



A

Annual Average Daily Traffic (AADT)

The total volume passing a point or segment of a highway facility in both directions for one year, divided by the number of days in the year.

Abutment

A retaining wall supporting the ends of a bridge or viaduct.



American Association of State Highway and Transportation Officials (AASHTO)

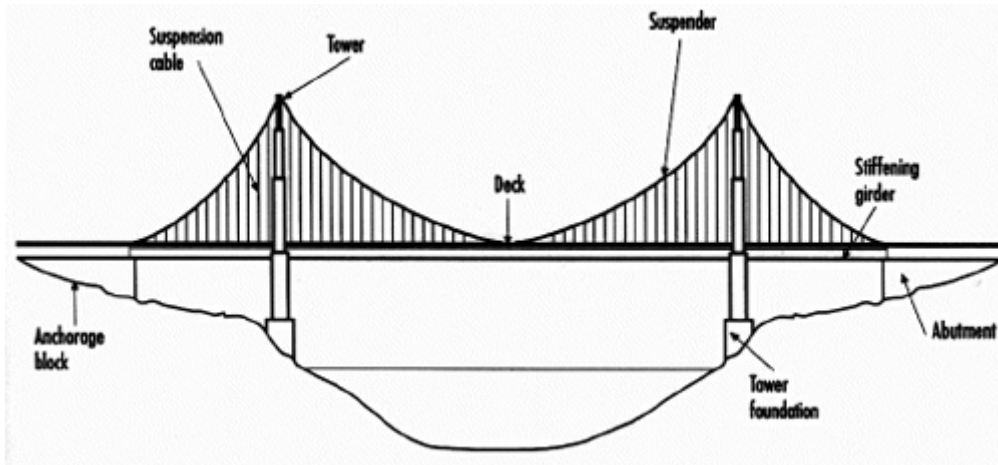
AASHTO is a nonprofit, nonpartisan association representing highway and transportation departments. Its guides and specifications are used to describe loading requirements for highway (vehicular) bridges.

Anchor Span

Located at the outermost end, it counterbalances the arm of a span extending in the opposite direction from a major point of support. Often attached to an abutment.

Anchorage Block

Located at the outermost ends, the part of a suspension bridge to which the cables are attached. Similar in location to an abutment of a beam bridge.



Approach

The part of the bridge that carries traffic from the land to the main parts of the bridge.

Approach Span

The span or spans connecting the abutment with the main span or spans.

Aqueduct

A pipe or channel, open or enclosed, that carries water. May also be used as part of a canal to carry boats. Sometimes carried by a bridge.

Arch

A typically curved structural member spanning an opening and serving as a support.

Arch Bridge

A bridge whose main support structure is an arch. Additionally, the bridge may be termed a *through* arch, which is simply one where the roadway appears to go through the arch.



Arch Barrel

The inner surface of an arch extending the full width of the structure.

Awards

Projects authorized to proceed with construction after bids have been received and accepted by the authorizing transportation agency.





B

Bascule Bridge

From the French word for "see-saw," a bascule bridge features a movable span (leaf) that rotates on a horizontal hinged axis (trunnion) to raise one end vertically. A large counterweight is used to offset the weight of the raised leaf. May have a single raising leaf or two that meet in the center when closed.



Beam

A horizontal structure member supporting vertical loads by resisting bending. A girder is a larger beam, especially when made of multiple plates. Deeper, longer members are created by using trusses.

Beam Bridge

A bridge built of beams, either classified as a short-span or long-span beam bridge, which is supported on beams whose ends rest on piers or abutments.

Bearing

A device at the ends of beams that is placed on of a pier or abutment. The ends of the beam rest on the bearing.

Bedrock

The solid rock layer beneath sand or silt.

Bed Timbers

Timber components typically located between the of an abutment or pier and the underside of the truss bottom chord. Intended to serve as sacrificial components they are easily replaced when deteriorated from rot, thus protecting truss components from similar deterioration.

Bent

Part of a bridge substructure. A rigid frame commonly made of reinforced concrete or steel that supports a vertical load and is placed transverse to the length of a structure. Bents are commonly used to support beams and girders. An end bent is the supporting frame forming part of an abutment.

Each vertical member of a bent may be called a column, pier or pile. The horizontal member resting on of the columns is a bent cap. The columns stand on of some type of foundation or footer that is usually hidden below grade.

A bent commonly has at least two or more vertical supports. Another term used to describe a bent is capped pile pier. A support having a single column with bent cap is sometimes called a "hammerhead" pier.

Bid Opening

The opening of construction project bids from contractors conducted by the transportation agency.



Bowstring Truss

A truss having a curved chord and straight bottom chord meeting at each end.

Box Girder Bridge

A box girder bridge is a bridge where the main beams comprise girders in the shape of a hollow box. The box girder normally comprises either prestressed concrete, structural steel, or a composite of steel and reinforced concrete. The box is typically rectangular or trapezoidal in cross-section. Box girder bridges are commonly used for highway flyovers and for modern elevated structures of light rail transport. Although normally the box girder bridge is a form of beam bridge, box girders may also be used on cable-stayed bridges and other forms.



Brace

A structural support or to strengthen and stiffen a structure to resist loads.

