

Arches

Objectives : At the end of this lesson you shall be able to,

- **define arch**
- **state the technical terms regarding the arch**
- **identify the components of arch**
- **classify the arches.**

Introduction

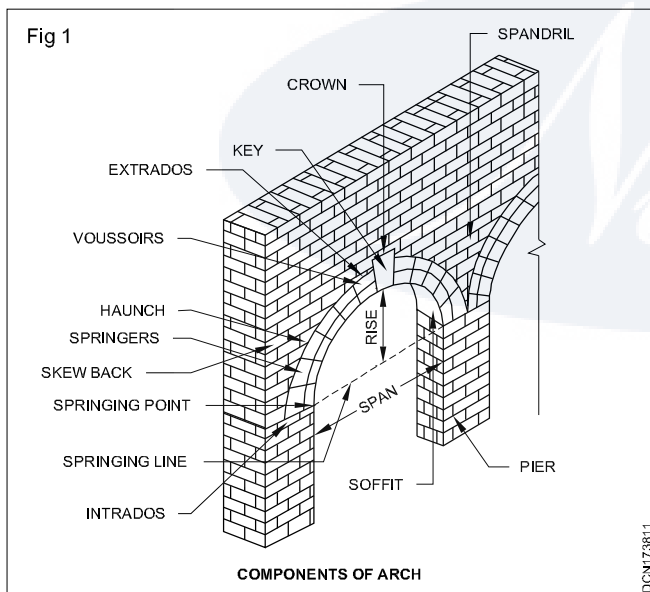
It is a geometrical shaped structure placed over an opening to transfer the load coming over it. It generally consists of small wedge shaped units which are joined together with mortar.

Arches made of steel and R.C.C are built in single units without the use of wedge shaped units and they are used for bridge construction.

Definition

An arch is a structure which is constructed to span across an opening.

Components of arch



Intrados : Inner curve of an arch.

Soffit : Inner surface of an arch.

Extrados : Outer curve of an arch

Voussoirs : Wedge shaped units of masonry

Crown : Highest part of extrados

Key : Wedge shaped unit fixed at the highest point of arch.

Spandril : Curved triangular space formed between extrados and the horizontal line through the crown.

Skew back : Inclined splayed surface on the abutment which is Prepared to receive the arch.

Springing point : Points from which the curve of the arch springs.

Springing line : It is an imaginary line joining the springing points.

Springers : The lowest voussoir immediately adjacent to the skewback.

Abutment : End support of an arch

Pier : An intermediate support of an arch

Arcade : Row of arches.

Haunch : Lower half of the arch.

