Apparent Depth of Field

Practical Use in Landscape Photography

By Joe Englander

Depth of field, sometimes erroneously called depth of focus, is, like almost every other tool in photography, an illusion. As long as you work within the illusion's envelope, the illusion works; if you push its boundaries, failure is certain. Every time you make an enlargement, you are making an estimation of the amount of apparent sharpness in depth that will be available from your negative.

First of all, focus occurs in one geometric plane, and only in that plane. From high-school geometry, you may remember that a plane has no depth. In reality, there is no depth of focus or depth of field. Any image made with any lens can have focus only in one place; everything else is *absolutely* out of focus.

So why do we think we have depth of field? *Because of the failure of our eyes to sharply resolve lack of focus until that lack becomes overwhelmingly obvious!* What about those wide-angle photos that seem to have everything in focus? Just enlarge them enough and only a single plane will be in focus. We have to enlarge them to see the failure, because our eyes can't resolve the difference clearly. A clue to operation is already appearing: The degree of enlargement has a direct effect on the illusion of depth. When we remember that long focal length lenses magnify an object compared to short focal length lenses, we also note that the apparent depth of field available diminishes with shorter focal lengths when the photographic object is magnified equally.

If both a wide-angle lens and a tele are focused on the same object, from the same position, at the same aperture, and the final image receives the same enlargement, the object will be smaller in the wide-angle, and objects around it will appear to be in better focus than in the tele's image. However, if you enlarge the wide-angle's image until the *objects* are the same size, the apparent depth will be the same in both pictures.

If depth of field is an illusion, you can make it work for you or you can let it work against you. On most manual, fixed

WINTER SUNRISE THROUGH MIST AT BLACK SANDS BASIN, YELLOWSTONE. BECAUSE OF THE TALL TREES IN THE FOREGROUND, NO VIEW CAMERA MOVEMENTS WERE POSSIBLE. ABSOLUTE SHARPNESS WAS ACCOMPLISHED BY USING THE DEPTH-OF-FIELD TECHNIQUE FOR INCLUSION OF INFINITY.

cameras, no matter what their format, the lenses are scribed with depth-of-field indexes. Caution must be used with these indexes. Check your manufacturer's instructions. The indexes are accurate only up to a certain degree of enlargement. Painfully, the size of enlargement contemplated is usually unreasonably small; it's only around 4X for 35mm—that's only a 4x5 print! There are a few medium format cameras with indexes good for only a 2X magnification, which is still a 4x5 print. If you intend to make greater enlargements, those scales will prove to be useful but inaccurate. Typically, to recover their usefulness, figure on using one smaller aperture for each magnification size; e.g., if the scale says you can use 5.6 to cover all the objects in your photograph (and you have found that like Leica, Nikon, Canon, Hasselblad, etc., your manufacturer thought you'd never enlarge greater than 4x5 or look at your slide through a loupe), do not change focus, but stop down to 8 for a 5x7, 11 for an 8x10 and 16 for an 11x14. These substitutes are not absolutely mathematically correct, but in practice they work well.

Why aren't such lenses marked for the magnification to achieve an 8x10? Because if you compared a lens marked with DOF scale calculated for 4x5 compared to one marked for 8x10, it would appear that the former had more depth than the latter, and no one wants to try to sell a lens that has less depth of field! Remember that, in the beginning, it was a great achievement for a 35mm or 6x6 to be able to produce a 4x5 print that compared to a Speed Graphic 4x5. The original calculations have stuck because no one wants to be the first to change.

With view cameras, things get more complicated. Most of the depth-of-field devices I have seen are based on the Sinar design, which recently went out of patent protection. The Sinar design, and therefore those slavishly based on it, is useful primarily in the studio, the place where Sinar cameras are usually found. Their depth-of-field calculator generally fails when infinity is involved.

Here's why. Sinar engineers didn't invent a new law of physics with their little calculating knob. What they did was to notice that the lenses scribed with DOF scales are symmetrically scribed on either side of the hyperfocal indicator (which is to say, the distance) and that the lens barrel distance indicators are also measurements of bellows extension. Clearly, the same technique is transferable to view cameras: The change in the extension of the bellows which occurs when focusing on the distant, and then the near, object is divided in half to find the exact hyperfocal distance no matter which lens is used.

Almost everyone else does their calculations from the camera to the object, and if you have some kind of measuring rangefinder—a calculator, etc.—you can accurately, albeit slowly, figure what aperture was required for what depth for any photograph. Sinar decided, since they are Swiss and terribly accurate, that they could work in millimeters instead of meters and do their calculation based on the small distances between the lens and the image formed. All that Sinar's depth-of-field knob is, is a ruler wrapped around the focusing knob. In operation it goes like this: Focus on the far object, set the knob to zero, focus on the near object, divide the distance traveled by ½ and reset the focus to that point. Unfortunately, just as with fixed cameras, they have built a specific magnification into their calculation of which *f*/stop is required to sharply cover: 2X! So it works for catalogues, where the magnification is usually to an 8x10, but not for scenics, where the more common magnification from 4x5 is to 11x14 or 16x20. Just as with the fixed cameras, these depth-of-field calculators benefit from choosing a smaller aperture than that suggested.

