ELEMENTS OF ENGINEERING I (ENGG 111)

BUILDING MATERIALS, COMPONENTS AND STRUCTURE

BRIDGES, DAMS AND TRUSSES

BRIDGES, DAMS AND TRUSSES

A. BRIDGES

- A structure providing passage over an obstacle without closing the way beneath.
- Passage may be for Road, railway, Canal, Pipelines.
- According to NRS 2027(Nepal Road Standard)
  - A structure providing passage over an obstacle without closing the way beneath with span >6 m are called BRIDGE
  - If <6 m they are called CULVERT.

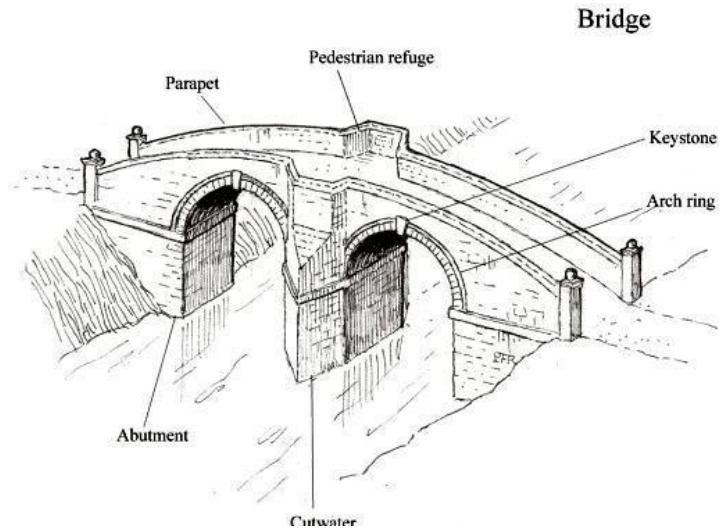
Characteristic of IDEAL Bridge

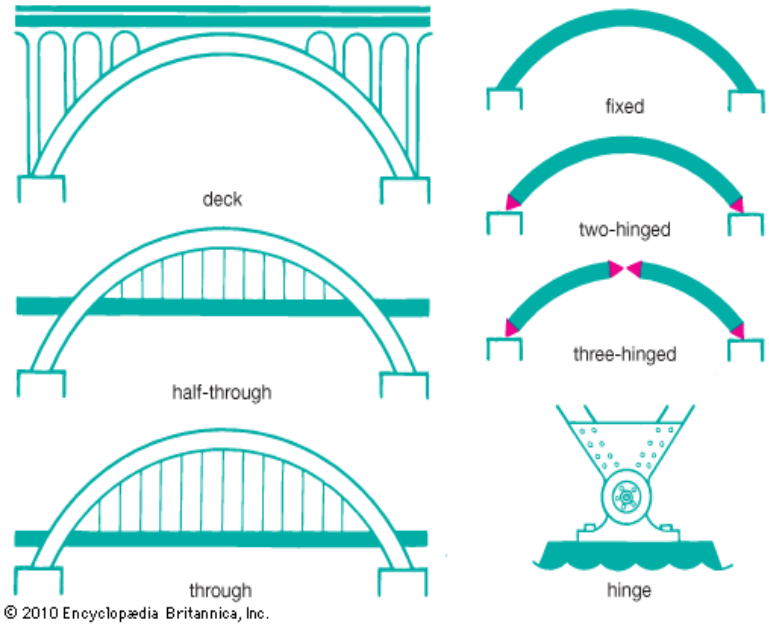
1. The line of bridge **should not have serious deviation** from the line of approach road.
2. Should **be in level**.
3. Width of bridge should be **sufficient to incorporate future traffic**.
4. Bridge **should not produce undue obstruction of stream, provide adequate waterway.**
5. Economical
6. Foundation **should be in firm ground, sufficient depth**.

Types of Bridges

Arch Bridge

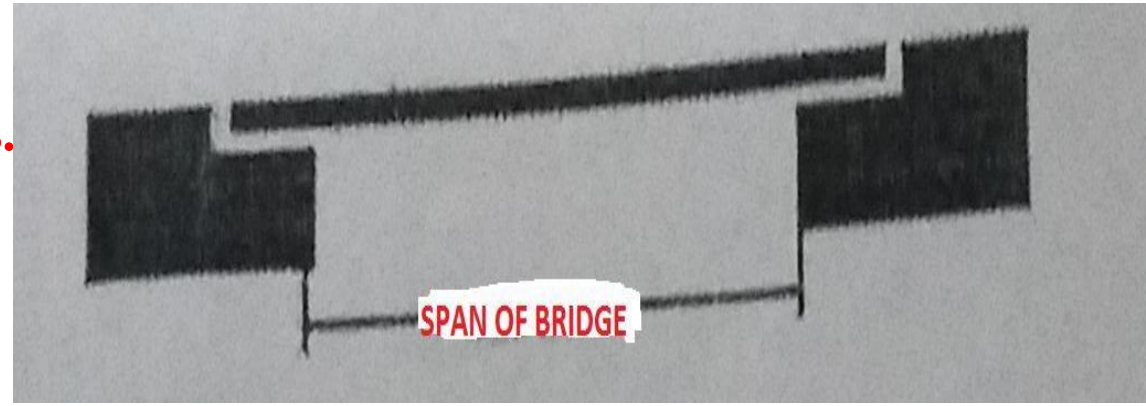
- They have **arc as main structural component, located below (generally) the bridge.**
- Instead of **pushing straight down, the load of an arch bridge is carried outward along the curve of the arch to the supports at each end.** Weight of bridge is thrusted to its abutment.