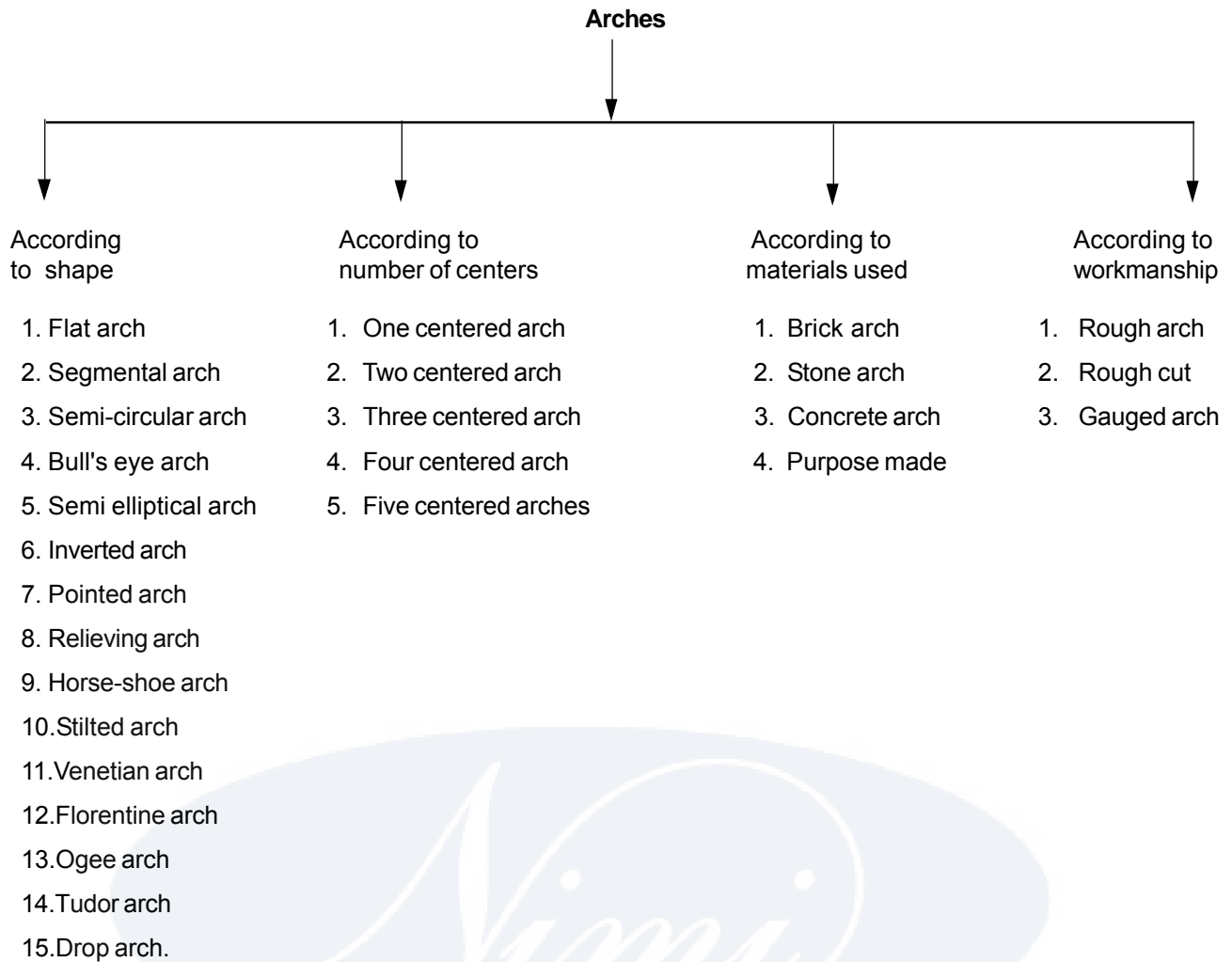
Span : Clear horizontal distance between supports

Rise : Clear vertical distance between highest point on the intrados and the springing line.

Depth : Perpendicular distance between the intrados and extrados.

Thickness : Horizontal distance measured perpendicular to the front and back faces.

Classification of arches



Arches according to shape

Objectives : At the end of this lesson you shall be able to,

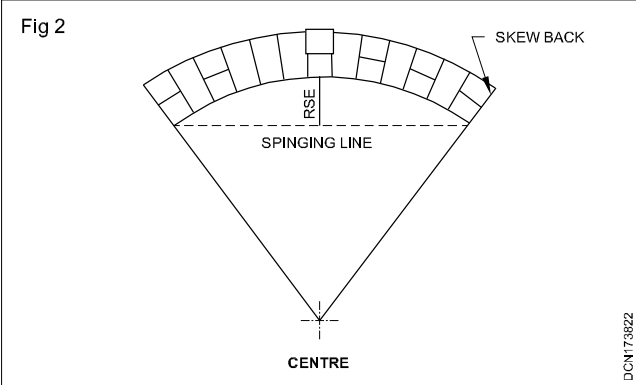
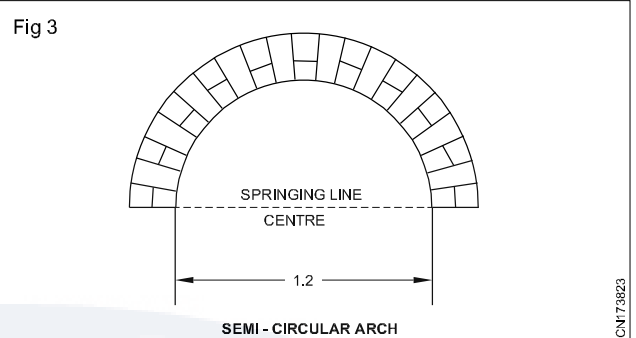
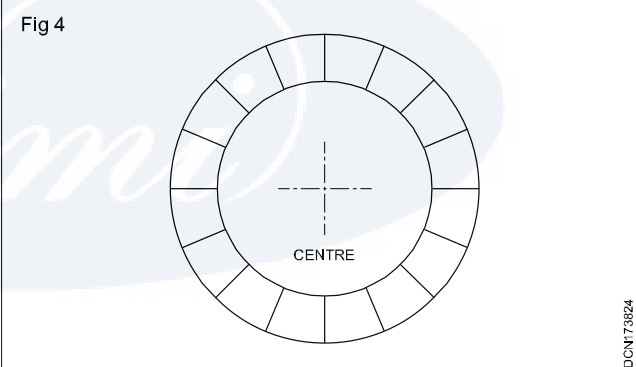
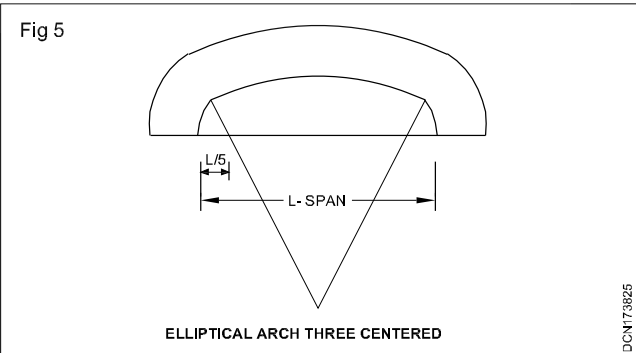
- **classify arches according to shape**
- **state the technical terms regarding the arch**
- **classify the arches.**

