

Al-Mustansiriyah University  
College of Engineering-Civil Engineering Department  
MSc. Course –Structures 2018-2019

# Bridge Engineering

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Part-1-  
Introduction

## 1-What is Bridge?

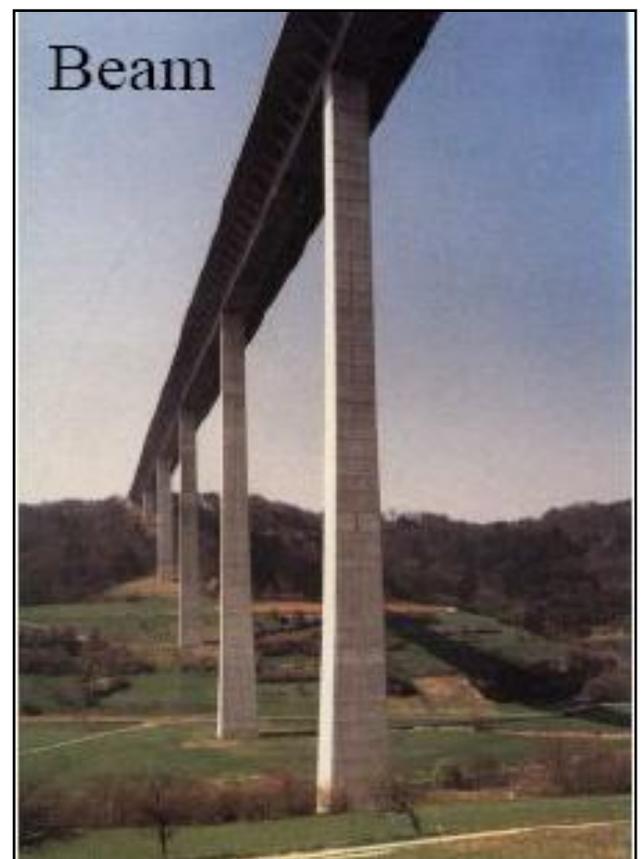
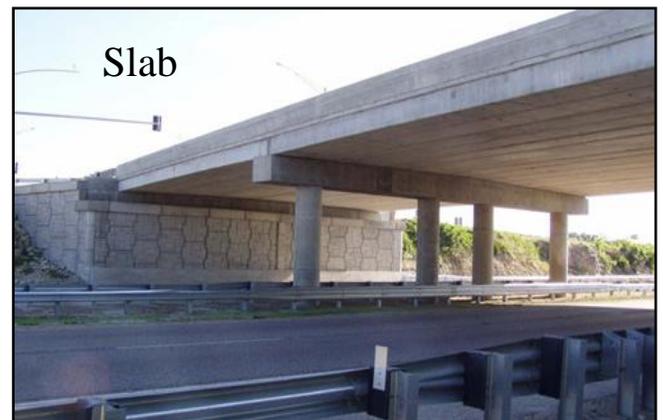
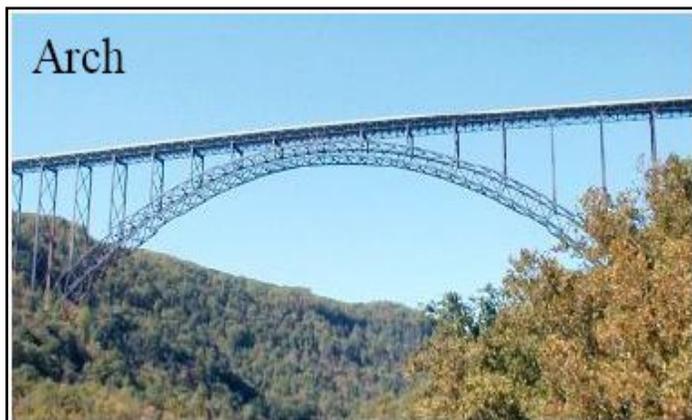
-A structure spanning and providing passage over a gap or barrier.