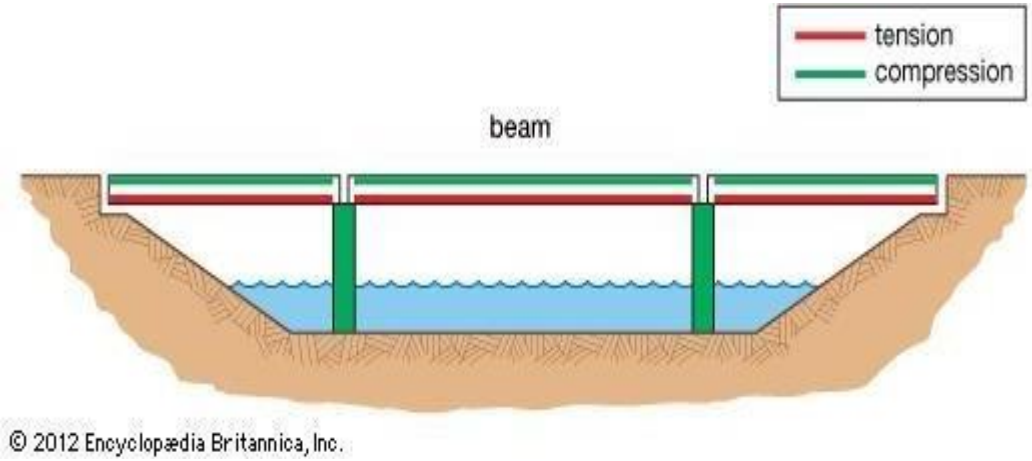




Beam Bridge

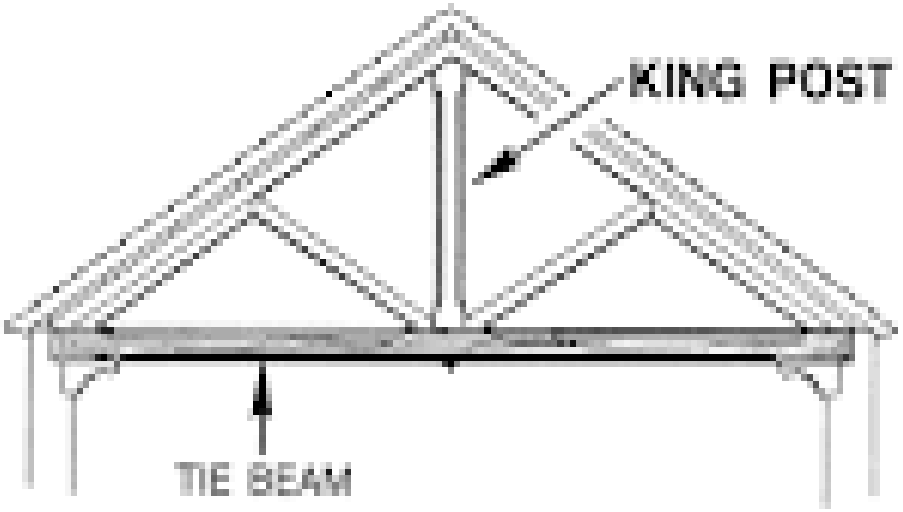
- Most common
- They are **supported by several beams of various shape and size made of steel or wood**.
- They are the horizontal beams supported at each end by substructure.
- Can be multiple span type.
- **Intermediate supports are called Piers.**

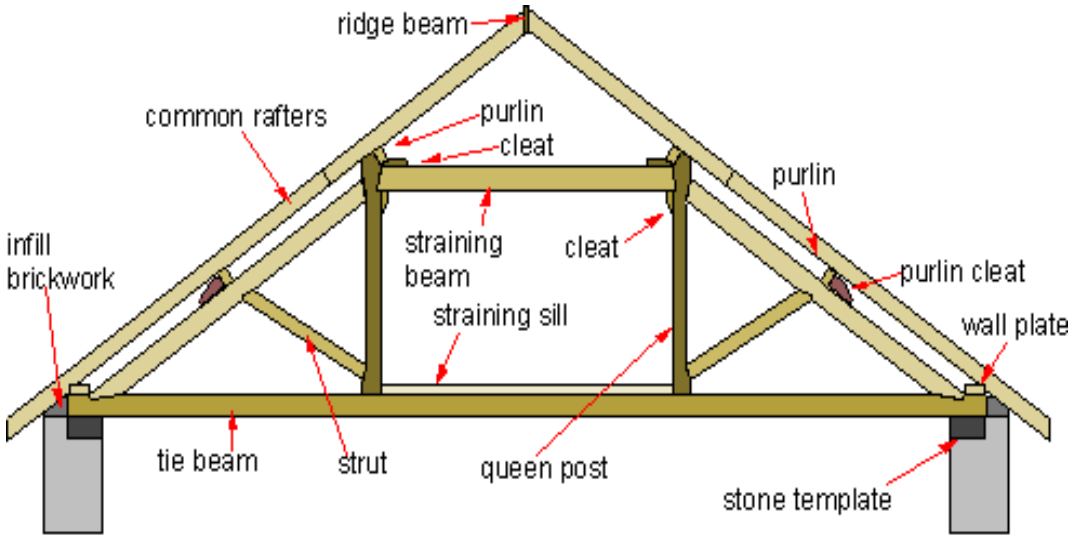




Truss Bridge

- Uses **truss as the main load bearing superstructure**.
- Truss: a structure of connected elements forming triangular units





Traditional Queen Post Roof Truss

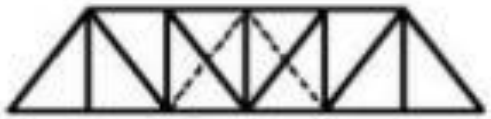
King Post :

2 diagonal members supported by single vertical post at center.

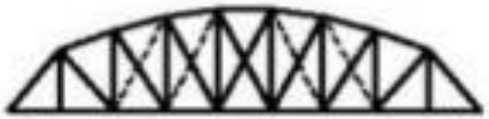
Queen Post:

2 diagonal members,2 vertical ,members and Horizontal member connecting 2 vertical members at top.

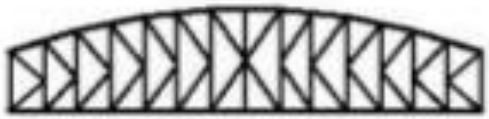
BRIDGE TRUSS TYPE



Pratt



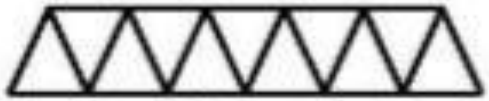
Parker



K-Truss

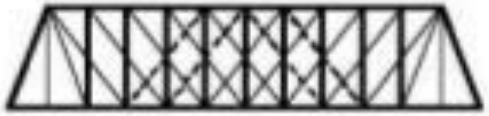
Howe

Camelback



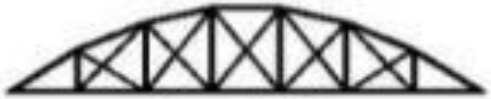
Warren

Fink



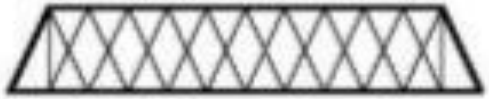
Double Intersection Pratt

Warren (with Verticals)

