# Advanced Tutorial – Designing a Medium Flood Beam with an LED Source

This tutorial demonstrates designing a reflector around an LED to create a medium flood beam, and using an anisotropic material. It is a good idea to complete the beginner tutorials before attempting this advanced tutorial, since many of the more basic functions and concepts are not explained in this tutorial.

Import the Lamp

1. Start a new project and choose **File > Save As** to give it a name such as *LED Medium Flood*.

2. Choose **File > Import Lamp** and then browse for the file named *W42180.LAMP*, which is the Seoul P4. Insert the LED at 0,0.
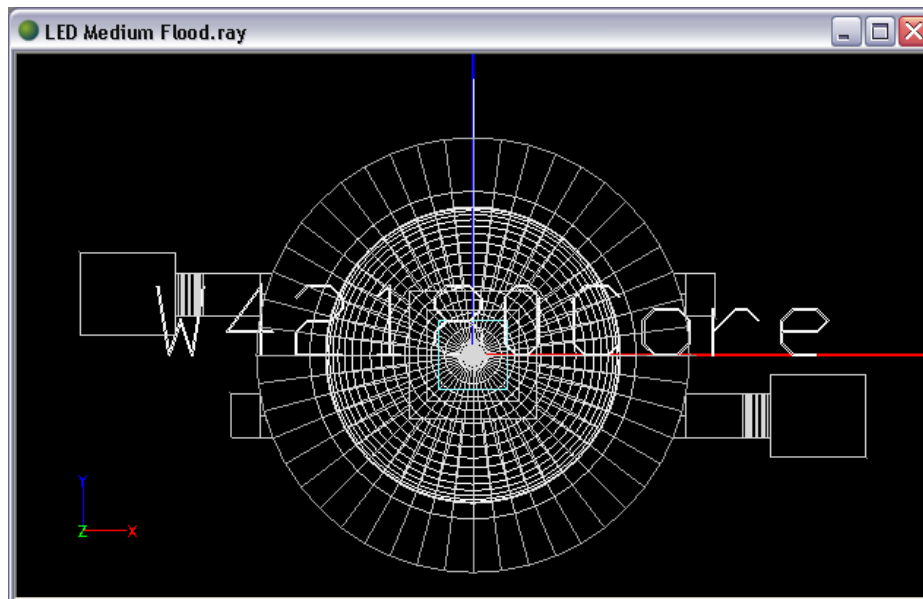

Build the Reflector

3. From a front view, choose **Design > Reflector: Aiming Based > Extruded Symmetric**.

    a. Press Enter to accept the default lamp center of 0,0.

    b. Click a start point close to the base of the LED's dome lens.

    c. Enter -50 for the reflector extent, in degrees.

    d. Enter 0 for the aiming of the first section, in degrees.

    e. Enter -40 for the aiming of the last section, in degrees.

    f. Enter 5 for the angle increment, in degrees.

