RSSB-JE 2020

Rajasthan Staff Selection Board

Combined Junior Engineer Direct Recruitment Examination

Civil Engineering

Construction Technology

Well Illustrated **Theory** *with*
Solved Examples and **Practice Questions**

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CHAPTER 5

Lintel and Arches

5.1 Introduction

A lintel is a horizontal member which is placed across the openings. A lintel is thus a sort of beam, the width of which is equal to the width of the wall, and the ends of which are built into the wall. The bearing of lintel should be the minimum of the following:

(i) 10 cm

(ii) Height of lintel

(iii) $\frac{1}{10}$ th to $\frac{1}{12}$ th of the span of the lintel

- An arch is normally a curved member comprising of a mechanical arrangement of wedge shaped building units upholding each other by mutual pressure of their own weight and maintained in equilibrium by reaction from supports called abutment. However, arches of steel or reinforced concrete are built in single units of rigid nature, without units. Brick or masonry arches may be so flat.
- Lintels are simple and easy to construct, while special centering/form work is required for the construction of an arch. However, arches are constructed where
  - Loads are heavy
  - Span is more
  - Strong abutment are available
  - Special architectural appearance is required

5.2 Classification of Lintels

Lintels are classified into the following types, according to the materials of their construction:

(i) Timber lintels (ii) Stone lintels

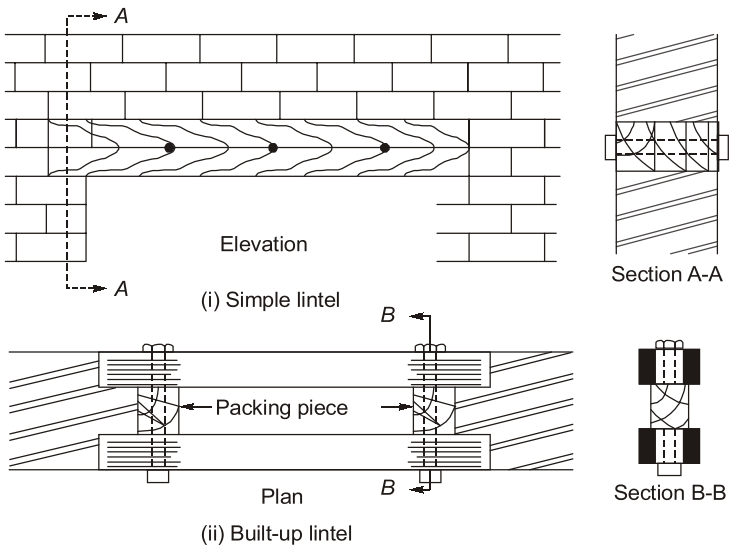
(iii) Brick lintels (iv) Steel lintels

(v) Reinforced concrete lintels

5.2.1 Timber Lintels

These lintels consist of pieces of timber which are placed across the opening. The timber lintels are the oldest type of lintels and they have become obsolete except in hilly areas or places where timber is easily available.

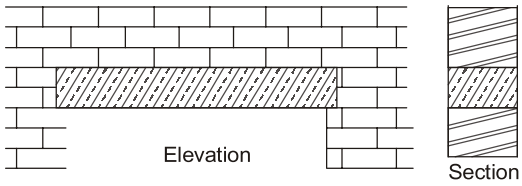
- Timber lintels are relatively costlier, structurally weak and vulnerable to fire. They are also liable to decay if not property ventilated.
- Sometime timber lintels are strengthened by the provision of mild steel plates at their top end bottom, such lintels are called flitched lintels.



Wooden lintel

5.2.2 Stone Lintels

- These lintels consist of slab of stones which are placed across the openings. The stone lintels may be formed of a single piece or more than one piece.
- The depth of stone lintel is kept equal to 10 cm per metre of span, with a minimum of 15 cm. They are used upto spans of 2 m. For wider spans, stone slabs are kept on edge. Stone is very weak in tension. Also it cracks if subjected to vibratory loads. Hence, stone lintels should be used with caution where shock waves are quite common.

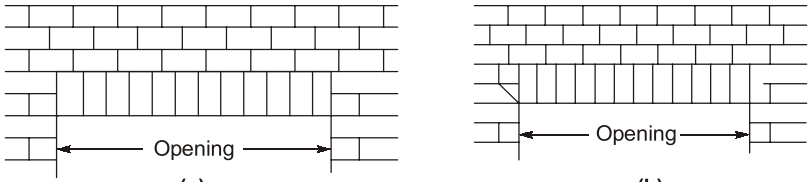


Stone Lintel

5.2.3 Brick Lintels

Brick lintels are not structurally strong, and they are used only when the opening is small (< 1 m) and loads are right. A brick lintel consists of bricks placed on end or edge, as shown in figure (a).

