

Verdugo Fire Academy

Ventilation: Basic Building Construction

Part 3



CSFM Unit L
FFFS Chapter 14



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Long Beach Fire Department

Ventilation: Basic Building Construction

Fighting an advanced fire in a building ranks with the world's most hazardous occupations.

It would seem to be obvious that the fire combat forces should know as much as possible about the building before the fire...



History of Construction

- We in the fire service must protect ourselves with our knowledge of the ways in which different types of buildings can fail and with specific information about the particular building on fire
- In 2000 B.C., Hammurabi, the King of Babylon, promulgated his famous edict which, in effect, said that if a building collapsed and killed the owner, the architect (builder) would be put to death... we don't have that option today. Buildings will continue to be built to save money... this is not to our advantage and here is why...

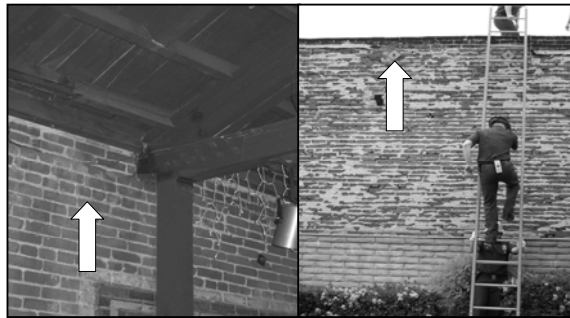
**Review,
types of Building Construction**

- 1. Type I Fire Resistive
- 2. Type II Non-combustible
- 3. Type III Ordinary
- 4. Type IV Heavy timber
- 5. Type V Wood frame

Also consider the buildings
age

Construction & Building Age

AGE OF BUILDING PRE- 1933



Construction & Building Age

AGE OF BUILDING 1933-1950



Construction & Building Age

AGE OF BUILDING 1950- PRESENT



Construction Methods

- Frame/ Stucco
- Frame/ Wood
- Metal
- Masonry
- Curtain
- Concrete



Frame/Stucco



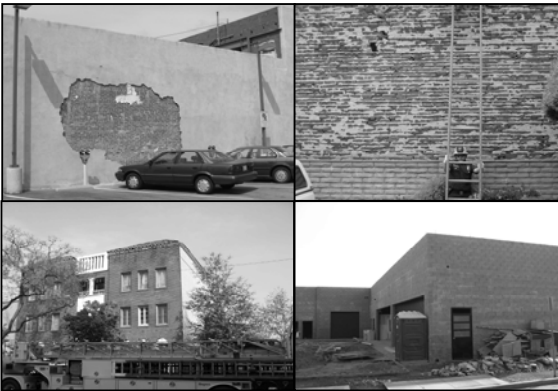
Frame/Wood



Metal



Masonry



Curtain



CONCRETE



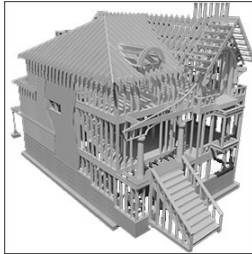
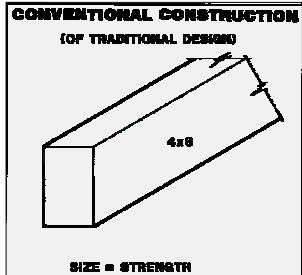
Styles of Construction

- Conventional
- Lightweight



Conventional Construction

- Structural members depend on:
SIZE FOR STRENGTH
- Greater spans = Greater size



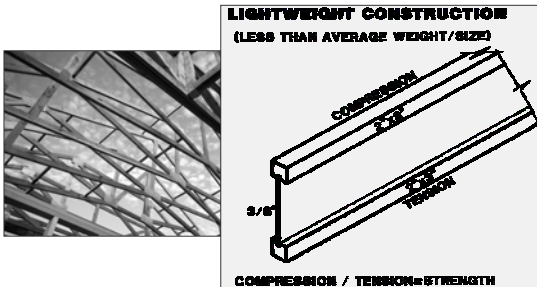
Conventional Construction

- The larger the size the greater the
TIME
we have to work...
- 2X4 to mill timber is the standard
–The construction of the past

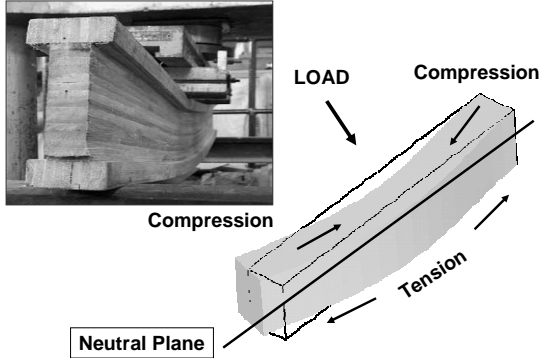


Lightweight Construction

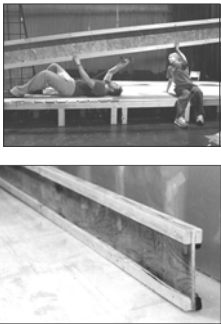
- Lightweight construction utilizes multiple members that are in **TENSION** and **COMPRESSION** for its **STRENGTH**



