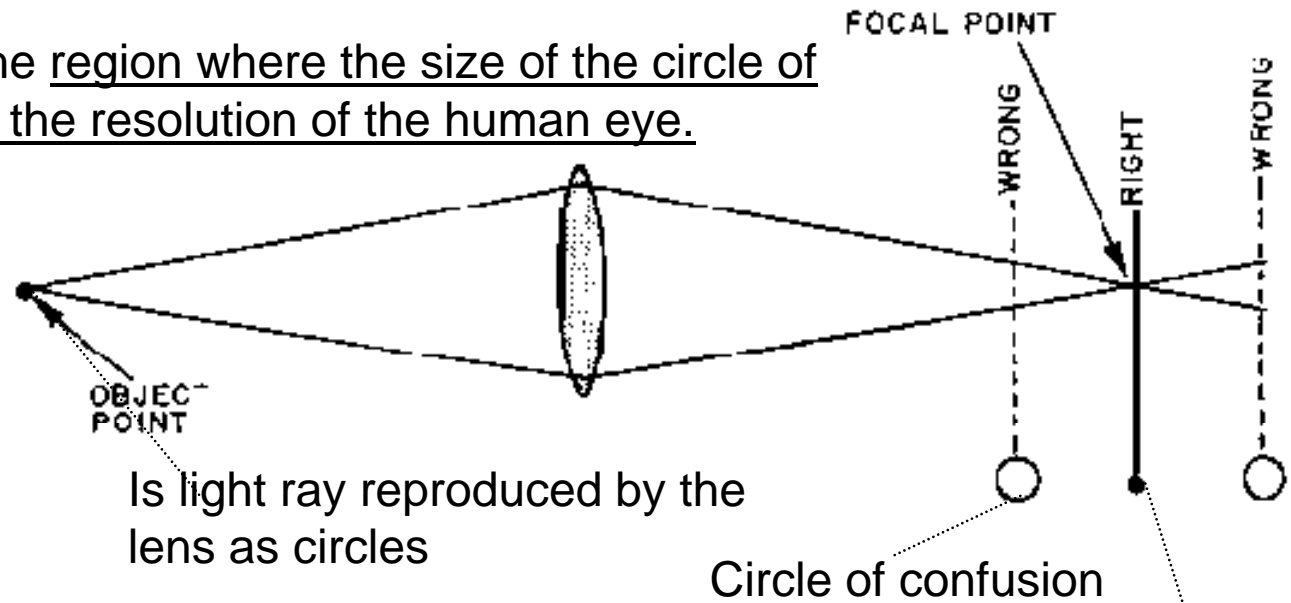


Depth of field

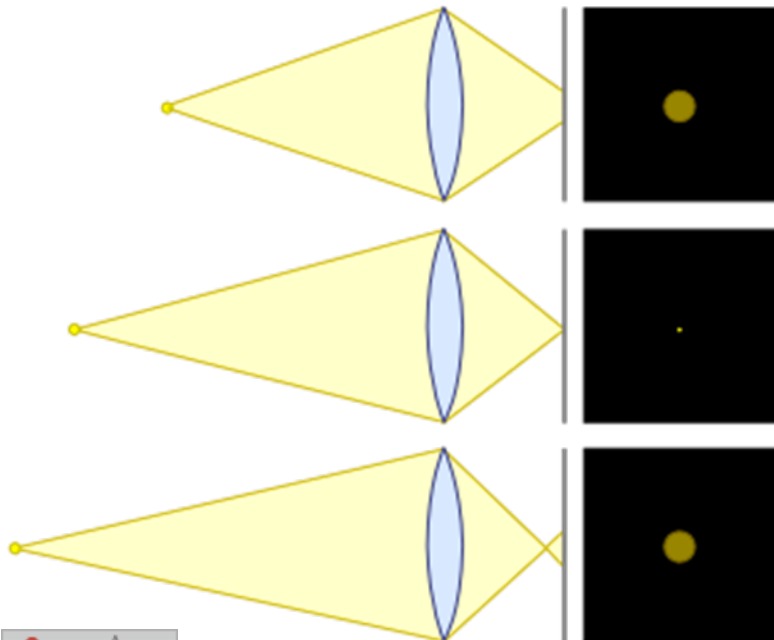
II

The depth of field is the region where the size of the circle of confusion is less than the resolution of the human eye.