Brace-Ribbed Arch (Trussed Arch)

An arch with parallel chords connected by open webbing.



Bridge Condition Ratings

Through periodic safety inspections, data is collected on the condition of the primary components of a structure. Condition ratings, based on a scale of 0-9, are collected for the following components of a bridge. A condition rating of 4 or less on one of the following item classifies a bridge as structurally deficient.

- The bridge deck, including the wearing surface:
- The superstructure, including all primary load-carrying members and connections
- The substructure, considering the abutments and all piers

To be eligible for federal aid the following is necessary (a local match is required):

- Replacement: bridge must have a sufficiency rating of less than 50 and be either functionally obsolete or structurally deficient.
- Repair: bridge must have a sufficiency rating of less than 80 and the jurisdiction is prevented from using any additional federal aid for 10 years.



C

Cable

Part of a suspension bridge extending from an anchorage over the tops of the towers and down to the opposite anchorage. Suspenders or hangers are attached along its length to support the deck.

Cable-Stayed Bridge

A variation of suspension bridge in which the tension members extend from one or more towers at varying angles to carry the deck. Allowing much more freedom in design form, this type does not use cables draped over towers, nor the anchorages at each end, as in a traditional suspension bridge.

Caisson

"Caisson" is the French word for "box." A caisson is a huge box made of steel-reinforced and waterproof concrete with an open central core. At the base of the caisson is its "cutting edge" of plate steel. In a suspension bridge the caisson becomes the foundation, the pier, supporting for the bridge's towers.

Camber

A positive, upward curve built into a beam that compensates for some of the vertical load and anticipated deflection.

Camelback Truss

A truss having a curved top chord and straight bottom chord meeting at each end, especially when there are more than one used end to end.

Cantilever

A structural member that projects beyond a supporting column or wall and is counterbalanced and/or supported at only one end.



Cast-in-Place

Concrete poured within formwork on site to create a structural element in its final position.

Castellated Girder

A steel beam fabricated by making a zig zag cut along its web, then welding the two sides together at their peaks. This creates a beam that has increased depth and, therefore, greater strength, but is not increased in weight.

Catenary

Curve formed by a rope or chain hanging freely between two supports. The curved cables or chains used to support suspension bridges may be referred to as catenaries.



Catwalks

Temporary foot bridges, used by bridge workers to spin the main cables (several feet above each catwalk), and to attach the suspender cables that connect the main cables to the deck.

Centering

Temporary structure or falsework supporting an arch during construction.

Chord

Either of the two principal members of a truss extending from end to end, connected by web members.

Closed Spandrel Deck Arch

One of the oldest and strongest types of bridges, the arch has been used in bridge building since the Roman era. An arch supports weight by compression on an axis or keystone. The axis or keystone transfers the stress of gravity (the traffic load) outward toward the base of the arch.

Supports called abutments absorb the pressure and stop the ends of the bridge from spreading apart. Most arch bridges have vertical supports called spandrels that distribute the weight on the deck to the arch below.

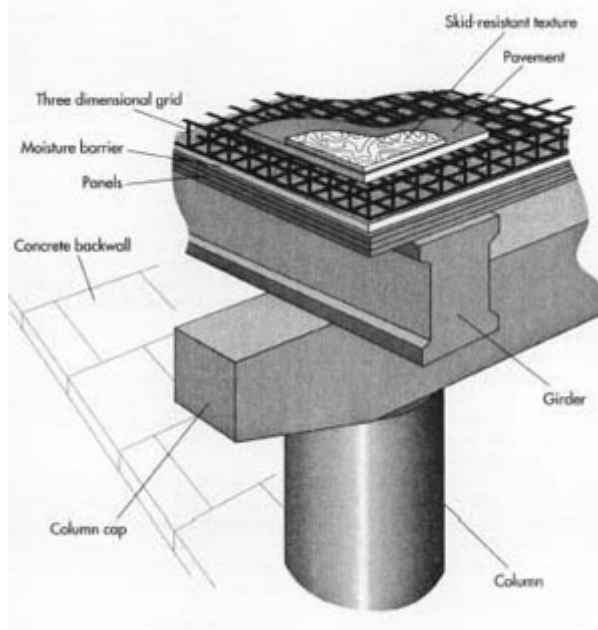
The first arch bridges were built of stone but now are constructed of concrete or steel for greater strength and durability. Arch bridges are strong because the entire structure is under compression. Therefore, they must be built of materials that are strong under compression. Putting more weight on the arch actually compresses the material and makes the structure more rigid. Most arch bridges span between 200-800 feet.





Column

A vertical, structural element, strong in compression.



Column Cross Brace

Transverse brace between two main longitudinal members.

Compression Member

An engineering term that describes a timber or other truss member that is subjected to squeezing or pushing. Also see tension member.

Condition Ratings

According to the National Bridge Inspection Standards (NBIS), condition ratings are used to describe an existing bridge or culvert compared with its condition if it were new. The ratings are based on the materials, physical condition of the deck (riding surface), the superstructure (supports immediately beneath the driving surface), and the substructures (foundation and supporting posts and piers). General condition ratings range from 0 (failed condition) to 9 (excellent).

Continuous Span Beam Bridge

A simple bridge made by linking one beam bridge to another; some of the longest bridges in the world are continuous span beam bridges.