   g. Enter 12 for the extrusion length, in inches.
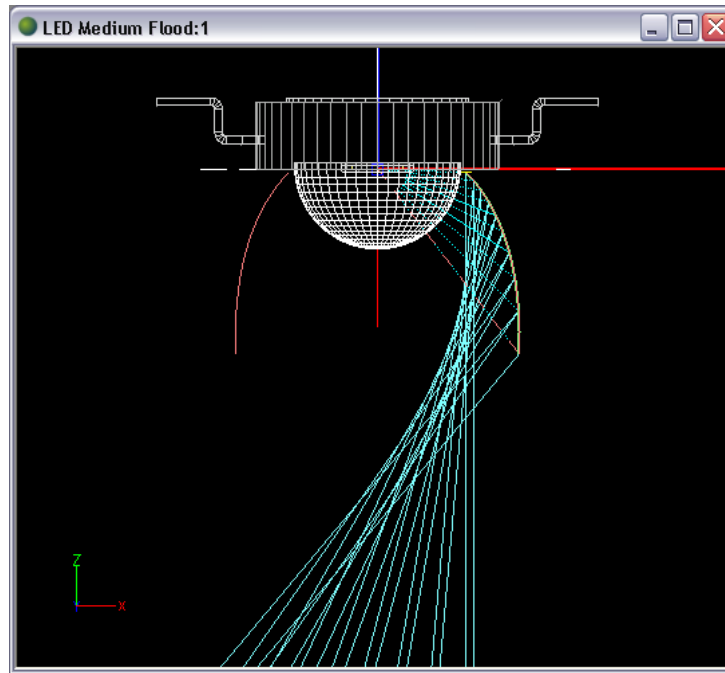
4. Use **Draw > Polygon Surface** to create a reflector end-cap. Click the points in a rectangle shape that encloses the reflector profile.
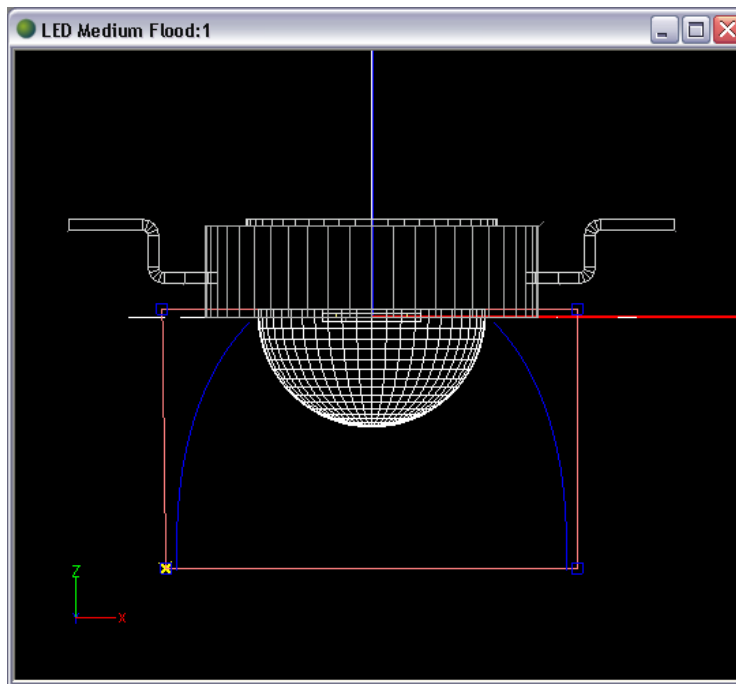

5. Under **Settings > Layers**, create a new layer for the end-caps called *REFL-End-caps* with a color such as cyan. Place the end-caps on the new layer by selecting them and using the property control. Note that we need to place the end-caps on a different layer than the main reflector in this case because we will be giving a different anisotropic material orientation to the different pieces, and to do so they must not be on the same layer.

6. Move (under the **Modify** menu) the end-cap to one end of the reflector by selecting it from the top view, and the moving it up 6".

7. Mirror (under the **Modify** menu) the end-cap along a line from 0,0 to 1,0 to create the other end-cap.

8. Use Show Surface Orientation (right-click in CAD view, then choose View Style) and Orbit (right-click in CAD view, then choose Dynamic Views) to make sure that the end-caps are oriented correctly. The layer color (blue or cyan) should be faced inward, towards the LED.
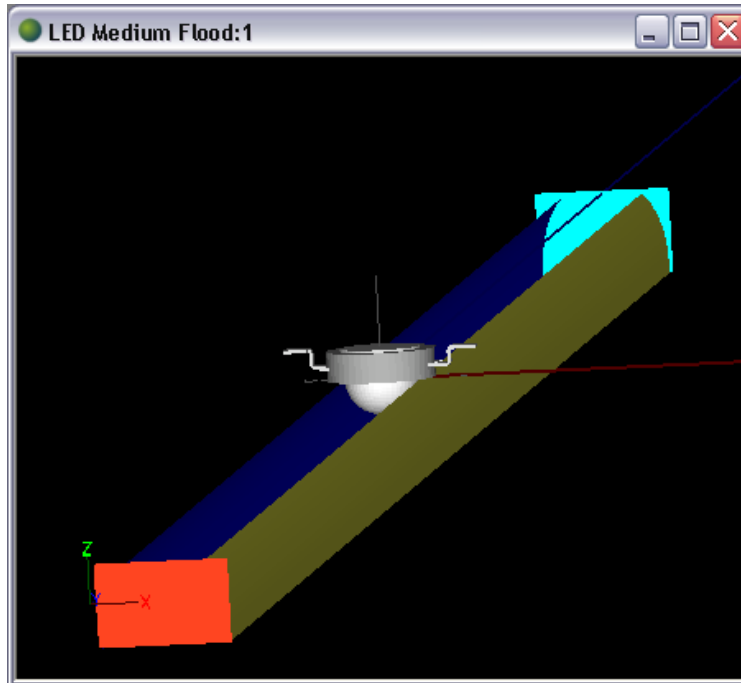

