

# Innovating the Application of BSDF Files for Radiance Modeling of Spaces Using Tubular Daylighting Devices

*A World of Opportunities*



Solatube BSDF Data Files,  
a New Technical Design Resource

May 14, 2019



# Using the Solatube Daylighting Product BSDF XML Files

- Solatube International, Inc. is proud to provide ground-breaking Bidirectional Spectral Distribution Function (BSDF) Data Files for Optically-Complex Tubular Daylighting Devices (TDDs).
- Solatube Daylighting System BSDF Data Files are available for all primary product configurations of the Brighten Up, SolaMaster, and SkyVault Product Families.
- The Radiance file for each supported product configuration contains application notes about the file's use.
- For Applications in Northern Latitudes, due south is aligned with Klems input patches 4, 14, 31, 52, 76, 100, 122, 137, so the Solatube Daylighting System object (and associated BSDF data file) should be properly oriented in Daylighting Models to reflect this Optical System orientation standard.

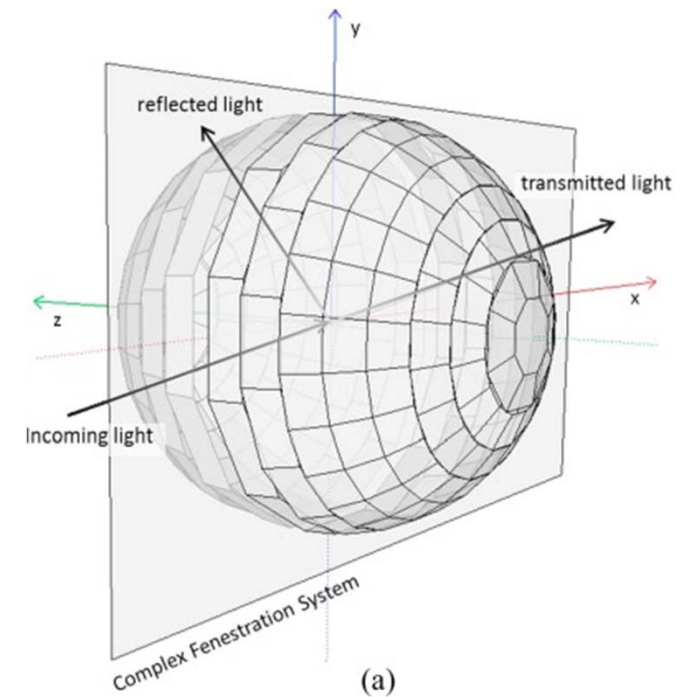
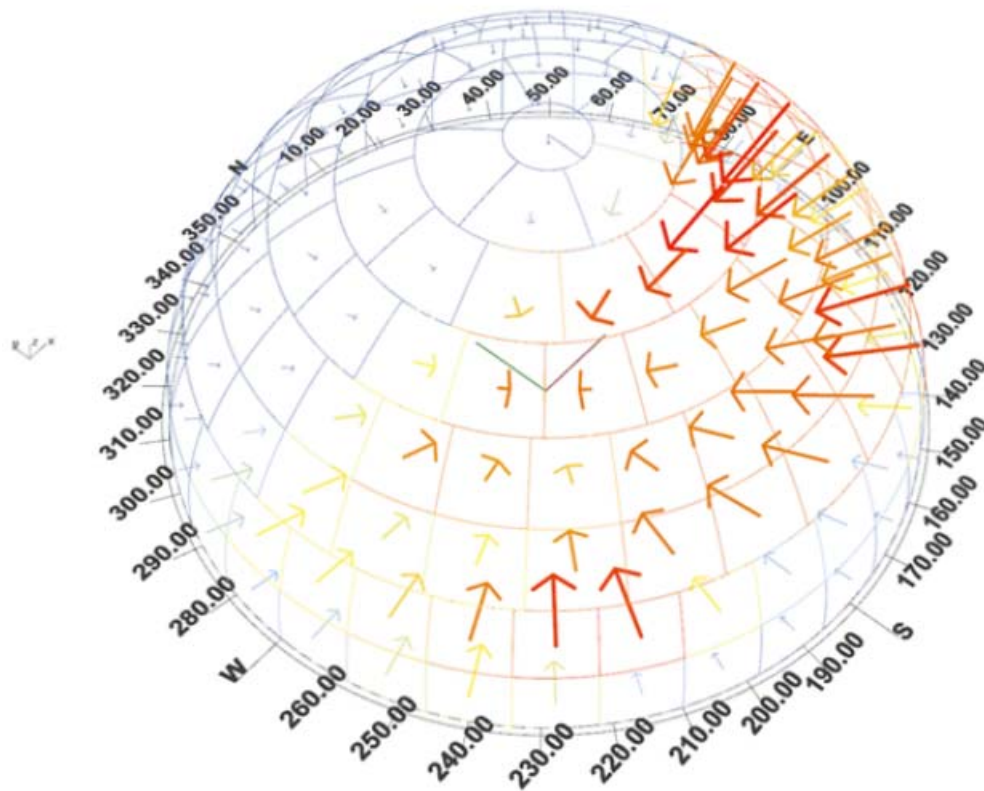
**Note:** The Solatube BSDF Data Library is available for download at: <http://www.solatube.com/support/technical-resources>

```
<!-- Area in the Material section should be used as the device size in Radiance to ensure proper efficiency -->
<!-- Due South is input patches 4-14-31-52-76-100-122-137 -->
<WindowElementType>System</WindowElementType>
<FileType>BSDF</FileType>
<Optical>
<Layer>
  <Material>
    <Name>160DS-DAI-L4</Name>
    <Manufacturer>Solatube</Manufacturer>
    <Thickness unit="meter">0.00000</Thickness>
    <Width unit="meter">0.22510</Width>
    <Height unit="meter">0.22510</Height>
    <DeviceType>Skylight Tube</DeviceType>
  </Material>
</Layer>
</Optical>
```



