American Society of Engineers & Architects

Truss Design & Strength Competition

Date: Saturday, March 7,2020
Time: 8:00 AM to 12:00 Noon
Location: Citrus College
Address: Citrus, CA
Parking: Adjacent Parking Lot
Building: PC Building
Room: 309

STRUSS STRUCTURE DESIGN AND STRENGTH TESTING SPECIFICATIONS:

Competition:

Design and build a bridge type structure using Toothpicks and Hot Glue Guns. Two or more trusses will be constructed to span between two wood support elements that will be provided. Cross bracing between the trusses is necessary and required to create the bridge structure designed to support as many steel weights possible applied at the center of the truss structure with a 4” maximum width. The structure will then be submitted for Design and Structural Strength judging. During the strength testing competition steel weights will be placed on the center of the truss until the truss fails.

Design Criteria:

1. *Minimum clear span between bridge supports to be: 15"*
2. *Minimum clear height from the center of the truss span and the wood support base to be: 4", and maximum bridge width also 4”.*
3. *Two 5” X 6” foam core panels will be provided to you on the day of the competition. These panels are to be attached to each end of the truss structure and later inserted into the wood supports during the strength testing part of the competition. (See wood support isometric drawing.)*
4. *Provide a minimum 4” X 4” flat area at the center of the truss structure to support the steel weights. Flat steel plates will be placed on the center of the truss structure one on top of another until the truss fails. Each steel plate is 1/8” thick, 3 1/8” square and weighs 10.6 oz.*
5. *Weight testing is achieved with the assistance of a steel structure designed to hold the steel weights at the center of the truss until it fails*

Design Competition Judging Criteria:

1. *Craftsmanship*
2. *Esthetics – Visually pleasing*
3. *Economy of Materials*
4. *Constructed within the maximum and minimum dimensions*

Strength Competition Judging Criteria:

1. *Maximum weight supported prior to failing*
2. *Constructed within the maximum and minimum dimensions*
3. *Minimum flat area provided at center of truss to support vessel and weights*

Materials provided by others:

1. *2 - 5" X 6" foam core panels – Secure one at each end of each truss structure*
2. *Toothpicks (2 Boxes per Team)*
3. *2 Hot Glue Guns per team, 2 bags of Glue sticks per team*

Materials Provided by Competing Student Team:

1. *X - Acto Blades*
2. *Scissors*
3. *Cutting Mats*
4. *Other*

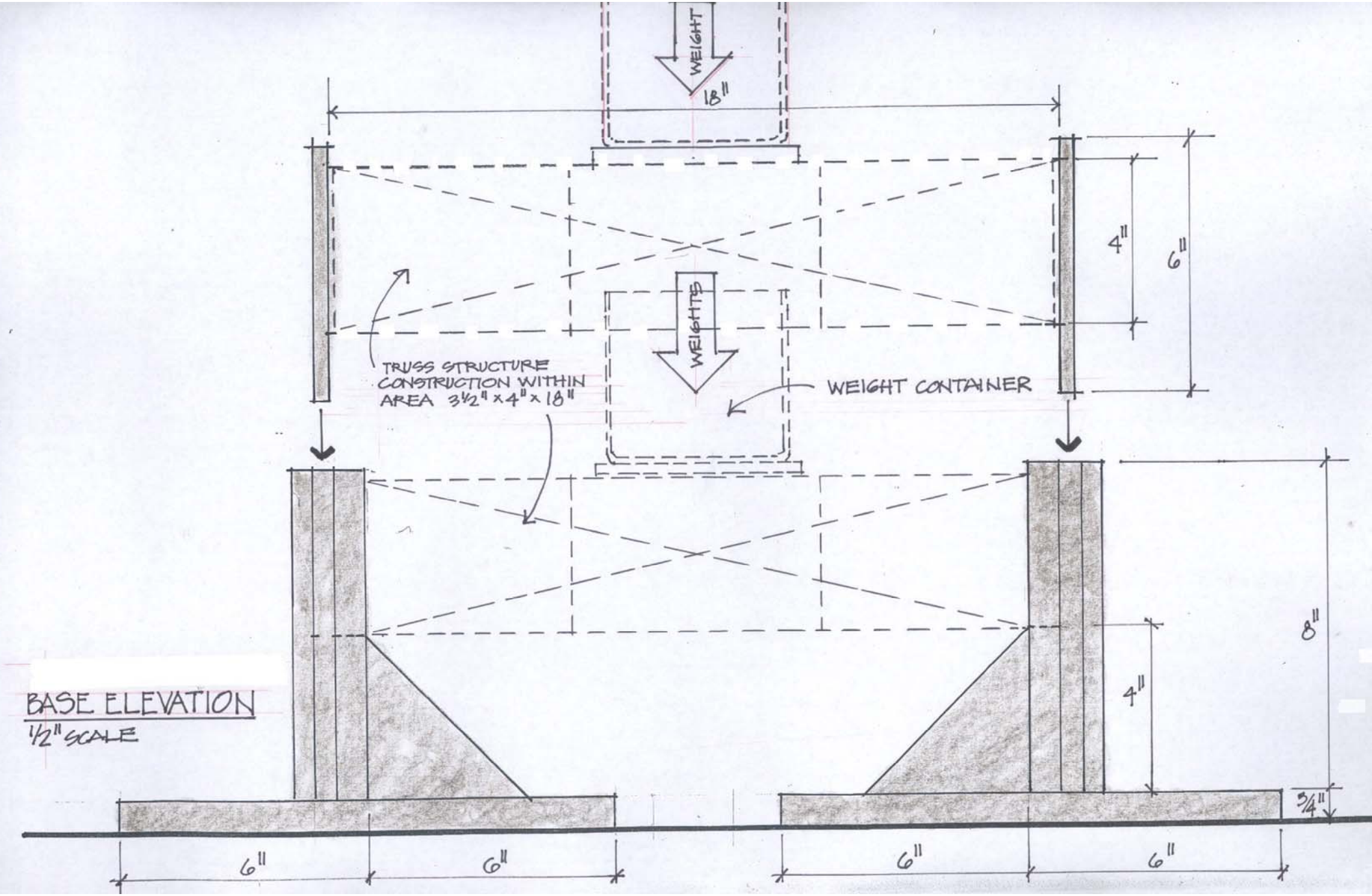
Additional Information:

1. Students participating in the Toothpick Competition are encouraged to consider the design and construction of their truss structure design prior to the competition day.

