

## **Chapter 4 : ARCHES**

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### **Types of Arches**

Arches are classified based on:

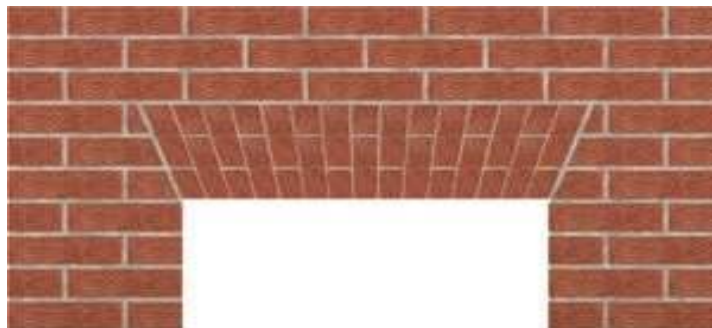
1. Shape
2. Number of Centre's
3. Workmanship
4. Materials of construction

### **Types of Arches based on shape:**

Based on the shape of construction arches are classified into 10 types and they are discussed below.

#### **Flat Arch**

- For flat arch, the intrados is apparently flat and it acts as a base of equilateral triangle which was formed by the horizontal angle of  $60^\circ$  by skewbacks.
- Even though the intrados is flat but it is given that a slight rise of camber of about 10 to 15 mm per meter width of opening is allowed for small settlements.
- Extrados is also horizontal and flat. These flat arches are generally used for light loads, and for spans up to 1.5m.



#### **Segmental Arch**

- This is the basic type of arch used for buildings in which Centre of arch lies below the springing line.

- In segmental arch, the thrust transferred in inclined direction to the abutment.



## Semi-Circular Arch

The shape of arch curve looks like semi-circle and the thrust transferred to the abutments is perfectly vertical direction since skewback is horizontal. In this type of arch, the Centre lies exactly on the springing line.



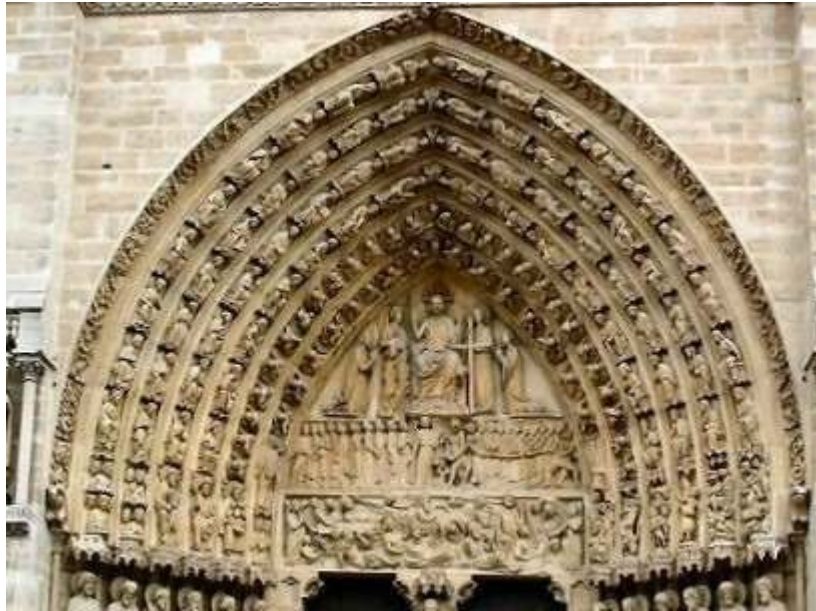
## Horse Shoe Arch

Horse Shoe Arch is in the shape of horse shoe which curves more than semi-circle. This is generally considered for architectural provisions.



## Pointed Arch

The other name of pointed arch is Gothic arch. In this type of arch two arcs of circles are met at the apex hence triangle is formed. This may be either isosceles or equilateral.



## Venetian Arch

Venetian arch is also pointed arch but its crown is deeper than springing's. It contains four Centre's, all located on the springing line.



## **Florentine Arch**

Intrados of arch is in the shape of semi-circle and rest of the arch is similar to Venetian arch. It has three Centre's, all located on the springing line.



## **Relieving Arch**

Relieving arch is constructed above flat arch or on a wooden lintel to provide greater strength. In case of relieving arch, we can replace the decayed wooden lintel easily without disturbing the stability of structure. The ends of this arch should be carried sufficiently into the abutments.



## Stilted Arch

Stilted Arch consists of a semi-circular arch with two vertical portions at the springing's. The Centre of arch lies on the horizontal line through the tops of vertical portions.