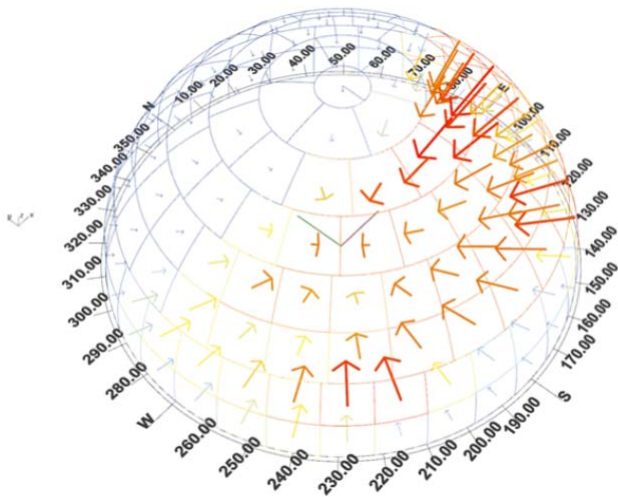
# Overview – BSDF Object/Surface Orientation

- The BSDF Data Files contains a Matrix of Klems patch input path and resulting % of light output for each exiting Klems patch.
- Uses standard 145 Klems Input and Output patches for efficient calculations.

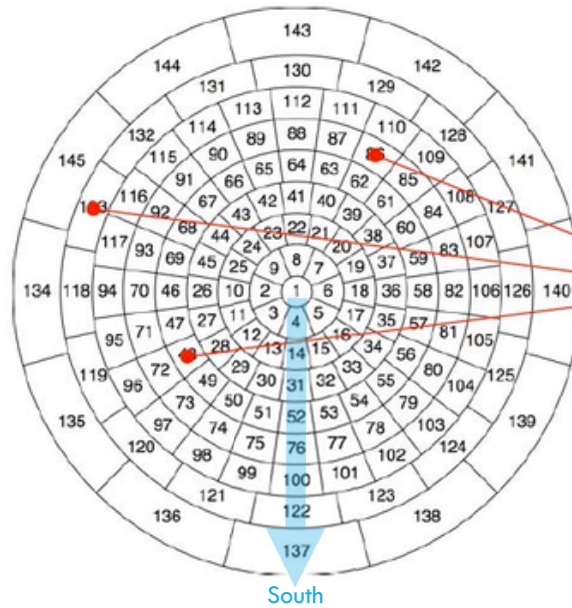


# Overview – BSDF Object/Surface Orientation

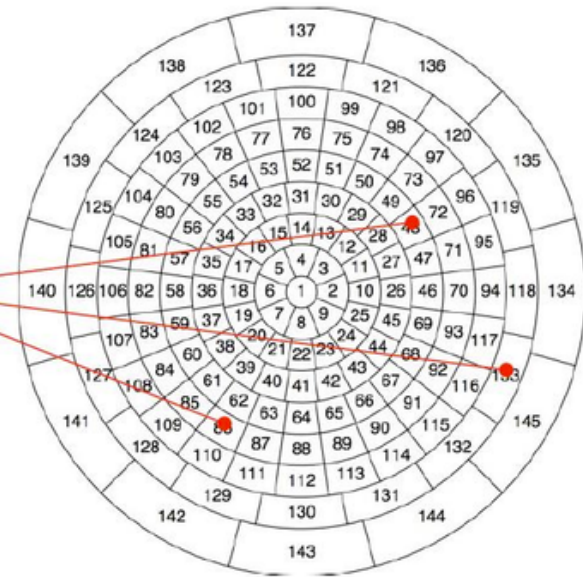
- One XML file is available for each common product configuration, using the standard optical tube length.