Crown

On road surfaces, where the center is the highest point and the surface slopes downward in opposite directions, assisting in drainage. Also a point at the top of an arch.

Culvert

A drain, pipe or channel that allows water to pass under a road, railroad or embankment.





D

Damping

The action of reducing the vibration of an object. This tends to return the vibrating object to its original position.

Dead Load

The static load imposed by the weight of materials that make up the bridge structure itself.

Debarment

Legally preventing a company or person from participation in bid lettings or construction proceedings.

Deck

The roadway portion of a bridge, including shoulders. Most bridge decks are constructed as reinforced concrete slabs, but timber decks are still seen in rural areas and open-grid steel decks are used in some movable bridge designs.



Deck Bridge

A bridge in which the supporting members are all beneath the roadway.

Deck Plate Girder

A plate girder bridge is a bridge supported by two or more plate girders. The plate girders are typically I-beams made up from separate structural steel plates (rather than rolled as a single cross-section), which are welded (or occasionally bolted or riveted) together to form the vertical web and horizontal flanges of the beam. In some cases, the plate girders may be formed in a Z-shape rather than I-shape.

Plate girder bridges are suitable for short to medium spans and may support railroads, highways or other traffic.

In the deck-type bridge, a steel or reinforced concrete bridge deck is supported on of two or more plate girders, and may act compositely with them. Additional beams may span across between the main girders, for example in the form of bridge known as ladder-deck construction.



Also, further elements may be attached to provide cross-bracing and prevent the girders from buckling.



Deck Truss

A bridge whose roadway is supported from beneath by a truss.



Deck Truss Cantilever Bridge

A cantilever bridge is a bridge built using cantilevers: structures that project horizontally into space, supported on only one end. For small footbridges, the cantilevers may be simple beams; however, large cantilever bridges designed to handle road or rail traffic use trusses built from structural steel, or box girders built from prestressed concrete. A simple cantilever span is formed by two cantilever arms extending from opposite sides of the obstacle to be crossed, meeting at the center. In a common variant, the suspended span, the cantilever arms do not meet in the center; instead, they support a central truss bridge which rests on the ends of the cantilever arms.



Deflection



The displacement of a structural member or system under load.

Diaphragm

Bracing that spans between the main beams or girders of a bridge or viaduct and assists in the distribution of loads.

Diagonal

A sloping structural member of a truss or bracing system.

Diversion Channel

A bypass created to divert water around a structure so that construction can take place.

Downstream Face

The side of the bridge that is not against the water.



E

Embankment

Angled grading of the ground.

End Post

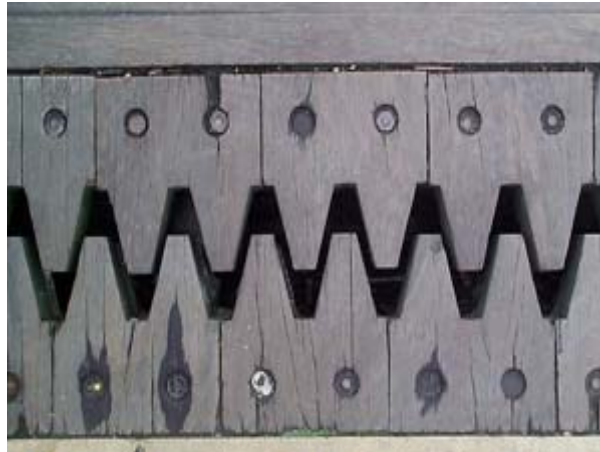
The outwardmost vertical or angled compression member of a truss.

Environmental Impact Statement (EIS)

A comprehensive study of potential social, economic and environmental impacts related to a federally-assisted project. Projects for which an EIS is required are defined in the National Environmental Policy Act of 1969, as amended.

Expansion Joint

A meeting point between two parts of a structure that is designed to allow for movement of the parts due to thermal or moisture factors while protecting the parts from damage. Commonly visible on a bridge deck as a hinged or movable connection.



Extrados

The outer exposed curve of an arch; defines the lower arc of a spandrel.

Eye Bar

A structural member having a long body and an enlarged head at each end. Each head has a hole through which a pin is inserted to connect to other members.



F

Fatigue

Cause of structural deficiencies, usually due to repetitive loading over time.

Federal Fiscal Year

October 1 through September 30 of the following year.

Federal Highway Administration (FHWA)

The mission of FHWA is to administer the Federal-Aid Highway Program to create the best transportation system in the world for the American people through proactive leadership, innovation, and excellence in service. The FHWA is a part of the United States Department of Transportation and is headquartered in Washington, D.C., with field offices located across the United States.

Fill

Earth, stone or other material used to raise the ground level, form an embankment or fill the inside of an abutment, pier or closed spandrel.

Fixed Arch

A structure anchored in its position. Compare to hinged arch.

Fixed-span Bridge

A bridge without a movable, or draw, span.

Floor Beam

Horizontal members that are placed transversely to the major beams, girders or trusses; used to support the deck.

Flutter

Self-induced harmonic motion. A self-excited aerodynamic instability that can grow to very large amplitudes of vibrations.

Flyover

A bridge formed when one roadway crosses over another at a higher level; an overpass.