-A bridge is a structure built to span a gorge, valley, road, railroad track, river or other body of water, or any other physical obstacle.

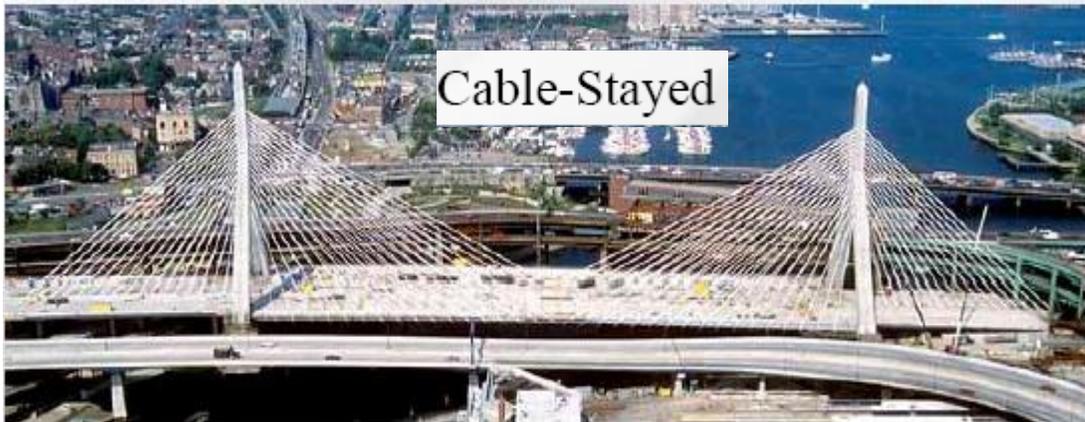
-The purpose of a bridge is to allow passage of people, vehicles, trains or ships over an obstacle.

## 2-Bridge Forms

The bridges can be constructed in several forms according to, function, material, structural requirements, environmental requirements, geotechnical requirements, geometrical design requirements, ....ect.



## Common Types of Bridges



## Common Types of Bridges

**Typical Span Length for Various Types of Bridges**

Type of Bridge	Material of Construction	Range of Span (m)
Slab	Concrete	6 - 12
Beam	Concrete	12 - 300
	Steel	30 - 300
Arch	Concrete	90 - 420
	Steel	240 - 550
Truss	Steel	90 - 550
Cable Stayed	Steel, Composite	90 - 1100
Suspension	Steel	300 - 2000

### 3-Classification of Bridges

Bridges can be classified based on:-

- 1-Purpose of construction (Road, Railway, Pedestrian, Water or Patrol lines....).
- 2-Construction materials (Wood, Brick, Stone, Steel, Reinforced Concrete..)
- 3-Construction method (Slab, Truss, Arch, Pre-cast, Composite, Box, ....)

4-Relationship between spans and method of supports (Simple, Continuous, stay, suspension ...).

5-Type and duration for use (Temporarily, Permanent, Military)

#### **4-Components of Bridge**

Generally, the components of bridge can be divided into two main parts:-

##### **4-1-Superstructure**

Consist all the components of a bridge over the supports (the upper visible part of the bridge):-

4-1-1-Wearing surface (surfacing or asphalt pavement): portion of the deck cross section which resists traffic wear.

4-1-2-Deck: the physical extension of the roadway across the obstruction to be bridged.

Main function: distribute loads along the bridge cross section or transversely

4-1-3-Primary members (girders): distributes loads longitudinally and are usually designed principally to resist flexure, shear and torsion.

4-1-4-Secondary members (Diaphragms, floor beams, cross frame and steel bracing): bracing between primary members designed to resist cross-sectional deformation of the superstructure frame or transform the loads to other parts.

4-1-5-Other parts: side walk, parapet, hand rail, lighting post, ....

##### **4-2-Substructure**

Consists of all elements required to support the superstructure and overpass roadway.

4-2-1-Abutment: earth-retaining structures which support the superstructure and overpass roadway at the beginning and end of a bridge.

