

OSA Design Congress

# Freeform Optic Design Method with Multiple 2D Profiles

## Type III Roadway Lens Example

Meg Tidd

7/12/17

# Introduction

## Roadway lighting applications

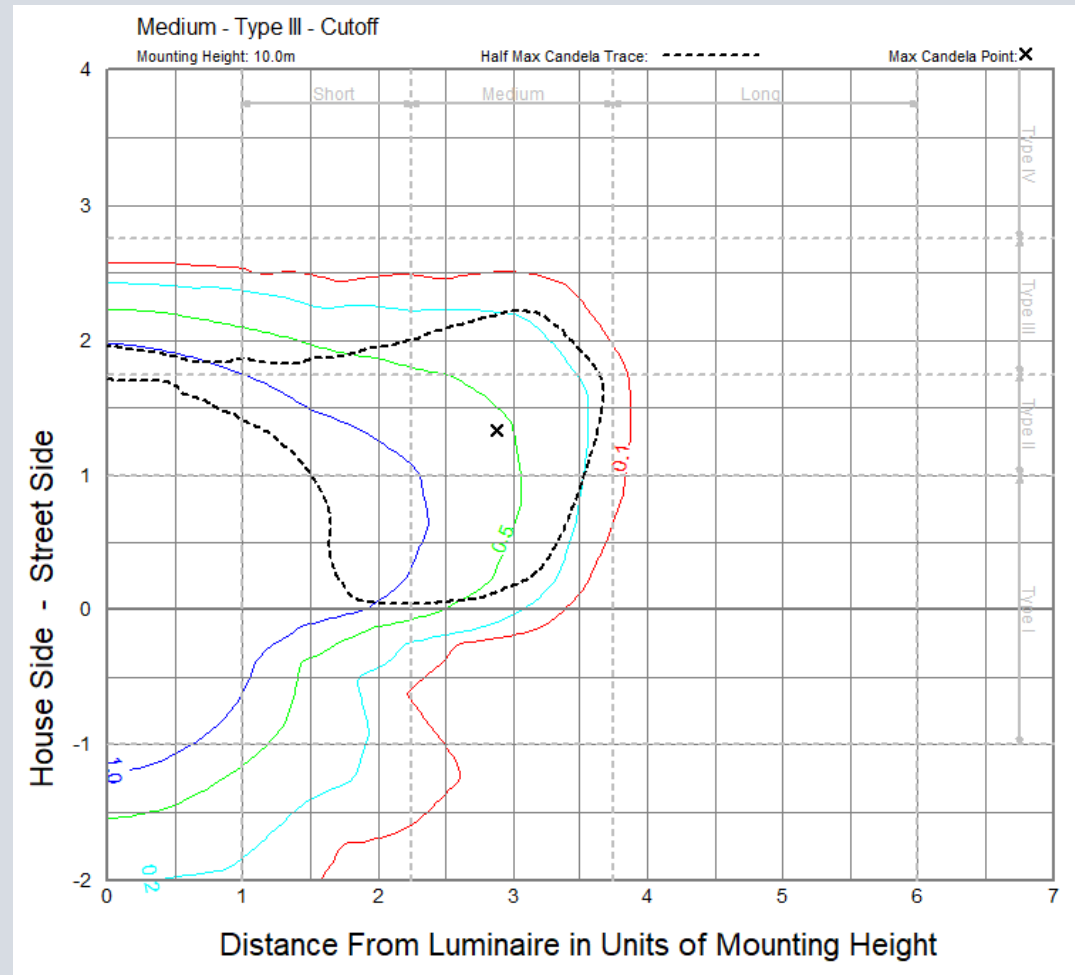
Performance Requirements	Achieved By:
General rectangular illumination pattern	Freeform lens optics (any design method)
Specific performance goals (e.g. IESNA Type classification, $E_{\max}/E_{\min}$ , BUG rating)	Higher level of designer freedom and control

**Design method: specify multiple 2D aiming profiles of lofted freeform shape**

# Optic Performance Goals

## IESNA Lateral Distribution

- How wide max intensity reaches
- Longer lateral distribution = wider pole spacing
- “Medium” = max between 2.25 – 3.75 MH to side



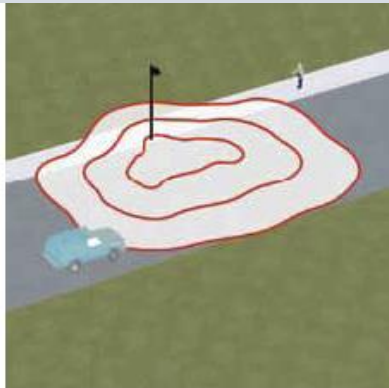
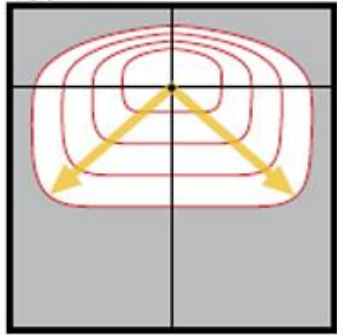
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# Optic Performance Goals

