Comparison of a zone plate with a convex lens

Similarities:

1. The relation connecting the conjugate distances are similar.
2. Focal lengths of both depend upon wavelength of light used. Hence both show chromatic aberration.
3. Both form real image of an object on the side opposite to that of the object.
4. The formulae for linear magnification for a zone plate and convex lens are similar.

Differences:

1. For a particular wavelength, a convex lens has one focus while a zone plate has a number of foci depending on the zones used. Thus for a fixed object a lens produces only one image whereas a zone plate produces a number of images.
2. Light from the consecutive clear zones of the zone plate arrives at the image point after one complete period of the wave. In a lens, the rays reach the image point in the same phase.

3. The focal length of a lens is given by the formula — $\frac{1}{f} = (\mu - 1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$ whereas the focal length for a zone plate is given by $\frac{1}{f} = \frac{n\lambda}{r_n^2}$.

4. The thickness of a convex lens varies from point to point but that of a zone plate is constant everywhere.

5. For a zone plate focal length decreases as λ increases. Therefore, focal length for red light is shorter than that for violet light ($\because \lambda_r > \lambda_v$). But for a lens, focal length increases as λ increases. So for a lens $f_r > f_v$.

6. In case of a zone plate, the image is formed by the diffraction phenomenon. In case of a convex lens, the image is formed due to refraction of light.

7. A zone plate can be used over a wide range of wavelengths from microwaves to X-rays. Glass lens cannot be used beyond the visible region.

8. A zone plate acts simultaneously as a convex lens and a concave lens. In addition to a real image, a virtual image is also formed simultaneously.
A convex lens forms only a real image.

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So we can say that zone plate is a practical application of Fresnel's half period zones. According to the construction of half period zones, light from any two successive zones reaches ~~A~~ The point under consideration in opposite phases. As a result, the intensity is greatly diminished. If then the alternate zones are made opaque, either the odd or the even numbers will be effective and we get intense illumination in the point under consideration. A transparent plate made on this principle is called a zone plate.