4-2-2-Piers: support the superstructure at intermediate points between the abutments. Most visible components of a highway bridge.

4-2-3-Footing: Transfer loads from the substructure to the subsoil.

#### **5-Bearing**

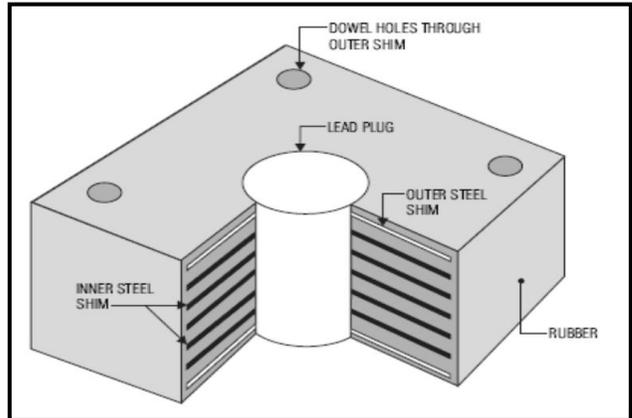
Mechanical systems transmit the loads from the superstructure to the substructure. It is a damping system at contact areas between superstructure and substructure.

5-1-Expansion bearing: accommodate both translational and rotational deck movement.



## Expansion rollers

5-2-Fixed bearing: allows rotational, translational movements or both (the common types are: Rocker bearing, Roller bearing, Sliding plate bearing, Pot bearing, Spherical bearing, Elastomeric bearing, Lead rubber bearing).



## Pot Bearing, Elastomeric Bearing, Rocker Bearing, Lead Rubber Bearing

### 6-Expansion Joint

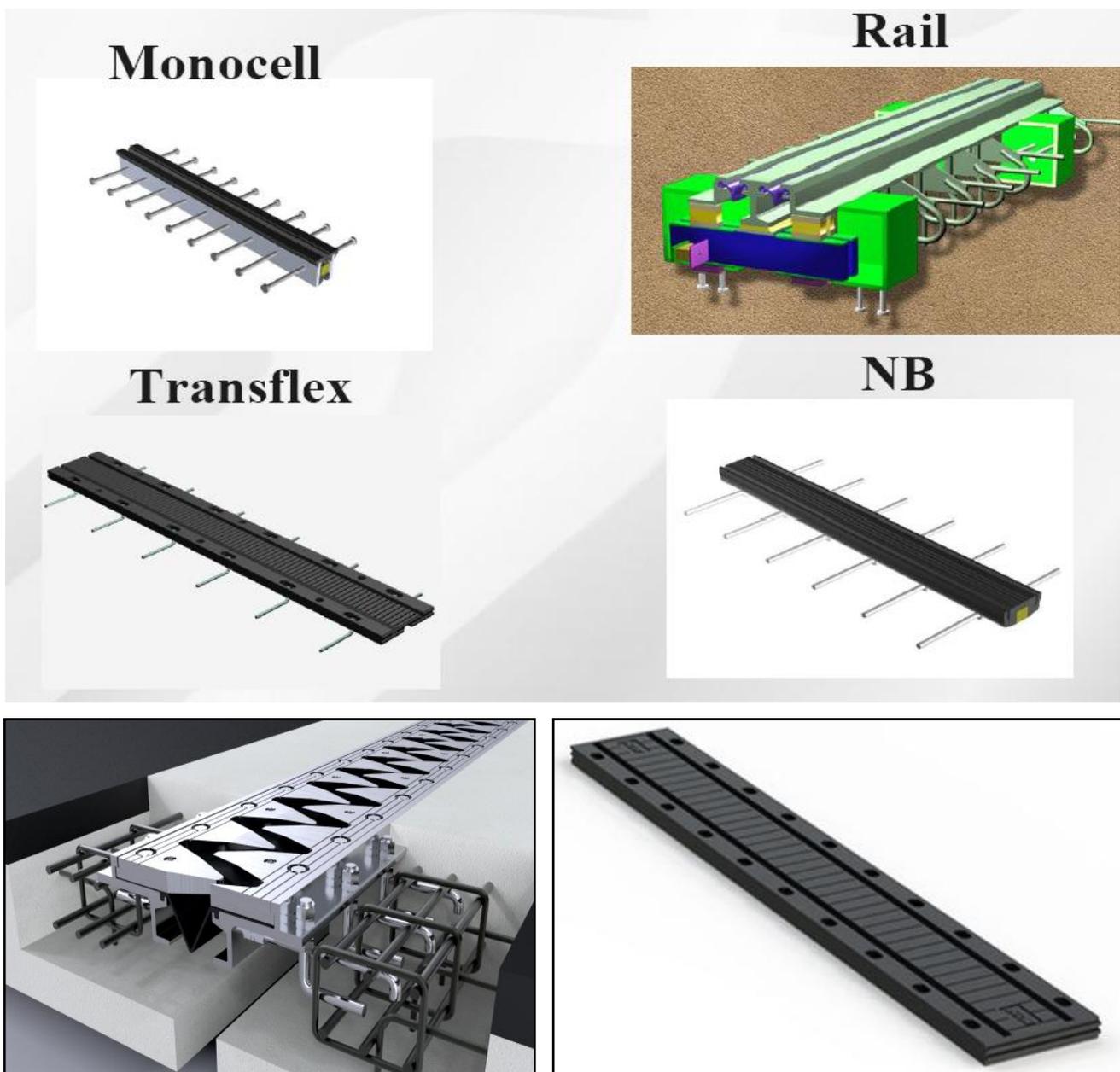
Play a critical role in the overall performance of a structure. Accommodate bridge deck movements due to thermal expansion/contraction and provide safety to the traffic over the gap between bridge and abutment.