A better way of forming brick lintel is shown in Fig. (b)

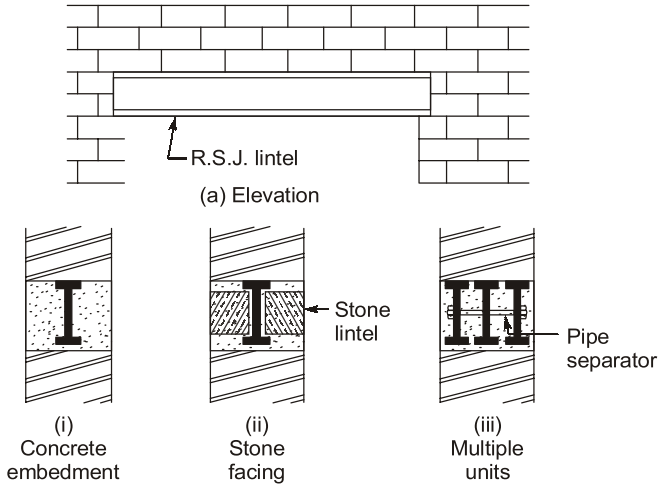


Brick Lintels

The depth of brick lintel varies from 10 to 20 cm, depending upon the span.

5.2.4 Steel Lintels

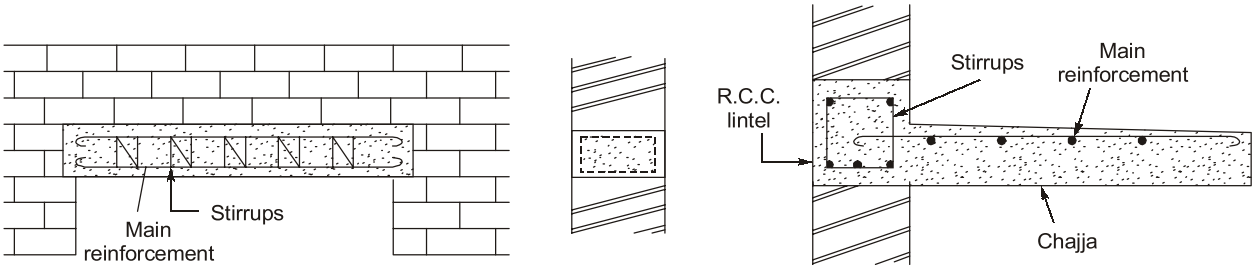
Steel lintels are provided where the opening is large and where the superimposed loads are also heavy. It consist of rolled steel joists or channel sections either used singly or in combination of two or three units.



Steel Lintels

5.2.5 Reinforced Cement Concrete Lintels

Reinforced cement concrete lintels have replaced practically all other types of lintels because of their strength, rigidity, fire resistance, economy and easy in construction.



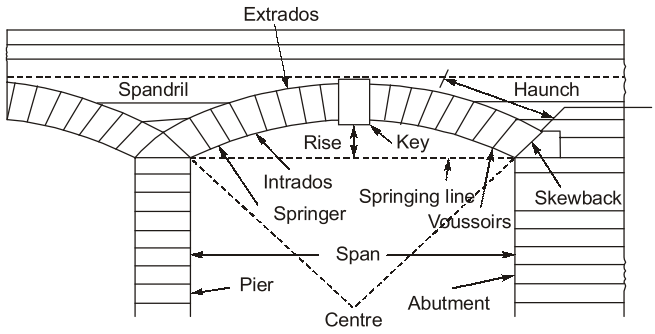
Lintel with Chhajja Projection

5.3 Arch: Terms Used

An arch is a structure constructed of wedge shaped units (bricks or stone) jointed together with mortar and spanning an opening to support the weight of the wall above it alongwith other super imposed loads.

Due to wedge like form, the units support each other, the load tends to make them compact and enables them to transmit the pressure downwards to the support

Figure below shows various elements of an arch.



Elements of a segmental Arch

The following technical terms are used in arch work:

1. **Intrados:** This is the inner curve of an arch.
2. **Soffit :** It is the inner surface of an arch. Sometimes, intrados and soffit are used synonymously.
3. **Extrados :** It is the outer curve of an arch.
4. **Voussoirs :** These are wedge-shaped units of masonry, forming an arch.
5. **Crown :** It is the highest part of extrados.
6. **Key :** It is the wedge-shaped unit fixed at the crown of the arch.
7. **Spandril :** This is a curved-triangular space formed between the extrados and the horizontal line through the crown.
8. **Skew back :** This is the inclined or splayed surface on the abutment, which is so prepared to receive the arch and from which the arch springs.
9. **Springing points:** These are the points from which the curve of the arch.
10. **Springing line:** It is an imaginary line joining the springing points of either.
11. **Springer:** It is the first voussoir at springing level; it is immediately adjacent to the skewback.
12. **Abutment :** This is the end support of an arch.
13. **Pier:** This is an intermediate support of an arcade.
14. **Arcade:** It is a row of arches in continuation.
15. **Haunch:** It is the lower half of the arch between the crown and skew back.
16. **Ring:** It is a circular course forming an arch. An arch may be made of ne ring or more than one ring.
17. **Impost:** It is the projecting course at the upper part of a pier or abutment to stress the springing line.
18. **Bed joints:** These are the joints between the voussoirs which radiate from the centre.
19. **Centre or striking point :** This is the geometrical centre point from where arcs forming the extrados, arch rings and intrados are described or struck.

