Structure and Materials

1. Shell
   Single building material provides:
   structural support & outer covering.
   Common materials: brick, stone and wood
   (log cabin).

2. Skeleton & Skin
   Skeleton: Frame -- wood, iron, steel
   Skin: Lt. weight: wood, shingles, aluminum, glass
   Balloon Frame
   Early sarcastic term-- structure might blow away.

   Post and lintel or post and beam. 4000 years old
   Two upright posts and horizontal cross piece.
   Posts carry weight to ground
   Common materials: stone and wood

Materials Considerations

1. Compression Strength
   Weight of entire building must be carried safely to ground.

2. Tensile Strength
   Ability to span horizontal distance, with minimum support.
   Tensile Strength: Steel best, then wood, then stone.

Iron
   Mid-19th century used for architecture
   Weight and mass no longer dictated esthetics
   Crystal Palace
   First English skeleton and skin architecture.
   Iron and glass.
   Built for international arts exposition.
   Eiffel Tower
   Built to publicize Paris World Exposition.
   A system of trusses.
   Tallest man-made structure until Chrysler building.

Arch
   2nd century B.C.E. Roman
   Root of the word architecture.
   Semi circle
   Arch requires considerable side support to stand.
   Incorporates complex forces:  
     Tension -- pulling apart
     Compression pushing together
   Advantages of arch:
   permits opening of large spaces in a wall
   covers long spans safely and economically
   reduces amount of material used

   Vault -- barrel vault or tunnel vault
   Many arches placed flush, one behind the other.
   Known as Romanesque architecture.
   Many cathedrals constructed in this way.
   Disadvantages of arch/vault:
   Height is limited by width of arch
   Weight & darkness -- visual and literal

Gothic Arch (pointed)
   Advantages:
   Weight is channeled down to the ground.
   Vaults made with this type of arch can be taller.
   Permitted addition of large windows.
   Columns could be made thinner & more decorative.

   Flying Buttress:
   Ribs to support side of Gothic structures

Dome
   An arch rotated 360 degrees on axis.
   Stresses like arch -- pushes outward
   Requires exterior support

Truss (triangle)
   Most resistant to stress.
   Supports considerable load over a large span.

Cantilever
   Beam supported at one end, unsupported at opposite end.
   Used when clear space is required below.
   Steel or reinforced concrete

Suspension Architecture
   One of the oldest engineering forms.
   Cables support weight, strung from vertical pylons.
   Road bed rises and falls (wind and traffic).
   Advantages:
   Economical, allows spans over water.
   Early Problems:
   Stability -- wind forces, storms, heavy snows
   John Roebling
   Masterpiece -- Brooklyn Bridge (1869-83)
   Credit for solving early suspension structure problems.

   Tacoma Narrows Bridge (Galloping Gertie)
   Collapsed four months after opening.

Geodesic Dome
   1947 Buckminster Fuller
   Only structural support attributed to single person.
   Series of triangular rods -- based on truss.
   Not noted until ’67 World’s Fair
   Advantages:
   Economical
   Lightweight material: glass, plastic, wood
   Requires no interior support
   Quickly assembled -- modular

Classical Architecture
   Greek and Roman architecture
   Parthenon, Athens
   Post & lintel construction. Doric style columns.
   Refined version of this type of architecture.
   Perfect proportions width to length.
   Few straight lines:
     Steps arch in middle.
     Columns bulge in middle (entasis).
     Facade is tilted back (slightly).
     Corner columns thicker.

   Pantheon, Rome
   Use of dome.
   No interior supports.
   Oculus -- opening in center of dome for light.

Neoclassical or Classical Revival
   Based on classical design
   Classical details are ornamental, not structural.

   Thomas Jefferson:
   Virginia State Capitol
   Univ. of Virginia, library rotunda
   (modeled after Pantheon)
   Monticello, Virginia  Jefferson's home.

Arts and Crafts
   began England, mid 1800's
   Reaction to poor quality designs of Industrial Revolution.
   Aim to make objects once again beautiful.

