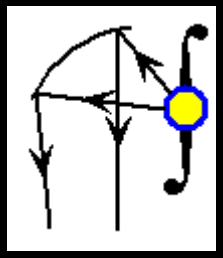

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Batwing Distribution for General Illumination (Down Lighting or Up Lighting)

BATWING ILLUMINATION PATTERN

- Expert Consensus is that the "Batwing" (aka Trouser Leg) distribution is the ideal distribution for down lighting.
- In the past this was achieved at considerable expense to optical luminaire efficiency- currently unacceptable due to increased energy usage concerns.

The Design of Lighting, book by Peter Tregenza et al

- Quote :
- "In general office, ceiling-mounted luminaires need to have a low downward light output but a substantial sideways intensity…" (The Batwing Distribution)

Tregenza's Depiction of Batwing Light Distribution

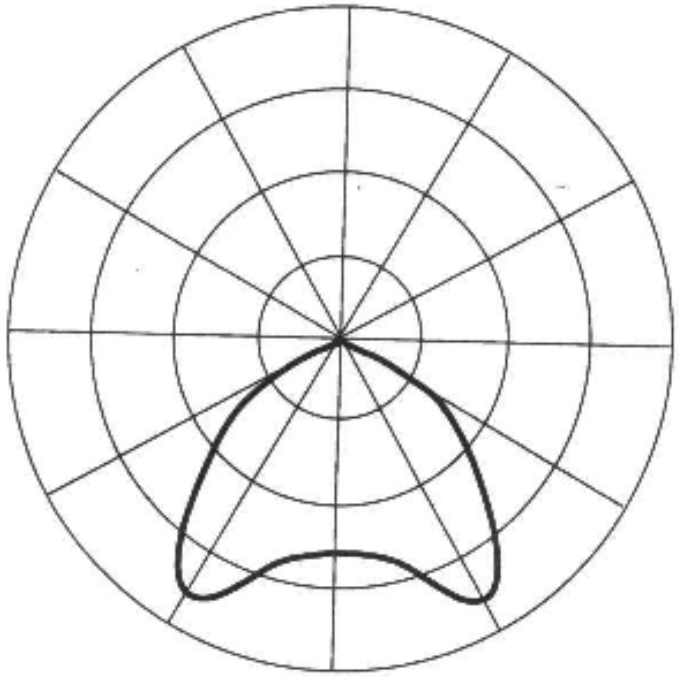


Figure 9.6 *Transverse polar curve of a bat wing distribution.*

"Applied Illumination Engineering" book by Jack L. Lindsey

- Discussing Fluorescent Lenses:

"Other lenses are available that offer high quality light with widely spread radial batwing distribution as shown by Curve D."

