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ENGINEERING SERIES**

MODERN LENS DESIGN

A Resource Manual

WARREN J. SMITH
GENESEE OPTICS SOFTWARE, INC.

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Modern Lens Design

A Resource Manual

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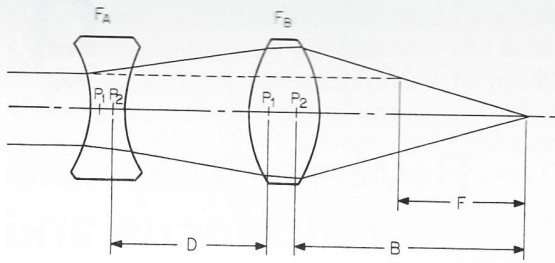


Figure 9.1 The basic power arrangement for a reversed telephoto lens yields a back focal length which is longer than the effective focal length.

should be low-index; this reduces the overcorrected Petzval contribution from this component.

It is apparent that there is absolutely no hope of any semblance of symmetry in this type of lens. Thus we can expect the correction of coma, distortion, and lateral color to be difficult. In many other design types, these aberrations are reduced or corrected by an approximately symmetrical arrangement of the elements about the aperture stop. In order to correct both the axial and lateral chromatic of the retrofocus, both components must be individually achromatized. (Although in a system which has only a modestly extended back focus, the front negative component may be weak enough that a high- V -value crown singlet will be acceptable.) The simplest *fully* corrected form is thus a pair of achromatic components. Usually the aperture stop is at the rear component; the natural shape for the front negative achromat is then that of a meniscus, concave toward the stop.

In an unsymmetrical system, as noted above, coma, distortion, and lateral color are difficult to control. Of these, only distortion does not affect the image definition. If it can be tolerated, allowing a few percent distortion will sometimes permit a better level of correction for all the other aberrations. Thus it is often worthwhile in the course of the optimization process to greatly reduce the weight on distortion in the merit function to see if an overall improvement will result.

9.2 The Basic Retrofocus Lens

Figure 9.2 is a relatively simple retrofocus design with an airspaced doublet achromatic front and a rear component which is a split-rear-crown triplet form. Designed as a single-frame 35-mm projection lens, it covers a modest 37° field at a speed of $f/3$. Note that the glass types are all rather ordinary. As is true of most retrofocus designs, this lens

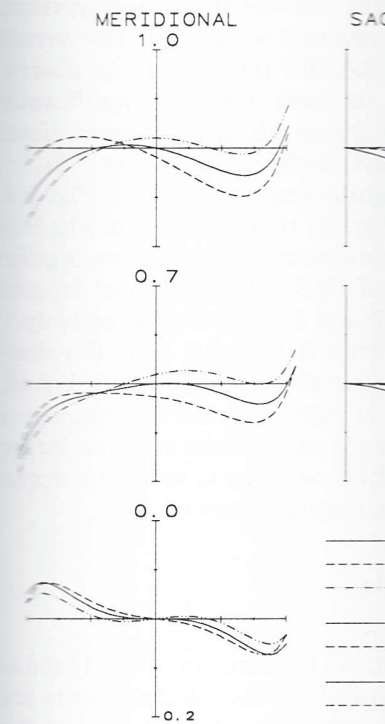
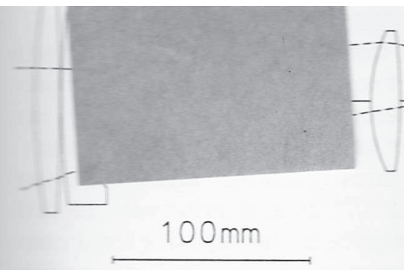


Figure 9.2