Footing

The enlarged lower portion of the substructure or foundation that rests directly on the soil, bedrock or piles; usually below grade and not visible.

Force

Any action that tends to maintain or alter the position of a structure.

Forms

Temporary structures or molds made of wood, metal, or plastic used when placing concrete to ensure that it is shaped to its desired final form.

Formwork

A total system of support for freshly placed concrete, including the mold and all supporting members, hardware, and necessary bracing. Formwork must be strong enough to support the considerable weight and pressure of wet concrete without bending or breaking.

Fracture-Critical

A fracture-critical bridge is one that does not contain redundant supporting elements. This means that if those key supports fail, the bridge would be in danger of collapse. This *does not* mean the bridge is inherently unsafe, only that there is a lack of redundancy in its design.

Full-Depth Replacement of Concrete Deck

A technique used to restore the structural integrity and rideability of distressed concrete pavement. It involves removing the deteriorated concrete down to the base, repairing the base, and refilling the excavated area with new concrete. Full-depth replacement is a particularly effective technique for pavement repairs near joints and cracks. By removing and replacing



isolated areas of deterioration, pavement can be restored close to its original condition.

Functionally Obsolete

A functionally obsolete bridge is one that was built to standards that are not used today. These bridges are not automatically rated as structurally deficient, nor are they inherently unsafe. Functionally obsolete bridges are those that do not have adequate lane widths, shoulder widths, or vertical clearances to serve current traffic demand, or those that may be occasionally flooded.

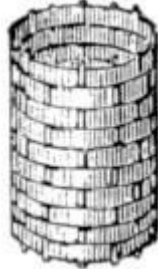
A functionally obsolete bridge is similar to an older house. A house built in 1950 might be perfectly acceptable to live in, but it does not meet all of today's building codes. Yet, when it comes time to consider upgrading that house or making improvements, the owner must look at ways to bring the structure up to current standards.



G

Gabion

A galvanized wire box filled with stones used to form an abutment or retaining wall.



Girder

A horizontal structure member supporting vertical loads by resisting bending. A girder is a larger beam, especially when made of multiple metal plates. The plates are usually riveted or welded together.



Girder Bridge

A girder bridge is perhaps the most common and most basic bridge. The cross section of the girder takes the shape of the capital letter "I". The vertical plate in the middle is known as the *web*, and the top and bottom plates are referred to as *flanges*. A box girder is much the same as an I-beam girder except it takes the shape of a box. The typical box girder has two webs and two flanges. However, in some cases there are more than two webs, creating a multiple chamber box girder. Other examples of simple girders include pi girders, named for their likeness to the mathematical symbol for pi, and T shaped girders.

Glu-lam Freespan

Glu-lam bridges can freespan over 100 feet. This makes a Glu-lam freespan the ideal choice for road overpasses, bridging steep ravines and creating a crossing where pile foundations would be prohibited.



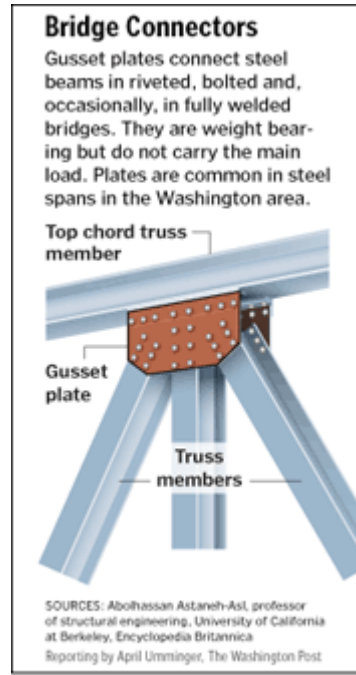
Gross Vehicle Weight (GVW)

Refers to the total curb weight of the vehicle and payload. Expresses the maximum continuous load for vehicles traversing a bridge.



Gusset Plate

A metal plate used to unite multiple structural members of a truss.





H

Hanger

A tension member serving to suspend an attached member.

Haunch

The enlarged part of a beam near its supported ends that results in increased strength; visible as the curved or angled bottom edge of a beam.



Haunched Girder

Typical slab-on-beam bridges have space between the bottom of the slab and the of the flanges of beams. This space, referred to as the fillet or haunch, typically consists of unreinforced concrete that increases the dead load of the section but is not normally considered to add strength.

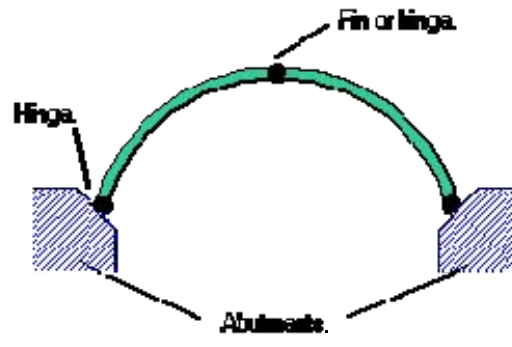


Headwall

The device placed at the end of a bridge that comprises a large portion of the abutment. Headwalls are used to retain the road formation soil around and above the abutments and prevent erosion at the abutment.

Hinged Arch

A two-hinged arch is supported by a pinned connection at each end. A three-hinged arch also includes a third pinned connection at the crown of the arch near the middle of a span. Compare to fixed arch.