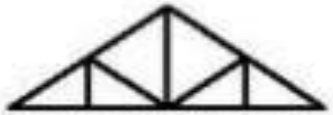


Bowstring

Baltimore



Double Intersection Warren



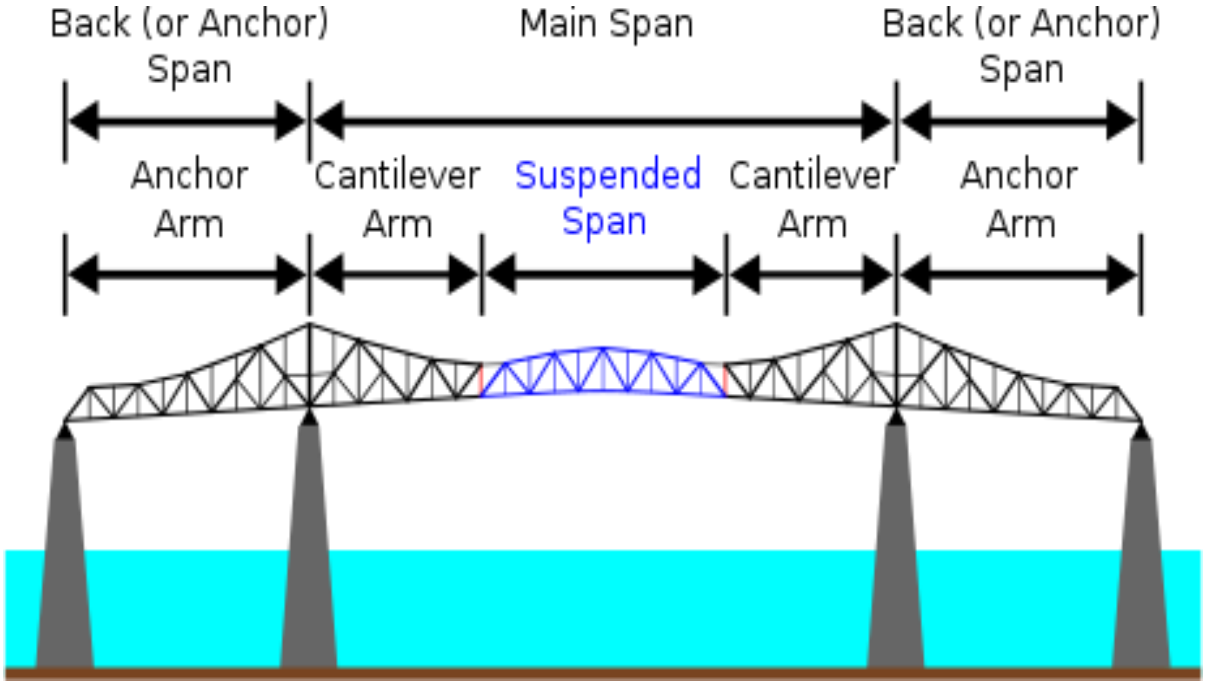
Waddell "A" Truss

Pennsylvania

Lattice

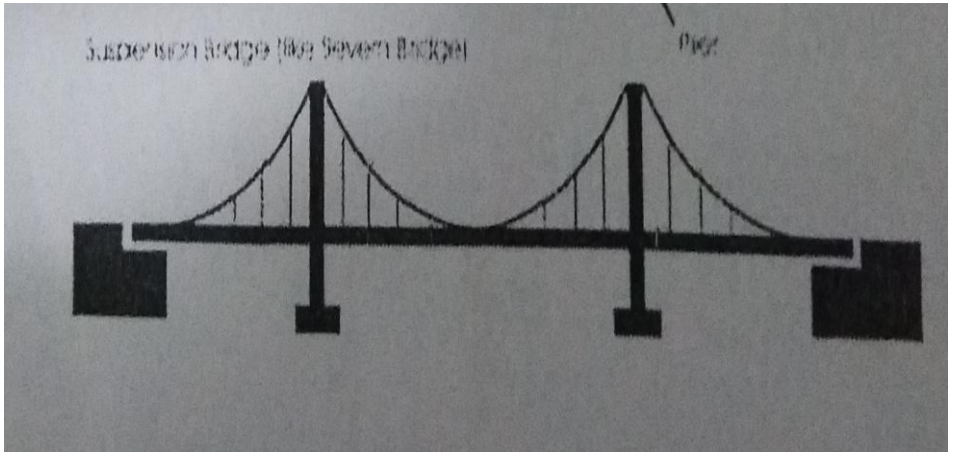
Cantilever Bridge

- Use of **Cantilever-horizontal beams supported on only one end**.
- May use pair of Continuous spans extending from opposite sides of Supporting piers.
- For small foot bridges **the cantilever bridge may be a simple beam** and
- For **larger bridges, they use trusses**



Suspension Bridge

- Uses rope or cables from the vertical suspender to hold weight of bridge deck and traffic.

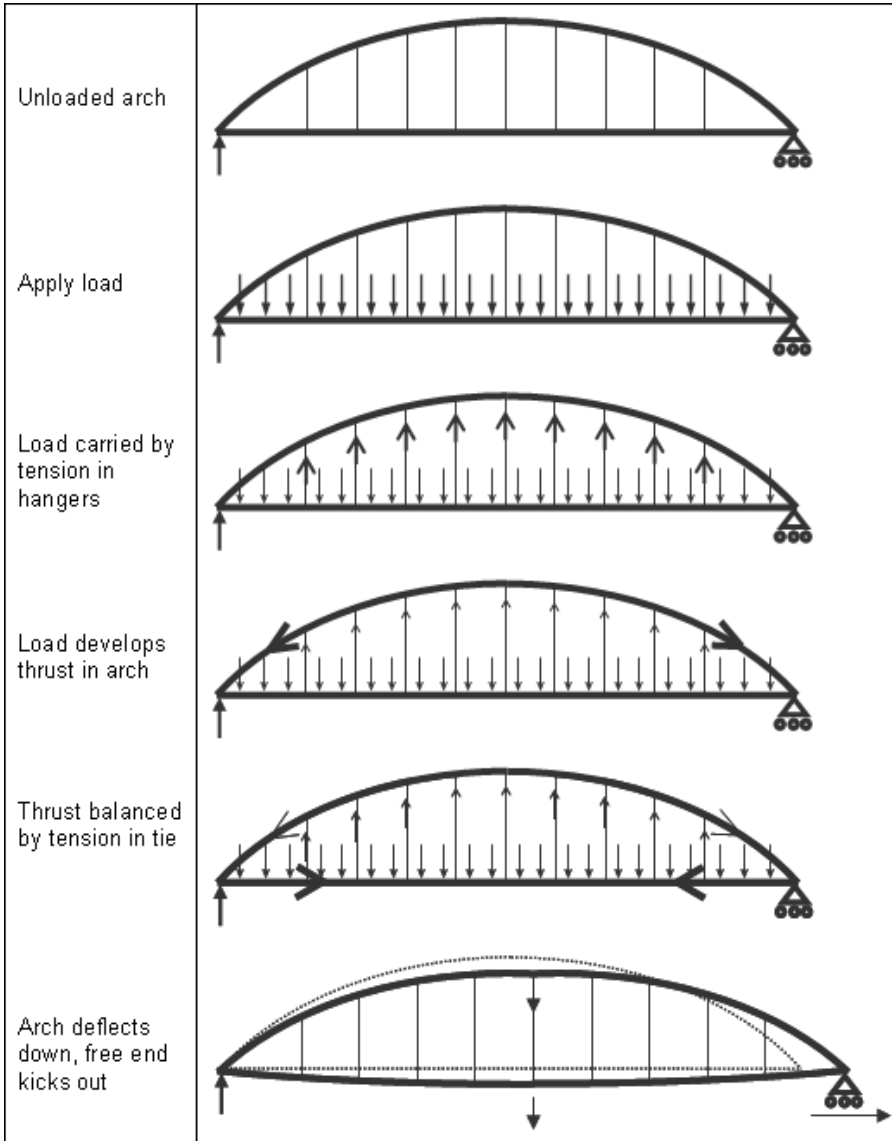


Cable Stayed Bridge

- Uses deck cables connected directly to one or more vertical columns.

