

Relative Depth of Field and Focal Length Myth Busted...well sort of...

By Mike McBride

Those in attendance at the February meeting might recall that I mentioned a theory I had about depth of field. There is a common belief that shorter focal length lenses inherently have more depth of field than longer focal length lenses. My hypothesis was that this had more to do with how we tended to use these different lenses. I theorized that if you moved closer to the subject with the wide angle lens so that the subject filled the exact same area in the frame that it did with the telephoto lens, that the depth of field in terms of feet would be the same with both lenses when using the same aperture. When you see the results and realize that I shoot extensively with telephoto lenses and utilize the largest apertures on those lenses it may be apparent how I came to develop my theory.

I had tried to test this theory through test shots and subsequent evaluation. These shots, taken for the most part within close distances tended to support my theory but not conclusively because it became difficult to evaluate the results objectively, especially since the background objects tended to fall off rapidly with the wide angle lenses. So, I resorted to the Internet to help me prove or disprove my theory mathematically.

The attached sheet shows the results of the calculations. The first table assumes that the subject of our photo has a height of 8 feet. The second table assumes the subject has a height of 16 feet. The distance is calculated for each focal length such that the subject occupies the entire frame given the angle of view produced by that focal length on a 35mm camera. My interpretation of the results is summarized below:

- Wide-angle lenses do not inherently possess greater depth of field to any meaningful degree, however...
- Wide-angle lenses do inherently possess a greater ability to produce greater depth of field
- At relatively close distances (5.31 feet with a 28mm lens, 109.87 feet with a 600mm lens) there is very little difference in depth of field between a wide-angle lens and a telephoto lens when using a large f/4 aperture (1.88 inches or 10.7%).
- At relatively close distances there is very little difference between short telephoto lenses (105mm) and super telephoto lenses (600mm) when using a mid-range aperture and not a significant difference even when using small apertures.
- At relatively close distances there is not even a huge difference between wide angle (28mm) and telephoto (600mm) when using a mid range aperture (f/11). The difference in the first table is only 3.4 feet.
- At greater distances (10.62 feet with a 28mm lens, 219.74 feet with a 600mm lens) the difference in depth of field becomes greater between the wide angle and telephoto lenses. Still, though, it is only 2.29 feet at f/4.
- In summary, as the distance from subject decreases the actual difference in depth of field between different focal lengths decreases. As the aperture size increases, the difference in depth of field between different focal lengths also decreases.
- The real summary – Wide-angle lenses can provide some advantages when your desire is to increase depth of field as long as you use smaller apertures. However, if your desire is to create a shallow depth of field, particularly at close distances, aperture is much more important than focal length. Don't forget, though, that distance from subject controls perspective and different focal lengths can accommodate the desired perspective and help you achieve your desired results.

Depth of Field Comparison with Object Size Constant

Focal Length (mm)	Angle of View	One-Half of Angle	Object Height (ft)	Tangent Ratio	Calculated Distance (ft)	Depth of Field (ft) @ f/4	Depth of Field (ft) @ f/11	Depth of Field (ft) @ f/22
28	74	37	8	0.75355	5.31	2.25	9.08	2.8-Infinity
35	62	31	8	0.60086	6.66	2.23	7.79	81.1
50	46	23	8	0.42447	9.42	2.15	6.7	20.3
105	23.5	11.75	8	0.20800	19.23	2.01	5.81	12.4
200	12.3	6.15	8	0.10775	37.12	2.06	5.87	12
400	6.17	3.085	8	0.05390	74.22	2.06	5.84	11.7
600	4.17	2.085	8	0.03641	109.87	2.01	5.68	11.4

Focal Length (mm)	Angle of View	One-Half of Angle	Object Height (ft)	Tangent Ratio	Calculated Distance (ft)	Depth of Field (ft) @ f/4	Depth of Field (ft) @ f/11	Depth of Field (ft) @ f/22
28	74	37	16	0.75355	10.62	10.4	4.92-Infinity	3.2-Infinity
35	62	31	16	0.60086	13.31	9.8	179.6	4.7-Infinity
50	46	23	16	0.42447	18.85	9.06	41.5	8.2-Infinity
105	23.5	11.75	16	0.20800	38.46	8.2	25.2	71.1
200	12.3	6.15	16	0.10775	74.24	8.35	24.2	52.4
400	6.17	3.085	16	0.05390	148.44	8.33	23.7	48.3
600	4.17	2.085	16	0.03641	219.74	8.11	23	46.3

Focal Length (mm)	Angle of View	One-Half of Angle	Object Height (ft)	Tangent Ratio	Calculated Distance (ft)	Depth of Field (ft) @ f/4	Depth of Field (ft) @ f/11	Depth of Field (ft) @ f/22
28	74	37	0.5	0.75355	0.3318	0.01	0.02	0.04
35	62	31	0.5	0.60086	0.4161	0.01	0.02	0.04
50	46	23	0.5	0.42447	0.5890	0.01	0.02	0.03
105	23.5	11.75	0.5	0.20800	1.2019	0.01	0.02	0.03
200	12.3	6.15	0.5	0.10775	2.3201	0.01	0.02	0.03

<Notes>

Rounding Error - The angle of view and calculated distance are calculated to two decimal places. This creates a small rounding error in the depth of field calculations explaining some of the variation in results.

Circle of Confusion - The acceptable size for the circle of confusion in these calculations is .025mm. There is always only one plane that is actually in focus. Items in front of or behind that plane will be out of focus creating what is called a circle of confusion. The more out of focus an object is, the larger the circle of confusion. In depth of field calculations it is necessary to determine what constitutes "acceptable sharpness" as expressed by the maximum acceptable diameter of the circles of confusion.