Setup the Materials and Output

9. Choose **Edit > Design Properties** to assign the materials. Assign *Alanod 722 GP (a)* to REFL-Main and REFL-End-caps. Note that you will also see some layers that already have materials assigned to them. These are the LED layers that were imported with the lamp model and they are already setup correctly for the LED.
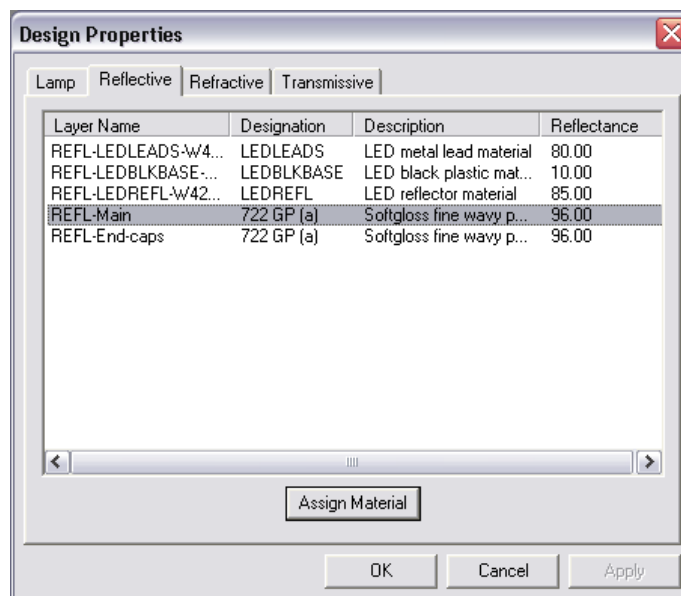
Since we chose an anisotropic material (designated by the "(a)"), we need to orient the anisotropic material on the reflector. Assume that the grain goes along the direction of the extrusion.

10. Orbit in the CAD view to get a better view of the reflector. Use Wireframe view (right-click in CAD view, then choose View Style).
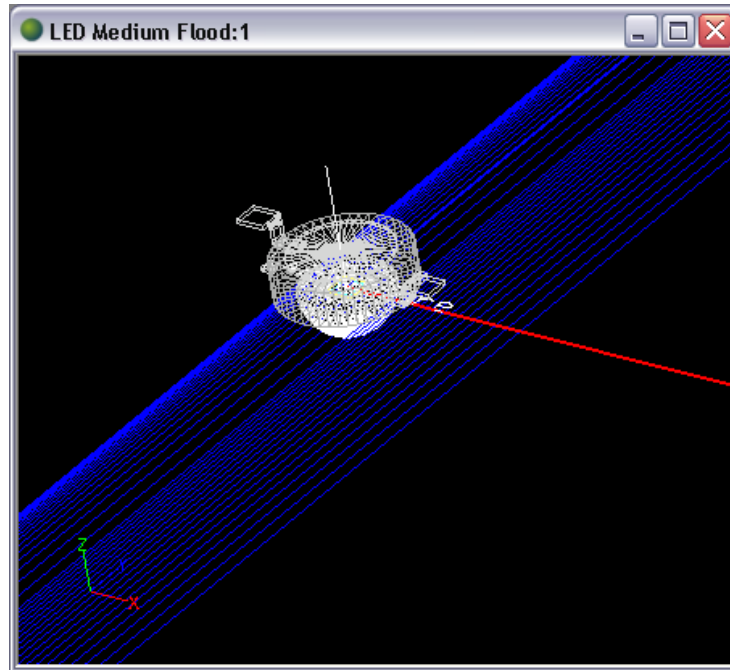

