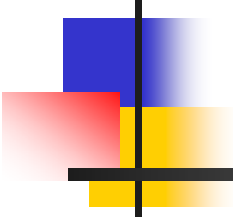
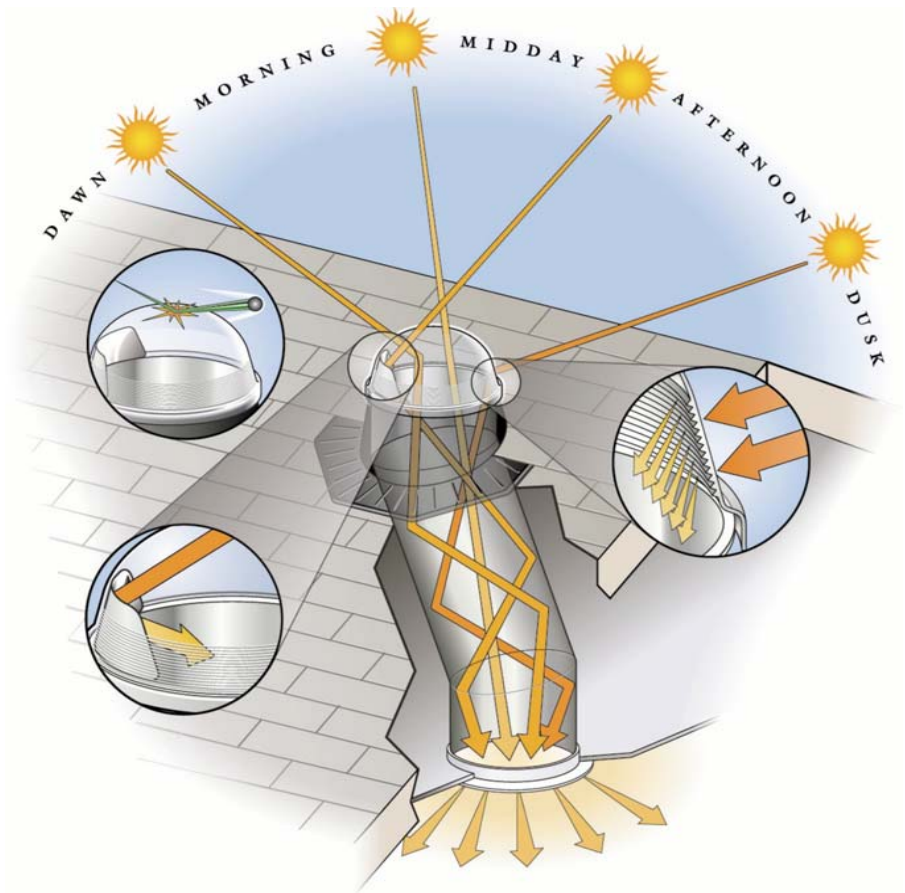


# *Visible Transmission Testing for Tubular Daylighting Devices*

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- *What is a TDD and why is it different ?*
  - *Transmission parameters and testing requirements*

# *Tubular Daylighting Devices (TDD)*

- *TDD's collect light through a transparent dome, transport it down a reflective tube and distribute it with a diffuser*
- *A majority of the dome openings are horizontal and the tubes are installed vertically*
- *Tube sizes vary from 10" to 22" in diameter and the average length is 48 inches*
- *NFRC has established testing procedures for determining the SHGC and U-values*