Tied Arch Bridges

- Have arch shaped superstructure
- Instead of transferring the weight of bridge to abutments, the ends are restrained by tension in the bottom chord
- Also called Bowstring Arches.



WORKING OF TIED ARCH BRIDGE

B. DAMS

- It is the obstruction or a barrier constructed across a river or a stream.
- Water is accumulated at the back of this barrier forming a pool of water called Reservoir.
- Water gets collected at its Upstream and the other side is called Downstream

<u>Dams</u>
Simply a Hydraulic structure constructed across a river that raises the water level behind it to form a reservoir for the use of any social function such as Hydropower, Irrigation, Water Supply ,Recreation ,Flood Prevention etc.

Classification of Dam

1. Based on Purpose

- *Storage Dam*
- *Detention Dam*
- *Diversion Dam*

2. Based on Material

- *Non Rigid Dams*
  - *Earthen Embankment Dam*
  - *Rock Fill Dam*
- *Rigid Dams*
  - *Concrete Dam*
  - *Roller Compacted Con. Dam*
  - *Timber Dams*
  - *Steel Dams*

3. Based on Head

- *High Head Dam > 100 m*
- *Medium Head Dam 50 – 100m*
- *Low Head Dam <50m*

4. Based on Structure

- *Gravity Dams*
  - *Embankment Dams*
    - *Earthen Dams*
    - *Rock fill Dams*
- *Arch Dam*
- *Buttress Dam*

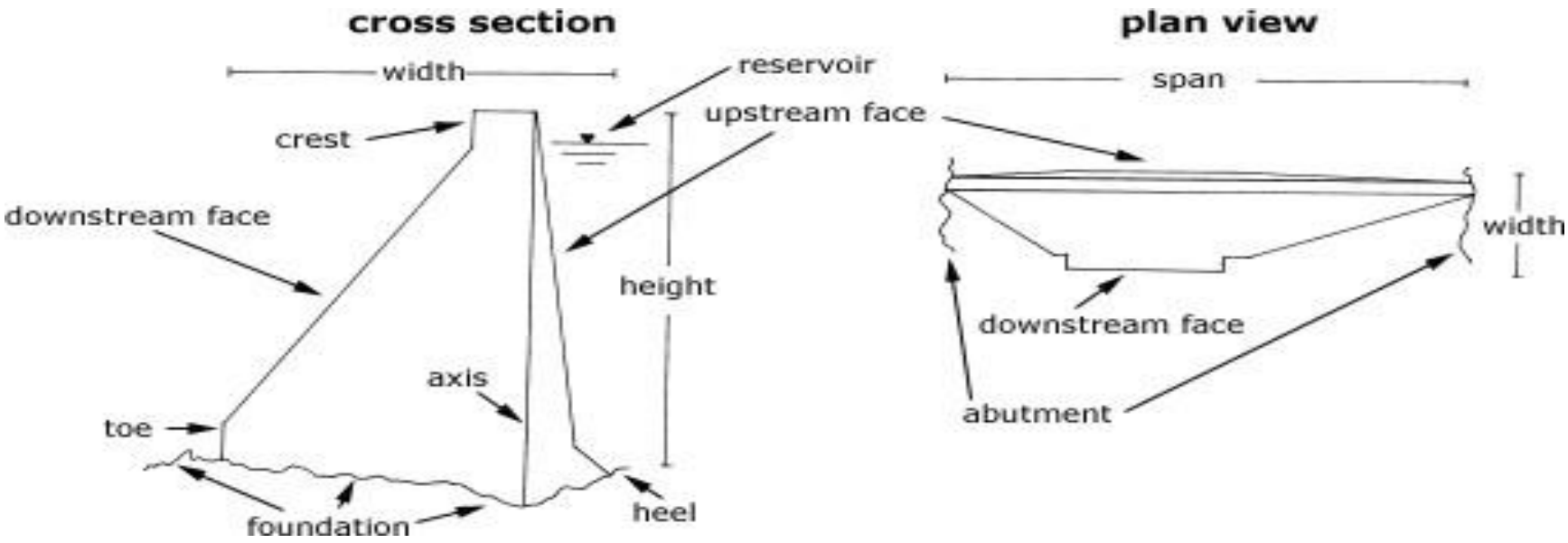
Based on structure

i) Gravity Dams

Gravity dams are dams which resist the horizontal thrust of the water entirely by their own weight.

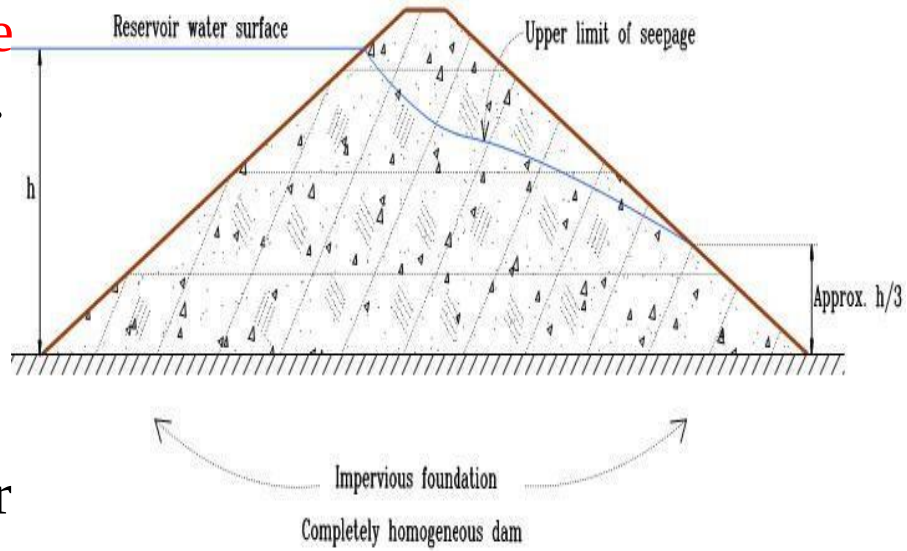
They use their weight to hold back the water in the reservoir.