11. Select the reflector and choose **Modify > Orient Anisotropic Material**.

12. In the property control at the right of the screen, choose a Mapping Type of *Project Along Y from XY Plane*. Notice the arrows on the reflector; you may have to zoom in to see them. They are now in the correct orientation, along the direction of the extrusion.
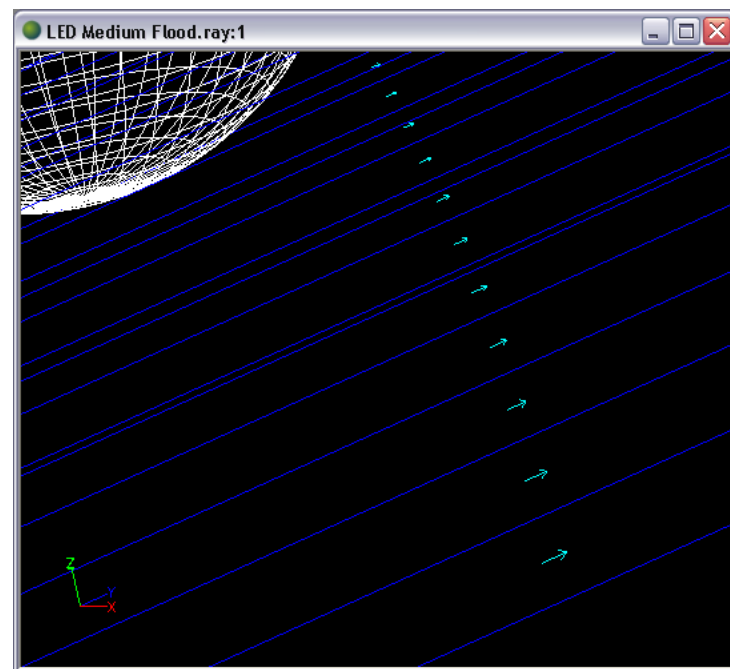
13. Select both of the end-caps and choose **Modify > Orient Anisotropic Material**.

14. Choose the mapping type, *Project Along X from XY Plane*, and then zoom in on the end-caps to confirm that the material orientation is appropriate.
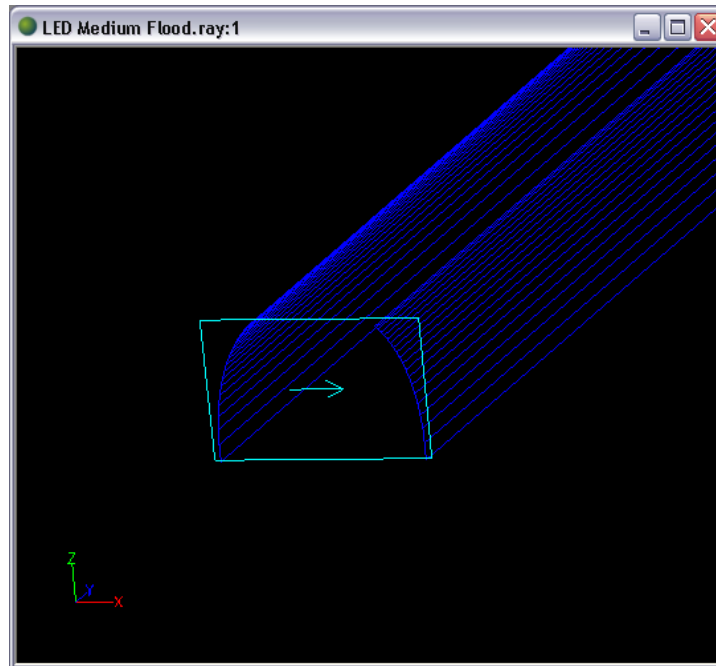
15. Choose **Analysis > Photometric Output Specification** and go to the Photometric Report tab. Change the Horizontal angles to 0(10)90. Keep the Vertical angles at their default of 0(5)90. Then change the Photometric Center Z coordinate to -0.24 and the Luminous Z Dimension to 0.
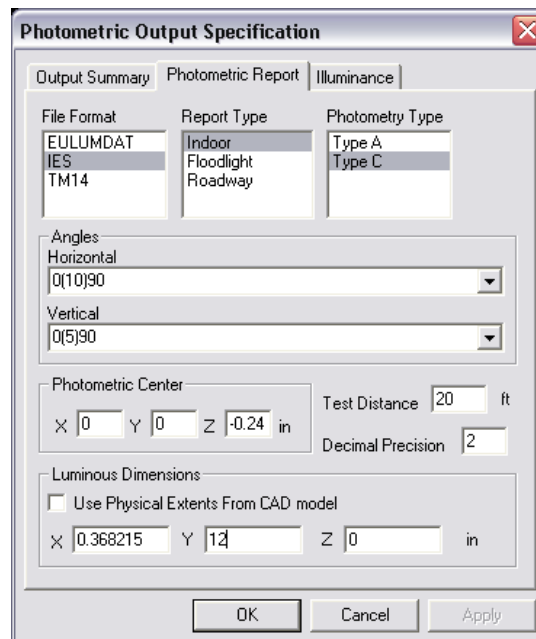
16. Under the Illuminance tab, create an illuminance plane 40'x100', 8' below the luminaire. Use Column and Row Spacings of 0.5 feet (under Calculation Points).