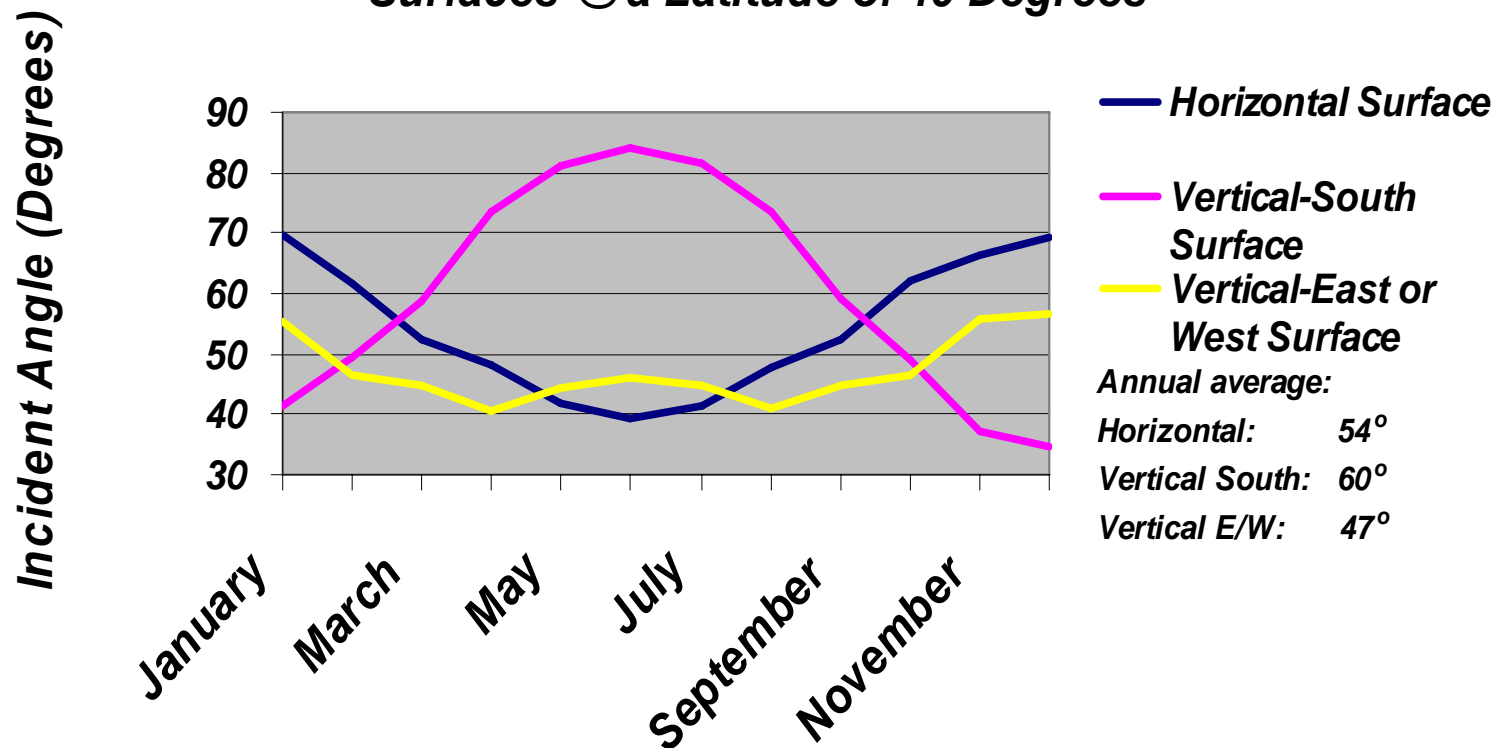
# *Why a different test ?*

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- *Current issues:*
  - *Windows are installed in a vertical plane with light entering at many incident angles*
  - *Windows are tested for transmission with the light source normal to the surface*
  - *TDD's aperture is installed on a horizontal plane with light entering at many incident angles*
  - *TDD's request a non-normal transmission test*