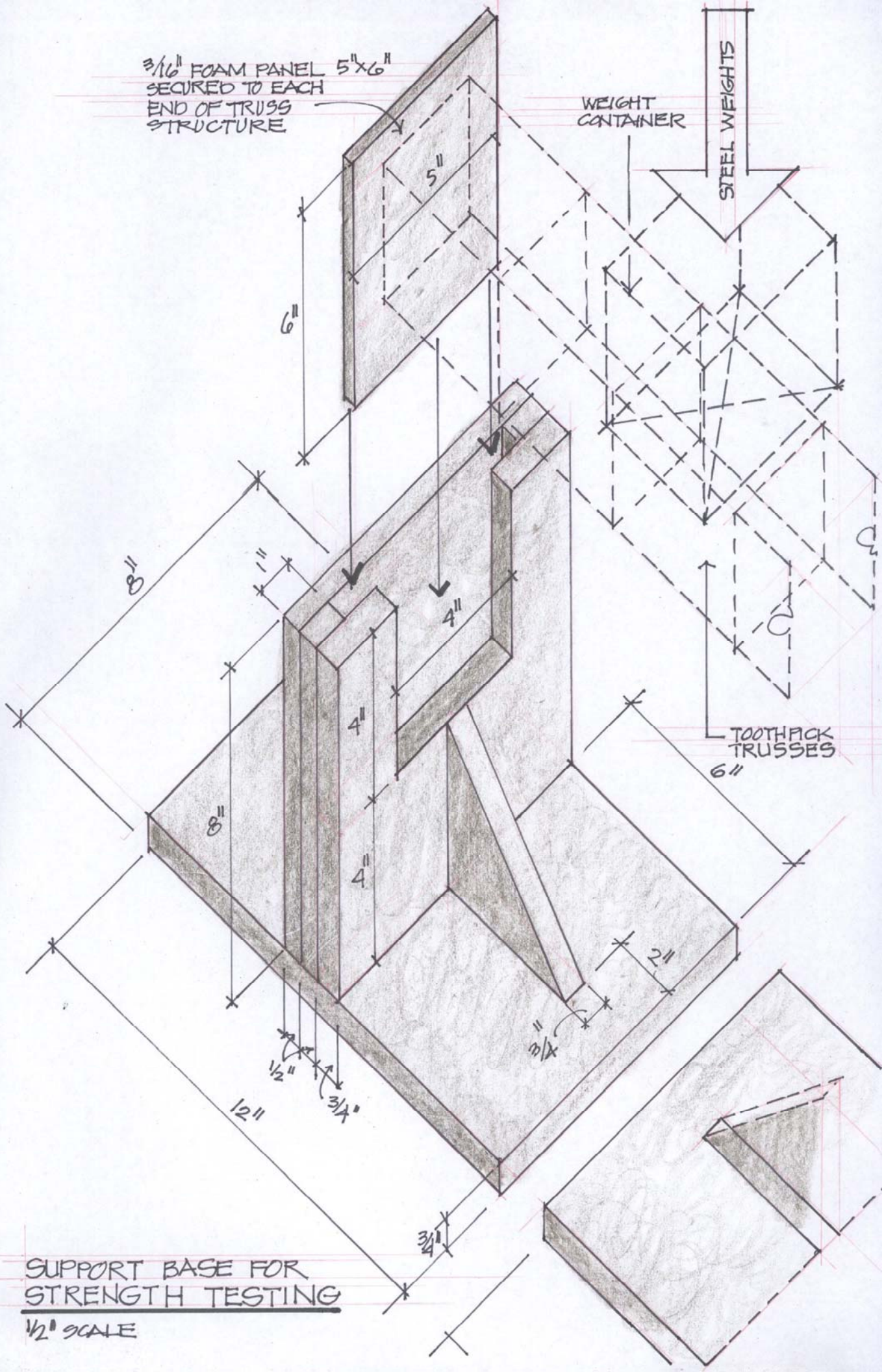
2. *The Toothpick Competition (Design and Construction) is a team competition with 2 to 4 students per team.*
5. *The number of toothpick boxes and glue provided to each team will be determined the day of the competition.*
4. *Construction time will be approximately four hours starting at 8:00 AM till 12:00 noon. Soft drinks and pizza will be provided for the participating students while the judging for design is in process.*
5. *Winners will be announced the day of the competition.*
6. *Certificates and monetary awards will be presented to the winning teams for esthetics and strength at the ASEA Award Banquet in May with the exact date to be announced. The number of winners for esthetics and strength will depend on the number of entries. Traditionally ASEA has awarded three winners for design and strength. This year the number of winners will depend on the number of teams participating.*

Winners to be announced on June 13th Student Award Barbecue

"Every student will be given a certificate of participation for their portfolio"



BASE ELEVATION
½" SCALE



SUPPORT BASE FOR STRENGTH TESTING

1/2" SCALE

Truss: Definition, Design & Types

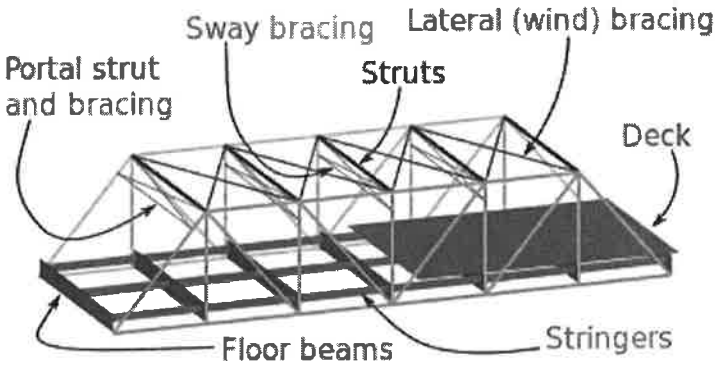
In this lesson, we'll learn about a truss, which is a versatile design that allows structures to safely transfer weight to its foundations and anchors.