Illuminance Plane

Description:
40'x100' Plane, 8' Below

Location of Plane
Lower Left Corner   X: -20   Y: -50   Z: -8
Lower Right Corner X: 20   Y: -50   Z: -8
Upper Right Corner X: 20   Y: 50   Z: -8
Upper Left Corner   X: -20   Y: 50   Z: -8

Calculation Points
Number of Columns 80   Column Spacing 0.5
Number of Rows   200   Row Spacing   0.5

Units: ft   OK   Cancel

The default Raytrace Settings are appropriate for now, so we won't adjust them at this point.

Design Results

17. Start the analysis by choosing **Analysis > Begin Analysis**.

18. Open the Photometric Report by choosing **View > Photometric Report**. Towards the bottom of the report is the Full Beam Angle, which is just over 80 degrees. This is a good medium flood beam size.

19. View other output such as the Shaded Illuminance Plot and the Polar Candela Plot (under the **View** menu). Overall, the design looks good.
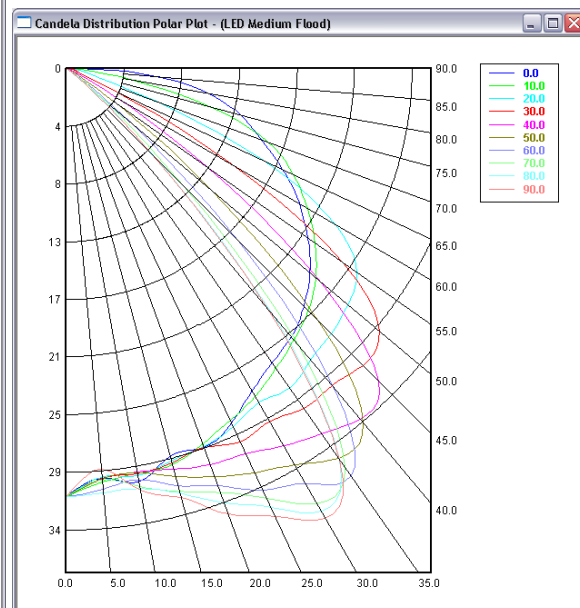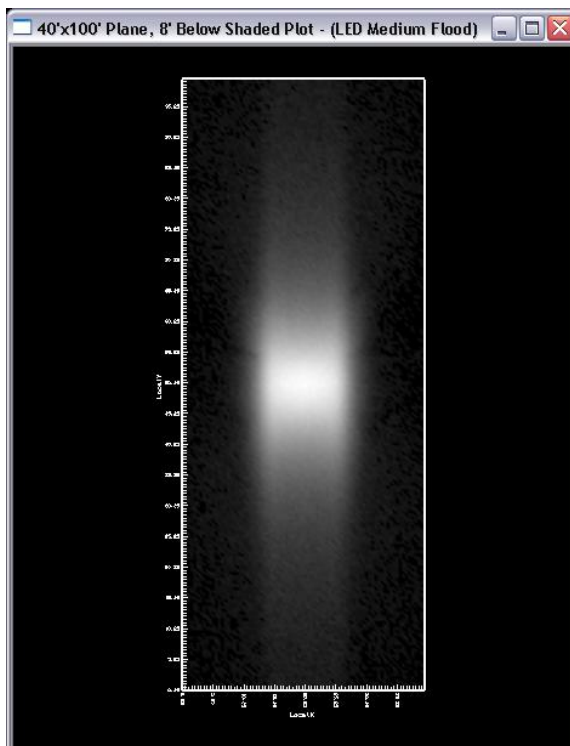
Array the LED