Is light ray reproduced by the lens as circles

Circle is smaller than 1/100 inch so it appears as a sharp point to the eye

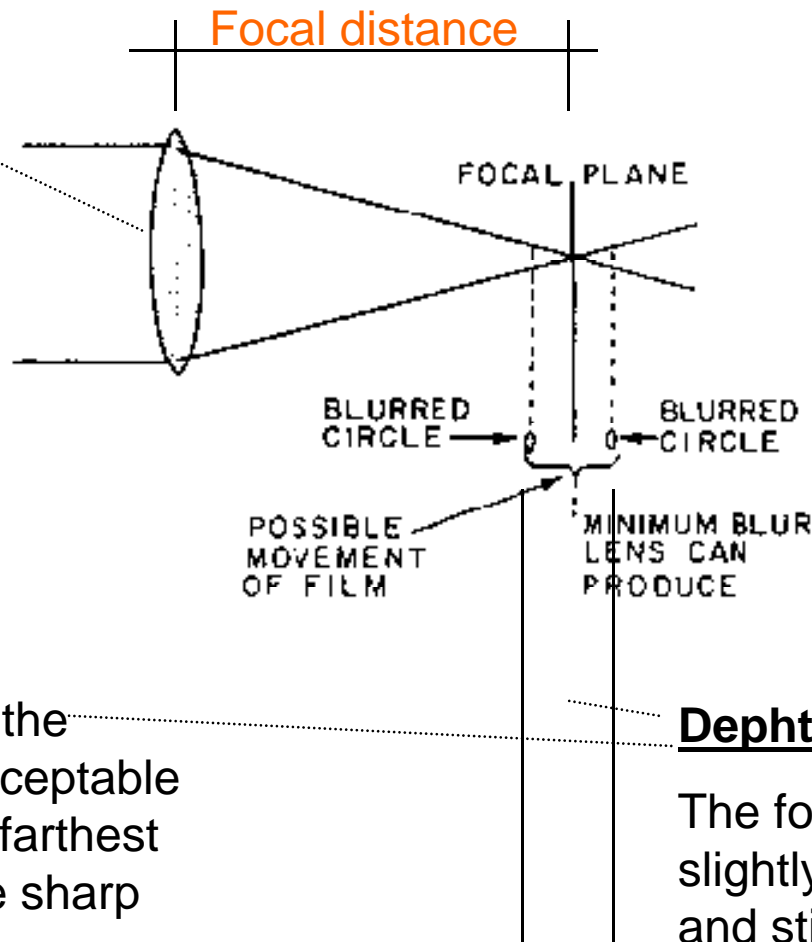


Although **print size** and **viewing distance** are important factors which influence how large the circle of confusion appears to our eyes, **aperture** and **focal distance** () are the two main factors that determine how big the circle of confusion will be on your camera's sensor.

Lens aperture

Decreasing lens opening narrows the light rays making smaller the circles of confusion (negligible)

Small lens opening can record, as clearly as possible, several objects at varying distances



The size of the circle of confusion that is permissible depends on:

- the film format size or electronic sensor)
- viewing distance and print size combination

The distance from the nearest point of acceptable sharp focus to the farthest point of acceptable sharp focus

Depth of field

The focal plane can be moved slightly (forward or backward) and still retain an acceptable sharp image

An acceptably sharp circle of confusion is loosely defined as one which would go unnoticed when enlarged to a standard 8x10 inch print, and observed from a standard viewing distance of about 1 foot.