Humpback

A description of the sideview of a bridge having relatively steep approach embankments leading to the bridge deck.



Impost

The surface that receives the vertical weight at the bottom of an arch.

Intrados

The interior arc of an arch.



J

Jersey Barrier

A low, reinforced concrete wall wider at the base, tapering vertically to near mid-height, then continuing straight up to its top. The shape is designed to direct automotive traffic back toward its own lane of travel and prevent crossing of a median or leaving the roadway. Commonly used on new and reconstructed bridges in place of decorative ballustrades, railings or parapets.



Joint

A device connecting two or more adjacent parts of a structure. A roller joint allows adjacent parts to move controllably past one another. A rigid joint prevents adjacent parts from moving or rotating past one another.



K

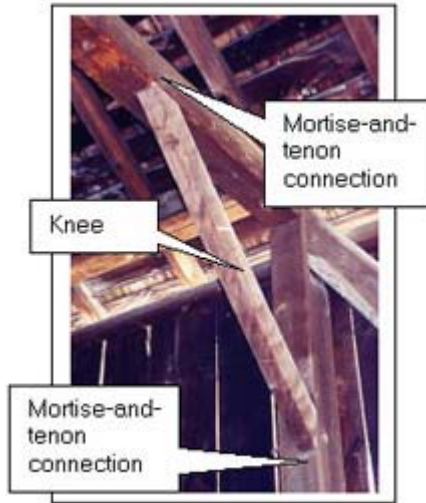
Keystone

The uppermost wedge-shaped voussoir at the crown of an arch that locks the other voussoirs into place.



Knee Brace

Additional support connecting the deck with the main beam that keeps the beam from buckling outward. Commonly made from plates and angles.





Lag

Crosspieces used to connect the ribs in centering.

Lateral Bracing

Members used to stabilize a structure by introducing diagonal connections.

Lattice

An assembly of smaller pieces arranged in a gridlike pattern; sometimes used a decorative element or to form a truss of primarily diagonal members.



Letting Date

The date bids are scheduled to be opened by the transportation agency.

Lift Span

The part of a movable-span (or drawbridge) that opens to allow river traffic. Also called the draw-span.

Live Load

Vehicular traffic, wind, water, and/or earthquakes.

Load

Weight distribution throughout a structure; loads caused by wind, earthquakes and gravity affect how weight is distributed throughout a structure.

Load Posted

Any bridge or structure restricted to carrying loads less than the legal load limit. Load posting a bridge is required by National Bridge Inspection Standards when a bridge is not capable of safely carrying a legal load.

Lower Chord

The bottom horizontal member of a truss.



M

Main Beam

A beam supporting the spans and bearing directly onto a column or wall.

Main Span

The longest span in a multi-span bridge and located between the bridge's main piers or towers (supports). Bridges typically compared using main-span lengths, which do not account for the length of the entire bridge or its approaches.

Member

An individual angle, beam plate or built piece intended to become an integral part of an assembled frame or structure.

Movable Bridge

A bridge in which the deck moves to clear a navigation channel; a swing bridge has a deck that rotates around a center point; a drawbridge has a deck that can be raised and lowered; a bascule bridge deck is raised with counterweights like a drawbridge; and the deck of a lift bridge is raised vertically like a massive elevator.



N

National Environmental Policy Act of 1969 (NEPA)

Legislation requiring that any project using federal funding or requiring federal approval (including transportation projects) examine the effects of alternative choices on the environment before a decision is made.



O

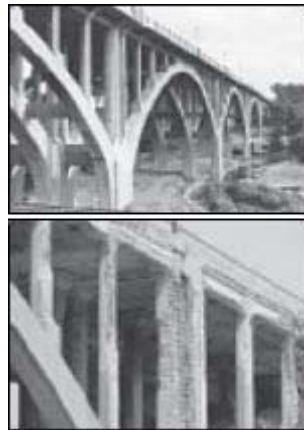
Obligation Authority

The maximum amount of federal formula funds that can be obligated or authorized in a federal fiscal year. The use of obligation authority does not affect the apportionment or allocation of federal funds a state receives. It only controls the rate of expenditure.

Open Spandrel Deck Arch

An arch bridge is based on the ancient concept of spanning an opening with a curved structural member. The arch transmits the load from the bridge deck to the abutments on both sides of the span and thus to the ground below. Early arch bridges were built of stone blocks wedged together to form the arch. Short modern arch bridges may use wood or concrete, while longer arch spans are built of steel. Since the arch requires no central support, it can be used to bridge long open spans. The arch can be either above or below the bridge deck. The arch pushes downward and outward against its abutments, which must be heavy to resist the thrust. Since the abutments transfer both horizontal and vertical forces from the bridge deck, arch bridges can only be used where the ground or foundation is solid and stable. The curved arch structure offers a high resistance to bending forces.

Arch bridges can be constructed with the deck above the arch (a *deck arch bridge*), or the deck can be hung from a segment of the arch which rises above the deck (a *through arch* or *tied arch* bridge). In a deck arch bridge, the space between the bottom of the arch and the deck can be solid (a *closed spandrel deck arch*) or open with supporting vertical members (an *open spandrel deck arch*).