Can be made of earth or rock fill or concrete.



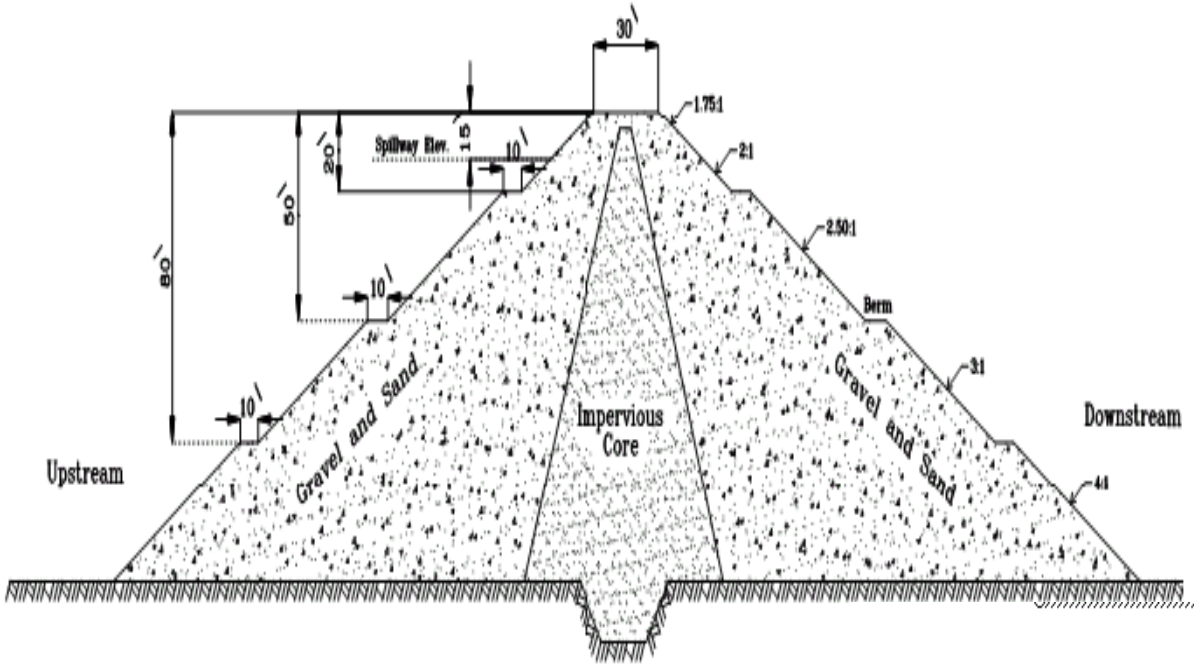
ii) Embankment Dam

1. Are made up of compacted Earth or the rock fill without any cementing agents.
2. Are further classified into Earthen Dams and Rock Fill Dams
3. Has impervious core of compacted earth fill
4. Rely on their weight to hold back water

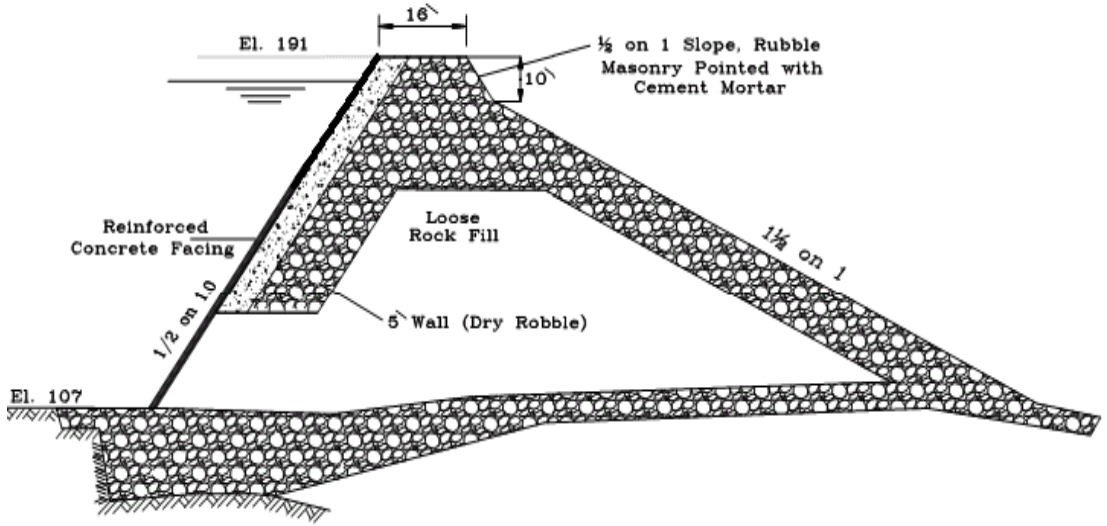


Earthen Dam Vs. Rock Fill Dam

- *Compacted Soil accounts for more than 50 % of the placed volume of material.*
- *When 50 % of the fill material are classified as rock, the dam is classified as rock fill dams.*



Earthen Dam



Section through Beaver Park Dam, Colorado.
(Eng. News, 73,p.660)

Rockfill dam with RCC facing

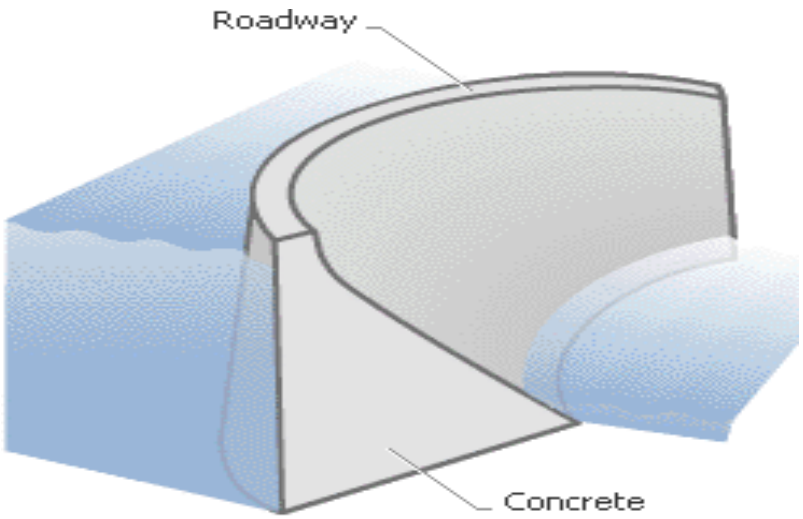
Advantages

1. Are suitable for river valleys
2. Can accommodate to a broad range of foundation condition ranging from good rock to permeable rock
3. Uses naturally available materials
4. Less costly

