Control of Light Through Optical Systems

Stops in Optical Instruments

The functions of stops in optical systems

- Control aberrations of the image
- The depth of focus and depth of field
- The illuminance of the image
- The resolving power of the instrument
- The field of view

Aperture Stop & Field Stop

Aperture Stop

The aperture stop is the physical component that limits the amount of light reaching the image and therefore controls the illuminance (brightness) of the image. The aperture stop can be located in front of, behind, or within the lens system. One of the lenses may serve as the aperture stop. The aperture stop depends on the location of the object.

Entrance Pupil: the image of the aperture stop as seen from the object.
Exit Pupil: the image of the aperture stop as seen from image space.

Field Stop

The field stop determines the extent of the object that will be represented in the image (the field of view).

Entrance Window: the image of the field stop as seen from object space.
Exit Window: the image of the field stop as seen from the image space.

Field of View

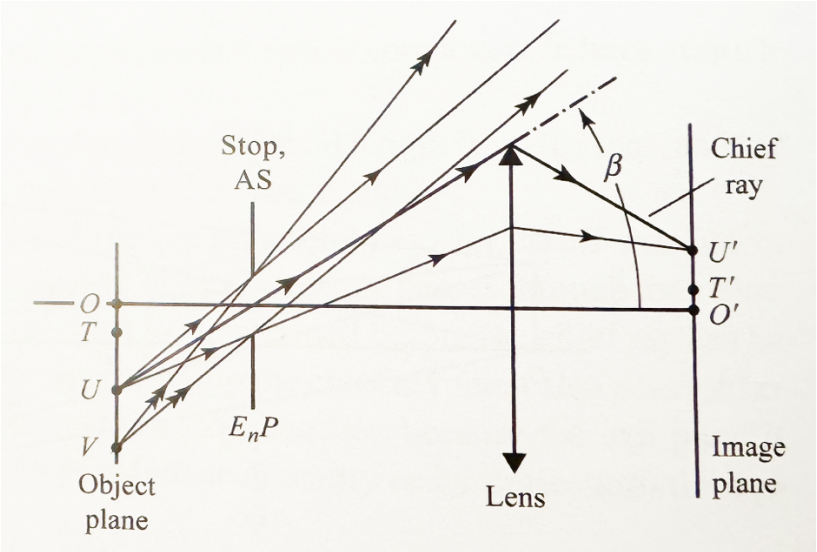
The maximum observable dimensions of an extended object or the angular extent of the object measured relative to a particular point on the optic axis. The Field Stop is the physical component that determines the FOV by limiting the angle of the principal (chief) rays from off axis points that can pass through the optical system.

Principal Ray: passes through the center of the entrance pupil and after refraction, passes through the center of the exit pupil.

The FOV can be quantified as the angle subtended at the Entrance Pupil by the edges of the Entrance Window (in degrees).

Field of Half Illumination

The edge of the field of view where ½ of the light passes through the optical system. The Principal Ray defines the boundary of the Field of Half Illumination.



(from Pedrottis 2025)

Vignetting

The image becomes dimmer as the radius of the image increases.

Field of View Calculation

$$FOV\ (\alpha) = 2\theta$$

$$tan\theta = \frac{radius\ of\ EnW}{distance\ of\ EnP\ to\ EnW}$$

Where:

EnW is the Entrance Window
EnP is the Entrance Pupil

Depth of Field & Depth of Focus

Depth of Field

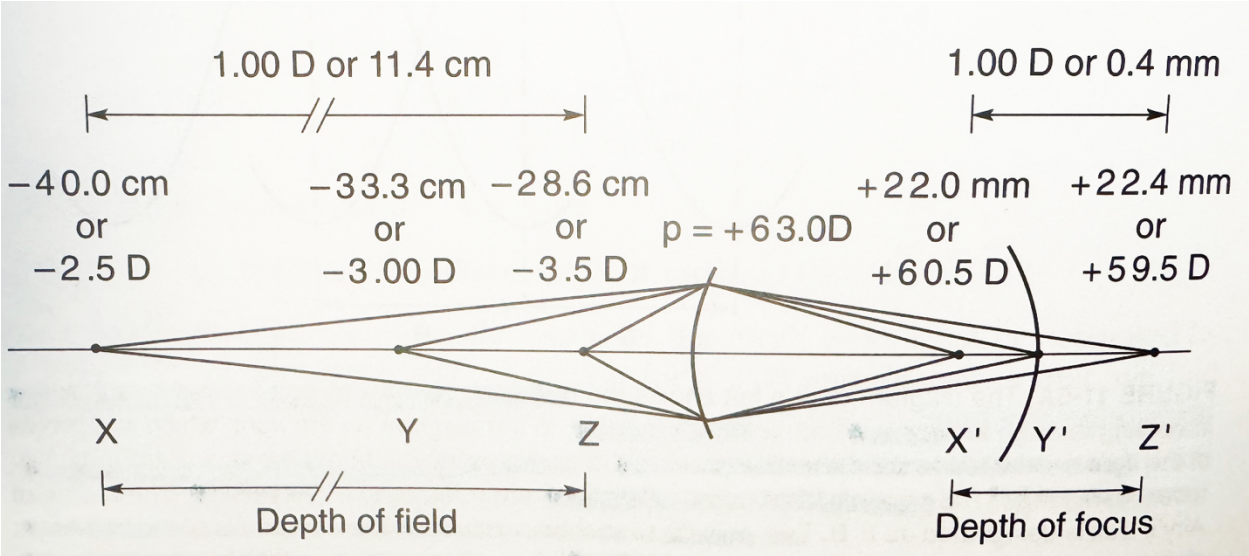
The total axial range (along the optic axis) over which the object can be moved without noticeable deterioration in the image quality given a fixed image plane.

Depth of Focus

The total axial range (along the optic axis) over which the image plane can be moved without noticeable deterioration in the image quality given a fixed object.

Depth of Field & Depth of Focus are dependent on aperture size.

Depth of Field & Focus



(from Schwartz 2002)

This illustration shows the extent of depth of field (object space) and depth of focus (image space). Both can be specified as linear distances or dioptric equivalents.