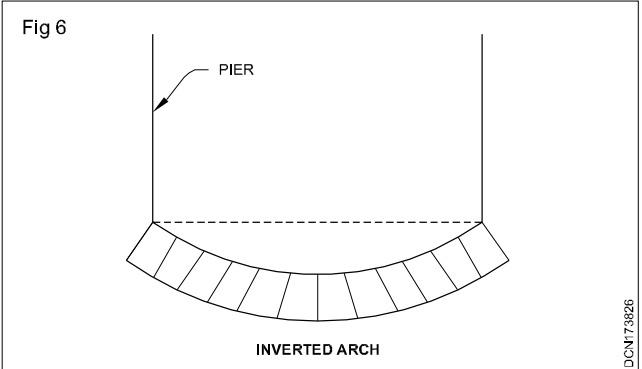
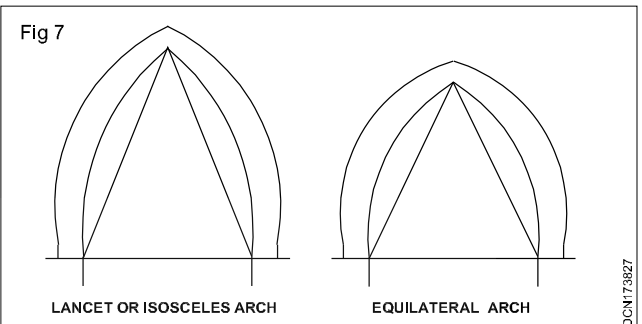
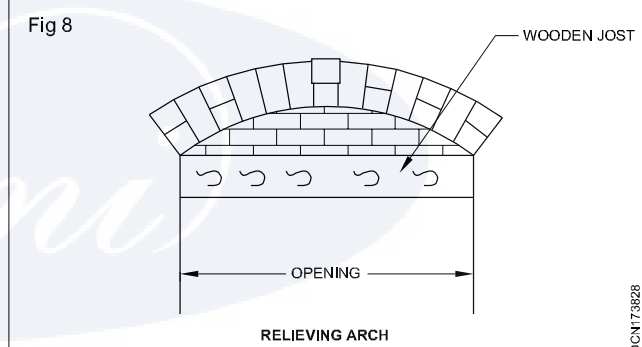
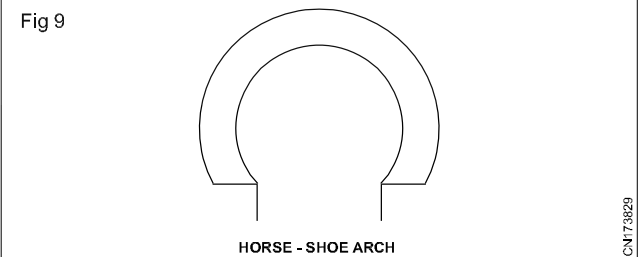
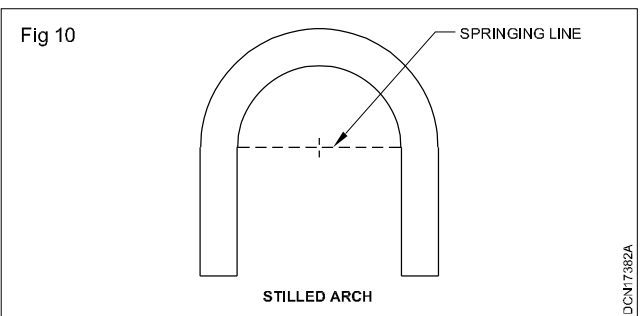
According to shape ,the arches are classified as follows.

