View Camera Focus and Depth of Field — Part II

by Harold M. Merklinger

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While in-depth knowledge of photographic technology is not essential to the production of great images, certain principles can assist the photographer in working efficiently. In Part I we tried to illustrate the basic principles of view camera focus. The Scheimpflug Principle, although necessary in a scientific sense, is of lesser practical help than another similar rule we called the hinge rule. The aim of this second part is to describe how depth of field works for view cameras. As we shall see, depth of field is also closely related to the hinge rule.

The hinge rule states that as the lens-to-film distance is adjusted through simple focusing motions of the camera back, the subject plane rotates as though it were 'hinged' at a specific location in space. That location is determined by the amount of lens tilt (relative to the camera back) and the direction of that tilt. It is convenient to name the line about which the subject plane pivots "the hinge line." The distance from the lens to the hinge line is controlled by the amount of tilt and the focal length of the lens. Simple tables can be prepared to provide the quantitative information needed.

Many readers will be familiar with the depth-of-field gauges provided on the back focusing mechanisms of a number of view camera models. These gauges indicate how far the back can be moved from its nominal position and still keep the central subject within acceptable focus limits for the f-number in use. Since the plane of sharpest focus pivots on the hinge line as the back is moved, it follows that the limits of acceptable depth of field correspond to the position of the plane of sharpest focus for the two extreme settings of the back as indicated by that depth of field mechanism. The acceptable depth of field region is thus wedge-shaped, with the apex of the wedge located at the hinge line.

We can describe the dimensions of the depth of field wedge in simple terms most photographers already know. An accompanying drawing depicts a side view of a camera set up with its back vertical, and with the lens tilted forward by some appropriate amount. The limits of the depth of field wedge are established by just three factors: the hyperfocal distance (H) for the focal length and aperture in use, the position of the plane of sharpest focus, and by the lens-to-hinge line distance (called J in Part I). The hyperfocal distance is, of course, the distance at which we focus a 'normal' camera in order to put the far limit of depth of field at infinity. H usually corresponds to about 1500 times the physical diameter of our lens aperture.

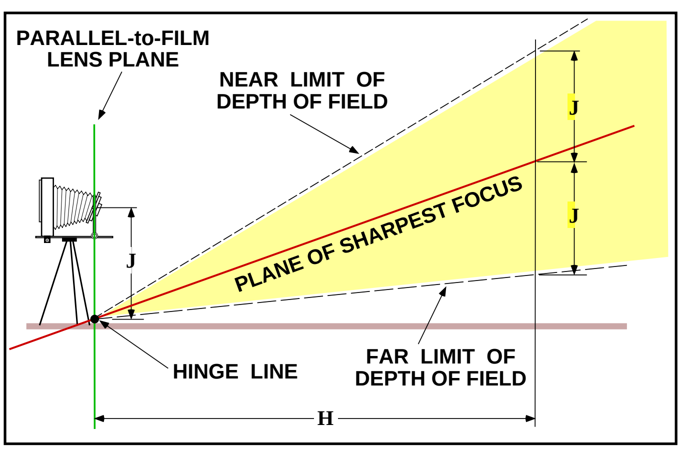
At the hinge line the depth of field is zero. One hyperfocal distance in front of the camera, the depth of field, measured vertically (parallel to the camera back) is (approximately) equal to that distance J. At other distances depth of field scales with distance. At a distance H/2, the depth of field is J/2 and so on. It's really simple! A minor correction factor is necessary under close-up conditions.

As was the case for focusing, there are a few subtleties we need to keep in mind. In order to establish where the depth of field is equal to J we must measure out the hyperfocal distance in a direction perpendicular to the film plane. That seems quite logical when the film is vertical, but circumstances will arise where it will seem a very strange way to measure things. At the hyperfocal distance the depth of field extends a distance J on either side of the subject plane, measured in the same direction we originally measured J. J is always measured in a direction parallel to the film plane.