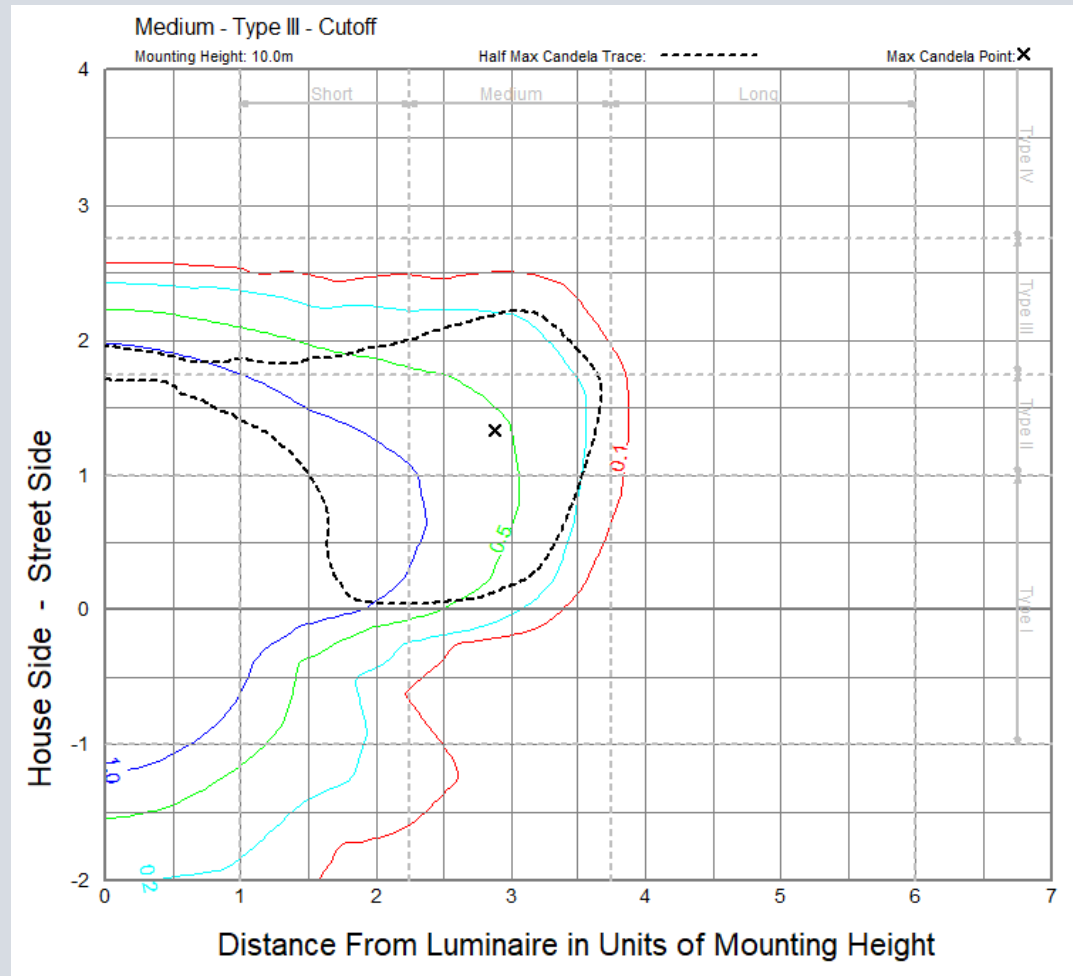
## IESNA Transverse Distribution

- Defines general beam shapes
- “Type III” = half-max between 1.75 -2.75 MH forward

Type III



<http://electricalsmarts.com/light-distribution-types/>

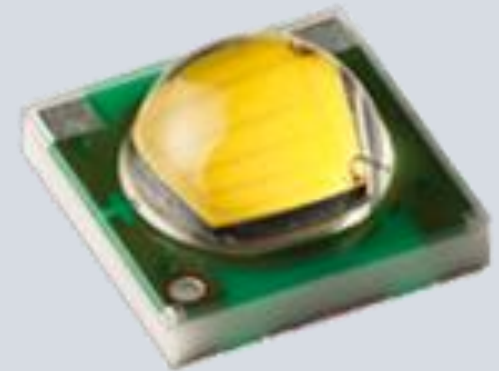


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# Design Constraints

Ensure resulting design is realistic.