Lightweight Construction



Lightweight Construction

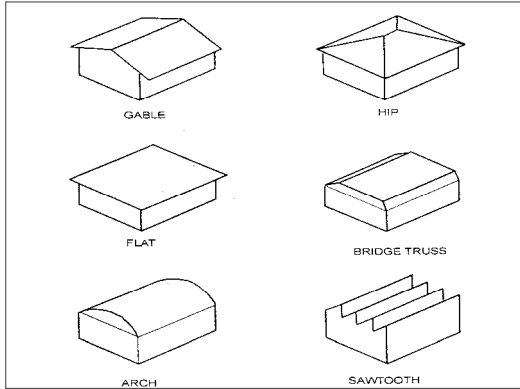


- Spans up to 70' can be obtained by 2X4's in tension and compression
- Less time required for collapse when exposed to fire
- 2X3's - 2X4's are the standard

Styles of Construction, lightweight vs. conventional



Roof Styles six basic roof styles



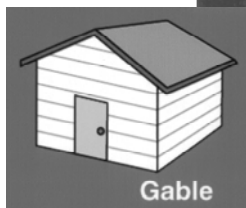
Roof Styles

- Both Gable and Hip roofs have pitch design to them...
- Lantern is another pitched roof design.
- The roofs pitch can vary greatly.
- Don't get the design and styles confused.
- Remember, use a roof ladder on any pitch that makes footing difficult.



Roof Designs

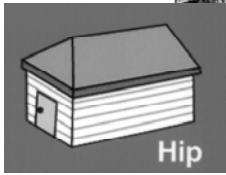
- Designs
- Pitched
 - Gable



Roof Designs

Designs

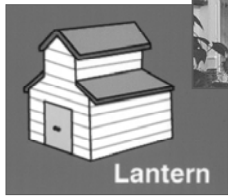
- Pitched
- Hip



Roof Designs

Designs

- Pitched
- Lantern



Roof Styles Gable

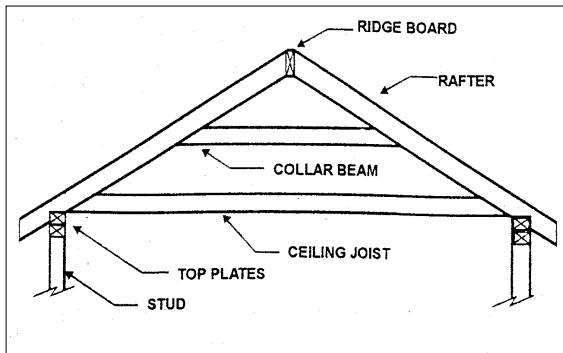


Conventional Gable

- “A” frame configuration
- Ridge board, Rafters, Joists
- Collar beams/Joists for support
- Usually 2”X6” or larger
- Found 16”-24” can be 36” O.C.
- Sheathing:
 - Straight, Space, Diagonal or Ply-wood



Conventional

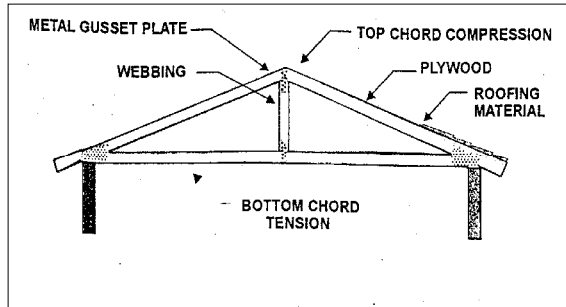


Lightweight Gable

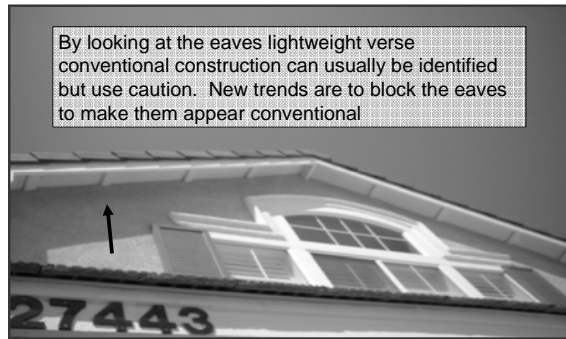
- Utilizes 2”X3” or 2”X4” trusses
- Trusses share top chords, bottom chords and webbing
- Held by metal gusset plates
 - 18 gauge - 3/8” penetration
- Found 16”-24” O.C.
- Sheathing: 3/8” or 1/2”
 - Ply-wood
 - OSB



Light Weight

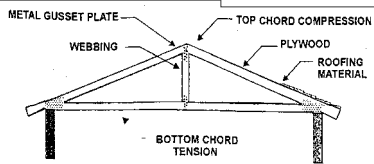


Light Weight

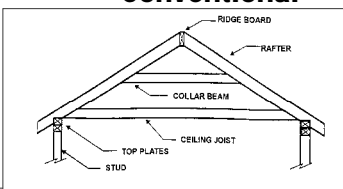


Light Weight

Multiple members under tension and compression



Conventional



Size equals strength

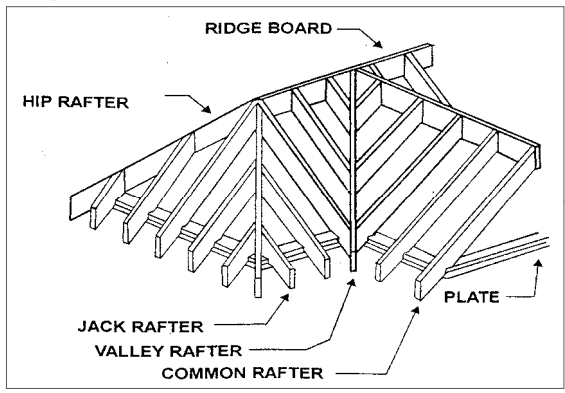
Gable (Strengths/Hazards)