20. **Span:** It is the clear horizontal distance between the supports.
21. **Rise:** It is the clear vertical distance between the highest point on the intrados and the springing line.
22. **Depth or height :** It is the perpendicular distance between the intrados and extrados.
23. **Thickness (or breadth of soffit):** This is the horizontal distance, measured perpendicular to the front and back faces of an arch.

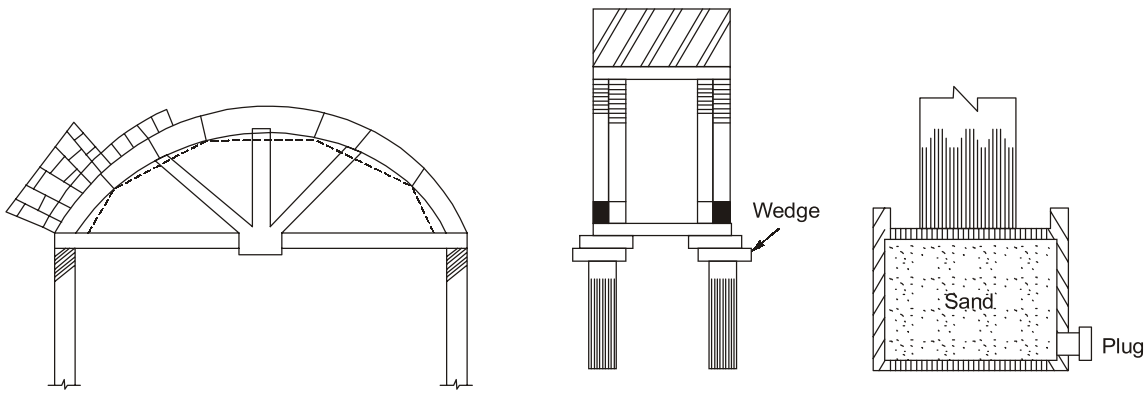
5.4 Construction of Arches

After preparing voussoirs of the desired shape and size, the following steps are involved in the construction of arches:

- Installation of centering
- Laying of arch
- Removal of centering

5.4.1 Installation of centering

Centering is a temporary construction required for the construction of a permanent structure. It is made to the required shape of the arch and is supported over a staging. The centring for minor works is done with mud masonry and is plastered with mud mortar or with lean cement plaster. It is a common practice to choose wood centring for arches of smaller spans. Figure shows a typical wood centring. Steel centring is preferred for larger spans and repeated uses. A pair of wedges are provided between the centring and staging, to allow the centering to be tightened or loosened. Wedges are useful in dicentering [Figure (b)]. The best arrangements for decentering is by using sand boxes [Figure (c)].



(a) Elevation (b) Decentering by using wedges (c) Decentering by sandbox method

Wood Centering

5.4.2 Laying of arch

Skewbacks of exact size and shape are laid carefully on both sides of the arch. Voussoirs are then laid and the work proceeds towards the crown from both sides. The joints are made with mortar, the thickness of mortar being 5-15 mm. Finally, the key stone is inserted and the arch is locked. It is necessary to fill up the spandril as work progresses towards the crown, so that the thrust of the arch is counteracted. Before mortar hardens, the centring is slackened by easing the wedges by 2-3 mm so that the voussoirs sit on

their beds tightly. Till the whole arch is built, the arch work is kept damp so that no portion hardens before the arch load develops fully.

5.4.3 Removal of centring

The centring is removed after a period of 1-6 weeks, depending on the size of the arch and the materials used. Two days before complete removal, the centring is eased so that voussoirs may close in and compress the mortar. The centring should be removed without shock. If wedges are provided for removing the centring, due care should be taken to remove them gently. The sandbox method, in which sandboxes are provided between the centring and staging, is the best method. The sandbox has a hole which can be plugged. While easing, the plug is removed for a short time. For final removal, the plug is withdrawn for complete draining of sand.

Example - 5.1 Match List-I with List-II and select the correct answer using the codes given below the lists:

List I
1. The topmost point of the arch
2. Inner surface of the arch
3. Wedged shaped masonry units used in arches
4. The inner curve of the arch

List II
A. Voussoirs
B. Crown
C. Soffit
D. Intrados

Codes:

	A	B	C	D
(a)	3	1	2	4
(b)	1	2	3	4
(c)	4	3	1	2
(d)	2	1	3	4

Solution: *(a)*

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