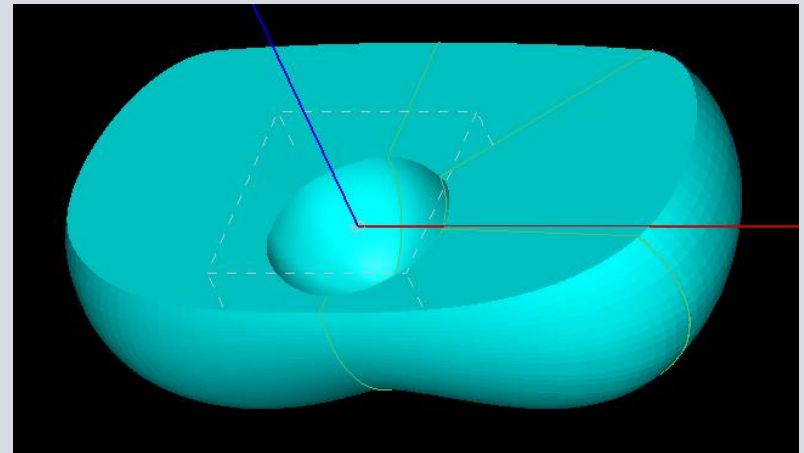
- Source: Cree XP-G LED array
- 1.5mm radius hemispherical opening
- Material: PMMA (n=1.491)
- PCB model: white



<http://www.cree.com/led-components/products/xlamp-leds-discrete/xlamp-xp-g>



<http://www.visionairelighting.com/productDetails.asp?productID=458>

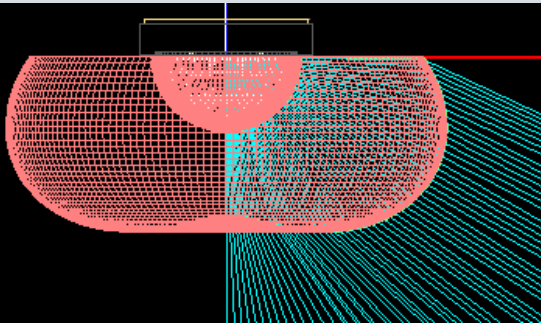


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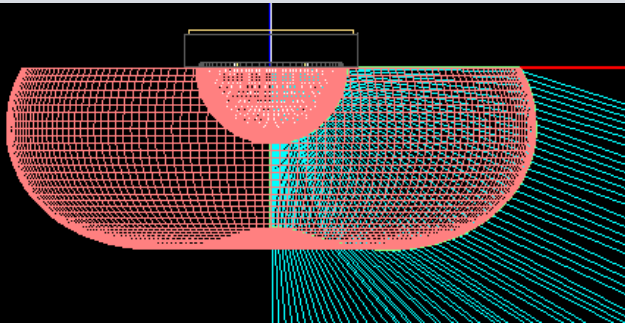
# Process

Start with round, axially symmetric optics:

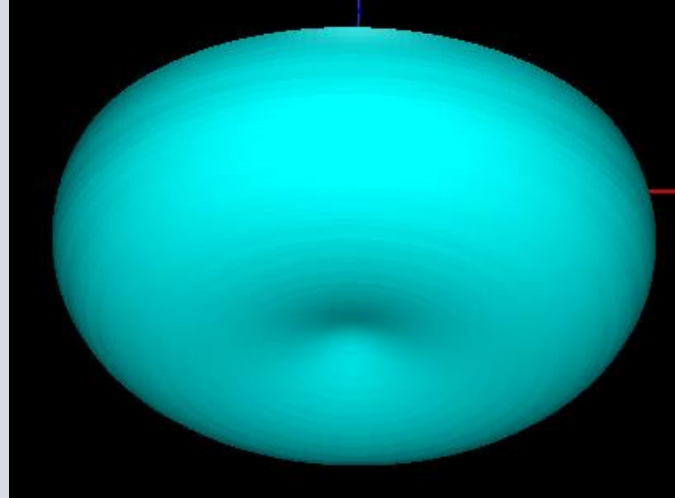
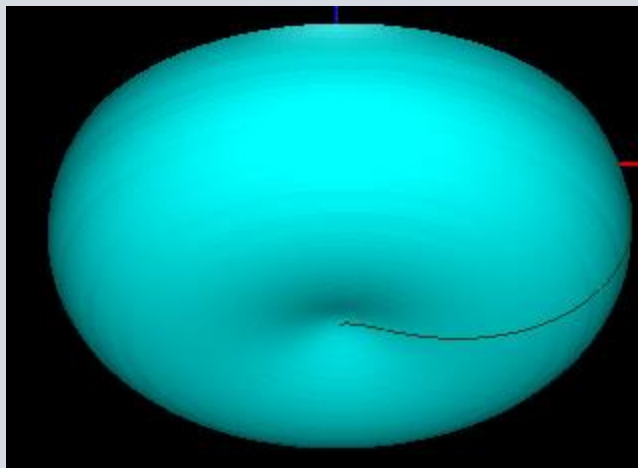
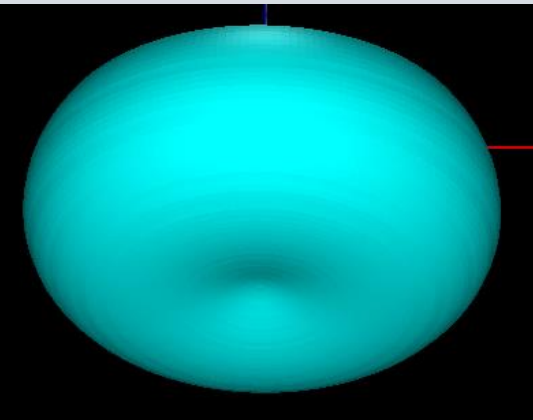
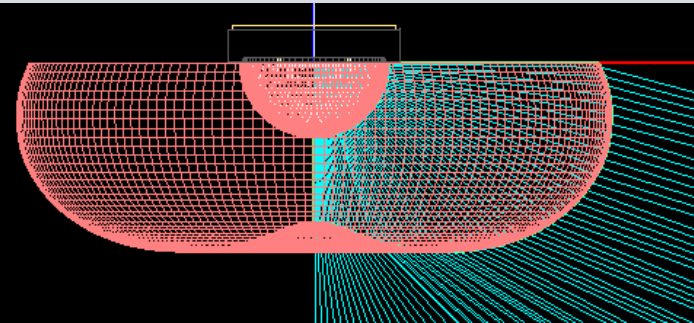
Peak: 60°



Peak: 67.5°



Peak: 70°

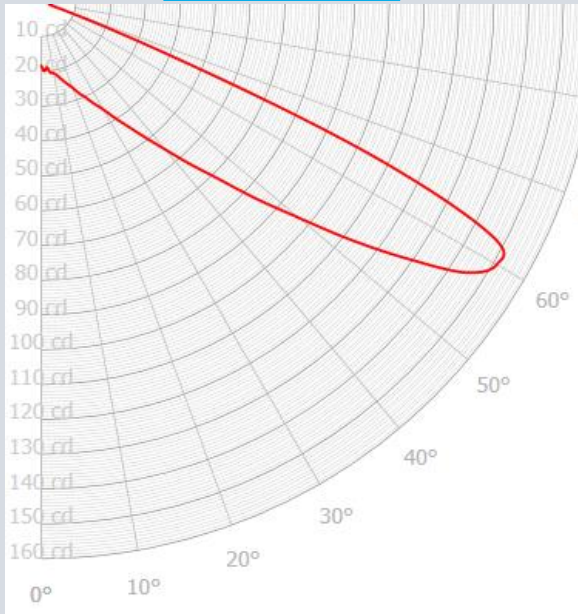


Created in Photopia

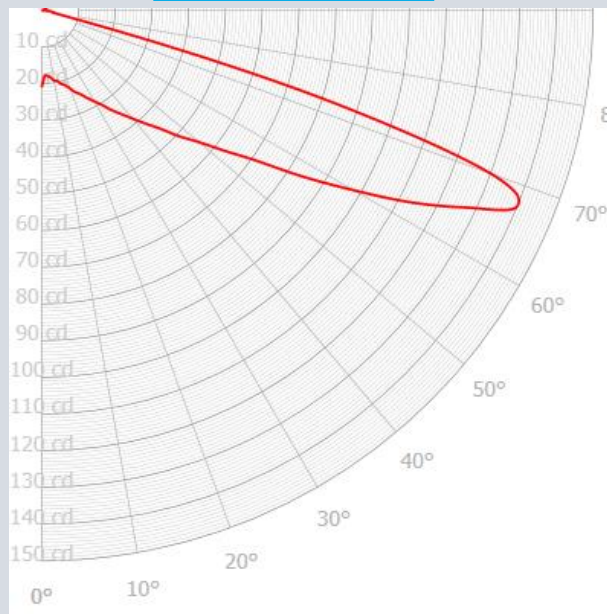
# Process

Producing similar intensity distribution at beam centers:

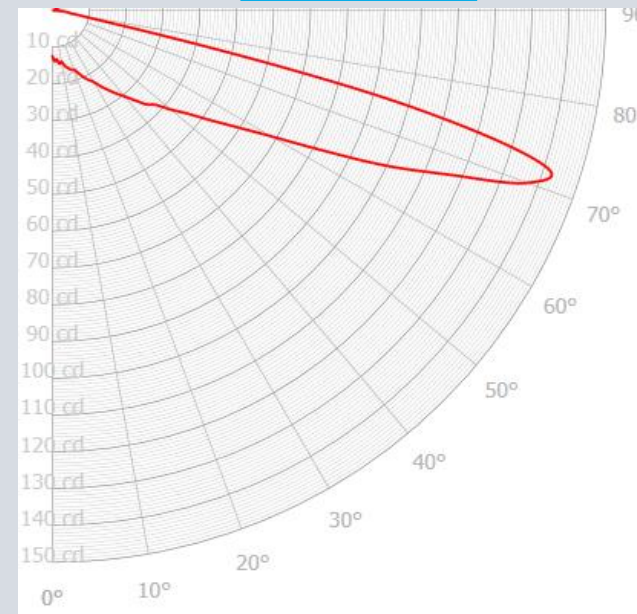
Peak: 60°



Peak: 67.5°



Peak: 70°

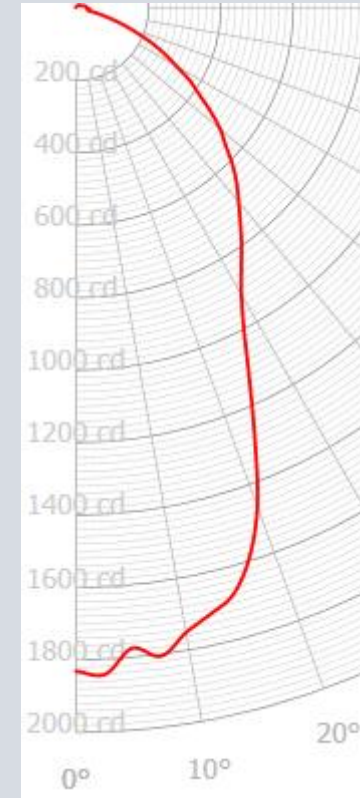
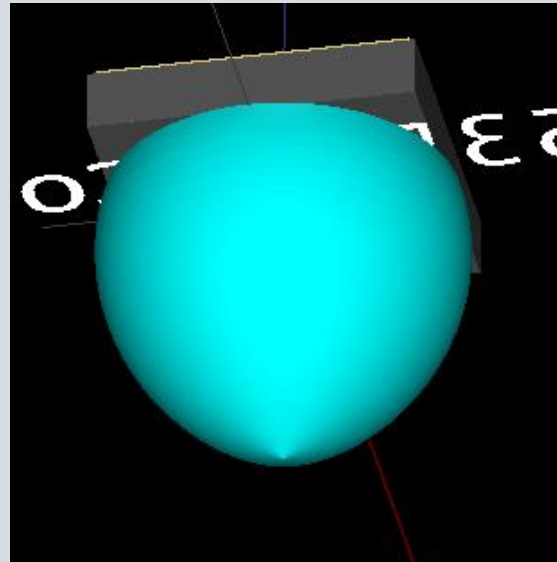
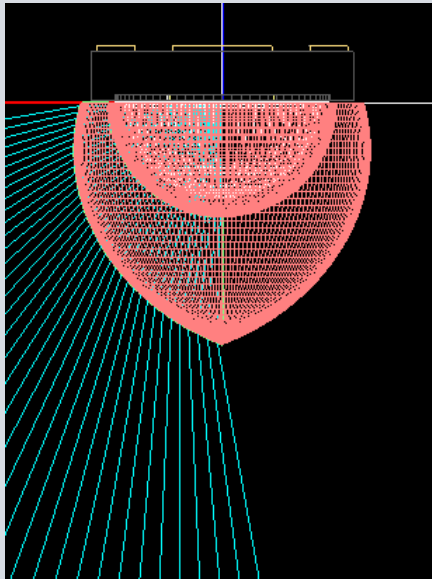