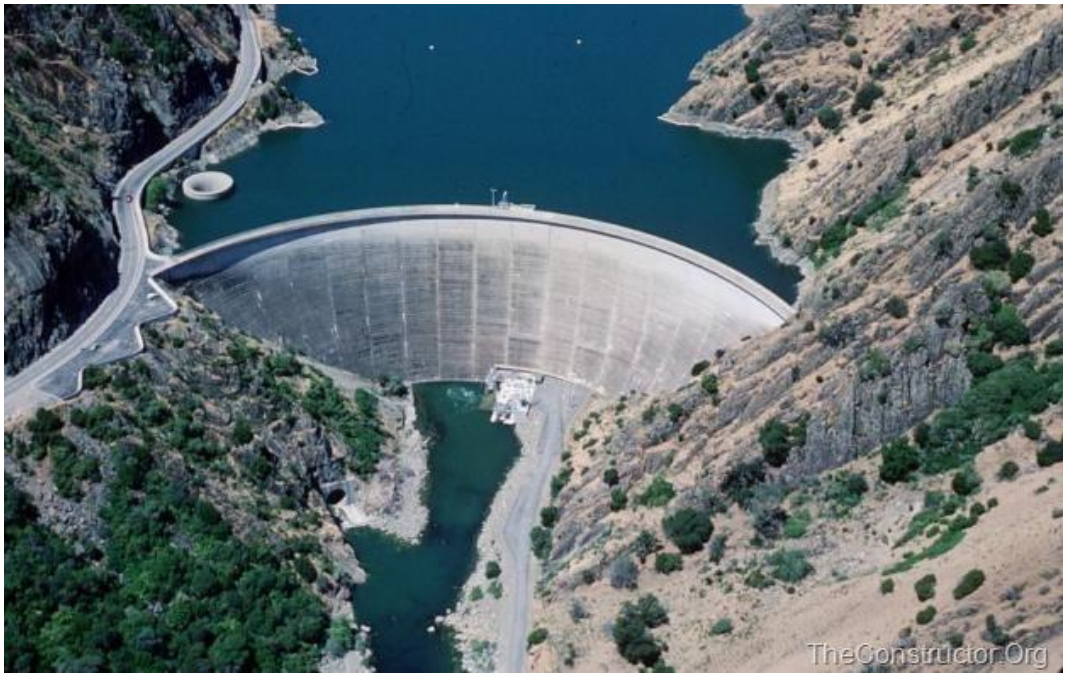
Disadvantages of Embankment Dam

1. Are more susceptible to damage than Concrete gravity dams
2. Seepage problem is higher

iii) Arch Dam



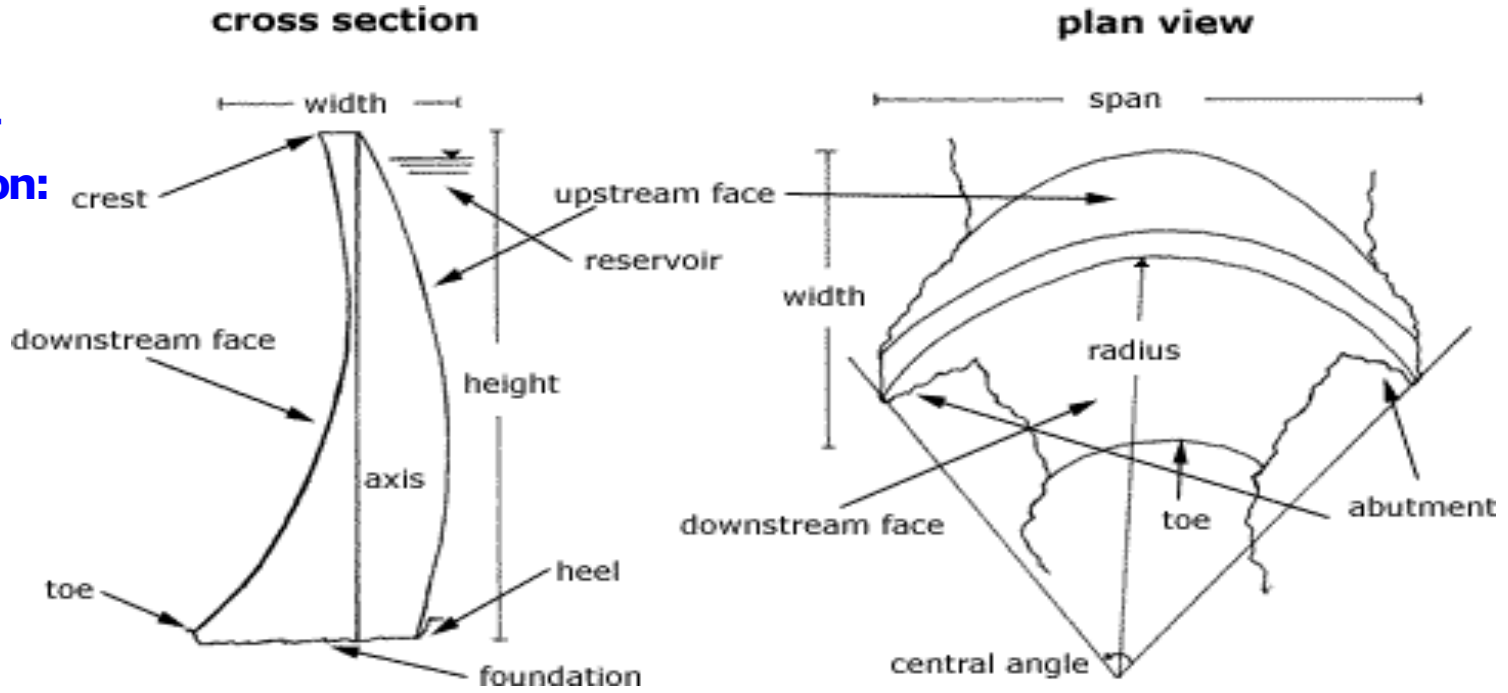
Arch dam



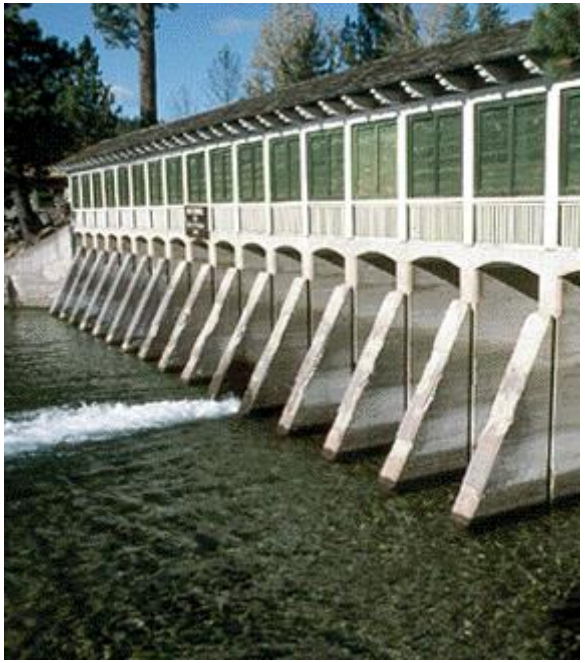
HOOVER DAM, USA

- An arch dam is **a curved dam which is dependent upon arch action for its strength.**
- Transmits most of horizontal water thrust behind them to the abutments by the arch action.
- Arch dams **are thinner and therefore require less material than any other type of dam.**
- Arch dams are good for sites that are narrow and have strong abutments.