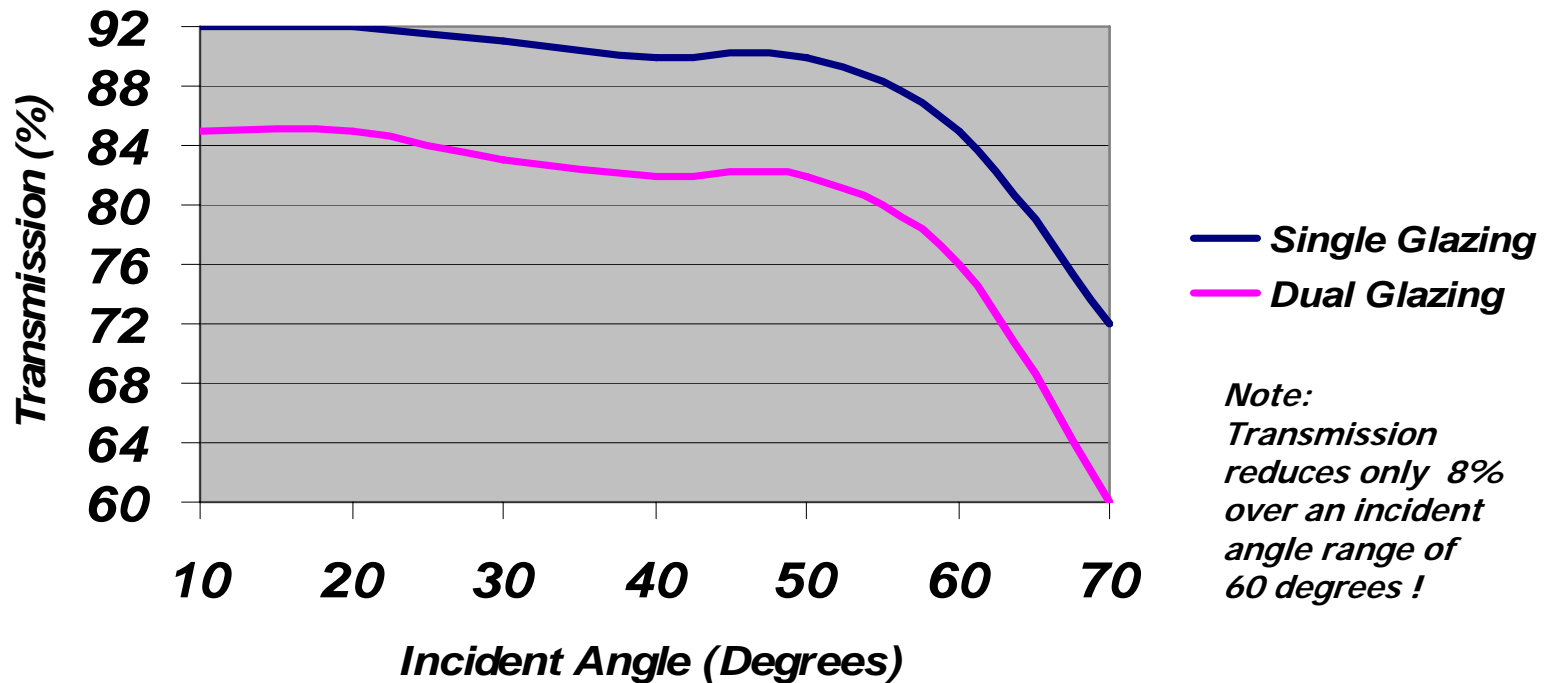
# *Sunlight Incident Angles To Various Window Surfaces*

**Average Monthly Sunlight Incident Angle to Various Surfaces @ a Latitude of 40 Degrees**



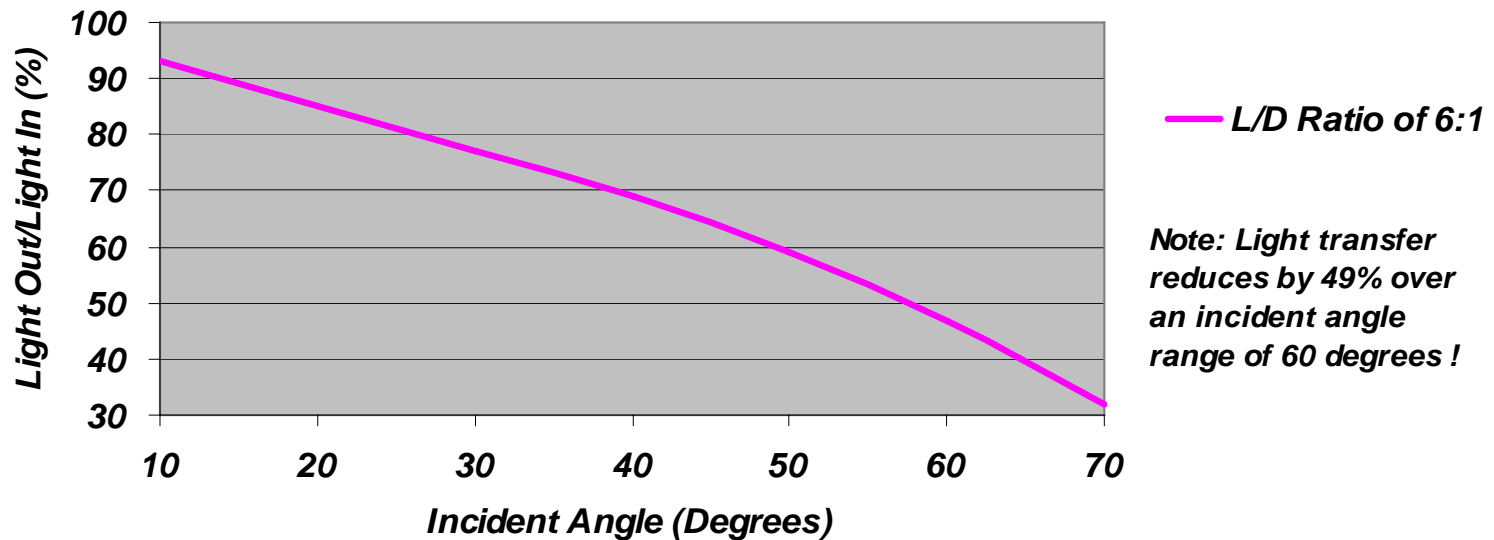
# Light Transmittance In Window

Visible Light Transmission Versus Incident Angles for Single and Dual Glazed Glass Windows