- S- 2X6 or larger ridge boards and rafters
- S- Conventional takes longer to burn
- S- Ridges and outside walls are safe to walk on
- S- Older roofs use 1X4" or 1X6" space sheathing
- H- Metal gusset plates fail early
- H- 2X3 or 2X4 construction
- H- Newer roofs use 3/8" or 1/2" plywood

Roof Styles Hip



Hip Roof

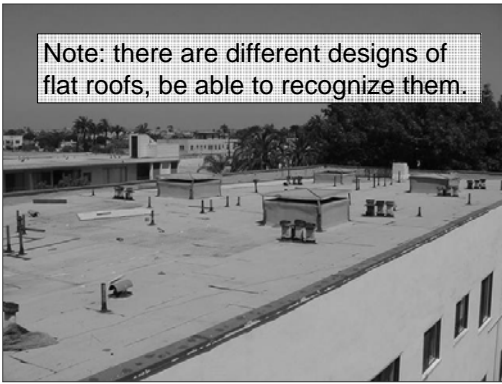


Hip (Strengths/Hazards)

- S- 2X6 or larger ridge pole and rafters
- S- Conventional takes longer to burn
- S- Ridge pole, valley rafters, hip rafters and outer walls are safe areas
- S- Older roofs use 1X4" or 1X6" space sheathing
- H- Metal gusset plates fail early
- H- 2X3 or 2X4 construction
- H- Newer roofs use 3/8" or 1/2" plywood

Roof Styles Flat

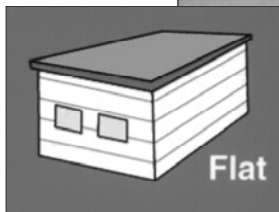
Note: there are different designs of flat roofs, be able to recognize them.



