

SYMMETRY

Symmetry represents an imaginary line separating the structure with a balanced arrangement of mass on either side of the line.

The force of gravity is the same on both sides of the structure.

For a symmetrical structure to be stable the mass on either side of the structure must be distributed equally around the center of the base, making the force of gravity equal on both sides.

LOADS

A load is an external force acting on a structure.

A static load is the structure itself with the non-moving load it supports. The static load is also called the dead load.

A dynamic load is an external force that moves or changes as it acts on the structure. These types of loads are also called live loads.

BRIDGE TYPES

GIRDER (BEAM) – the most basic type of bridge connecting a span supported on both ends.

TRUSS – simple skeletal structure spanning a distance.

ARCH – utilizes a curved shape, with no piers required in the center.

CANTILEVER – modified beam bridge with the support in the middle.

CABLE-STAYED – continuous girder with one or more towers above piers in the middle of the span.

SUSPENSION - continuous girder with one or more towers above piers in the middle of the span.

INTERNAL FORCES

All of the component parts of a structure exert force on each other within the structure and are called internal forces.

COMPRESSION: force acting to compact the components within the structure.

TENSION: force that acting to stretch or pull the components of the structure.

SHEAR: force tending to force components in opposite directions, causing them to rip or tear apart.

COMPLIMENTARY: occur when different internal forces act on a structure at the same time (bending).

STRUCTURAL SHAPES

A TRIANGLE is the strongest 2-D structural shape.



A TRIANGULAR PRISM is the strongest 3-D shape.



When combinations of structural components experience internal and external forces they are put under structural stress, often leading to structural fatigue (repeated use) or structural failure (collapse of the structure).

STRUCTURAL COMPONENTS

ARCH is a structural component that distributes the load down each side of the arch from the keystone.

BEAM: is a structure (flat, I shape, box shape) supported at both ends. The box beam is called a girder.

TRUSS: is a framework of beams joined together usually in interlocking triangles, supported at both ends. A cantilever truss is supported only at one end.

COLUMN: is a solid structural component that can stand alone, or is used to support beams.

STRUCTURAL MATERIALS

Structural materials are classified by their properties: brittleness, ductility, hardness, and elasticity, resistance to heat, resistance to water, compression rating and tensile strength.

In addition to these properties materials for structures are chosen because of aesthetics, availability (supply and demand), cost, disposal and effect on the environment.

Deformation - a change in the shape or performance of a structural component supporting a load. Flexibility is also a structural quality that may impact value.

JOINTS

A joint occurs where structural components connect together.

Joints can be rigid (fixed) or flexible (movable).

FRICTION JOINTS: nails, screws, rivets, tacks, staples interlocking pieces and mass.

BONDING JOINTS: glue, tape, cement and welds.

SAFETY and STRENGTH

The limits within a structure's safe performance of its intended function are referred to as SAFETY MARGIN. Structural safety may be based on weather conditions, extreme events (hurricanes, earthquakes, etc.) and environmental factors (soil type).

CORRUGATION – layers of materials that have a wave-like ridge between.

LAMINATION – glue layers together.

REARRANGE materials - to improve components strength.

FASTENER reinforcement - to make components stronger.