But here's something else, and it's just as important for 35mm as for 8x10. The illusion that allows depth of field to work is based on the eye's inability to resolve detail below a certain size. This inability is not simply physical; it is judgmental as well. Someone practiced at looking at photographs will probably demand higher resolution than a casual viewer. And, I believe, the criteria of sharpness will be based on whether the object in the photograph appears to be closer or farther or at infinity.

In landscape photography, sharpness at infinity is usually more critical than for closer objects. When neither object is at infinity—when their separation is essentially negligible, as in a studio—then the criteria are the same for both objects. Focus is split between the near and the far, and the same criteria of focus falls on both near and far. However, when a line of trees on a ridge against the sky is compared to a rock in the foreground, much higher resolution is required for the

When Infinity is not involved/ camera movements are used:
difference between near and far, use

1.5 mm	*f*/11
2.5 mm	*f*/16
3.5 mm	*f*/22
5.0 mm	*f*/32
7.0 mm	*f*/45
10 mm	*f*/64
14 mm	*f*/90

1) Focus on near.
2) Focus on far.
3) Look up the bellows extension in the chart and note the minimum *f*/stop required for that extension.
4) Set standard to ½ that distance and close down to appropriate *f*/stop.

When Infinity is involved/ no camera movements used:
1) Focus on near.
2) Focus on far.
3) Look up the bellow extension in the chart and note the minimum *f*/stop required for that extension.
4) Set standard to infinity + ⅓ that distance and close down to appropriate *f*/stop, which is one stop smaller than specified in the above chart.

trees to be acceptably sharp than is required for the rock. If the Leica-Canon-Nikon-Minolta-Pentax-Sinar-Horseman-Linhof-Cambo-ImageQuest-etc. method of dividing by half the focusing extension used, then very small apertures must be closed down as much as two extra stops to obtain equal apparent sharpness at infinity as was necessary for nearer objects.

Our perceptual demands for sharpness are biased toward infinity and perhaps our focus should be as well. If the focus is biased toward infinity, then effectively two different criteria of sharpness are used; infinity is more tightly in focus since the focus has been shifted toward it, and thus more of a stringent criterion is being used on the objects at infinity. The problem is solved. But how much should the bias toward infinity be?

Fortunately, thanks to John Ward of Estes Park, Colorado, an excellent mathematician and fine photographer, an answer is available. His method is similar to Sinar's: Measure the distance the standard moves when focusing, and divide that distance. However, when infinity is involved, focus on the nearer object and extend your bellows 1/3 the distance measured beyond the infinity focus point. Or, retract from the near focus point by 2/3 the total distance measured. Fixed cameras benefit from the same operation too. Instead of needing to close down two more stops to obtain the kind of critical sharpness at infinity as you might do with the 50/50 method, you only need to close down one more stop with this 1/3-2/3 method. This pragmatic approach works with cameras of all formats.

With view cameras, this fudging toward infinity works perfectly as long as the infinity focus is actually the farthest point from the camera! If, however, you use a tilt, for instance, then infinity focus—your shortest bellows extension—is no longer the farthest point from the camera. Therefore, you'll want to distribute sharpness equally over the entire image—thus requiring you to fall back to the 1/2 method.

Each measured distance, whether using the 1/2 or the 1/3, results in an aperture—required to accomplish enough depth of field for a particular magnification. The included tables are empirically based on allowing a 4x5 to be enlarged to 11x14, when bellows correction for close-ups is not involved. If you find that the following numbers aren't sharp enough, use a smaller *f*/stop; if they are too constrictive, use the next larger one. These suggestions are loosely based on Ward's calculation of making enlargements to 11x14 with a circle of confusion of 0.05mm or 0.002" for 4x5, which is substantially more stringent than that suggested by most manufacturers. Sinar, Linhof and ImageQuest all suggest the more liberal 0.006" for 4x5, which would allow about a stop and a half more open aperture (as a point of reference, most sheet film is between 0.01" and 0.007" thick). So, feel free to customize the numbers to your own needs and personal tolerance. Remember: Do all camera movements first!

SUNRISE, *MILL CREEK*. IF THE TREES AGAINST THE SKY WERE NOT CAPTURED WITH MAXIMUM SHARPNESS, THE PHOTOGRAPH WOULD BE CONSIDERED LESS THAN SHARP. OUR EYES DEMAND THAT SUCH SUBJECTS BE RENDERED WITH EXTRAORDINARY CLARITY.

Joe Englander has been photographing and exhibiting for the past 20 years. Working primarily in the 8x10 format since 1980, he has been producing both color and black-and-white photography for commercial and artistic projects. Joe has been teaching photographic workshops since 1981.