Roof Designs

Designs

■ Flat



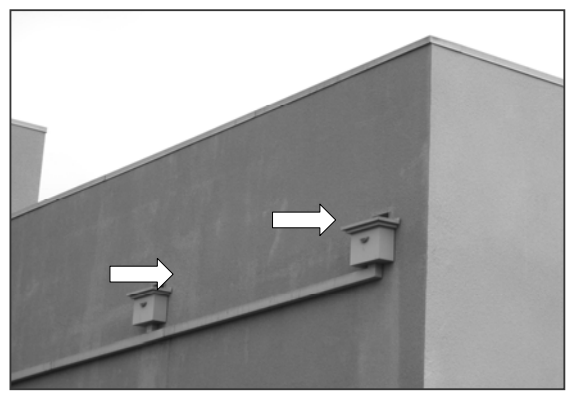
Construction Feature you need to know

- Parapet
- Scuppers

PARAPET



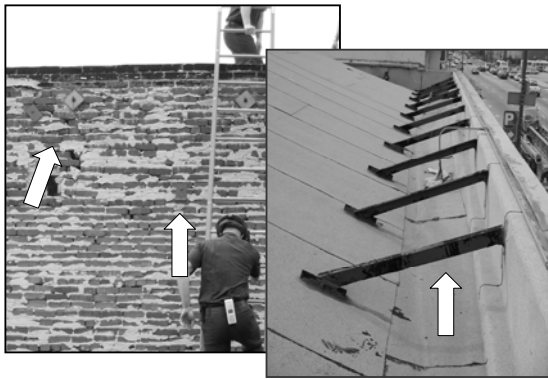
SCUPPER



FACADE

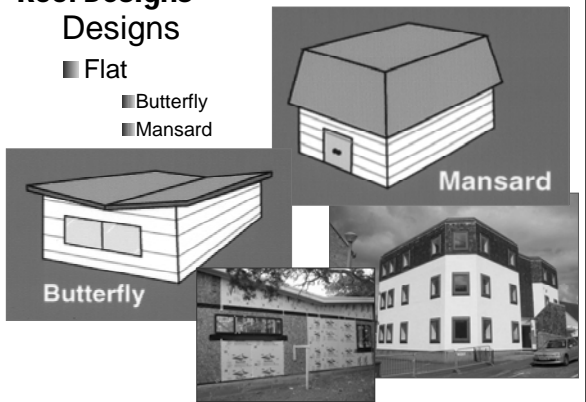


TIE PLATE

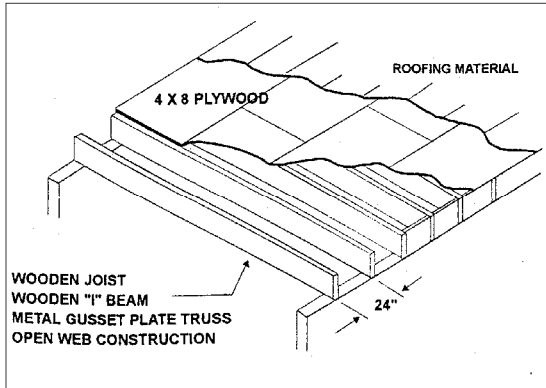


Roof Designs

- Flat
- Butterfly
- Mansard



Conventional Flat roof



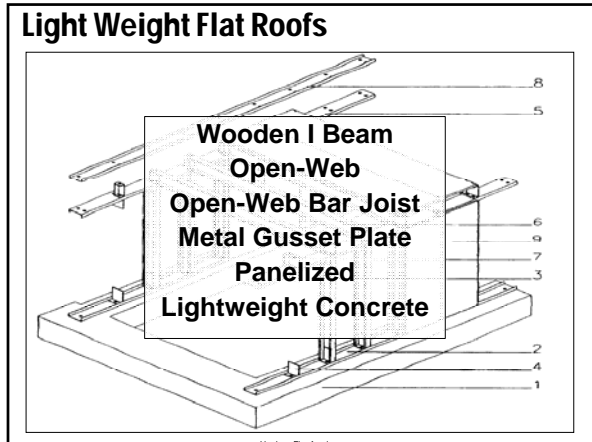
Conventional Flat roof



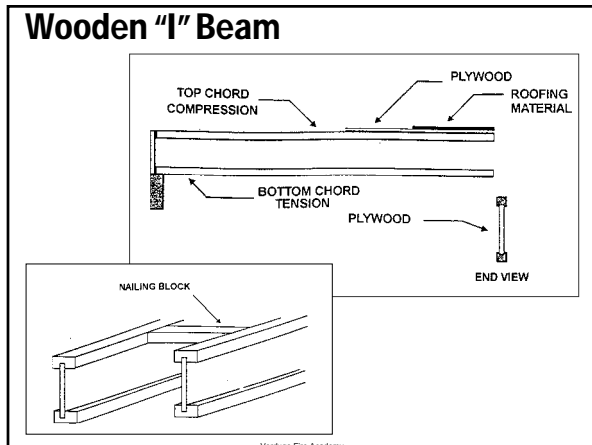
Conventional Flat Roof (Strengths/Hazards)

- S/H- Dependent upon size of rafters, on center spacing, and type of decking
- S- 1X6 sheathing as roof decking
- S- Perimeter of building is a strong point
- H- Roofs covered in 3/8 or 5/8 plywood roof decking

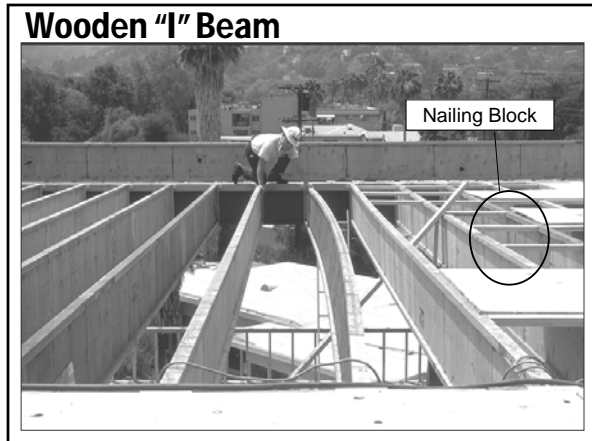
Light Weight Flat Roofs



Wooden "I" Beam



Wooden "I" Beam



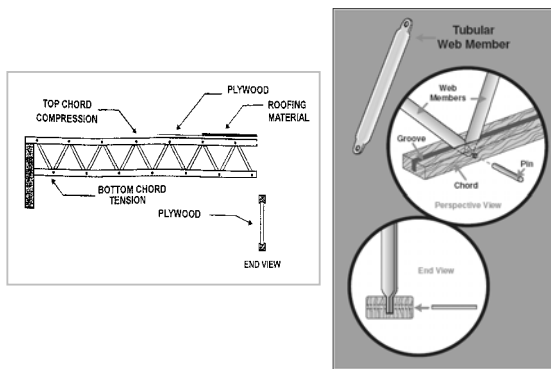
Wooden "I" Beam



Wooden I Beam (Strengths/Hazards)

- S- Perimeter of building is considered a strong area
- H- Stem burns quickly
- H- Stem cut for heating and air conditioning ducts