## Semi-Elliptical Arch

This is a type of arch of semi-ellipse shape and having three or five Centers.



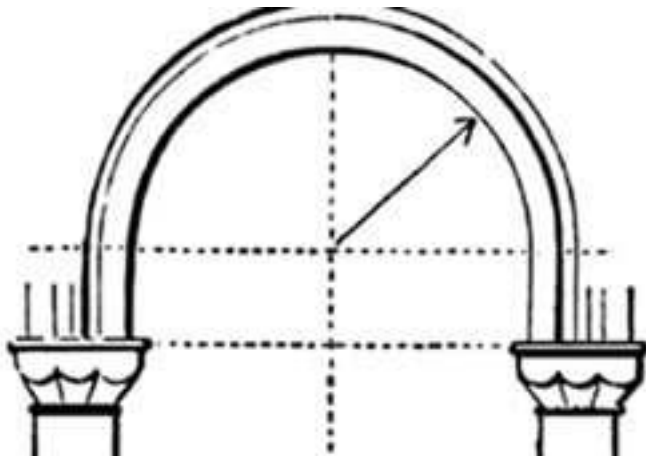
## Types of Arches based on number of Centers

Based on number of centers the arches are classified as:

### One-centered Arches

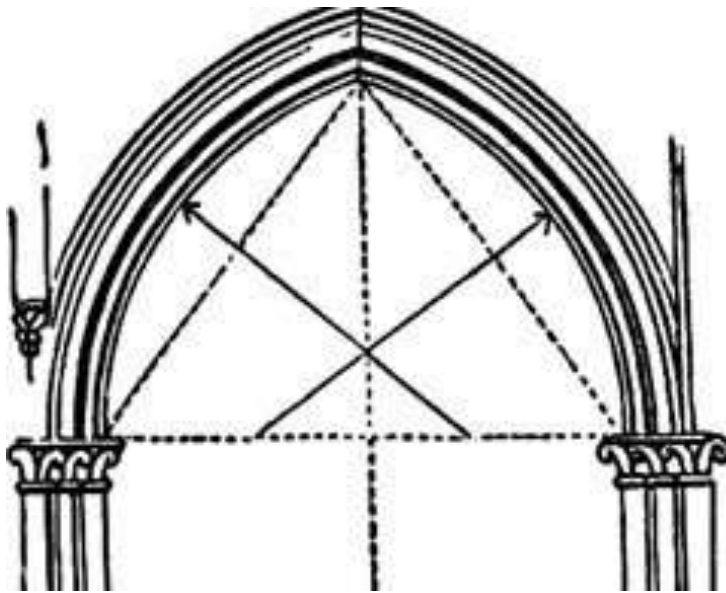
Segmental, semi-circular, flat, horse-shoe arches and stilted arches are one centered arches.

In some cases, perfectly circular arch is provided for circular windows which is called as bull's eye arch is also come under these category.



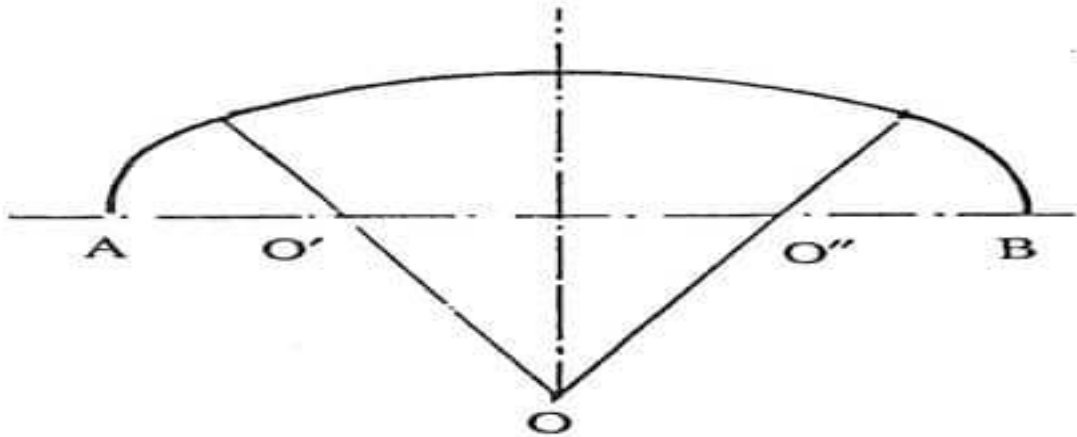
### Two Centered Arches

Pointed or gothic or lancet arches are generally come under this type.