Alternatively, the depth of field can be based on when the circle of confusion becomes larger than the size of your digital camera's pixels.

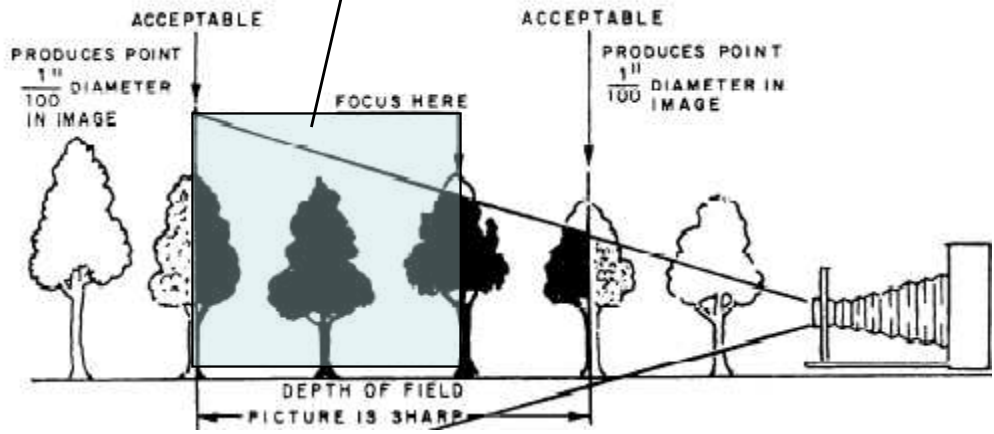
At this viewing distance and print size, camera manufacturers assume a circle of confusion is negligible if no larger than 0.01 inches (when enlarged). As a result, camera manufacturers use the 0.01 inch standard when providing lens depth of field markers (shown for f/22 on a 50mm lens).

<http://www.cambridgeincolour.com/tutorials/depth-of-field.htm>

Even though the total depth of field is virtually constant (lens focal length), the fraction of the depth of field which is in front of and behind the focus distance does change with focal length, as demonstrated below:

Focal Length (mm)	Distribution of the Depth of Field	
	Rear	Front
10	70.2 %	29.8 %
20	60.1 %	39.9 %
50	54.0 %	46.0 %
100	52.0 %	48.0 %
200	51.0 %	49.0 %
400	50.5 %	49.5 %

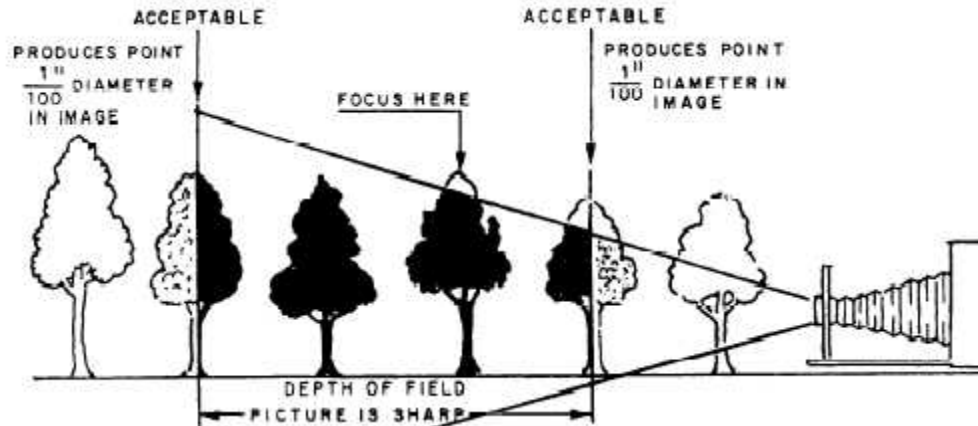
A wide angle lens provides a more gradually fading DoF behind the focal plane than in front, which is important for traditional landscape photographs.