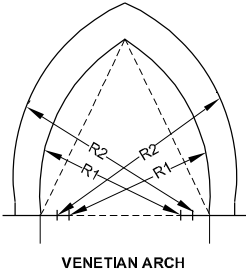
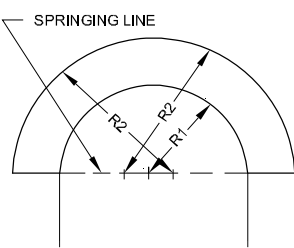
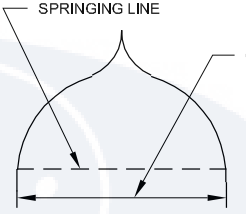
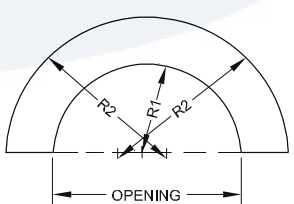
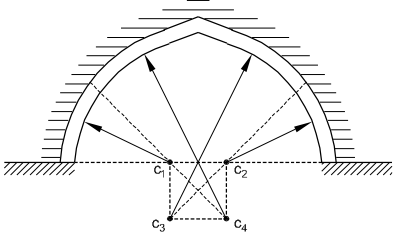
Classification of arches according to shapes

Classification of arches according to shapes

| Name of arch | Features | Figure |
|--------------------|---|--|
| <p>1 Flat arch</p> | <ul style="list-style-type: none"> • Shape flat and skewback forms 60 degree with horizontal. • Depth equal to course of masonry. • Slight rise of about 10mm to 15mm per metre length of masonry opening. • Max. span upto 1.5m • Used for light loading. | <p>Fig 1</p> <p style="text-align: center;">INTRADOS</p> <p style="text-align: center;">CENTRE OPENING</p> <p style="text-align: right; font-size: small;">DCN173821</p> |

| Name of arch | Features | Figure |
|--------------------|---|---|
| 2 Segmental arch | <ul style="list-style-type: none"> Centre of arch is below spring line. Thrust transferred to the abutment in an inclined direction | <p>Fig 2</p>  <p>DCNT173822</p> |
| 3 Semi-circular | <ul style="list-style-type: none"> Centre of arch lies on the springing line Skewback is horizontal. Thrust transferred to the abutment in vertical direction. | <p>Fig 3</p>  <p>DCNT173823</p> |
| 4 Bull's eye arch | <ul style="list-style-type: none"> One centre only. Used for circular windows | <p>Fig 4</p>  <p>DCNT173824</p> |
| 5 Semi -elliptical | <ul style="list-style-type: none"> More than one centre arch (Three or five) | <p>Fig 5</p>  <p>DCNT173825</p> |

| Name of arch | Features | Figure |
|-------------------|---|--|
| 6 Inverted arch | <ul style="list-style-type: none"> • Constructed between piers to increase the bearing power of soil. • Rise is 1/5 to 1/10 of span. • Built in ½ brick rings. |  <p>Fig 6</p> <p>PIER</p> <p>INVERTED ARCH</p> <p>DCN173826</p> |
| 7 Pointed arch | <ul style="list-style-type: none"> • Two curves meeting at the apex of a triangle. Two types are • Equilateral arch and • Lancet or isosceles arch. |  <p>Fig 7</p> <p>LANCET OR ISOSCELES ARCH</p> <p>EQUILATERAL ARCH</p> <p>DCN173827</p> |
| 8 Relieving arch | <ul style="list-style-type: none"> • Constructed over a wooden joist or flat arch. • It relieves the joist or flat arch from carrying load. |  <p>Fig 8</p> <p>WOODEN JOIST</p> <p>OPENING</p> <p>RELIEVING ARCH</p> <p>DCN173828</p> |
| 9 Horse shoe arch | <ul style="list-style-type: none"> • Adopted from architectural considerations. • Shape include more than a semicircle. |  <p>Fig 9</p> <p>HORSE - SHOE ARCH</p> <p>DCN173829</p> |
| 10. Stilted arch | <ul style="list-style-type: none"> • Semi circular portion attached at the top of two vertical portions. • Springing line passes through the top of vertical portions. |  <p>Fig 10</p> <p>SPRINGING LINE</p> <p>STILLED ARCH</p> <p>DCN17382A</p> |

