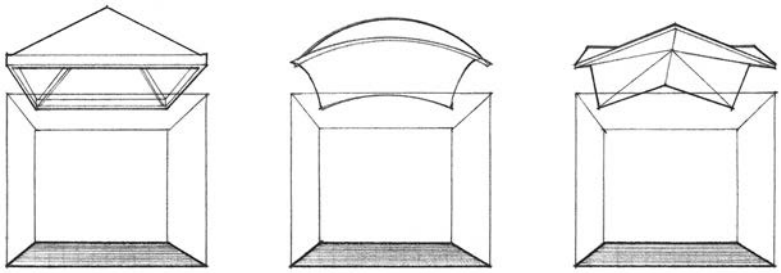


The other horizontal dimension of space, its length, is limited by desire and circumstance. Together with width, the length of a space determines the proportion of a room's plan shape.

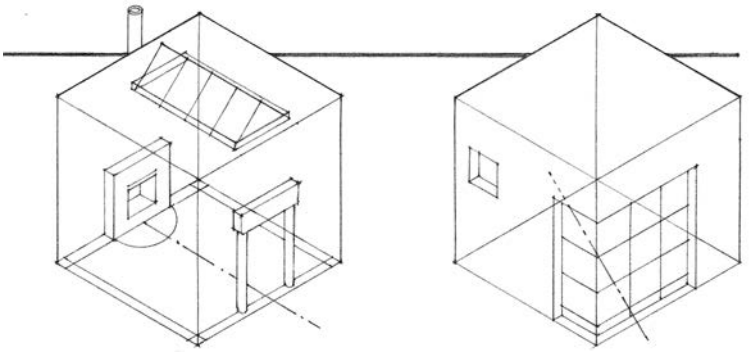
A square room, where the length of the space equals its width, is static in quality and often formal in character. The equality of the four sides focuses our attention in on the room's center. This centrality can be enhanced or emphasized by covering the space with a pyramidal or dome structure.

To deemphasize the centrality of a square room, the form of the ceiling can be made asymmetrical, or one or more of the wall planes can be treated differently from the others.

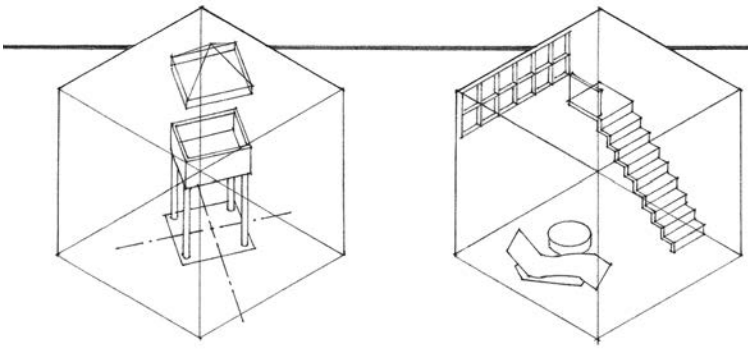




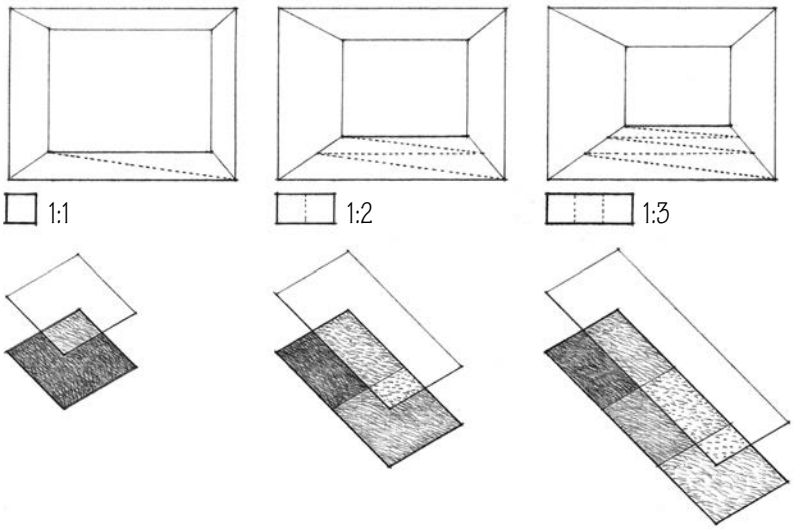
Pyramids, domes, and similar roof forms can emphasize the centrality of square spaces.