   Greene and Greene (brothers)
   Residential -- pioneered California bungalow.
   Low-pitched roofs.
   Broad, overhanging eaves for shade.
   Extended rafters, decorative effect.
   Sleeping porches.
   Fine wood & joinery prominent.
   Asian, primarily Japanese influences.
Art Nouveau 1895 (until WW I)  
European centered: Spain, France, Germany, Italy  
Hector Guimard -- Paris metro stations  
Victor Horta -- Brussels  
Continuation of Arts and Crafts  
Materials: metal castings, iron, glass, ceramic, concrete  
Stylized forms: curvilinear, S shapes, sinuous flowing lines and whiplash styles, plants, floral.  

Victorian  
American period, late 1800’s  
Decorated box.  
Arches, columns, and brackets  
often decorative, rather than structural.  
Mail order plans and architectural ornaments.  
Largest U.S concentration: San Francisco  
due to:  
Most of city built second half of 1800's.  
Long narrow lots (more space with height).  

Art Deco  
Exposition of Decorative Arts, Paris 1925  
American Deco examples:  
Empire State Building  
Chrysler Building, 1930  
Financing -- success of automobile industry  
Art Deco two styles:  
1. Zig Zag 20’s  
Ornamentation: Repetitive patterns: chevrons, sunbursts, zig zags, cubes & angles  
Flourished in cities /skyscrapers.  
Inspiration: Native American, Africa,  
Materials: steel, bronze, glass, ebony, ivory chrome.  
2. Streamline or Modern 30’s  
Coincided with depression.  
Less expensive materials and craftsmanship.  
Abandoned ornamentation.  
Smooth walls, rounded edges, circular windows.  

Frank Lloyd Wright 1867 - 1959  
“Organic Architecture”  
Buildings harmonize with environment.  
Earthy colors, ornamental detail  
Imperial Hotel Tokyo  
Survived 1923 earth quake  
Johnson Wax Racine Wisconsin  
Wright’s first significant use of curves.  
Large open office plan.  
Controversial:  
Thin column supports -- mushroom shape  
Guggenheim Museum - New York  
Dedicated to abstract art  
Materials: Coils of unadorned white concrete.  
Open center space lighted by glass dome.  
Idea of a continuous space --spiral ramp, 6 stories.  
Marin County Civic Center  
Wright’s only work for government.  
Integrates architecture, highway, and automobile.  
Robie House  
Most famous Prairie House.  
Ribbon windows, gently sloping roofs.  
Dominant horizontal lines.  
Heavy-set chimneys and overhangs.  
Designed outward from fireplace  
Designed furniture for homes, even some dishes.  
Generally two-story with single-story wings.  
Rooms flow together in uninterrupted space  

Wright (cont.)  
Falling Water -- Kaufman House  
Wright’s most famous residential structure.  
Cantilever construction anchored in rock.  
Materials:  
Vertical elements constructed of native stone.  
Horizontal elements poured concrete.  
Floors throughout paved in stone  
Taliesin, Wisconsin  
Wright’s own home, burned twice.  
Taliesin West Arizona.  
Winter home for Wright & students.  

Modern Architecture  
Later called International Style.  
Design Characteristics:  
Use of modern materials.  
Importance of building not related to decoration.  
Striped of applied ornamentation  
No historic reference  
Rectilinear forms  
Light color plain surfaces.  
Open interior spaces -- visually weightless quality  
Materials: Reinforced concrete, glass & steel.  

Bauhaus  
1919-33, Germany  
Art and architecture school, with housing  
Walter Gropius and Mies Van Der Rohe, directors  
Birthplace of Modern Movement  
Most influential design school.  
Integration of art and technology.  
1933 Nazis close school.  

Walter Gropius  
Bauhaus director  
Modern Architecture  
Pioneer of steel frame in architecture  
Prefabrication of parts and assembly on the site.  
Interested in: economy & functionalism,  
mass production.  
Glass Curtain Wall  
Bauhaus Dessau, Germany  
Supporting structure (steel)  
Skin (glass & stucco).  
Fagus Shoe - First large building.  
Pan American Building  
Unpopular with public.  
59 floors, blocks view down Park Avenue.  
Reduced bulk by cutting the four corners.  
Shape resembles wing (Pan American Airways.)  