Oscillation

A periodic movement back and forth between two extreme limits. An example is the string of a guitar that has been plucked. Its vibration back and forth is one oscillation. A vibration is described by its size (amplitude), its oscillation rate (frequency), and its timing (phase). In a suspension bridge, oscillation results from energy collected and stored by the bridge. If a part of the bridge has to store more energy than it is capable of storing, that part could fail.



P

Parabola

A form of arch defined by a moving point that remains equidistant from a fixed point inside the arch and a moving point along a line. This shape when inverted into an arch structure results in a form that allows equal vertical loading along its length.



Parapet

A low wall along the outside edge of a bridge deck used to protect vehicles and pedestrians.

Pier

A vertical structure that supports the ends of a multi-span superstructure at a location between abutments. Also see column and pile.



Pile

A long column driven deep into the ground to form part of a foundation or substructure. Also see column and pier.

Pile Bent

A row of driven or placed piles with a pile cap to hold them in their correct positions.



Pile Driver

A machine that repeatedly drops a heavy weight on of a pile until the pile reaches solid soil or rock or cannot be pushed down any farther.



Pile-Supported Bridge

Pile-supported structures are supported by timber piling at regular intervals (typically 10 to 15 feet on center). A pile-supported structure can be built to any length and virtually any height.



Pin

A cylindrical bar that is used to connect various members of a truss; such as those inserted through the holes of a meeting pair of eyebars.

Pony Truss

A truss that carries its traffic near its chord, but not low enough to allow crossbracing between the parallel chords. Compare to deck truss and through truss.

Portal

The opening at the ends of a through truss with forms the entrance. Also the open entrance of a tunnel.

Post

One of the vertical compression members of a truss that is perpendicular to the bottom chord.

Pre-Cast Girder

Girder is fabricated off-site Portland cement using reinforcing steel and post-tensioning cables. These girders are shipped to the construction site by truck and hoisted into place by cranes.

Project Number

A specific number assigned to all federal, state and local projects. The funding source (prefix), functional classification, a sequential number and possible suffix compose the elements of a project number.

Public Hearing

Meeting held with purpose of receiving public comments on proposed projects.

Pylon

A monumental vertical structure marking the entrance to a bridge or forming part of a gateway.



R

Railing

A fence-like construction built at the outermost edge of the roadway or the sidewalk portion of a bridge to protect pedestrians and vehicles.

Range of Stress

The algebraic difference between the minimum and maximum stresses in a member.

Reaction

The resistance of a support against the pressure of a loaded member.

Redundancy

A structural condition where there are more elements of support than are necessary for stability.

Redundant Member

A member in a bridge that renders it a statically indeterminate structure; the structure would be stable without the redundant member whose primary purpose is to reduce the stresses carried by the determinate structure.

Reinforced Concrete

Concrete with steel bars or mesh embedded in it for increased strength in tension.

Reinforcement

Adding strength or bearing capacity to a structural member. Examples include the placing of metal rebar into forms before pouring concrete or attaching gusset plates at the intersection of multiple members of a truss.

Resonance

The regular vibration of an object as it responds in step (at the same frequency) with an external force.

Retractable Draw Bridge

A bridge with a superstructure designed to move horizontally either longitudinally or diagonally from "closed" to "open" position, the portion acting in cantilever being counterweighted by that supported on rollers; also known as traverse draw bridge.

Revet

The process of covering an embankment with stones.

Revetment

A facing of masonry or stones to protect an embankment from erosion.

Rib

Any one of the arched series of members that is parallel to the length of a bridge, especially those on a metal arch bridge.

Rigger

An individual who erects and maintains scaffolding or other inspection access equipment.

Rigid

Ability to resist deformation when subjected to a load.

Rigidity

The measure of a structure's ability not to change shape when subjected to a load.

Rigid Frame

A structural frame in which the members are connected together without hinges.

Rigid Frame Bridge

A type of girder bridge in which the piers and deck girder are fastened to form a single unit.



Unlike typical girder bridges that are constructed so that the deck rests on bearings at the piers, a rigid frame bridge acts as a unit. Pier design may vary.

Rigid Frame Pier

A pier with two or more columns and a horizontal beam on top constructed monolithically to act like a frame.

Rip Rap

Gabions, stones, blocks of concrete or other protective covering material of like nature deposited upon river and stream beds and banks, lake, tidal or other shores to prevent erosion and scour by water flow, wave or other movement.

Rivet

A metal fastener used in pre-1970 construction; made with a rounded preformed head at one end and installed hot into a predrilled or punched hole; the other end was hammered into a similar shaped head thereby clamping the adjoining parts together.

Riveted Connection

A rigid connection of metal bridge members that is assembled with rivets. Riveted connections increase the strength of the structure.

Riveted Joint

A joint in which the assembled members are fastened by rivets.

Rocker Bearing

A bridge support that accommodates expansion and contraction of the superstructure through a rocking action.

Rocker Bent

A bent hinged or otherwise articulated at one or both ends to provide the longitudinal movements resulting from temperature changes and superimposed loads.

Roller

A steel cylinder intended to provide longitudinal movements by rolling contact.

Roller Bearing

A single roller or a group of rollers so housed as to permit longitudinal movement of a structure.

