Basic bridge designs are developed from natural bridges—a tree trunk that has fallen across a stream, vines hanging over a river, or stones that make a stepping-stone path across a shallow stream. These natural bridges were probably built upon by ancient bridge builders. For example, someone may have built up the stepping stones, placed flat stone slabs or logs on top of them, and connected the stones to create a low bridge. This type of bridge is called a "clapper bridge." It is one of the earliest bridge constructions. Such simple bridges are probably still built today in many places. In general, though, bridge construction has changed greatly.

The ancient Romans refined bridge building with two important contributions. Nearly all of their bridges used the arch design—a structure that can support more weight than a flat surface can. Also, the Romans’ discovery of natural cement allowed them to build strong, long-standing bridges. Many of these ancient Roman bridges are still standing today.

There were excellent bridge builders in Asia, too. Some early bridges in Asia used a cantilever design. This design enabled the builder to make simple, long-span bridges across fairly wide rivers. One famous bridge in China, built about 1300 years ago, is the Great Stone Bridge. Its graceful arch shape is not the same type of arch used by the Romans. Instead, this bridge is quite low, and the arch is very shallow.

The Renaissance brought new scientific ideas to bridge building. Leonardo da Vinci and Galileo developed theories about the strength of building materials. Their theories have helped architects understand how to make strong structures from lightweight materials. Bridge building became more exact as people began to use more mathematical theories about it. Another new development that changed bridge building was the development of metal.

About 200 years ago, the first cast-iron bridge was built. This was the Iron Bridge at Coalbrookdale in England. Before that time, bridges were made of stone, brick, clay, or timber. Eventually, wrought iron was used instead of cast iron. Much later, steel was used. Many new bridge designs were created and tested during this time. The Britannia Tubular Bridge, completed in 1850, showed one such new development. It was built from rectangular tubes of wrought iron. Similar tube sections are often used in bridges today.

Other important developments came with the truss bridge and the suspension bridge designs. The truss is an old design, but it was improved when engineers knew enough about science and mathematics to work out the mechanics of the design. Covered bridges were usually built on the truss design. Truss bridges were improved even more when metal was used. The suspension bridge was another basic design that was changed by the use of metal. The Brooklyn Bridge is one famous suspension bridge built during this time. It uses steel wires for the suspending cables.

About a hundred years ago, engineers began using concrete for bridges. A new method called "prestressing" helps prevent concrete from cracking after a structure is built. Today, most new bridges are made of prestressed concrete and steel.
HISTORY OF BRIDGE DEVELOPMENT

Clapper bridge

Roman arch bridge

Timber cantilever bridge design

Great Stone Bridge in China
HISTORY OF BRIDGE DEVELOPMENT

First Cast-Iron Bridge at Coalbrookdale

Britannia Tubular Bridge

Covered bridge

Brooklyn Bridge
BASIC BRIDGE TYPES

There are three basic types of bridges—beam, arch, and suspension. Bridges made to be a combination of such types are called “composite” bridges. Each of the different types of structure holds weight in a different way. In other words, a beam bridge supports weight differently than a suspension or arch bridge does, and so on. It is the balance between the downward forces (weight and gravity) and the upward forces (the supports) that allows a bridge to stand and to carry weight.

BEAM BRIDGES

A simple beam bridge is flat across and supported at the two ends. A longer beam bridge may also be held up along its middle by piers that stand in the river. The weight of the bridge itself, plus any load it carries, plus gravity, are the downward forces acting on the beam bridge. These downward forces are spread evenly across the length of the bridge. The upward forces that hold the bridge up come from the piers.

ARCH BRIDGES

A simple arch bridge reaches across the river in an arching shape rather than straight across the river. Gravity, the weight of the bridge, and the weight of its load all create the downward force. But since the bridge is curved, this force becomes a downward, outward force. Rather than the force being spread evenly along the bridge surface, it is concentrated on the end supports. Some arch bridges have a series of arches under the surface. On other arch bridges, the arch actually reaches above the deck of the bridge.

SUSPENSION BRIDGES

A simple suspension bridge droops down between the two ends that hold it up. The droop causes the downward force to go inward as well. A modern suspension bridge has towers above the bridge’s surface that carry cables to hold up the bridge.

DIFFERENT TYPES OF BEAM BRIDGES

There are several common variations of the beam bridge mentioned earlier. A clapper bridge is a simple, shallow kind of beam bridge that just connects “stepping stones” across the stream. A floating pontoon bridge is another kind of beam bridge, supported by the upward force of the water. Another type of beam bridge is the truss, which is lightweight but strong because of the open, diagonal (or triangular) beams along the sides. There are many different truss designs. Generally, the deck of a truss bridge goes straight across the river, without support at the middle.

The cantilever is a fourth kind of beam bridge. This kind of bridge is supported on two levers that are weighted by piers. The downward force at the center of the bridge is counteracted by the weights. This design allows engineers to build longer span beam-type bridges.

Engineers must consider many things before deciding which bridge design to use. They must consider how long the bridge must be, what it will be used for, how strong the riverbed earth is. The engineers also have to consider the effect of the river current (or ocean tide) on the bridge supports. Weather is another important factor. If the area is very windy or has sudden weather changes, the engineers may not want to design a suspension bridge, for example. The goal of a bridge engineer is to design the strongest, safest, most long-lasting, and economical bridge possible.
BASIC BRIDGE TYPES

Beam-type bridge

Arch bridge

Suspension-type bridge

Cantilever bridge
TRUSS BRIDGE DESIGNS

Pratt

Curved chord Pratt

Baltimore (Pratt)

Pennsylvania (Pratt)

Warren (without vertical supports)

Warren (with vertical supports)

Quadrangular Warren

Subdivided Warren types

Lattice

Whipple