Bridge Construction
Bridge Types

Bridges can be classified in a number of ways. The following characteristics are used in bridge type identification:

**Function**

a. Vehicular
b. Railroad
c. Pedestrian
d. Material Handling

**Span Length**

a. Short  - less than 100 to 200 feet
b. Intermediate  - from 100 to 600 feet
c. Long  - greater than 400 to 600 feet

**Span Type**

a. Simple span (beam, girder, or truss)
b. Rigid frame
c. Cantilever (beam, girder, or truss)
d. Continuous (beam, girder, or truss)
e. Arch (girder or truss)
f. Suspension
g. Cable stayed
h. Movable
   1. Swing
   2. Lift  (girder or truss)
   3. Bascule
i. Floating
j. Non-bridges
   1. Culverts
   2. Tunnels

**Structure Materials**

a. Timber
b. Steel
c. Concrete
   1. Reinforced
   2. Prestressed
   3. Post-tensioned
d. Composite (decks and girders)
e. Others (less frequently used in modern construction)
   1. Masonry
   2. Iron
   3. Aluminum
Cross Section

a. Deck
b. Half through
c. Through

Degree of Redundancy

a. Determinate
b. Indeterminate

Floor System

a. Conventional deck
b. Orthotropic deck

The most significant classification is by span type. It must be realized that several types of spans are often incorporated at various locations within the same crossing. The Commodore Barry Bridge over the Delaware River is a local example. The approaches begin with steel deck girders, then change to steel deck trusses, and finally to a cantilever through truss over the Delaware River. With the exception of floating bridges, all of the span types consist of one or more of the following structural elements: the flexural member, the arch, and the suspension system. Some types utilize combinations of elements within the same span. This is the case with cable-stayed structures, whose flexural members can usually carry the dead load but rely on the stays to support the live loads. To obtain the greatest economy on hybrid girders or trusses, different strengths of steel are used in various locations.

Bridge Components

- Superstructure - The superstructure is defined as the entire portion of a bridge structure which primarily receives and supports loads and, in turn, transfer the reactions resulting therefrom to the bridge substructure. The superstructure may consist of beam, girder, truss, or cable construction. Superstructure components include:

  a. Floor beams
  b. Girders
  c. Stringers
  d. Diaphragms
     1. Intermediate
     2. End
     3. Continuity
  e. Deck
     1. Roadway
     2. Sidewalk/overhang
Figure 2-14. Simple spans.

Figure 2-15. Two-span continuous structure.

Figure 2-16. Cantilever spans with a suspended span.

(a) Elements of a statically determinate cantilever bridge

(b) Relative maximum moments - single span versus cantilever span

Fig. 2.72. Cantilever bridge principles.
Figure 2-11. Girder bridges.
Figure 2-17. Concrete bridges.
Figure 2-10. Truss bridges.
Figure 2-18. Bascule bridge.

Figure 2-19. Swing bridge.

Figure 2-20. Vertical lift bridge.
f. Parapet and railings

g. Expansion dam

h. Truss members
   1. Chords (top and bottom)
   2. Vertical and diagonal web members
   3. Lateral bracing
   4. Portal
   5. End post

i. Struts and wind bracing

j. Cable system

k. Hangers - fixed and expansion type

A superstructure may consist of a single span upon two supports or a combination of two or more spans having the number and distribution of supports required by their type of construction, whether consisting of simple, continuous, cantilever, suspension, arch, or tower-bent construction.

- Substructure - The substructure is the foundation portion of the bridge that supports the superstructure and transfers the loads to the earth. The substructure includes:

a. Abutments
   1. Breastwall
   2. Wingwalls
   3. Bridge seat
   4. Backwall
   5. Footing or pile cap

b. Piers
   1. Stem wall
   2. Column or pier shaft
   3. Web wall
   4. Pier cap
   5. Footing or pile cap

c. Pile bent
   1. Piles (steel, concrete, or timber)
   2. Bent cap

d. Caisson

e. Piling

f. Dolphins and fenders - pier protection

- Bearings - Bearings transmit and distribute the superstructure loads to the substructure and permit the superstructure to undergo necessary movements without developing harmful overstress. The two general types of bearings are fixed and expansion. The principal difference is that fixed bearings allow rotation but no translation; expansion bearings, on the other hand, permit both rotation and translation. Without the ability of bearings to rotate, otherwise determinate structures would become statically indeterminate, bending moments would be induced in piers and footings.
Figure 5-38. Types of abutments.
Expansion bearings are designed primarily to allow longitudinal movement (translation) resulting from thermal growth and contraction. Inhibiting this movement can result in the buildup of stresses reaching enormous values.

- Abutments are portions of the substructure that not only support the superstructure loads but also retain the adjacent earth embankment and support the end of the approach slab. Abutment breastwalls can be high shear walls or the short stub type. Abutment construction can be cantilever, gravity, or counterfort types. Wingwalls can be designed as square (U-shape), skewed, or flared. Wingwalls can be constructed as conventional cast-in-place concrete or precast, mechanically stabilized earth walls.

**Construction Techniques**

The principal methods of bridge erection are:

a. on falsework  
b. by cantilevering  
c. by hoisting into position  
d. by rolling or sliding into position  
e. by floating into position  
f. by suspension erection  
g. segmental construction

The factors involved in determining which methods of erection are feasible include some of the following:

a. condition of the river bed  
b. amount of interference from navigation  
c. interference from railroad and vehicular traffic  
d. water depth  
e. stream current  
f. presence of driftwood, ice, etc. in the stream  
g. bridge height  
h. utility conflicts  
i. physical constraints imposed by adjacent structures or facilities  
j. locally available equipment  
k. a particular contractor’s resources and preferences

Basically, the type of structure dictates the method of erection; however, the above conditions do play a part. The feasibility of certain erection methods is governed by the stated site conditions, with other methods being uneconomical or physically impossible. The erection issue is a prime consideration reviewed at the Type, Size, and Location Study stage of preliminary design, and forms a part of the selection criteria.