Roller Nest

A group of steel cylinders used to facilitate the longitudinal movements resulting from temperature changes and superimposed loads.

Rolling Lift Bridge

A bridge of bascule type devised to roll backward and forward upon supporting girders when operated through an "open and closed" cycle.



S

Segmental Arch

An arch formed along an arc that is drawn from a point below its spring line, thus forming a less than semicircular arch. The intrados of a Roman arch follows an arc drawn from a point on its spring line, thus forming a semi-circle.



Shaft

A vertical, load bearing structure that uses end bearing and friction to support loads.

Shear

A force that causes parts of a material to slide past one another in opposite directions.

Shoefly

A temporary bridge taking the place of the main bridge while construction is completed on the main bridge.

Silt

Sediment particles ranging from 0.00016 to 0.0024 inches in diameter.

Simple Span

A span in which the effective length is the same as the length of the spanning structure. The spanning superstructure extends from one vertical support, abutment or pier to another without crossing over an intermediate support or creating a cantilever.

Skew

When the superstructure is not perpendicular to the substructure, a skew angle is created. The skew angle is the acute angle between the alignment of the superstructure and the alignment of the substructure.

Span

The horizontal space between two supports of a structure. Also refers to the structure itself. May be used as a noun or a verb.

The clear span is the space between the inside surfaces of piers or other vertical supports. The effective span is the distance between the centers of two supports.

Spandrell

The roughly triangular area above an arch and below a horizontal bridge deck. A closed spandrell encloses fill material. An open spandrell carries its load using interior walls or columns.

Specifications

A document that explains all material and construction requirements of the bridge structure to be constructed, usually used by engineers or architects in the planning stages of construction.

Splice Plate

A plate that joins two girders. Commonly riveted or bolted.

Springer

The first voussoir resting on the impost of an arch.



Smith Truss

Tipp City, Ohio, native Robert W. Smith received truss patents in 1867 and 1869.

Stanchion

One of the larger vertical posts supporting a railing. Smaller, closely spaced vertical supports are ballusters.

STIP

Statewide Transportation Improvements Project (STIP)

Stay

Diagonal brace installed to minimize structural movement.

Steel Stringers

Load-carrying beams in the viaduct's superstructure that rest on abutments and other intermediate supports.

Stiff

Ability to resist deformation.

Stiffener

On plate girders, structural steel shapes, such as an angle, are attached to the web to add intermediate strength.

Stringer

A beam aligned with the length of a span which supports the deck.

Structurally Deficient and Sufficiency Rating

A bridge sufficiency rating includes a multitude of factors: inspection results of the structural condition of the bridge, traffic volumes, number of lanes, road widths, clearances, and importance for national security and public use, to name just a few.

The sufficiency rating is calculated per a formula defined in Federal Highway Administration's Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges.

This rating is indicative of a bridge's sufficiency to remain in service. The formula places 55 percent value on the structural condition of the bridge, 30 percent on its serviceability and obsolescence, and 15 percent on its essentiality to public use.

The point calculation is based on a 0-100 scale and it compares the existing bridge to a new bridge designed to current engineering standards.

The bridge's sufficiency rating provides an overall measure of the bridge's condition and is used to determine eligibility for federal funds. Bridges are considered structurally deficient if significant load carrying elements are found to be in poor condition due to deterioration or the adequacy of the waterway opening provided by the bridge is determined to be extremely insufficient to point of causing intolerable traffic interruptions.

Every bridge constructed goes through a natural deterioration or aging process, although each bridge is unique in the way it ages.

The fact that a bridge is classified under the federal definition as "structurally deficient" does not imply that it is unsafe. A structurally deficient bridge, when left open to traffic, typically requires significant maintenance and repair to remain in service and eventual rehabilitation or replacement to address deficiencies. To remain in service, structurally deficient bridges are often posted with weight limits to restrict the gross weight of vehicles using the bridges to less than the maximum weight typically allowed by statute.

To be eligible for federal aid the following is necessary (a local match is required):

- Replacement: bridge must have a sufficiency rating of less than 50 and be either functionally obsolete or structurally deficient.



- Repair: bridge must have a sufficiency rating of less than 80 and the jurisdiction is prevented from using any additional federal aid for 10 years.

Strut

A compressive member.

Substructure

The substructure consists of all parts that support the superstructure. The main components are:

- Abutments or end-bents
- Piers or interior bents
- Footings
- Piling

Superstructure

The superstructure consists of the components that actually span the obstacle the bridge is intended to cross. It includes:

- Bridge deck,
- Structural members
- Parapets, handrails, sidewalk, lighting and drainage features

Suspension

Legally halting a company or individuals ability to bid or participate in construction proceedings for a defined period of time.

Suspended Span

A simple beam supported by cantilevers of adjacent spans, commonly connected by pins.

Suspenders

Tension members of a suspension bridge which hang from the main cable to support the deck. Also similar tension members of an arch bridge which features a suspended deck. Also called hangers.

Suspension Bridge

A bridge which carries its deck with many tension members attached to cables draped over tower piers.



Swing Bridge

A movable deck bridge that opens by rotating horizontally on an axis. Compare to bascule bridge and vertical lift bridge.



T

Tension

A stretching force that pulls on a material.

Tension Member

Any timber or rod of a truss that is subjected to pull or stretch.

