

Undergrads do problems 1 through 3
 Grads do all four problems

1. A wavefront error is given by $W(r,\theta) = -0.001r^2 - 0.0005 r^2 \cos 2\theta + 0.00005 r^4$. What is the power error $d\phi$ associated with this wavefront? For the horizontal meridian, plot $d\phi$ for pupil diameters ranging from 2 mm to 8 mm. Plot $d\phi$ as a function of θ for a pupil diameter of 4 mm. (Note that r is the radial coordinate in the pupil, so r ranges from 1 mm to 4 mm for pupil diameters of 2 mm to 8 mm).
2. The sag of a paraboloid is given by $z = \frac{x^2 + y^2}{2R}$. What is the Mean Curvature H of the surface? Show that the Mean Curvature of the paraboloid is the same as a sphere of radius R at the origin.
3. The picture below was taken at a distance of 30 feet from the storage container. The height of the storage container is 8 feet. What is the fundamental spatial frequency of the ribs in the side of the storage container in cyc/deg? What are the fundamental spatial frequencies in cyc/deg of the horizontal and vertical mortar lines in the brick wall? State your assumptions. The original image can be downloaded at <http://www.visualopticslab.com/OPTI535/Homeworks/Storage%20Container.jpg>.



*****Grads Only*****

4. In class we showed that the spherical aberration can be obtained from raytracing data from

$$d\phi = \frac{n'}{P'M'} - \frac{n'}{P'F'}$$

where $P'M'$ is the distance from the rear principal plane to the marginal ray focus, $P'F'$ is the distance from the rear principal plane to the rear focal point and n' is the index of the vitreous humor. Plot the spherical aberration of the Gullstrand-LeGrand and Arizona Eye models for ray heights ranging from 0 to 4 mm.