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Materials

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Foundation

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Structure Type Selection
Material is an important part in building structure. Each material has distinct properties of strength, elasticity, and stiffness. The most effective structural materials are those that combine elasticity with stiffness.
CONCRETE

- Elements: Cement, Portable Water, Aggregate
- Compression: 1,000 - 4,000 psi
- Tension: 0 psi
- Density: 145 pcf
- Weight: 150 pcf (normal reinforced concrete)

- Feature: Because concrete is relatively weak in tension, reinforcement consisting of steel bars, strands, or wires is required to adsorb tensile, shearing, and sometimes the compressive stresses in concrete member or structure. Concrete can be formed into various shapes and textures.
WOOD

- Classification: Softwood and Hardwood
- Softwood: The wood from any of various predominantly evergreen, cone-bearing trees used for general construction. (Pine, fir, hemlock, and spruce)
- Hardwood: The wood from a broad-leaved flower trees typically used for flooring, paneling, furniture, and interior trim. (Cherry, maple, and oak)
- Compressive Strength, Bending Strength, Stiffness, Hardness depend on the types of wood.
- Products: Lumber and wood panel products (Plywood, particleboard, oriented strandboard, and waterboard.
- Feature: Low cost, reusable, low density, easy to transport, strength decreases when wet
STEEL

- Steel refers to various iron-based alloys having carbon content less than cast iron and more than wrought iron.
- Compression: 24,000 - 43,000 psi
- Tension: 24,000 - 43,000 psi
- Density: 490 pcf
- Products: W shape, S shape, C shape, L shape, WT shape, Structural tubing, Bar
- Feature: Steel combines high strength and stiffness with elasticity. Steel is used for light and heavy structural framing, as well as wide range of building products such as windows, doors, hardware, and fastenings.
(a) Wide-flange Shape
(b) American standard beam
(c) American standard channel
(d) Angle
(e) Structural tee
(f) Pipe Section
(g) Structural tubing
(h) Bars
(i) Plates
TRUSSES

A truss is a structural frame based on the geometric rigidity of the triangle and composed of linear members subject only to axial tension or compression.
Truss Structure
Truss Size

Depth range for pitched trusses: span/4 to span/5

Depth range for bowstring trusses: span/6 to span/8

The increased depth of trusses allows them to span greater distances than steel beams and girders. Span range: 25’ to 120’ (7 to 36 m)
Truss Types

Pratt trusses

Warren Trusses

Howe Trusses

Bowstring Trusses

Belgian Trusses

Crescent Trusses

Fink Trusses

Scissors Trusses
The foundation is the substructure of a building. It is designed to transfer the loads of a building to the ground.
FOUNDATION MUST SUPPORT ALL POSSIBLE LOADS:

• DEAD LOADS
• LIVE LOADS
• RAIN AND SNOW LOAD
• WIND LOADS
• SEISMIC LOADS (Earthquake)
• SOIL AND HYDROSTATIC PRESSURE
SHALLOW FOUNDATIONS
Shallow Foundation:

- Transfers build load to the near surface.
- Good for foundation having depth is equal or less than the foundation width.
- It is used if the bearing capacity of soil is high at shallow depth.
- Good for compressive soils. It will help to reduce settlement.
- Not expensive
SPREAD FOOTING

• Takes Load of structure above and it spreads it onto the earth material below.
WHERE WE NEED DEEP FOUNDATION:

1. THE DEPTH OF SUFFICIENT BEARING MATERIALS IS TOO GREAT FOR SHALLOW FOUNDATION (IMPRACTICAL, TOO EXPENSIVE)

   AND / OR

2. PRIMARY AVAILABLE BEARING MATERIAL REQUIRES FRICTION RESISTANCE RATHER THAN BEARING FOR THE FOUNDATION SYSTEM
DEEP FOUNDATION

TRANSMIT BUILDING LOADS TO A DEEPER, MORE SUITABLE STRATUM.

THE TWO TYPES OF DEEP FOUNDATIONS ARE:

1. END BEARING
2. BEARING THROUGH FRICTION

THE TWO METHODS OF BUILDING DEEP FOUNDATIONS ARE

1. CAUSSONS (DRILLED)
2. PILES (DRIVEN)
A CONCRETE CYLINDER CAST INTO A HOLE DRILLED DOWN TO A SUITABLE BEARING STRATUM.

MOST CAISSONS ARE PRIMARILY END BEARING.
PILES:

A STRUCTURAL ELEMENT THAT IS
FORCIBLY DRIVEN INTO THE EARTH (AS
A NAIL IS DRIVEN INTO THE WOOD)

MATERIALS:

1. WOOD
2. STEEL
3. PRE CAST CONCRETE
UNDER WATER : WOOD PILES WORK WELL WHEN CONSISTENTLY SUBMERGED.
Structure type selection

Balloon frame structure

Platform structure

Concrete structure (precast or site caste)

Steel structure
Factors governing type selection

1. Economics - not necessary the one that requires the least structural materials.
2. Architectural, mechanical, electrical, and other costs may be effected.
Benefits of steel structures

Steel has a high strength compared to its own weight ratio. Thus, the dead weight of steel structures is relatively small. This property makes steel a very attractive structure material for:

1. High-rise buildings.
2. Long spans bridges.
3. Structures located on soft ground.
4. Structures located on highly seismic areas.
Steel structures main elements

1. Beams and girders.
2. Decking and joints.
3. Columns

How long is long span for building structure

- Structure with span larger than 20m (65.5’) can be regarded as long span structure for this span is usually unable to be achieved by ordinary reinforced concrete structure.
Steel construction rules of thumbs

Floors (beam and girders)

• To calculate the necessary depth of a beam, divide the span (in inches) by 20. For example, a 25’ span would be 25*12 / 20 = 15”. The width of this beam would be between 1/3 and ½ of the depth. The dimension of a girder would be the same.

Floors (decking and joists)

• Metal sheeting with shear studs, 2” deep spans 10’, 3” spans 15’ in the direction of the decking ribs. In the addition to the decking depth, a concrete floor of 2’-3” must be poured on top of the floor.

• Steel joists or trusses 6” deep span 10’. For each additional 2” of depth, add 2’ of the span up to 12” deep, every additional 3” of depth add 2’ of span.

Columns

• A column size depends on the floor area it is supporting; this floor area is calculated by subdividing the distance between the columns and all adjacent columns. This area is cumulative from floor to floor.

• A 6*6 column can support 750 sq.ft. 8*8 can support 3000 sq.ft. And 12*12 columns 6000 sq.ft. Each additional 2” can add 1500 sq.ft of supported area.
Two way flat-slab system

- Building measurements: 154’ * 123’ area = 18942 sq.ft
- 12” Columns can support 6000 sq.ft
- Sq root of 6000 = 77.45
- 12” steel columns can support 77.45’ in both directions.
- Building length = 154 / 77.45 = 2.3
- Building width = 123 / 77.45
  minimum need of 3 * 2 steel 12*12 ‘’ columns
concrete structure gird

Steel structure gird

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