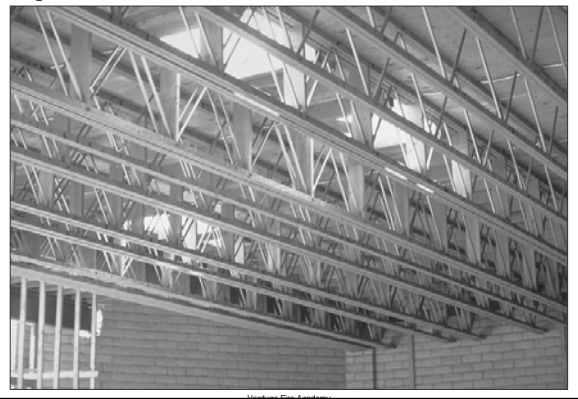
Open Web bar joist



Open Web bar joist



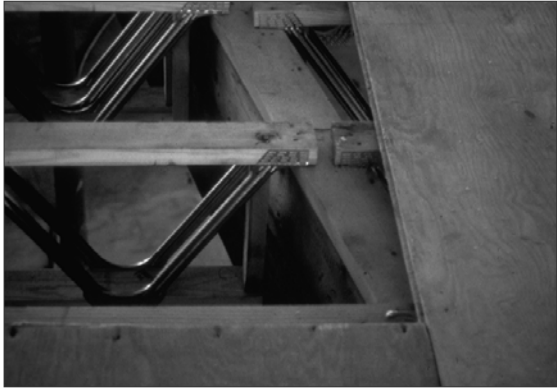
Open Web bar joist



Open Web design gusset plate



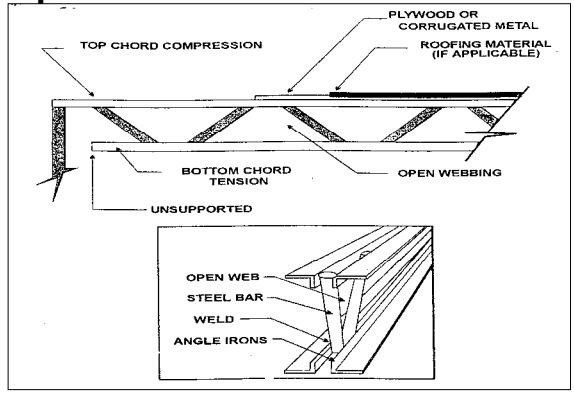
Open Web design gusset plate



Open Web (Strengths/Hazards)

- S- Perimeter of building is considered strong area
- H- 2X3 & 2X4 chords under tension and compression
- H- 1/2 inch plywood decking
- H- Chord members exposed to interior
- H- No fire stops
- H- Expect rapid failure of this roof when exposed to fire

Open Web Bar Joist



Open Web Bar Joist

Type II
Construction
Metal Roof



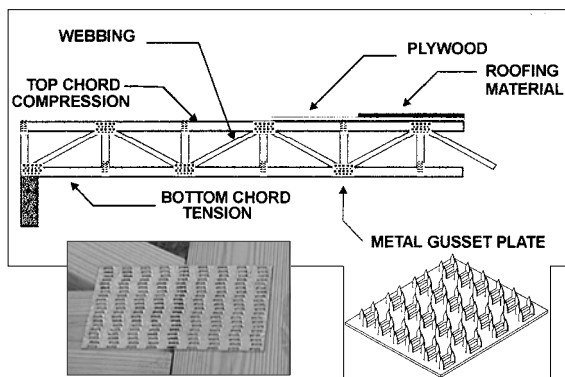
Type III
Construction
Wooden Roof



Open Web Bar Joist (Strengths/Hazards)

- S- Perimeter of building a strong area
- H- Metal will expand, twist and possibly fail at 1000°
- H- Early roof collapse is a major concern
- H- Ventilation operations difficult
- H- Ability of fire to burn through the multiple layers

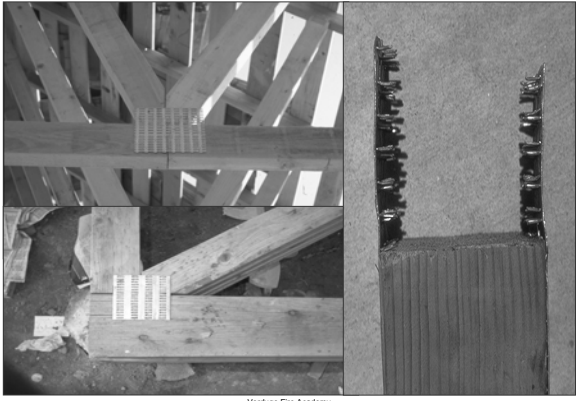
Metal Gusset Plate also known as gang nail