Material of Construction: Concrete

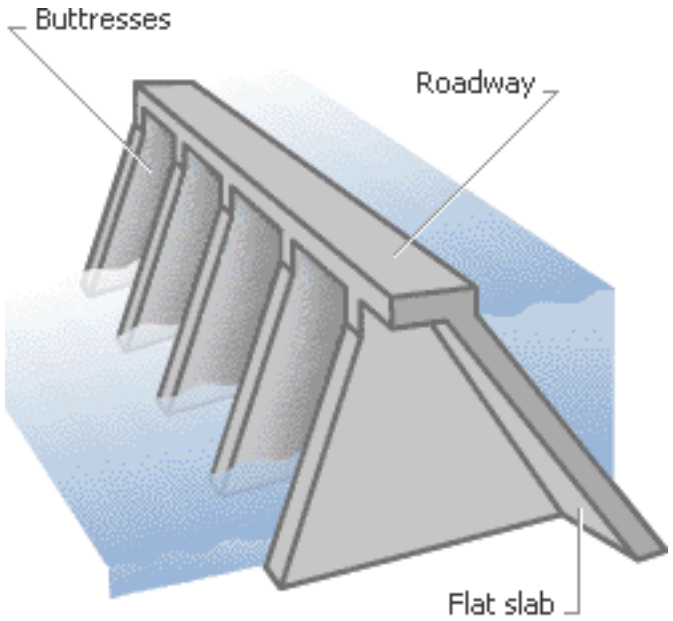


iv) Buttress Dams

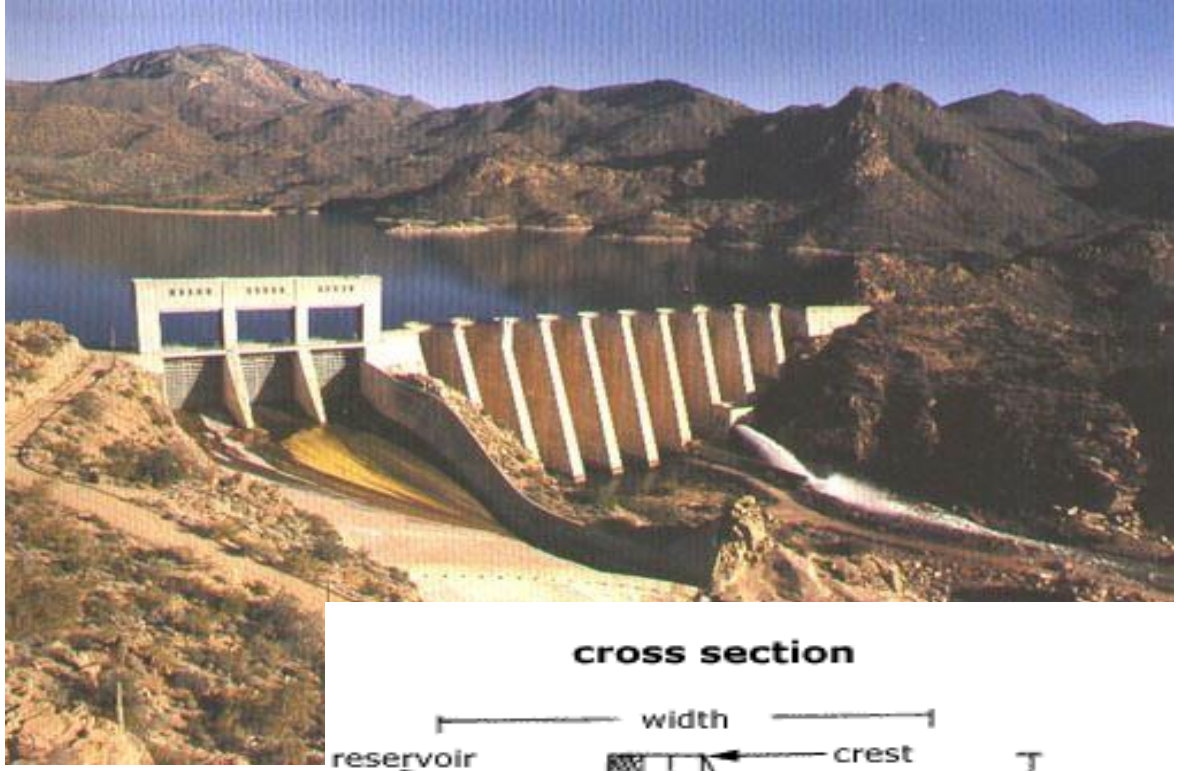


Buttress dams are dams in which the face is held up by a series of supports.

The face may be flat or curved.