Benefits of a Truss

Are you sitting in a room that is dry right now? Do you have lights on and music playing? Are you sitting in a chair that was shipped across the country? If so, you are benefiting from the use of trusses! The humble truss is an integral part of our world, and the many kinds of trusses are used to stabilize our roofs, to bridge rivers and canyons, and to erect buildings and structures that can withstand shifting weight, wind, and snow so that they do not collapse. As we will see, the truss is a structure that is key to construction!

Definition

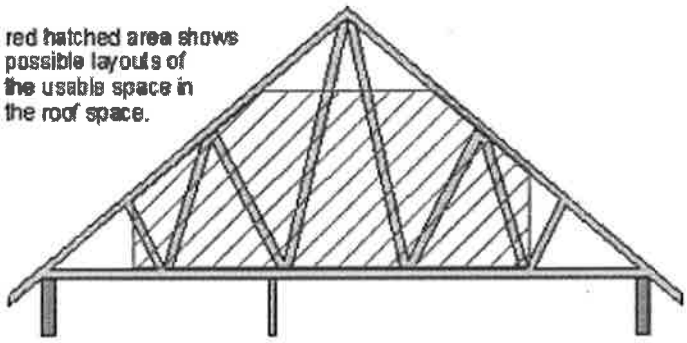
A **truss** is a structure that takes advantage of the inherent geometric stability of the triangle to evenly distribute weight, and to handle changing tension and compression. The truss uses a web of triangles that are joined so that pressure and tension are applied to the points of the corners of each triangle to take advantage of their stability to support a structure. By connecting a series of trusses together, an enormous amount of weight can be safely transferred to load-bearing beams, walls, or to the ground directly. In the diagram above, the triangles used in the bridge are built to deal with lateral wind. The uneven force that the bridge takes from wind is then safely distributed by the stability of the truss design.



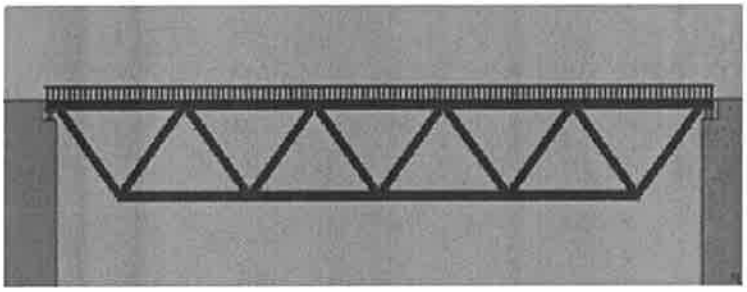
Truss Diagram

Types and Design

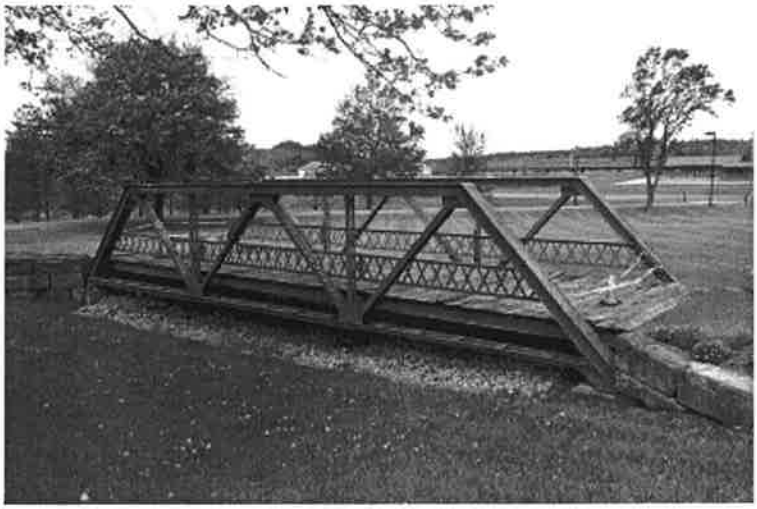
Beyond the use of triangular forms to give the truss stability, there is no specific design that determines the look of the truss. The design of a truss is truly determined by how and what the truss is used for. If the truss is used in buildings or towers, then the truss is designed to deal with shifting stresses that building may face (from wind and weather), or to carry weight evenly and safely to the foundation. By contrast, a truss used in a bridge will use triangular patterns to ensure that the strain of a train or cars is safely distributed to columns, or to the land. While there are many applications of the truss (from products to architecture), they are most commonly used in roofs, bridges and towers.