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# Process

## Fourth round optic for back side profile

### Back

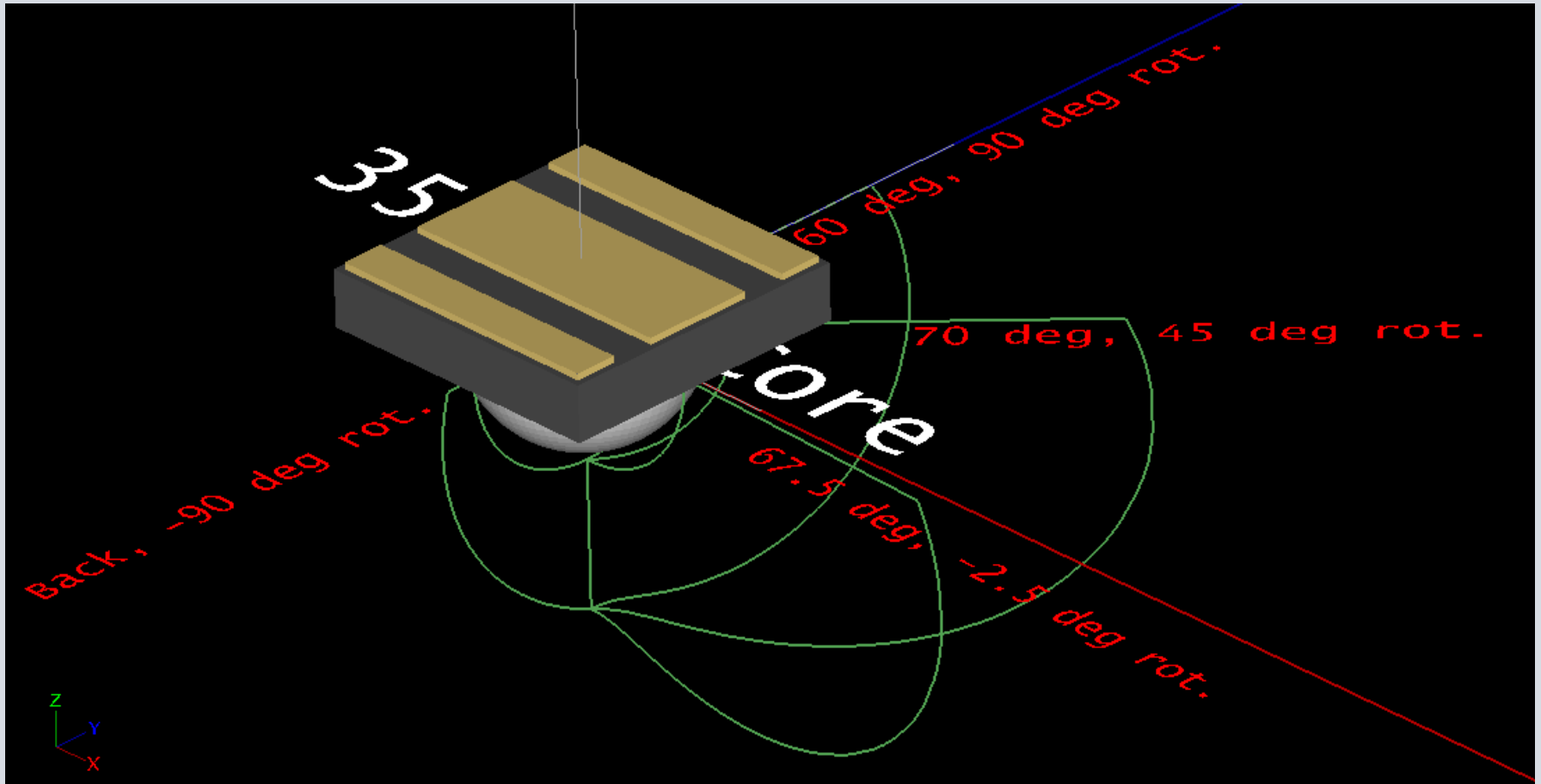