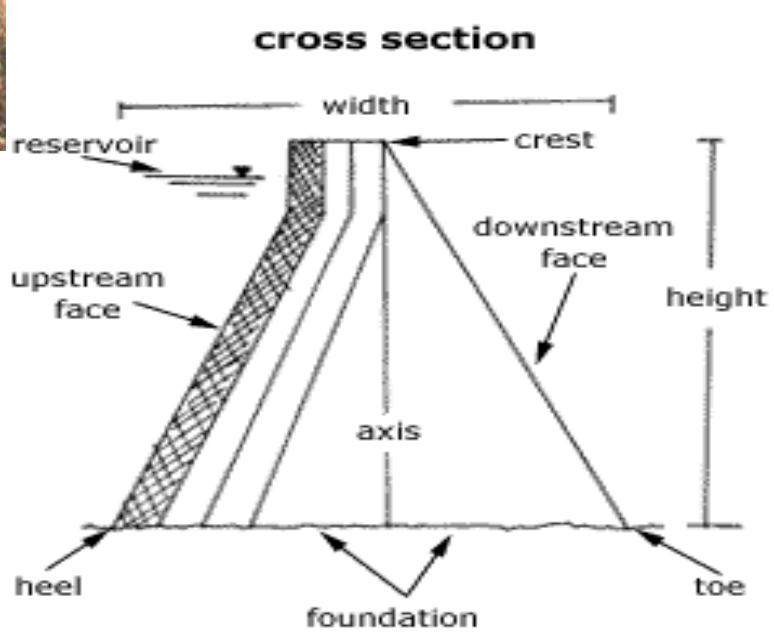
Flat slab buttress dam

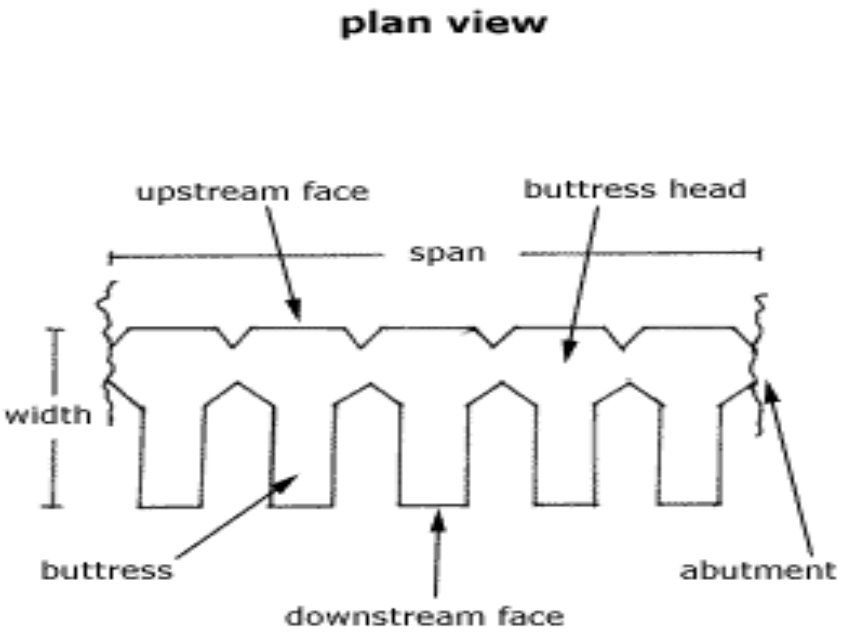


Bartlett Dam, Colorado

Material of Construction:

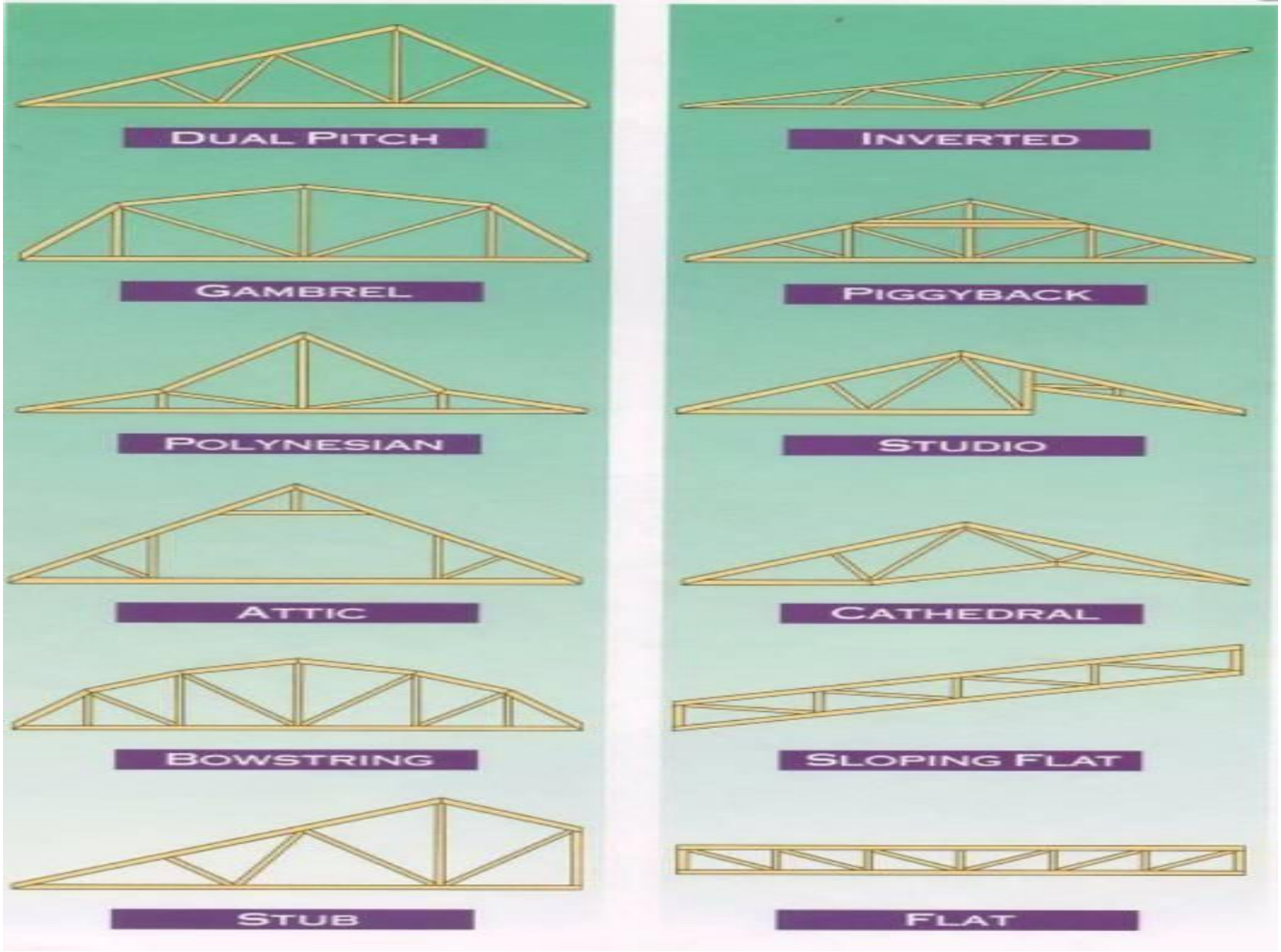
Concrete, Timber, Steel





C. TRUSS

- Truss is a structure composed of a number of members pin connected at their ends to form a stable framework.
- Members are subjected to axial forces only (tensile : tie and compressive : strut)
- If all member lie in same plane then it is called Planar Truss.
- While if members lie in space it is called Space Truss.


DUAL PITCH
INVERTED
GAMBREL
PIGGYBACK
POLYNESIAN
STUDIO
ATTIC
CATHEDRAL
BOWSTRING
SLOPING FLAT
STUB
FLAT

INTERIOR DESIGN

1. The total creative solution for a programmed interior i.e. Specific intended purpose or the use of built environment.
2. Encompasses the conceptual planning, aesthetic and technical solution applied to achieve desired function.
3. Element of Design ranges from:

I. Visual (Color, Lighting, form)

II. Surfaces, Shape, Texture, Space

III. Auditory (Noise, Echo)