Summary

Although **print size** and **viewing distance** are important factors which influence how large the circle of confusion *appears* to our eyes, **aperture** and **focal distance** are the two main factors that determine how big the circle of confusion will be on your camera's sensor.

Larger apertures (smaller F-stop number) and closer focal distances produce a shallower depth of field.



CALCULATING DEPTH OF FIELD

In order to calculate the depth of field, one needs to first decide on an appropriate value for the maximum allowable circle of confusion. This is based on both the camera type (sensor or film size), and on the viewing distance / print size combination.

Depth of field calculations ordinarily assume that a feature size of 0.01 inches is required for acceptable sharpness (as discussed earlier), however people with 20-20 vision can see features 1/3 this size. If you use the 0.01 inch standard of eyesight, understand that the edge of the depth of field may not appear acceptably sharp. The depth of field calculator below assumes this standard of eyesight, however I also provide a more flexible depth of field calculator.

Depth of Field Calculator	
Camera Type	digital SLR with CF of 1.6X
Selected aperture	F 1.4
Actual lens focal length	70 mm
Focus distance (to subject)	2 meters
<input type="button" value="Calculate"/>	
1.978 m	Closest distance of acceptable sharpness
2.023 m	Furthest distance of acceptable sharpness
0.045 m	<i>Total Depth of Field</i>

Note: CF = "crop factor" (commonly referred to as the focal length multiplier)

Death of field scale

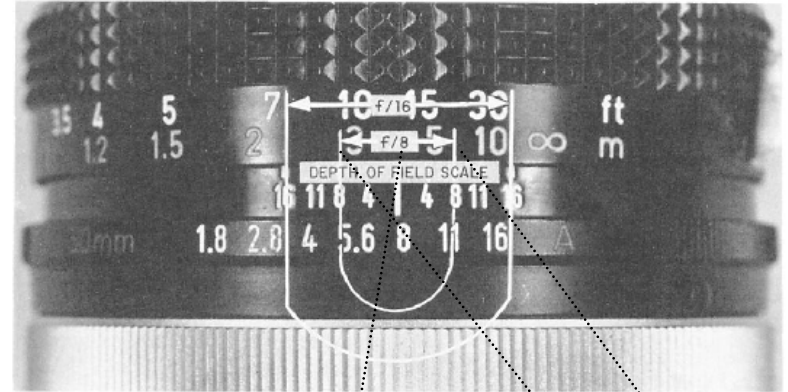
PRACTICE

Care should be taken not to let all of these numbers get in the way of taking your photo.

I do not recommend calculating the depth of field for every image, but instead **suggest that you get a visual feel for how aperture and focal length affect your image.**

This can only be achieved by getting out there and experimenting with your camera. Once you have done this, the depth of field calculator can then be used to enhance those carefully planned landscape and macro of low-light images where the range of sharpness is critical.

A 35 mm lens set to [f/11](#). The depth-of-field scale indicates that a subject which is anywhere between 1 and 2 meters in front of the camera will be rendered acceptably sharp. If the aperture were set to *f/22* instead, everything from 0.7 meters to infinity would appear to be in focus.



f/8 ; df = 2.8m – 7m;



How the f-number affects depth of field



f/2.8



f/22



f/5



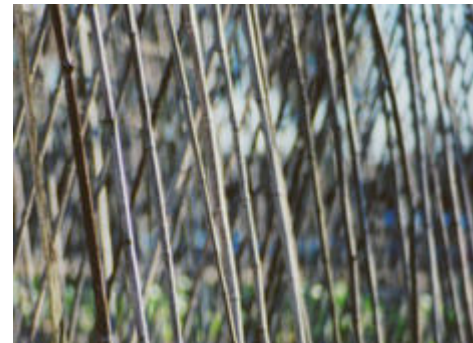
f/32



f/8



f/4



f/2.8