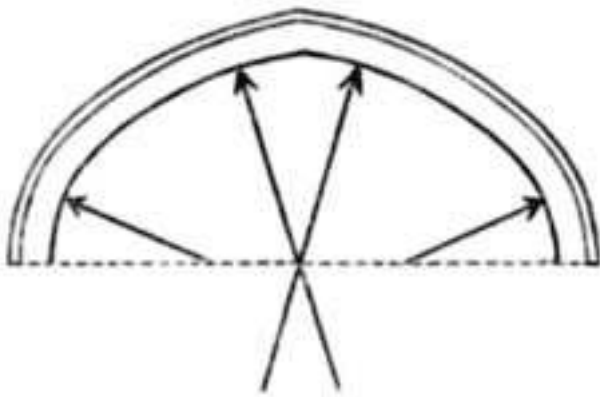
### Three Centered Arches

Semi elliptical and Florentine arches are generally having three number of centers



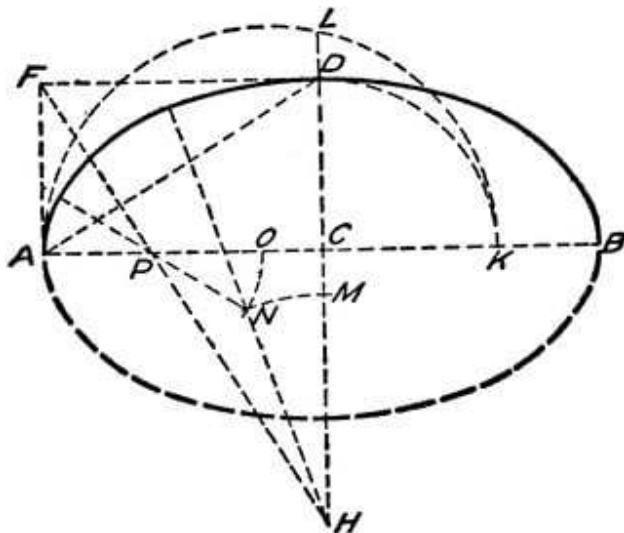
## Four Centered Arches

Venetian arch is a typical example for four-centered arch. Tudor arch is also having four centers.



## Five centered arches

A good semi-elliptical shape arch contains five centers.



## 1. Stone Arches

Based on workmanship, these are sub divided into two types. They are,

### Rubble arches

Rubble arches are very weak and used only for inferior work. These are used up to spans of 1m. These are made of rubble stones which are hammer dressed, roughly to shape and size and fixed in cement mortar. Sometimes these are also used as relieving arches up to a depth of 37.5cm, but these are constructed in one ring. If the depth is more, we can go for two rings in alternate course of headers and stretchers.



### Ashlar Arches

In this type, the stones are cut to proper shape of voussoirs (a wedge-shaped or tapered stone used to construct an arch) and fully dressed, joined with cement mortar. Ashlar stones are also used to make flat arches.





## 2. Brick Arches

Brick arches are also subdivided into:

### Rough brick arches

These are constructed with ordinary bricks without cutting to the shape voussoirs. The arch curve is provided by forming wedge shaped joints with greater thickness at extrados and smaller thickness at intrados. So, it looks unattractive. That's why it is not recommended for exposed brick works.



### Axed brick arches

The bricks are cut into wedge shape with the help of brick axe. So, these are roughly dressed in shape and size. Hence, Arch formed by these axed bricks is not very pleasant.



## Gauged brick arches

In this type arch, bricks are cut to exact shape and size of required voussoir with the help of wire saw. The bricks are finely dressed and these bricks are joined by lime putty. But, for gauged brick arches only soft bricks are used.



## Purpose made brick arches

The bricks are manufactured, matching with the exact shape and size of voussoirs, to get a very fine workmanship.



### 3. Concrete Arches

Concrete arches are of two types:

#### **Precast concrete block arches**

In Precast concrete block arches the blocks are cast in molds to the exact shape and size of voussoirs. For key stone and skewbacks special molds are prepared. These will give good appearance because of exact shape and size. Cement concrete of 1:2:4 is used.



#### **Monolithic concrete block arches**

Monolithic concrete block arches are suitable for larger span. These are constructed from cast-in-situ concrete. These may be either plain or reinforced, depending upon the span and magnitude of loading. Form work is used for casting the arch. The curing is done for 2 to 4 weeks.



\*\*\*\*\*END OF TYPES OF ARCHES \*\*\*\*\*