Act as a sealant that protects substructure elements from deicing agents and excessive moisture.

#### Type

6-1-Open joints

6-2-Closed (filled) joints (Compression seal joints, Strip seal joints, Modular joints, Finger Joints)



**Common Types of Expansion Joint**

**7-Design Requirements**

**7-1-Transportation Planning**

Route selection, functional requirements and geometric design.

**7-2-Preliminary Site Investigation**

Site survey to determine topography: required for development of site plans showing contours obtain and overlay on aerial photos with existing and proposed utilities.

**7-3-Geotechnical Investigation**

Site investigation may include: drilling bore holes to determine soil stratigraphy, extract samples for testing, install slope inclinometers to determine slope stability, install

piezometers to determine groundwater information, determine foundation design parameters and slope stabilization requirements.

#### 7-4-Environmental Investigation

Environmental regulatory agencies, environmental pre-screening/license, identify aquatic and wildlife habitat, identify short term effects from construction and long term effects of facility and identify mitigation strategies.

#### 7-5-Hydraulic Investigation

Identify future flow increases due to development, diversions, etc; undertake hydrologic study to flow characteristics, undertake hydraulic study to determine structure requirements to pass flow, water elevation important to property damage and drainage/outfalls.

#### 7-6-Structural Design

Preliminary design is an iterative process with above investigations to produce an economical optimum structure type, followed by detailed structural design, important to have understanding of how structure will be constructed. Prepare detailed drawing, specifications, and tender documents.

#### 7-6-1Structural Design Steps

Determine geometry, develop loads, design and detail components starting from the top down.

#### 7-6-2-Loads to Consider

- 1-Dead loads (Structural components such as girder, deck, barrier, wearing surface,....),
- 2-Vehicular Live Loads (vertical, dynamic load allowance, braking (longitudinal force), centrifugal,....).
- 3-Pedestrian live loads (side walk).
- 4-Earth Pressure.
- 5-Wind (transverse, longitudinal, vertical and on vehicle).
- 6-Utility Components (lighting posts, hand rail, services pipes, cables....).
- 7-Collision.
- 8- Other Loads (stream flow, ice, earthquake,.....).