- For Buildings in the Northern Hemisphere, due south is aligned with Klems input patches 4, 14, 31, 52, 76, 100, 122, 137, so the Solatube Daylighting System object (and associated BSDF data file) should be properly oriented in Daylighting Models to reflect this Optical System orientation standard.



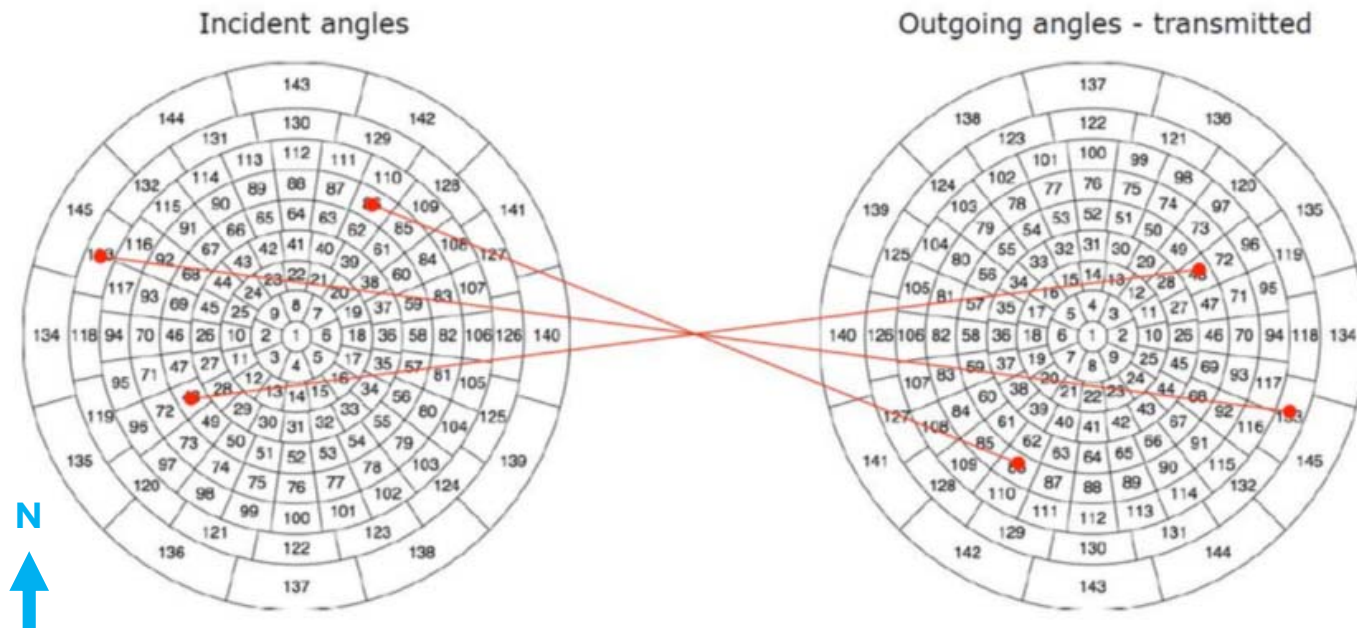
Incident angles



Outgoing angles - transmitted



# Orientation of 145 Klems Patches



Within the BSDF file, Input Klems patches correspond to these directions:

- 137 – Due South
- 143 – Due North
- 140 – Due East
- 134 – Due West

Note: Output patches are flipped / Reversed.