| Name of arch | Features | Figure |
|--------------------|---|--|
| 11 Venetian arch | <ul style="list-style-type: none"> • Depth at crown is more than that at the springing line. • Have four centres. | <p data-bbox="802 212 863 237">Fig 11</p>  <p data-bbox="1038 465 1166 483">VENETIAN ARCH</p> <p data-bbox="1406 421 1422 495" style="writing-mode: vertical-rl; transform: rotate(180deg);">DCN17382B</p> |
| 12 Florentine arch | <ul style="list-style-type: none"> • Similar to venetian arch except that the intrados has a Semi circular shape. | <p data-bbox="802 548 863 573">Fig 12</p>  <p data-bbox="1026 808 1171 826">FLORENTINE ARCH</p> <p data-bbox="1406 763 1422 837" style="writing-mode: vertical-rl; transform: rotate(180deg);">DCN17382C</p> |
| 13 Ogee arch | <ul style="list-style-type: none"> • Consist of three centres and with reverse (Ogee) curve. | <p data-bbox="802 891 863 916">Fig 13</p>  <p data-bbox="1050 1131 1150 1149">OGEE ARCH</p> <p data-bbox="1406 1086 1422 1160" style="writing-mode: vertical-rl; transform: rotate(180deg);">DCN17382D</p> |
| 14 Drop arch | <ul style="list-style-type: none"> • Consist of two centres | <p data-bbox="802 1214 863 1238">Fig 14</p>  <p data-bbox="1050 1400 1150 1417">OPENING</p> <p data-bbox="1406 1377 1422 1451" style="writing-mode: vertical-rl; transform: rotate(180deg);">DCN17382E</p> |
| 15 Tudor arch | <ul style="list-style-type: none"> • Consist of four centres. • This is a pointed arch of four centres. | <p data-bbox="802 1500 863 1525">Fig 15</p>  <p data-bbox="1406 1680 1422 1753" style="writing-mode: vertical-rl; transform: rotate(180deg);">DCN17382F</p> |

Arches according to number of centres

Objectives : At the end of this lesson you shall be able to,

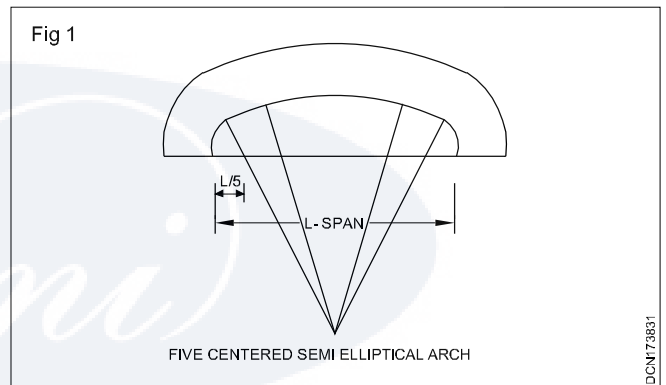
- **classify arches according to number of centers**
- **sketch the various arches with number of centers**
- **state the features of arches according to the number of centers.**

According to number of centers ,the arches are classified as follows

Classification of arches according to number of centres

| Name of arch | Description | Example |
|------------------------|--|--|
| 1 one- centered arch | This type of arches have only one centre | Flat, Segmental, Circular, Horse shoe, Stilted, Etc. |
| 2 Two- centered arch | This type of arches have two centers | Pointed arches ie, Equilateral pointed and isosceles pointed arch (Lancet and Drop). |
| 3 Three- centered arch | This type of arches has three centers | Three centered semi-elliptical arch, Florentine arch, Ogee arch. |
| 4 Four- centered arch | This type of arches has four centers | Venetian, Tudor. |
| 5 Five- centered | This type of arches has five centers | Five centered semi elliptical arch. |