Let's apply this to a couple of the sample photographs we used in Part I. We were using a 150 Symmar-S, always at f/11. The hyperfocal distance for a 150 mm lens at f/11 is about 67 feet. This assumes a 0.1 millimeter permissible circle of confusion diameter. The distance J was 4.2 or 2.1 or 7 feet for the examples illustrated. Lisa was typically about five feet in front of the camera lens. Thus the depth of field, on either side of the plane of sharpest focus, should have been about 4 inches, 2 inches or 7 inches respectively. It is fortuitous that with the hyperfocal distance being about 12 times the distance to the subject, the depth of field at the subject is one inch for every foot of lens-to-hinge line distance.

The permissible circle of confusion diameter cited above is appropriate for 8 inch by 10 inch photographic prints, but the illustrations here are printed on a smaller scale and using a half-tone screen. It is probably appropriate to expect that the effective depth of field for the illustrations as published is about three times the values just calculated.

Let's look again at Example 2. Here we have drawn in the estimated effective depth of field limiting planes. I think you'll agree that our corrected estimate (12 in.) seems reasonable.



This simple sketch shows the plane of sharpest focus as well as the limiting planes within which our image should be acceptably sharp. At a distance of one hyperfocal distance (H) from the camera lens, the depth of field, measured in a direction parallel to the film, is equal to the lens-to-hinge line distance. At other distances the depth of field is proportionately greater or less. The shaded area is the depth of field wedge.

When we cranked in additional lens tilt to produce Example 3, we reduced J by about a factor of about 2, and this means depth of field is reduced by the same factor also. A comparison of Examples 1 and 3 are reproduced here. The main difference between these two is just the distance J. Notice that Lisa's shorts and shoes are distinctly less sharp in Example 3 than in Example 1. Lisa's face is not much different for these two examples, but if you check back and examine the side views published in Part I, you'll see that Lisa's head is considerably farther above the plane of sharpest focus for Example 1 than for Example 3.

Now we come to the interesting case! For Example 4, we tilted the back forward by 30˚, and the lens forward by 26˚. This placed the hinge line about 6 feet directly over Lisa's head. We must measure the hyperfocal distance not horizontally, but in a direction perpendicular to the film plane. In this case, we measure the subject distance from the camera lens to Lisa's waist. Yes, on a strange downward angle. The actual distance measured this way is about 4 feet. Recall that depth of field is measured parallel to the film plane. For a subject distance of 4 feet rather than 5 feet, our corrected depth of field comes out at 16 inches (either side of the plane of sharpest focus), but measured in what seems a very strange direction! For this example she's pretty well entirely within the depth of field.

What seemed like a quite natural way to measure depth of field in our earlier examples, turns out not to be so natural in another case.

There are at least three other ways to describe depth of field for view cameras. Extensive depth of field tables are provided in *Focusing the View Camera* for two useful alternatives, and a third alternative is described in an addendum to the book. But the basic principles are as they have been described in this article.

There's a lesson here. Depth of field is influenced directly by the distance J. And J is in turn is determined by the amount of lens tilt used. More lens tilt essentially means less depth of field. In typical shooting situations, the photographer may have to make a compromise. Tilting the lens can improve overall sharpness by orienting the plane of sharpest focus to coincide with the subject. But tilting the lens also reduces the amount of depth of field on either side of that plane. For arrangements of subjects that naturally fall on or very close to a planar surface, adjusting the lens tilt is probably a good thing to do. On the other hand, if the objects are distributed more randomly throughout a three-dimensional space, tilting the lens may lead to a decrease in overall sharpness.

For the most part, the discussion here has centered on the application of simple lens tilt in the vertical plane. The view camera of course offers swings as well. The same principles apply in both cases. Swing is just tilt in a different plane. Combined swing and tilt complicate matters significantly, although a given amount of swing combined with some other amount of tilt is equivalent to just one angle of lens movement in a plane that is neither horizontal nor vertical.

I have tried to explain how focus and depth of field work for view cameras. But I can't offer rules for what is the right thing to do in every situation. There is enormous scope for the application of skill and judgment.

Some will ask if the model of depth of field cited here agrees with the usual formulae for 'normal' cameras. The answer is an unqualified "yes", but a bit of math is needed to prove it.