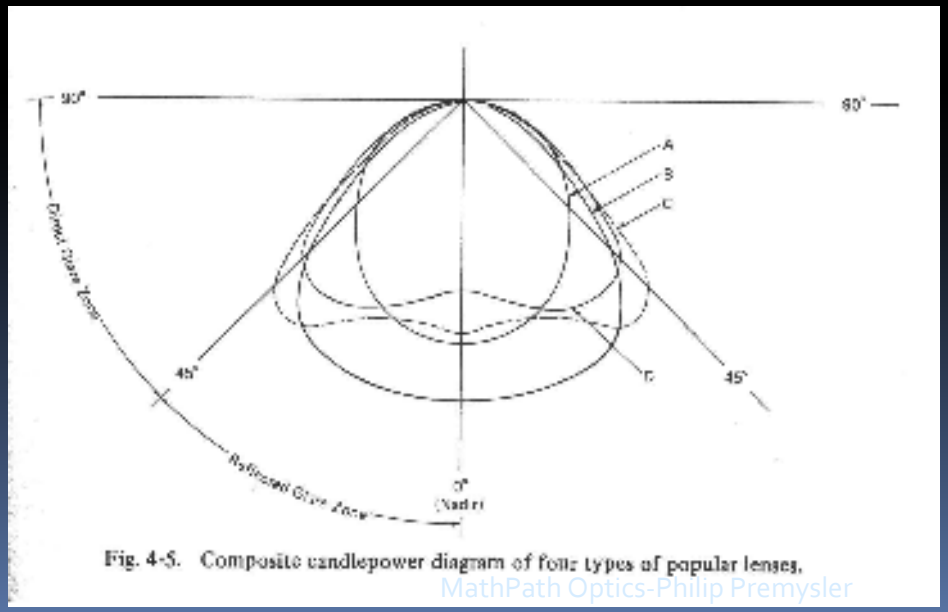
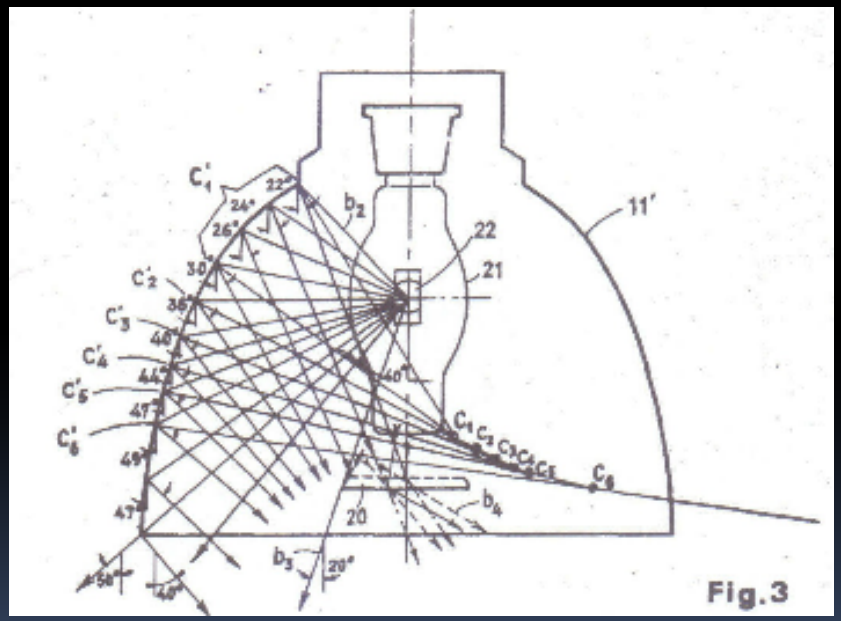
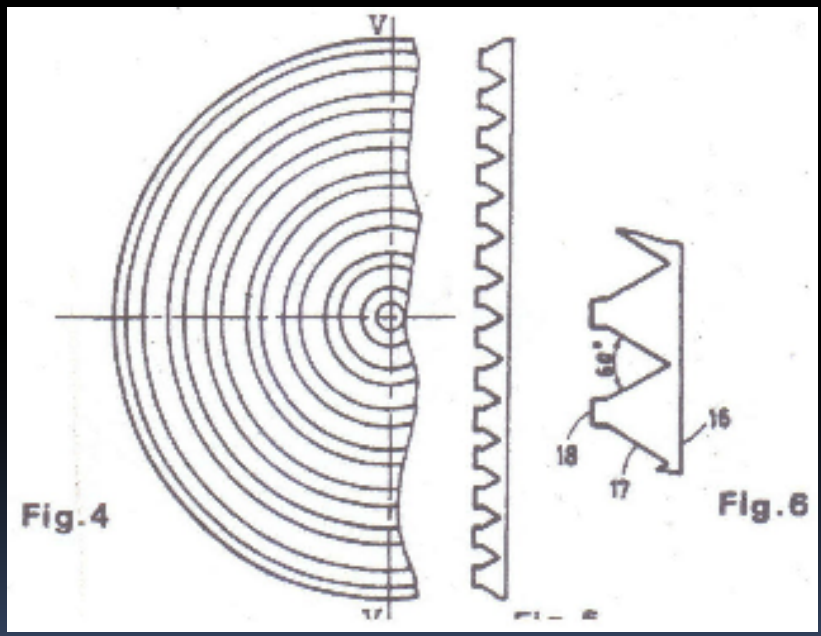


Fig. 4-5. Composite candlepower diagram of four types of popular lenses.

Batwing for Discharge Lamps and Fluorescent lamps

- Taltavull (1976) Patent 3,978,332





Taltavull Fixture
20 is Diffuser

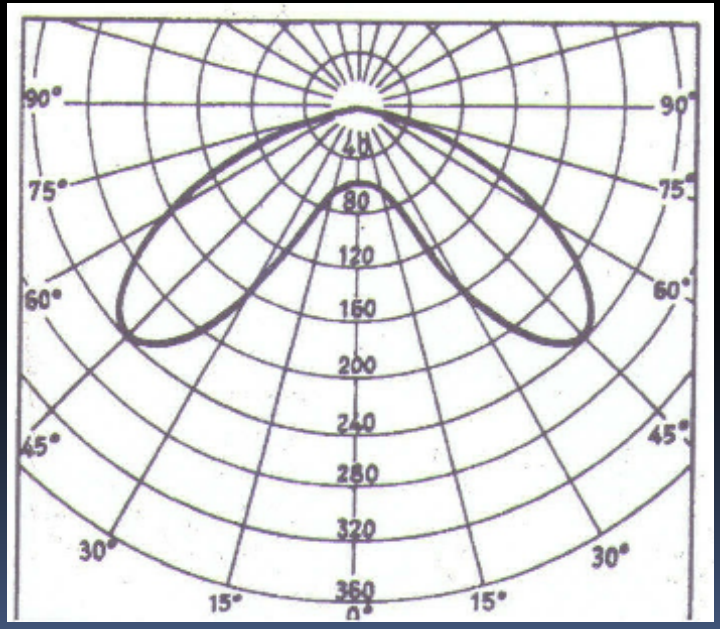
Taltavull Diffuser
Surface 18 opaque white