The placement of architectural elements, such as windows and stairways, can deemphasize the centrality of square spaces.



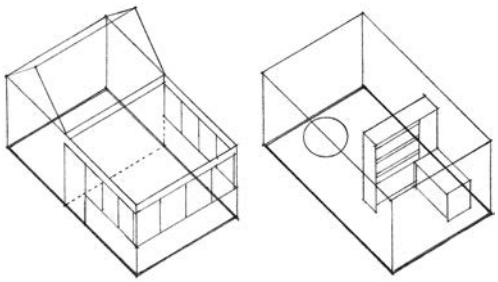
RECTANGULAR SPACES



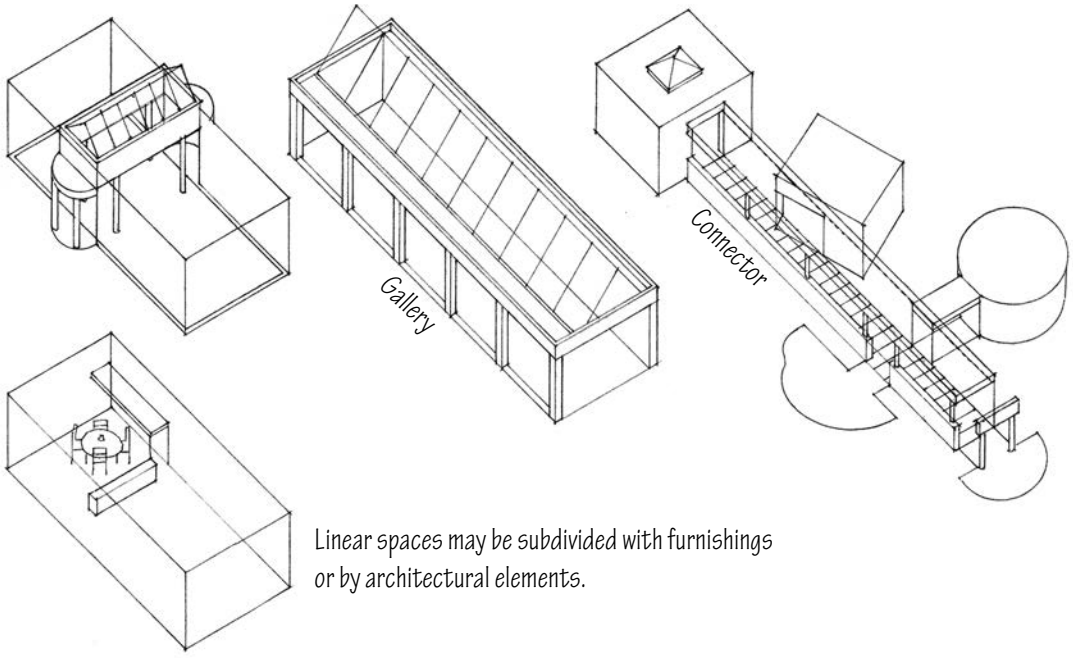
Square rooms are rare and distinctive. More often, a room will have a length greater than its width. A rectangular space, normally spanned across its width, is eminently flexible. Its character and usefulness are determined not only by its proportion of width to length, but also by the configuration of its ceiling, the pattern of its windows and doorways, and its relationship to adjacent spaces.

When the length of a space is greater than twice its width, it tends to dominate and control the room's layout and use. Given sufficient width, the space can be divided into a number of separate but related areas.

A space whose length greatly exceeds its width encourages movement along its long dimension. This characteristic of linear spaces makes them suitable for use as gallery spaces or as connectors of other spaces.



Horizontal dimensions alone do not determine the ultimate qualities and usefulness of a space. They only suggest opportunities for development.



Linear spaces may be subdivided with furnishings or by architectural elements.