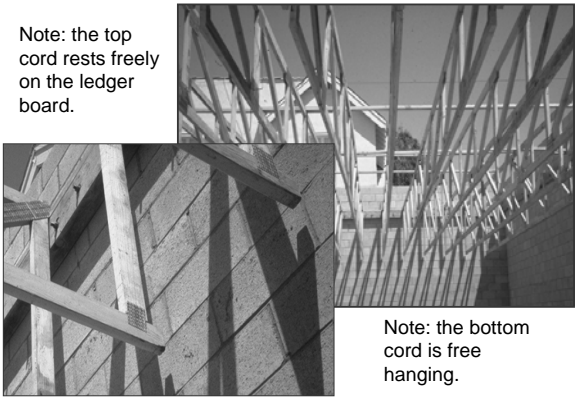
Metal Gusset Plate



Metal Gusset Plate



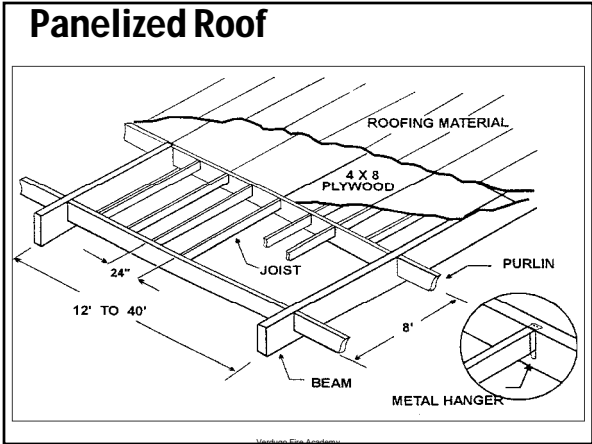
Metal Gusset Plate



**Metal Gusset Plate
(Strengths/Hazards)**

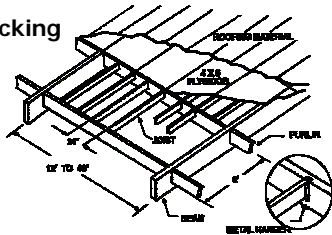
- S- Trusses that cross or terminate at outer bearing walls are strong areas
- H- 2X4's, MGP connectors = short burning time
- H- Trusses are in tension and compression
- H- Collapse will cause a domino effect
- H- Decking is comprised of 3/8 or 1/2 plywood

BRAKE



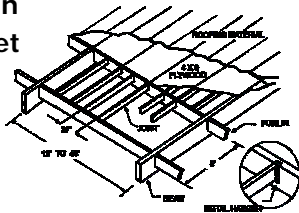
Panelized Roof components

- Consists of 4 major components
 - Beams (laminated wood or metal)
 - Purlins
 - 2X4 joist
 - 1/2 plywood decking



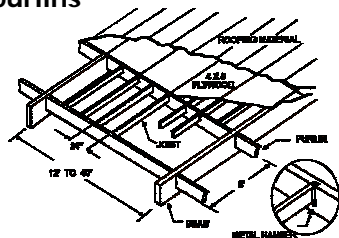
Panelized Roof Laminated beams

- 6X36 is common
- Beams are supported at ends by pilasters, wood or steel posts, or saddles
- Beams may be bolted together to provide lengths in excess of 100 feet
- Spaces between 12 to 40 feet



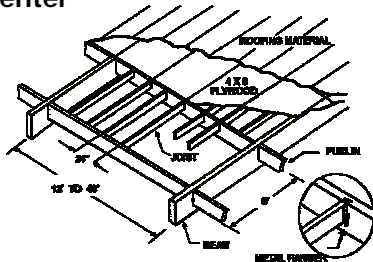
Panelized Roof Purlins

- 4X12 is common
- Spaced 8 feet apart
- MGP trusses are substituting conventional purlins



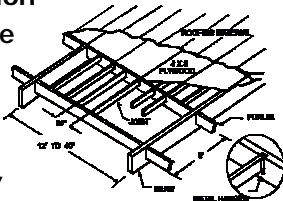
Panelized Roof Joists

- 2X4X8 is common
- Installed with metal hangers
- 2 foot on center between purlins



Panelized Roof Decking

- Sheets of 4X8X1/2 plywood
- Covered with composition roofing material
- Three layer insulation paper stapled to the underside "tar impregnated Kraft paper covered by thin aluminum foil"



Panelized Roof Laddering

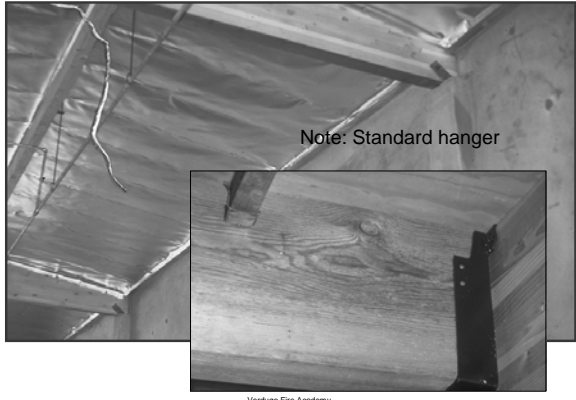
Concrete – Tilt-up & Strip-Mall have Long spans

Ladder 8 ft from Corner

50/50 (Purlin or Lam beam)