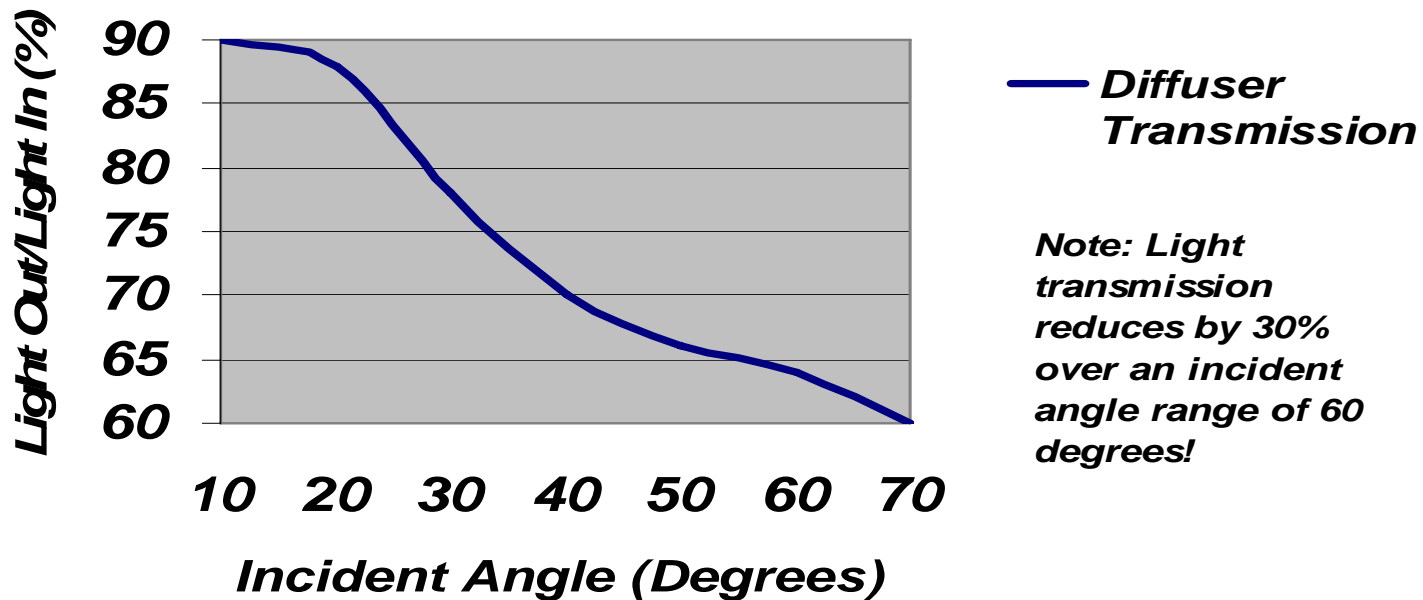
# *Light Transfer In A Tubular Daylighting Device*

**Light Transfer Efficiency for a 95% Reflective Tube at Various Incident Angles and a Length/Diameter Ratio of 6:1**



# *Light Transfer In A Tubular Daylighting Device*

## **Light Transfer Efficiency for a Common Prismatic Diffuser Used in a Tubular Daylighting Device**





# *TDD Visible Transmission Testing Suggestions*

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- *Perform visible transmission tests at an incident angle of 45 degrees*
- *Utilized a tube with a length of 48 inches*



# *TDD Visual Transmission Test Equipment Requirements*

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- *Utilize an Integrating Sphere on a azimuth tracker that is designed according to ASTM E 1175 specifications*
  - ✓ *Sphere surface area 200x aperture area*
  - ✓ *Minimum paint reflectance of 85%*
- *Test a TDD with known reference transmission values for proof of concept*



## *Tests @ LBNL*

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- *Sphere diameter of 79 inches with an aperture diameter of 11 inches*
- *TDD diameter of 9.625" and length of 57.75" for a length/diameter of 6:1*
- *Tested TDD @ incident angles of 0, 30, 45, 60 and 75 degrees*

# *LBL Integrating Sphere Setup*



*Incident angle of 60 degrees*





# *TDD Test Results*

## **Visual Transmission Difference Between A TDD Tested At 3M And LBL**

