

Figure 11-13 Masonry arch forms. (From BIA Technical Note 31.)

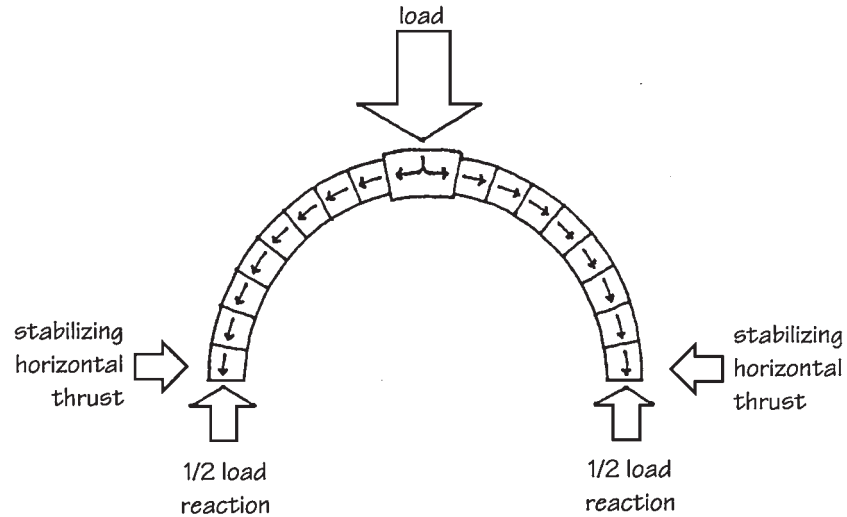


Figure 11-14 Load distribution in masonry arches. (From Beall and Jaffe, *Concrete and Masonry Databook*, McGraw-Hill, New York, 2003.)

11.2.1 Minor Arch Design

In a fixed masonry arch, three conditions must be maintained to ensure the integrity of the arch action: (1) the length of span must remain constant; (2) the elevation of the ends must remain unchanged; and (3) the inclination of the skewback must be fixed. If any of these conditions is altered by sliding, settlement, or rotation of the abutments, critical stresses can develop and may result in structural failure. Adequate foundations and high-quality mortar and workmanship are essential to proper arch construction. The compressive and bond strength of the mortar must be high, and only Types M, S, and N are recommended. It is also particularly important that mortar joints be completely filled to assure maximum bond and even distribution of stresses.

Arches are designed by assuming a shape and cross section based on architectural considerations or empirical methods, and then analyzing the shape to determine its adequacy to carry the superimposed loads. The following discussion of arch design is taken from the Brick Industry Association's *Technical Notes*, Series 31. Minor arch loading may consist of live and dead loads from floors, roofs, walls, and other structural members. These may be applied as concentrated loads or as uniform loads fully or partially distributed. The dead load on an arch is the weight of the wall area contained within a triangle immediately above the opening. The sides of the triangle are at 45° angles to the base, and its height is therefore one-half of the span. Such triangular loading is equivalent to a uniformly distributed load of 1.33 times the triangular load. Superimposed uniform loads above this triangle are carried beyond the span of the opening by arching action of the masonry wall itself when running bond patterns are used. Uniform live and dead loads below the apex of the triangle are applied directly on the arch for design purposes. Minor concentrated loads bearing directly or nearly directly on the arch may safely be assumed as equivalent to a uniformly distributed load twice the magnitude of the concentrated load. Heavy concentrated loads should not be allowed to bear directly on minor arches (especially jack arches).