Through Truss

A truss that carries its traffic through the interior of the structure with crossbracing between the parallel top and bottom chords. Compare to deck truss and pony truss.

Tie

A tension member of a truss.

Tied Arch

An arch that has a tension member across its base connecting one end to the other.

Timber Freespan

Timber freespan bridges can span up to 26 feet. A timber freespan is generally used to span a creek or other relatively small crossings.



Torsion

An action that twists a material.

Tower

A tall pier or frame supporting the cable of a suspension bridge.

Trestle

A bridge structure consisting of spans supported upon frame bents.

Truss

In addition to classifying metal truss bridges by name, their form is further distinguished by the location of the bridge deck in relation to the top and bottom chords, and by their structural behavior.

In a deck configuration, traffic travels on top of the main structure; in a pony configuration traffic travels between parallel superstructures, which are not cross-braced at the top; in a through configuration, traffic travels through the superstructure (usually a truss), which is cross-braced above and below traffic.

Trussed Arch

A metal arch bridge that features a curved truss.



Two-Hinged Arch and Three-Hinged Arches

Arches use a curved structure that provides a high resistance to bending forces. Unlike girder and truss bridges, both ends of an arch are fixed in the horizontal direction (i.e., no horizontal movement is allowed in the bearing). Thus when a load is placed on the bridge (e.g., a car passes over it) horizontal forces occur in the bearings of the arch. These horizontal forces are unique to the arch and as a result arches can only be used where the ground or foundation is solid and stable.

Like the truss, the roadway may pass over or through an arch or in some cases both. Structurally, there are four basic arch types: hinge-less, two-hinged, three hinged, and tied arches.

The three-hinged arch adds an additional hinge at the crown of the arch. The three-hinged arch suffers very little if there is movement in either foundation (due to earthquakes, sinking, etc.) However, the three-hinged arch experiences much more deflection and the hinges are complex and can be difficult to fabricate. The three-hinged arch is rarely used anymore.



U

U-Bolt

A bar bent in the shape of the letter "U" and fitted with threads and nuts at its ends.

Ultimate Strength

The highest stress that a material can withstand before breaking.

Ultrasonic Testing

Nondestructive testing of a material's integrity using sound waves.

Underpass

The lowest feature of a grade separated crossing.

Uniform Load

A constant load across a member.

Unit Stress

The stress per unit of surface or cross-sectional area.

Uplift

A negative reaction or a force tending to lift a beam, truss, pile, or any other bridge element upwards.

Upper Chord

chord of a truss.

Upstream Face

The side of a bridge that is against the water.



V

Vault

An enclosing structure formed by building a series of adjacent arches.

Vertical Curve

A sag or crest in the profile of a roadway.

Vertical Lift Bridge

A movable deck bridge in which the deck may be raised vertically by synchronized machinery at each end.

Viaduct

A long, multi-span structure, especially one constructed of concrete. More commonly used in relation to structures carrying motor vehicles. Trestle is the term for a similar structure when used in relation to railroads.

Void

An empty or unfilled space in concrete.

Vousoir

Any one of the wedge shaped block used to form an arch.

Vousoir Arch

An arrangement of wedge shaped blocks set to form an arched bridge.



W

Waterway

The available width for the passage of water beneath a bridge.

Wearing Surface

The most layer of material applied upon a roadway to receive the traffic loads and to resist the resulting disintegrating action; also known as wearing course.

Web

The system of members connecting the top and bottom chords of a truss. Or the vertical portion of an I-beam or girder.

Web Members

The intermediate members of a truss, not including the end posts, usually vertical or inclined.

Web Plate

The plate forming the web element of a plate girder, built-up beam or column.

Web Stiffener

A small member welded to a beam web to prevent buckling of the web.

Weephole

A hole in a concrete retaining wall to provide drainage of the water in the retained soil.

Weigh in Motion (WIM)

Equipment that measures the weight of moving trucks. Is used by state highway agencies for monitoring pavement loadings.

Weld

A joint between pieces of metal at faces that have been made plastic by heat or pressure.

Welded Bridge Structure

A structure whose metal elements are connected by welds.



Welded Joint

A joint in which the assembled elements and members are united through fusion of metal.

Wheel Guard

A raised curb along the outside edge of traffic lanes to safeguard constructions outside the roadway limit from collision with vehicles.

Wheel Load

The load carried by and transmitted to the supporting structure by one wheel of a traffic vehicle, a movable bridge or other motive equipment or device.



Wichert Truss

The Wichert Truss, designed by E.M. Wichert of Pittsburg, PA, in 1930, is a cantilever spandrel-braced deck arch that is not a "true arch" bridge. The curved lower chord gives the bridge the form of an arch, but it does not rely on arch action to carry the load. The open diamond panel above each pier is the easily recognized mark of this truss type; without a vertical truss member in this hinged location.

Wire Rope

Steel cable.

Working Stress

The unit stress in a member under service or design load.



X-Bracing

A form of additional supports for the piling of a bridge. The timbers are placed in a "criss-cross" pattern joining the supporting piling.



Y

Yield

Permanent deformation that a metal piece takes when it is stressed beyond the elastic limit.

Yield Stress

The stress at which noticeable, suddenly increased deformation occurs under slowly increasing load.