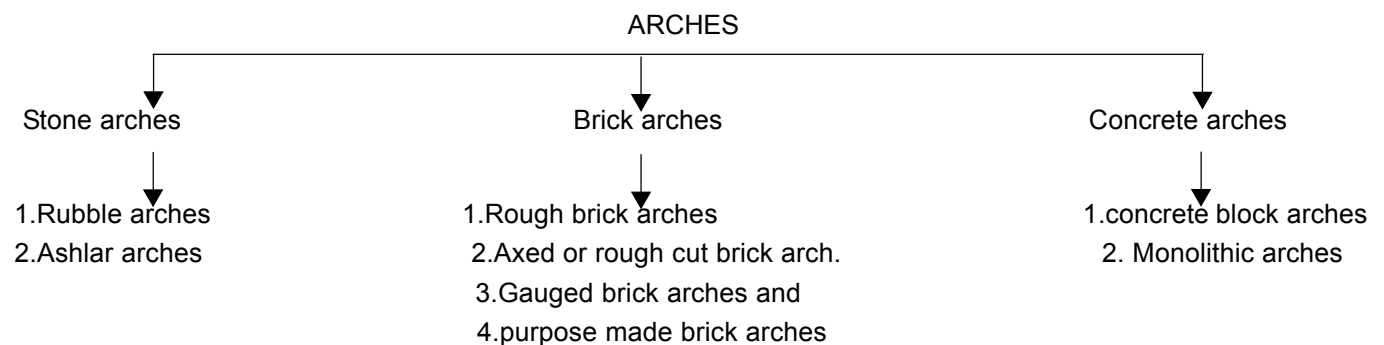
We can make more types of arches with more number of centers.



Arches according to material of construction & workmanship

Objectives : At the end of this lesson you shall be able to

- **classify arches according to material of construction & workmanship**
- **state the features of arches according to material of construction**
- **state the features of arches according to workmanship.**



Classification of arches according to materials of construction

| NAME | TYPE OF MATERIALS | DESCRIPTION |
|------------|---------------------|---|
| Stone arch | 1 In ashlar masonry | • Constructed from wedge shaped units. |
| | 2 In rubble masonry | • Stones should be laid with their natural bedding plane. |

| NAME | TYPE OF MATERIALS | DESCRIPTION |
|---------------|--------------------------------|---|
| Brick arch | 1 With ordinary bricks | <ul style="list-style-type: none"> Weak and used for inferior work. Span limited to 1m or so Joints are made wedge shaped. Not suitable for exposed brick work. Good quality arch work. Soft bricks are cut,sawn and rubbed to desired shape. |
| | 2 With purpose made brick | |
| | 3 With soft brick | |
| Concrete arch | 1 With precast concrete blocks | <ul style="list-style-type: none"> Similar to stone arches in ashlar masonry. Constructed from cast in -situ concrete and are suitable for long spans. |
| | 2 Monolithic concrete | |

Classification of arch according to workmanship

| Name | Description |
|--------------------------|---|
| 1 Rough arch | <ul style="list-style-type: none"> Using ordinary uncut bricks Bricks are rectangular shape and mortar joints are wider at extrados than at the intrados. Rough arch is used where appearance is secondary importance, the arch surface is plastered. The bricks used are wedge shaped by means of an axe The thickness of mortar joints varies 3 mm to 6 mm. The bricks used are wedge shaped by means of a wire saw, the bricks are cut finely. The mortar joints are 1.5mm to .75mm |
| 2 Axed or rough cut arch | |
| 3 Gauged arch | |

Centering of arches

Objectives : At the end of this lesson you shall be able to,

- **define centering of arches**
- **identify the components of a timber centering**
- **state the features of centering**
- **explain removal of centering.**

Definition

It is the temporary structure which supports arch during construction or till it attains strength.

Centering of arch

- Timber centering is commonly used because it is simple to erect, dismantle & reuse.
- Narrow wooden strips known as 'LAGGING' supports the brick or stone of arch.
- Two parallel boards called 'RIBS' having their upper edge shaped to the curvature of arch to support Laggings.
- The struts & braces strengthen the rib.
- A horizontal ties provided at lower end of rib to prevent from spreading.
- The bearer support the rib.

- The whole centering is supported by props.
- A pair of folding wedges used to tighten or loosen the centering.
- The whole centering parts except props can be replaced

Removal centering

- The centering can be removed after attaining sufficient strength for arch .
- For small spans the removal is done by slightly loosening the wedges
- Spans exceeding 7m or so , bottom of the prop secured in sand box which is filled with sand having a plug.
- To lower the centering remove the plug and the prop lowered gradually.