Using a single LED to create a design like this one can be a very good representation of the final product which may have multiple LED's. You can even change the lumen value under **Edit > Design Properties** so that the correct values of lumens, candelas, and footcandles/lux are displayed in your output for a multiple-LED luminaire. However, the longitudinal output (along the length that the LED is to be arrayed) may be slightly inaccurate in output such as the illuminance plots. For example, you may wish to confirm the accuracy of the Shaded Illuminance Plot along its length when using a row of arrayed LED's rather than a single LED representation. Now that we have a design that we like, we can run a Photopia analysis with multiple LED's. This run will be slower, but we already know that we like the current reflector design, and so a multiple LED analysis can be run with confidence that we will not have to go through several design iterations.

20. Save the current project, under **File > Save**.

21. Then choose **File > Save As** to save the project as *LED Medium Flood – 1' Array.ray*.

22. Go to a top view in the CAD view and select the LED.

23. Choose **Modify > Array**.

    a. Press Enter to accept the default array type, Rectangular.

    b. Enter 11 for the number of rows.

    c. Press Enter to accept the default number of columns, 1.

    d. Enter 1 for the distance between rows, in inches.

24. You should see the new array of LED's. To give the array the correct location, select it by clicking on one of the LED's, then enter -5 in the Origin Y value under **Array** in the property control.
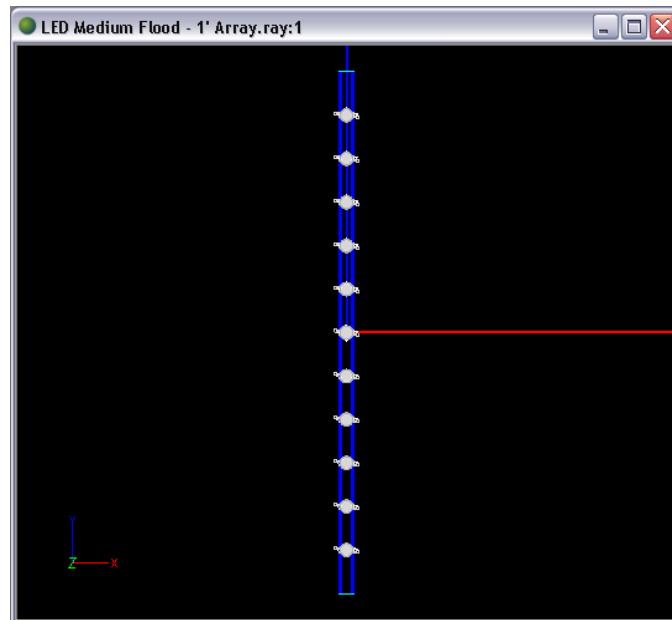
25. Under **Analysis > Raytrace Settings**, change the number of Initial Source Rays to 25,000,000 by adding a zero. Note that the number of rays are divided between the number of sources. Since we have arrayed the LED's, we need to increase the number of rays in order to maintain the same accuracy as the previous analysis.

26. Start the analysis.

27. We would expect that output such as the Polar Candela Plot and Full Beam Angle be the same as that of the single-LED representation, and in fact it is. Viewing the Shaded Illuminance Plot, this plot also looks the same as in the previous run, and so it appears that even the longitudinal output was accurately represented by a single LED as well. In this case, the illuminance plane is far enough away that the single-LED representation would have been sufficient to represent a 1' array length, but it is a good idea to confirm this.