# Radiance BSRF File Use

Using Thickness & Orientation Vector Parameters to Orient Solatube BSRF Files



## Up Orientation Vector:

An optional vector that sets the hemisphere that the BSRF material faces. For materials that are symmetrical about the HBSrf plane (like non-angled venetian blinds), this can be any vector that is not perfectly normal to the HBSrf. For asymmetrical materials like angled venetian blinds, this variable should be coordinated with the direction the HBSrfs are facing. The default is set to (0.01, 0.01, 1.00), which should hopefully not be perpendicular to any typical HBSrf.

[https://www.radiance-online.org/community/workshops/2011-berkeley-ca/presentations/day2/GW5\\_BSRFFirstClass.pdf](https://www.radiance-online.org/community/workshops/2011-berkeley-ca/presentations/day2/GW5_BSRFFirstClass.pdf)

[https://github.com/mostaphaRoudsari/honeybee/blob/master/src/Honeybee\\_Radiance%20BSDF%20Material.py](https://github.com/mostaphaRoudsari/honeybee/blob/master/src/Honeybee_Radiance%20BSDF%20Material.py)

## Up Orientation Vector:

Default behavior is (0 0 1) for wall-based products. **Setting to (0 1 0) (North) is necessary for ceiling-based products and top-lighting systems.**

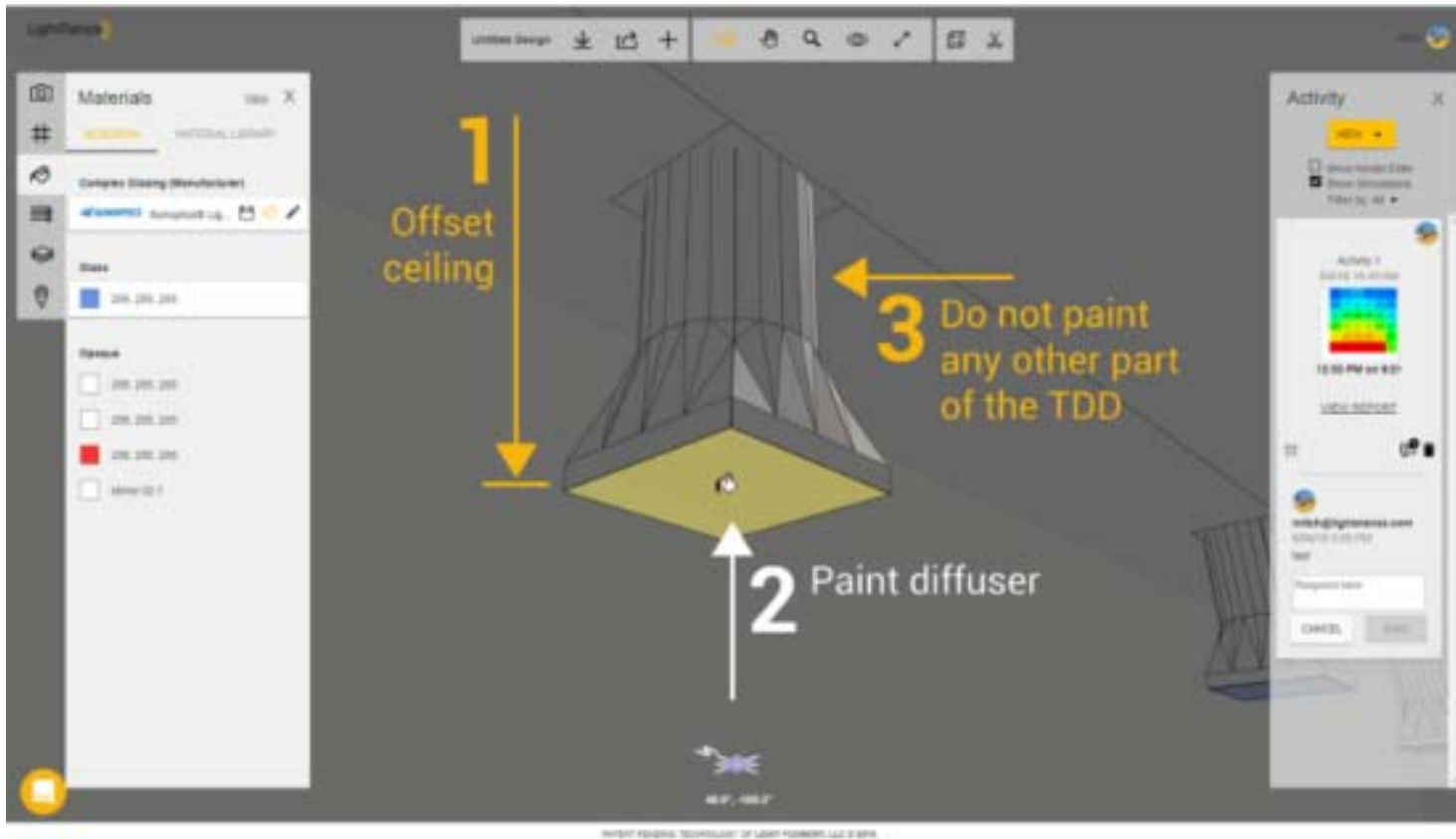
<https://www.manula.com/manuals/zrogers/spot-pro-v-5/1/en/topic/material-library-editor>