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# Process

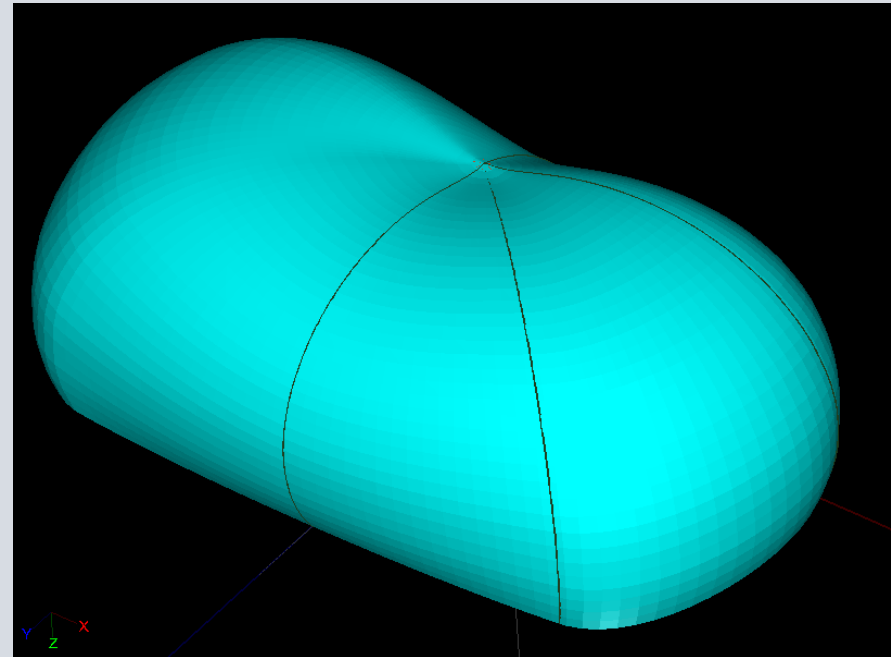
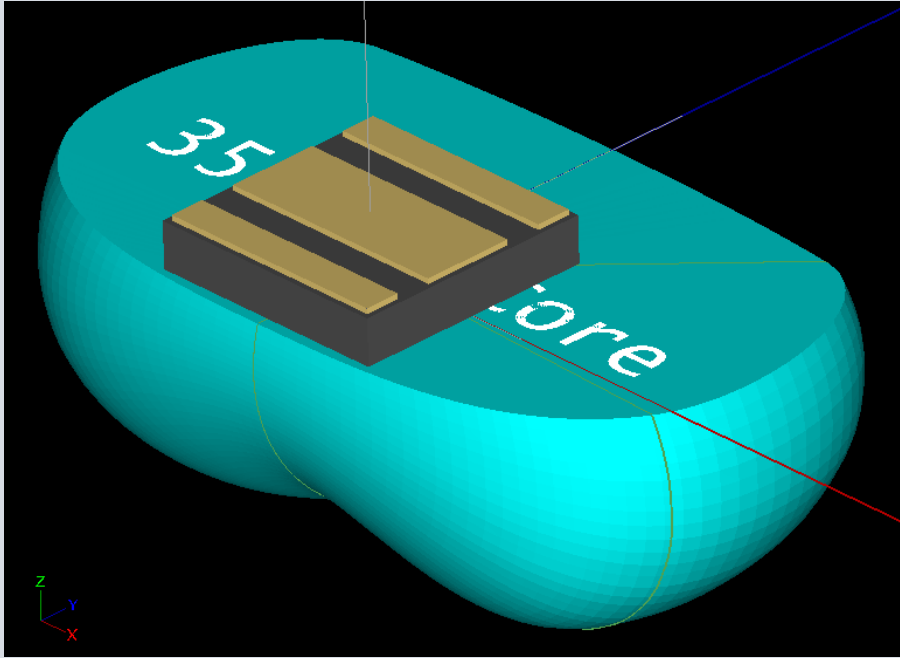
Extract 2D profiles and combine