Mies Van Der Rohe  
2nd Bauhaus Director  
Less is more = maximum effect from minimum use of form.  
Exposed metal structure, glass curtain wall.  
Used more highly finished materials than Gropius.  

German Pavilion (aka Barcelona Pavilion):  
International Exposition in Barcelona.  
Materials: travertine, marble, chrome onyx & glass.  
Farnsworth House  
Open simple floor plan -- glass house.  
Pure and weightless form.  
Eight steel beams and two deck slabs.  
Rectangular sheets of glass.  
Expressed ideals of the Modern Style.
Mies (cont.)
Seagram’s Building New York, Park Avenue
Model for skyscrapers and corporate America.
Steel frame, glass curtain wall.
Large granite-paved plaza.
Bronze exterior “columns”
Collaboration with Philip Johnson

Le Corbusier (Corbu -- Charles Edward Jeanneret)
Public considered his work too extreme.
“House a machine for living.”
Reinforced concrete.
Free-flowing designs with curves.
Ribbon windows -- strips running from wall to wall

Villa Savoy, France
One of the most famous Modern houses.
Disliked by owners and left abandoned.
Ground floor has a curved facade.

Unite de Habitation, Marseilles France
Twelve-story apartment block for 1,600 people
Alleviated severe postwar housing shortage.
Concrete grid, slotted precast apartments.
23 different configurations
Double-height living rooms
Deep balconies

Ronchamp or Notre Dame de Haute Chapel.
Away from machine look, more organic.
Walls are pierced with irregular small openings:
small on outside, widening on inside of thick walls
Roof not supported by walls
(vertical supports inside walls)
4” space between roof and walls admits light
Reinforced concrete & rubble of destroyed church
which chapel replaced (WWII)

Bernard Maybeck
Bay Area Architect, faculty U.C. Berkeley
Favorite materials and techniques:
native wood, hand-crafted details
materials associated with factories:
exposed concrete, factory windows
Important structures:
First Church of Christ, Berkeley
Palace of Fine Arts San Francisco (rebuilt in 60’s)
for Panama-Pacific Exposition (1915)
Neoclassical Theme Roman ruin - Greek ornament
Lost many structures in 2 different fires (1923,1991)

Julia Morgan
Studied with Bernard Maybeck
First woman:
enrolled in École des Beaux-Arts. Paris
granted architect’s license in California
Career advanced by: 1906 Earthquake & Hearst family
Important structures:
Berkeley Women’s City Club
Many YWCA’s
Hearst Estate at Wyntoon
St. John Presbyterians Church Berkeley
craftsman style
redwood, exposed beams and trusses
Hearst Castle San Simeon
28 years for completion
Lavish & ostentatious residences
Incorporated Hearst’s collection of antiques, & art

John Lautner
Apprenticed with Wright at Taliesin
Organic Modernism
“Un-buildable” sites
Houses with vast clear span interiors
Integrates water and the surrounding landscape
Use of concrete

Chemosphere House (Malin House)
1960 Hollywood Hills
45 degree sloping lot
A funicular
Saucer-shape house on single column
Subsidized by chemical companies

Elrod House
Curves like Corbu
Interior like Falling Water
Existing rock formations built into home
Glass wall in living room slides to expose exterior

Arango/Marbrisa House Acapulco
Free-form shapes, reinforced concrete.
Cantilever structure.
Pool flows through house and over edge
to Acapulco Bay.

IMAGES FROM GILBERT/GETLEIN BOOK
Pont du Gard; Nimes, France; early 1st century C.E.
The Pantheon; Built by Emperor Hadrian; Rome; 118-125 C.E.
The Crystal Palace; Joseph Paxton; London; 1851
The Eiffel Tower, Gustave Eiffel; Paris; 1889
U. S. Pavilion/geodesic dome; Fuller; Montreal; 1967
Notre-Dame Church Corbu; Ronchamp, France; 1950-55
Chrysler Building; William Van Alen; NYC; 1930
Falling Water; Frank Lloyd Wright; Bear Run, PA; 1936
Rotunda, University of Virginia; Jefferson; 1817-26