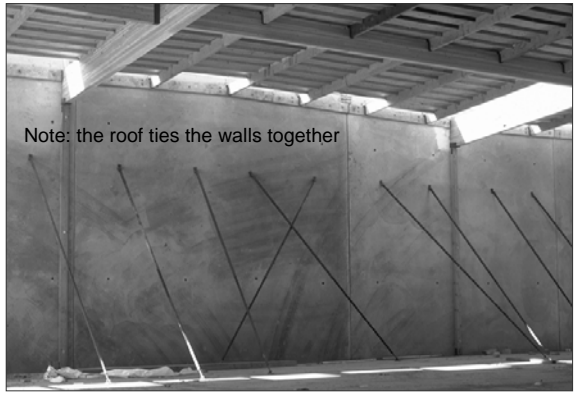
Panelized Roof



Panelized Roof



Panelized Roof



Panelized Roof



Panelized Roof with metal gusset plate

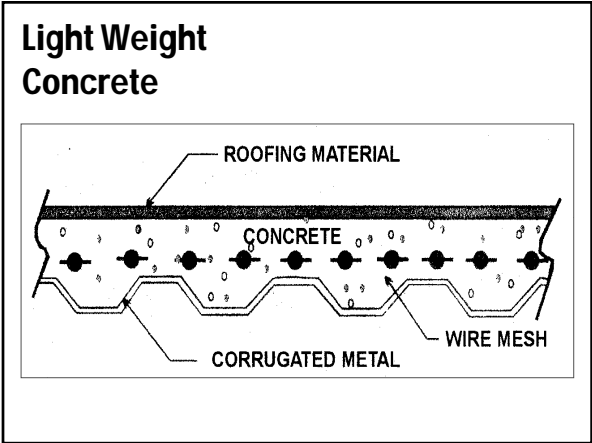


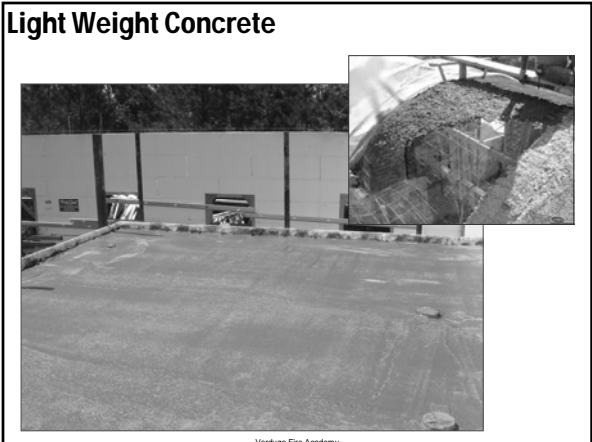
Panelized Roof with open web bar joist



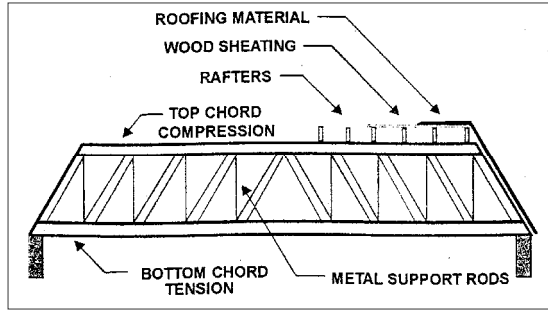
**Panelized Roof
(Strengths/Hazards)**

- S- Beams/purlins/building perimeter
- H- Weak beam span supports "4 inch hollow steel pipe"
- H- 2X4 joists and 1/2 plywood decking quickly burn
- H- Burning insulation gives off flammable gasses
- H- If lightweight trusses replace purlins consider rapid roof failure





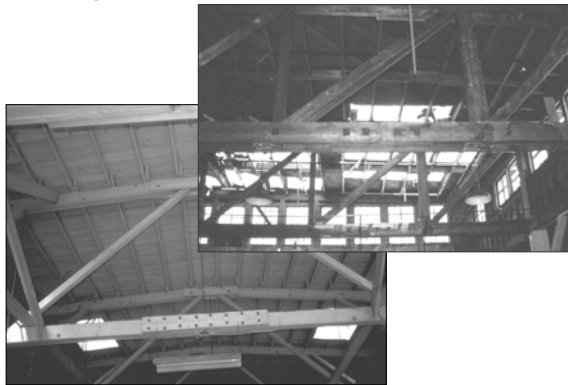
Bridge Truss



Roof Styles Bridge Truss



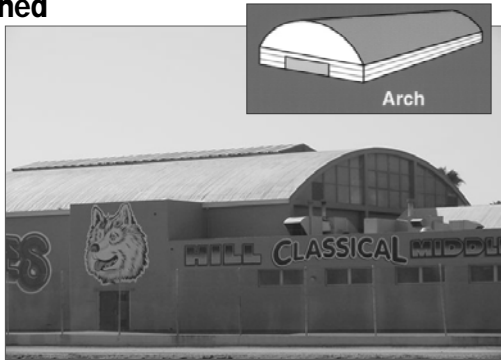
Bridge Truss



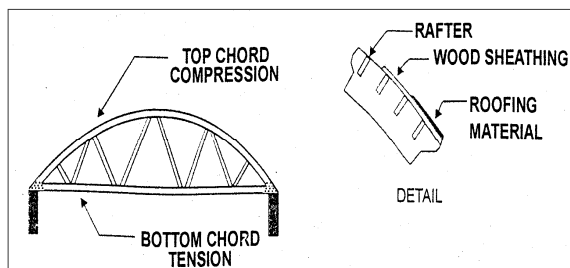
Bridge Truss Roof (Strengths/Hazards)

- S- Well constructed
- S- Characteristic sloping ends
- S- Roofs do not use plywood for decking cover
- H- Strength dependent upon size of lumber and span of trusses
- H- Trusses in tension and compression/will fail under severe fire conditions
- H- Underside usually exposed in warehouse type structures

Roof Styles Arched



Ribbed Arch similar to bridge truss



Ribbed Arch

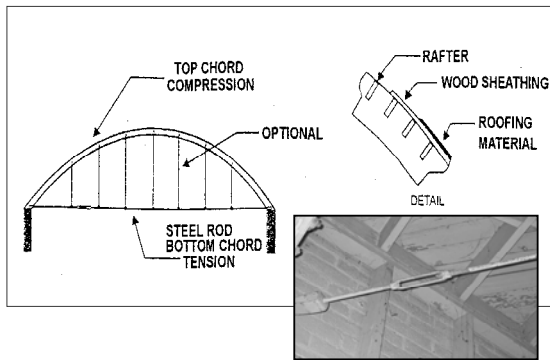


Ribbed Arch (Strengths/Hazards)

- S- Well constructed
- S- Early structural collapse not a primary concern
- S- Roofs do not use plywood for decking cover
- H- Strength dependent upon size of lumber and span of trusses
- H- Trusses in tension and compression/will fail under severe fire conditions
- H- Underside usually exposed in warehouse type structures

Tied Truss / Bowstring

uses metal tie rods to hold the walls of the building..