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# Results

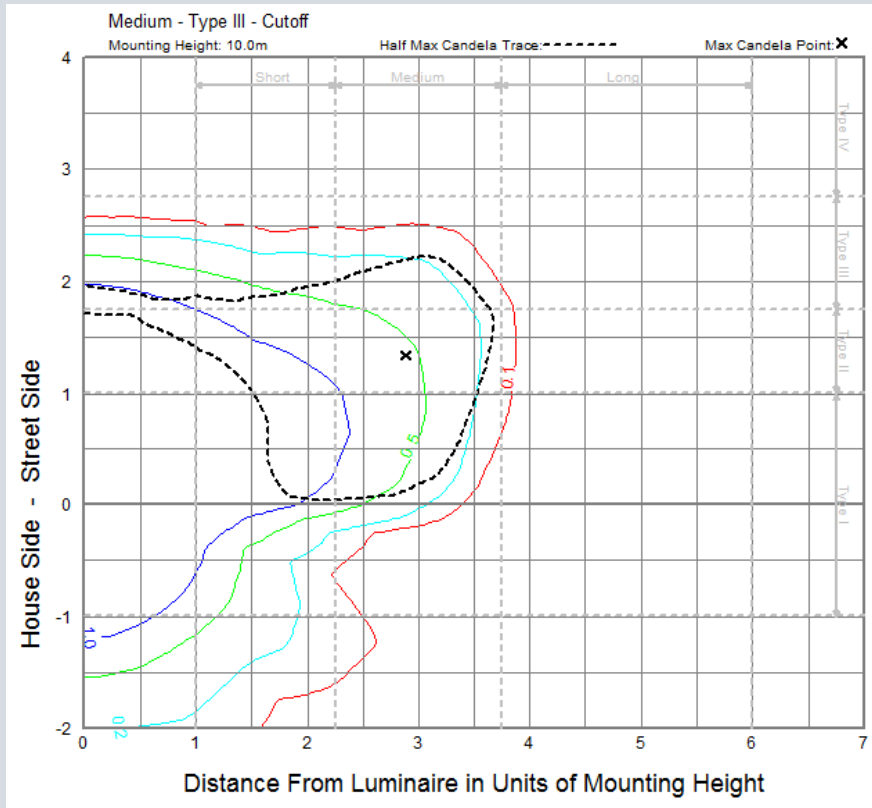
## Resulting freeform lens shape



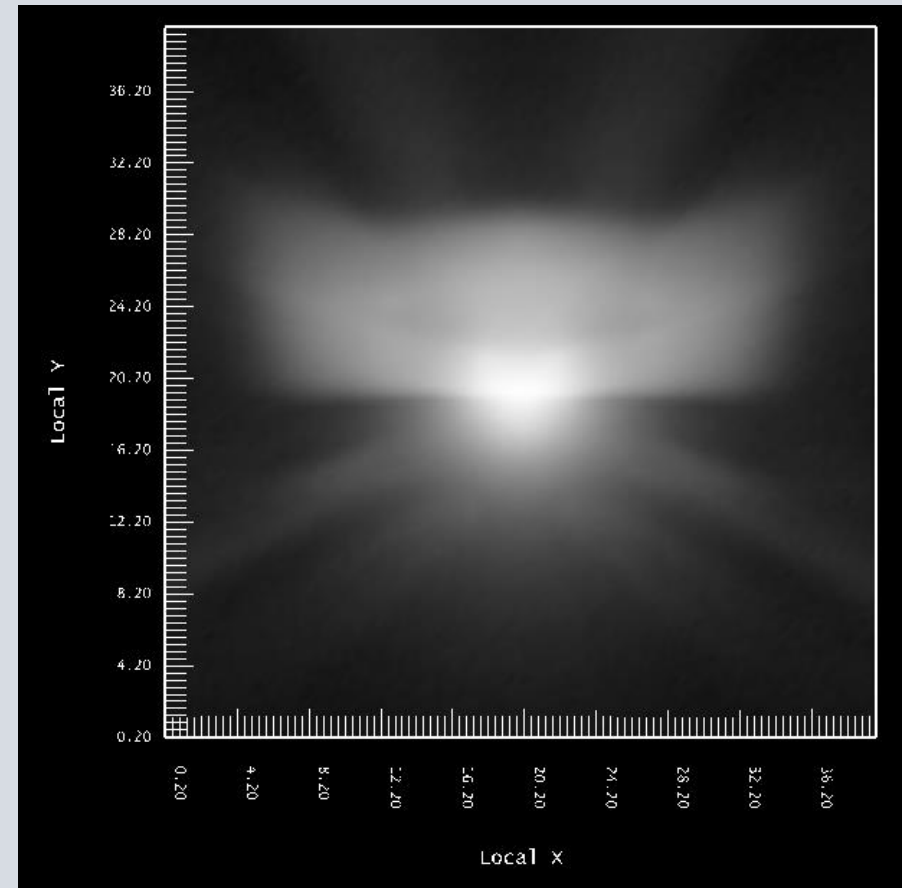
Created in Phoptopia

# Results

## Resulting performance



Type III Medium



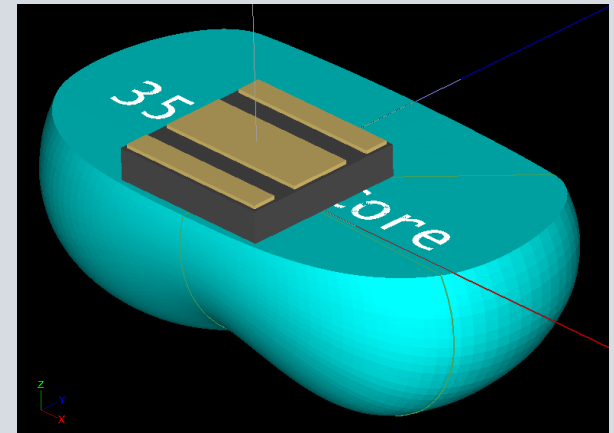
Relatively smooth pattern

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# Conclusions

## Freeform Optic Design Method with Multiple 2D Profiles

- Resulting freeform shape generated from 2D profiles (aiming and weighting factor parameters)
- Interactive manipulation
  - To create Type II, rotate 70° profile toward curb line
  - To create Long, increase peak angles
  - To avoid undercuts, transfer optical control to inner lens surface (weighting factor parameter)
- Flexibility for other applications
- Optimization may be applied



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