We did not rely at all upon the tilt scales on the Sinar F. And my own view cameras, an old B&J, is entirely devoid of scales of any kind. Tilt is the movement needed most often, and fortunately there are easy ways to set and measure tilt. For the illustrations in this article, we used an "Acu-Angle A-100" angle-measuring level. This is an approximately three inch square by half-inch thick item that claims to be able to measure angles in the vertical plane to within 0.2 degrees. That's more than adequate for general photographic use. You'll need extremely good eyes or a magnifier to get that quoted accuracy, however. One can also use a so-called "protractor head" removed from a carpenter's square. This item combines a bubble level and a protractor in one unit. The protractor head is good to a half-degree; and that's good enough.

Again I'm grateful for the kind assistance of Chris Reardon and Robinson-Campbell and Associates Ltd. of Halifax, Nova Scotia for production of the illustrations. And special thanks to our subject, Lisa. Polaroid Canada provided the Type P/N 55 film which proved excellent for this application. Thank you all. The Acu-Angle A-100 is available from Lee Valley Tools of Ottawa ON, Canada (1-800-267-8767) at a cost of $29.95 Canadian, plus shipping. And *Focusing the View Camera* is available here in The Book Bin.

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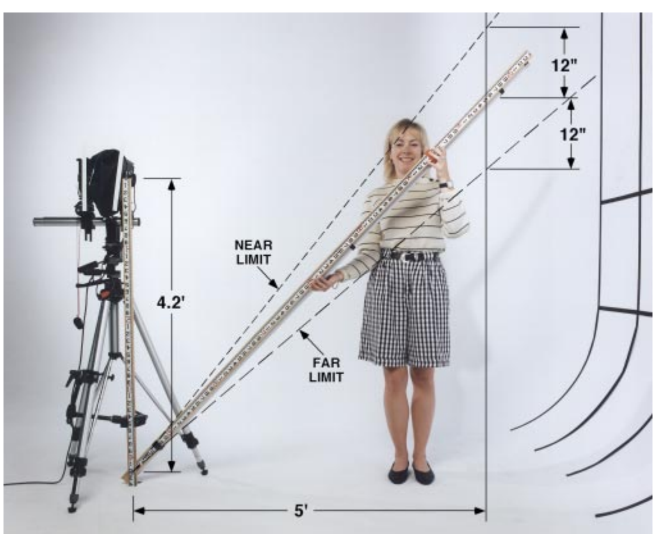
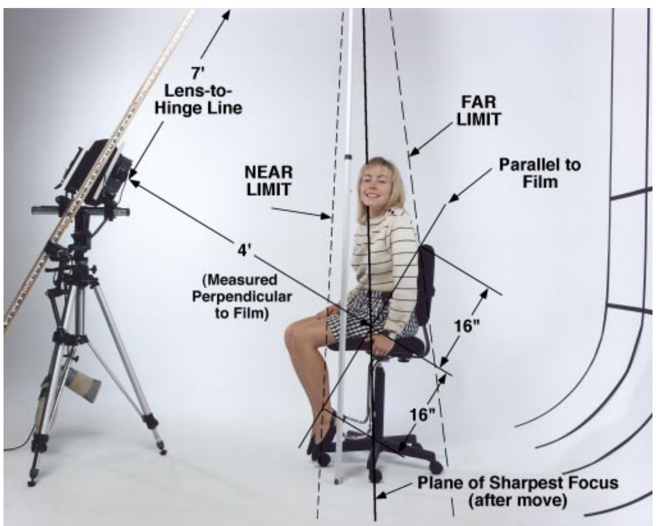


Here's Example 2 again, with the essential depth of field dimensions and limiting planes drawn in.

A comparison of the results of Examples 1 (left, J = 4.2 feet) and 3 (right, J = 2.1 feet) shows how reducing J reduces depth of field. Inspection of Lisa's shoes will show that the depth of field is indeed smaller for Example 3. In the original prints one can see by the texture of the sweater that the depth of field is indeed twice as great in Example 1 as in Example 3.



Example 4, 30° of back tilt and 26° of front tilt result in an unusual depth of field geometry. It seems a strange way to measure things, but this scheme adheres to the rules set out here for depth of field. We moved Lisa back just a bit for the shot at far left, so I've drawn the plane of sharpest focus to correspond.