Three-Centered Curves for Architecture: Arches, Bridges, Tunnels, Roofs, Domes, and Now Diagrids

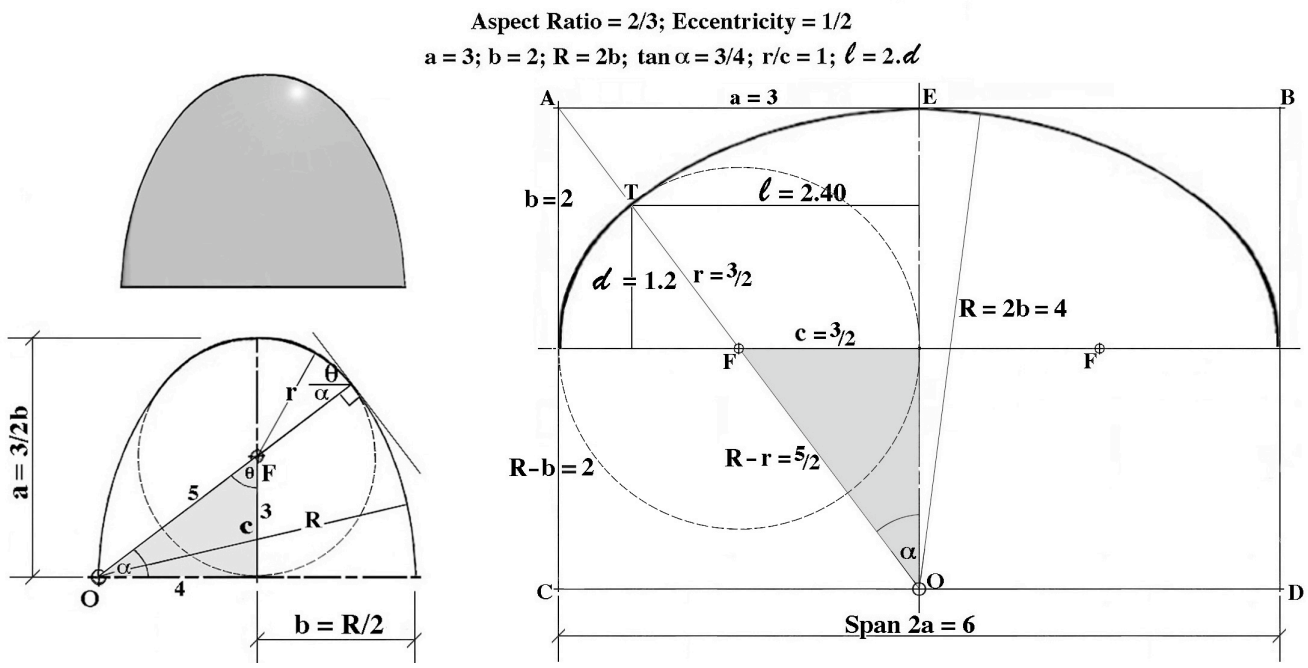
By Robert Stevens

Abstract

Thanks to the reduced ceiling or roof height compared with a semicircular arch, architects have often preferred a depressed or oblate elliptical arch. Now, with the success of the gherkin tower, the advantages of the prolate elliptical form can also be appreciated. But, with the added difficulty of making a perfect ellipse on a building site, many architects prefer a close approximation like the three-centered arch, sometimes called a basket-handle arch, and why not a 3-centered diagrid? While this is quite feasible once you know the measurements, finding the radii for formwork or trusses can be a time-consuming process if you don't know how to go about it; and most carpenters and handymen—and even architects—didn't learn more than a method of drawing an ellipse at school and don't have the number-crunching means of structural engineering companies to make complex calculations.

Rather than giving yet another method of drawing a 3-centered arc, this paper shows a simple way to calculate the radii for any 3-centered arc you wish, based on the required span width, rise height and eccentricity/aspect ratio, by developing a formula to find the minor radius r and the major radius R. Examples are given with various eccentricities, and hints are given for making oblate or prolate 3-centered arches, vaults or roof domes (formwork or trusses) for inerior or exterior applications.

For enthousiasts of proportion dating back at least 2,500 years, an appendix has been added for application of 3/4/5 triangles to 3-centered curves, and numerous examples of calculations are given for the exact dimensions of arcs of many types.



Example of prolate and oblate forms of the Achaemenid curve.