Roof trusses are frequently used in the construction of slanted roofs to stabilize shifting weight that they are subject to in the course of their lifetime. The roof you are sitting under right now may be subject to snow that piles up on top of it, or wind that hits it from one direction or another. The truss makes sure that the changing forces that the roof may encounter (known by architects as **live load**) won't cause it to shift or collapse.



Warren Truss



Warren Truss bridge

Types of Trusses

far as weight of building is considered.

A truss can be of two types as far as workspace is considered;-
1. Planar truss
2. e truss (SPACE TRUSS)

Pl truss is that in which members lie in a two dimensional plane while space truss lies in three di ion. ↖ PLANAR

A ↙ TRUSS is composed of three basic parts, one is top chord, the beam at the top which is usually in compression, bottom chord, beam at the bottom which is usually in tension, webs are interior beams.

There are variety of trusses available depending on the requirement including span length and loading condition.

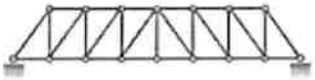
Basically two types of trusses exists :-
a) Bridge Truss
b) Roof Truss

1. Pratt Bridge Truss

It includes vertical members and diagonals that slope down towards the center. The diagonal members are subjected to tension while vertical members are subjected to compression.

2. Howe bridge Truss

It includes vertical members and diagonals that slope up towards the center.

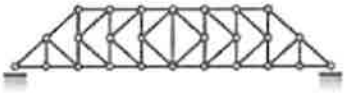


3. Baltimore Bridge Truss

A Baltimore truss has additional bracing in the lower section of the truss to prevent buckling in the compression members and to control deflection.

4. K Bridge Truss

A truss in the form of a K due to the orientation of the vertical member and two oblique members in each panel is known as a K bridge Truss

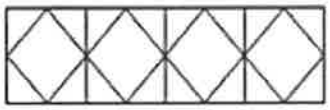


5. Warren Bridge Truss

It consists of longitudinal members joined only by angled cross-members, forming alternately inverted equilateral triangle-shaped spaces along its length.

6. Bailey Bridge Truss

It is designed for military use, the prefabricated and standardized truss elements may be easily combined in various configurations to adapt to the needs.



Roof Truss

1. Pratt Roof Truss

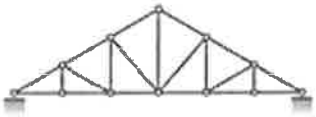
It uses vertical member for compression and horizontal members to respond to tension and is most efficient under static and vertical loading.

2. Fink Roof Truss

They are used for longer spans having high pitch roof, since the web members in such truss are sub-divided to obtain shorter members.

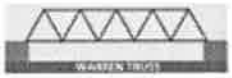
3. Howe Roof Truss

It is a roof truss with vertical web members to take tension forces and with angled braces to take compression.



4. Warren Roof Truss

In warren roof truss diagonal members are alternatively in tension and compression are used in a building ranging from 20-100 m in length.



5. King Post Roof Truss

A king post extends vertically from a crossbeam to the apex of a triangular truss. It connects the apex of the truss with its base, holding up the beam (in tension) at the base of the truss.