<https://www.radiance-online.org:447/pipermail/radiance-general/2018-April/012487.html>

<https://www.radiance-online.org:447/pipermail/radiance-general/2014-April/010242.html>



# Sample Application: LightStanza



In LightStanza, select the product and paint it onto the exit surface in the room.

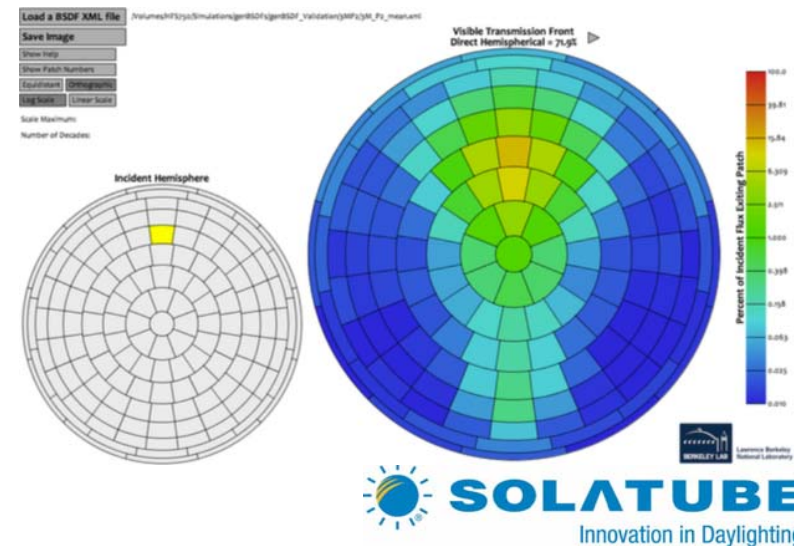
<http://lightstanza.com/support/reference-guides/modeling-tubular-daylight-devices/?orderby=votes>



# A note about BSDF File Throughput Efficiency %

Since BSDF Files require the use of a single area for the device, the Solatube BSDF Files use/report the room-side luminous surface area to define the daylighting aperture characteristics. However, when calculating the input lumens, a daylighting system/aperture would normally use the input area \* incident light level. If the input and output area are roughly equal, then this isn't an issue. However, for products with unequal input and output areas, the efficiency in the BSDF files isn't the true numerical efficiency, since it also includes this area ratio. When the exit area is larger than the input area, the efficiency reported is artificially low since Radiance addresses the input area as being larger than it is in reality. This is done, intentionally, to ensure that the actual output lumens is correctly calculated for these products as part of a Radiance-based daylighting simulation. As a result, the reported BSDF system Klems patch efficiencies for the following products are lower than what may be computed in other ways or measured via the NFRC 203 Standard for measuring VTannual of Tubular Daylighting Devices.

- Brighten Up 160DS-SL (*Klems output patch efficiency is about 41% low to account for larger exiting surface area*)
- SolaMaster 300, 330 and 750 DS-C and DS-CTM (*Klems output patch efficiency is about 40% low to account for larger exiting surface area*)
- SkyVault SM74 DS-O-A (*Klems output patch efficiency is about 36% low to account for larger exiting surface area*)





# Viewing XML Files

- LBNL's BSDF Viewer provides a visual way to choose an incident angle and see the % of light in each exiting zone.
- (<https://www.radiance-online.org/download-install/third-party-utilities/bsdf-viewer>)

