

Compound Parabolic Concentrator









Introduction

- Compound Parabolic Concentrators (CPCs) are designed to efficiently collect and concentrate distant light sources, with some acceptance angle.
- Compound Parabolic Concentrators are critical components in solar energy collection, wireless communication, biomedical and defense research, or for any applications requiring condensing of a divergent light source.







Layout



Trace Pr





Problem

Compound Parabolic Concentrator having following parameter:

- Shape :Hollow & Parabolic
- Front length (the distance from the focal point to the entrance port end of the concentrator) : 30 mm
- Back length (the distance from the focal point to the exit port end of the concentrator) : 8 mm
- Lateral focal shift (equal to the exit port radius for a textbook concentrator): 0
- Thickness : 0.1 mm
- Axis tilt (equal to the acceptance angle for a textbook concentrator) : 30
- Focal length(s) : 10
- Origin (X, Y, Z coordinates of the center of the exit port) : (0,0,0)
- Rotation (X, Y, Z rotation angles about the center of the exit port) : (0,0,0)







Design

Open New Trace Pro:

- Select > Insert > Reflector > 3D Compound
- Click Insert

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Trace Pr

Properties

- Material : PMMA
- Color : Transparent
- Surface 0 (Inner Surface) : Perfect Mirror

Bulk Scatter	Surface
Class and Oser Data Color Diffraction Exit Surface Fluorescence Gradient Index Importance Sampling Material Mueller Matrix Prescription Raytrace Flag RepTile Surface Surface Surface Source Temperature Temperature Distribution	Catalog: Default Name: Perfect Mirror Description: Mirror with 100% reflectance, no scatter Scatter: No Scatter Reference Data





Source

• Here we define collimated light source incident at certain angle.

Grid Source
Grid Setup Beam Setup Polarization Wavelengths
Name: Sun Source
Grid Boundary
Outer radius: 17 Inner radius: 0
Grid Pattern Circular V Rings: 10
Units: Radiometric Rays/wave: 271
Flux per ray
Grid Position and Orientation Grid orientation method: Direction Vectors
- Origin Normal vector Up vector
Y: 0 Y: 0.2 Y: 1
Z: 10 Z: 1 Z: 0
Color:
Insert <u>M</u> odify <u>S</u> et Defaults



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Detector

• Define Rectangular Block











Detector Properties

• Define front surface "Surface1" as Perfect absorber.

Apply Properties	
Bulk Scatter Class and User Data Color Diffraction Exit Surface Fluorescence Gradient Index Importance Sampling Material Mueller Matrix Prescription Raytrace Flag RepTile Surface Surface Surface Source Temperature Temperature Distribution	Surface Catalog: Default Name: Perfect Absorber Description: 100% absorbing, no reflectance or transmittance Scatter: No Scatter Reference Data







Trace Rays

• Raytrace > Tracerays









Analysis

Select surface 1 of Detector ٠



Total Flux:171.4 W, Flux/Emitted Flux:0.63247, 173 Incident Rays

Total - Irradiance Map for Incident Flux







At 0 degree Incidence

Grid Source
Grid Setup Beam Setup Polarization Wavelengths
Name: Sun Source
Grid Boundary
Outer radius: 17 Inner radius: 0
Grid Pattern
Circular Rings: 10
Units: Radiometric Rays/wave: 271
Flux per ray
Grid Position and Orientation
Grid orientation method: Direction Vectors
Origin Normal vector Up vector
Z: -10 Z: 1 Z: 0
Color:
Insert <u>M</u> odify <u>S</u> et Defaults
race Pr ww







Analysis



Total - Irradiance Map for Incident Flux Detector Surface 1 Global Coordinates

Total Flux:180.63 W, Flux/Emitted Flux:0.66654, 181 Incident Rays







At 30 Degree

🗖 Grid Source			
Grid Setup Beam Setup Polarization Wavelengths			
Name: Sun Source			
Grid Boundary			
Outer radius: 17 Inner radius: 0			
Grid Pattern			
Circular Rings: 10			
Units: Radiometric Rays/wave: 271			
Flux per ray			
Grid Position and Orientation			
Grid orientation method: Direction Vectors			
Origin Normal vector Up vector			
Y: 0 Y: 0.577 Y: 1			
Z: 1 Z: 0			
Color:			
Insert <u>M</u> odify <u>S</u> et Defaults			



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Analysis









At 31 Degree

Total - Irradiance Map for Incident Flux Detector Surface 1 Global Coordinates