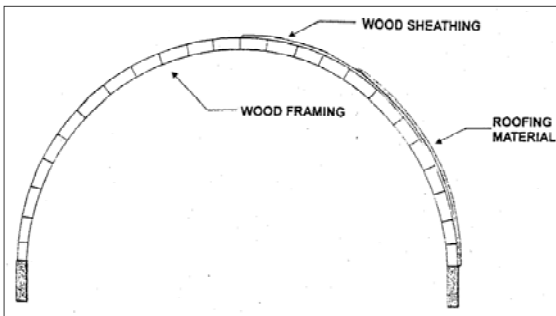
Tied Truss / Bowstring



Bowstring Arch Roof (Strengths/Hazards)

- S- Utilizes large sized lumber
- S- 1X6 sheathing as roof decking
- H- Early failure of metal tie rods and turnbuckles
- H- Total failure eminent

Lamella common on gymnasiums



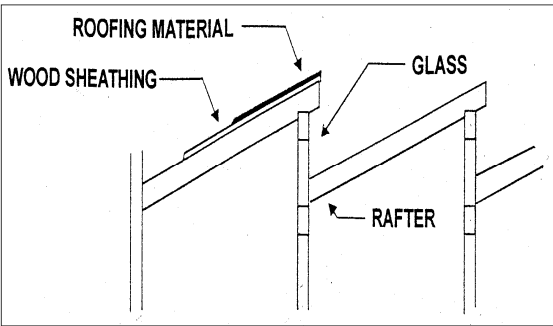
Lamella Arch



Lamella Arch Roof (Strengths/Hazards)

- S- Built solid
- S- Early structural collapse not a primary concern
- S- Roofs do not use plywood for decking cover
- H- Strength dependent upon size of lumber and span of trusses
- H- 20% of roof failure may result in total collapse "the domino effect"
- H- Underside usually exposed in warehouse type structures

Sawtooth Roof



Sawtooth



Sawtooth Roof (Strengths/Hazards)

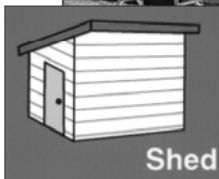
- S- Well constructed
- S- Early collapse not a primary concern
- S- Easy to ventilate
- H- Underside exposed to the inside
- H- Newer sawtooth roofs covered with 1/2 plywood

Shed

Designs

■ Shed

■ Note: Shed is as much a Roof Design as much as it is a type of building



Types of Roof Coverings

- Wood shingles
- Compositions shingles
- Composition roofing paper
- Tile
- Slate
- Hot mopped
- Tar and gravel
- Concrete
 - Lightweight

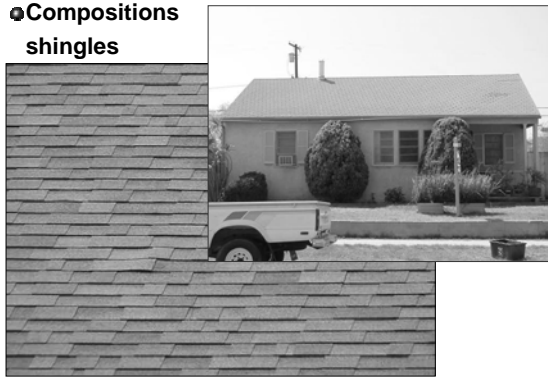
Types of Roof Coverings

- Wood shingles



Types of Roof Coverings

- Compositions shingles



Types of Roof Coverings

●Composition roofing paper



Types of Roof Coverings

●Tile



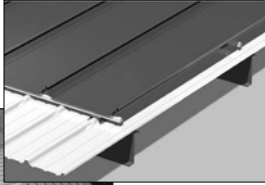
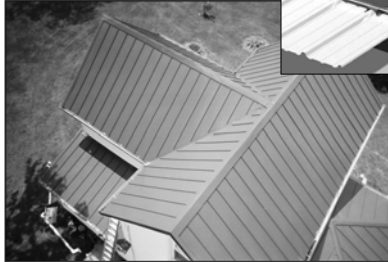
Types of Roof Coverings

●Tar and gravel



Types of Roof Coverings continued

- Light gauge steel
- Galvanized sheet metal
- Aluminum



Ventilation

As you can see there is much to learn about building construction.

This knowledge can mean the difference between a safe and efficient operation or death.

The more you apply yourself to learn this and other building construction methods, the better you will be prepared to handle both Engine and Truck Company operation.

Apply yourself.

BRAKE