Taltavull Patent Continued

- "Summing up, in a vertical cross plan of a luminaire with fluorescent lamps or with a discharge bulb, it is desired to have a minimum light distribution under 30˚, a maximum light distribution between 40 ˚ and 50 ˚, and a minimum over 60 ˚, because over 60 ˚ discomfort glare takes place, and under 30 ˚ veiling reflection takes place. This type of distribution is known as 'batwing distribution' "

Taltavull Design Performance

- States that he obtained efficiency near 70%
- Taltavull Batwing:



Critiques:

- Function is too fast—

Ratio of intensities at 0˚ to 45 ˚ is 4:1, should be 2.8:1 for uniform illumination. Drop off from peak takes 20˚-- glare control could be improved.

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Batwing for monchromatic sources e.g., LEDs

- Dey et al (1979) Patent No. 4,161,015
- Quote:

  "When the luminaire illuminates a room, the industry has found the most preferred distribution to be in the form of what is known in the art as a 'batwing'"

Dey et al. Patent Continued

- Multilayer Interference filter in aperture of reflector-*expensive*.
- Recycles light through diffuse reflector→ lowered efficiency.

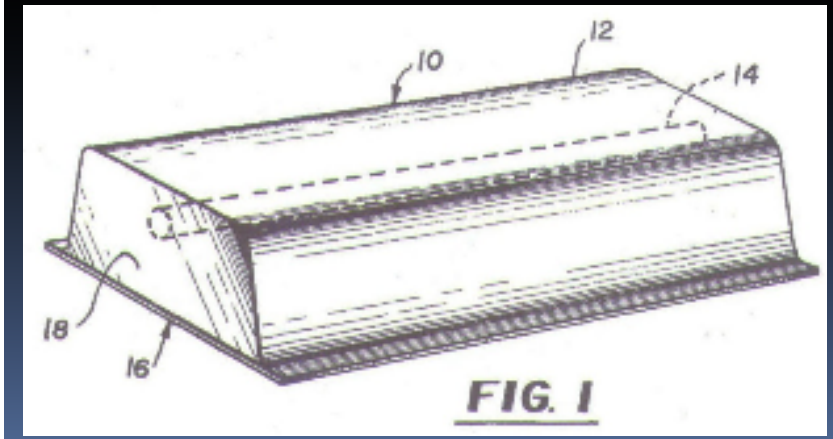
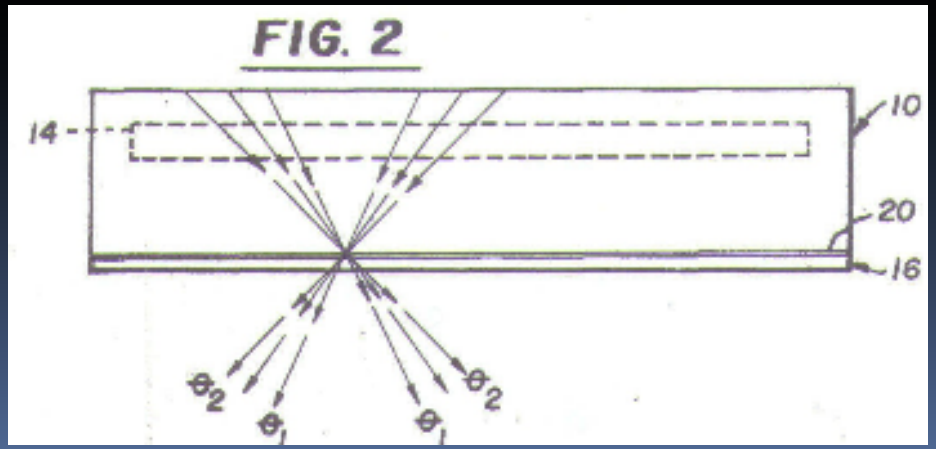


FIG. 1



Dey et al. Patent Continued

- Dey et al. Batwing:

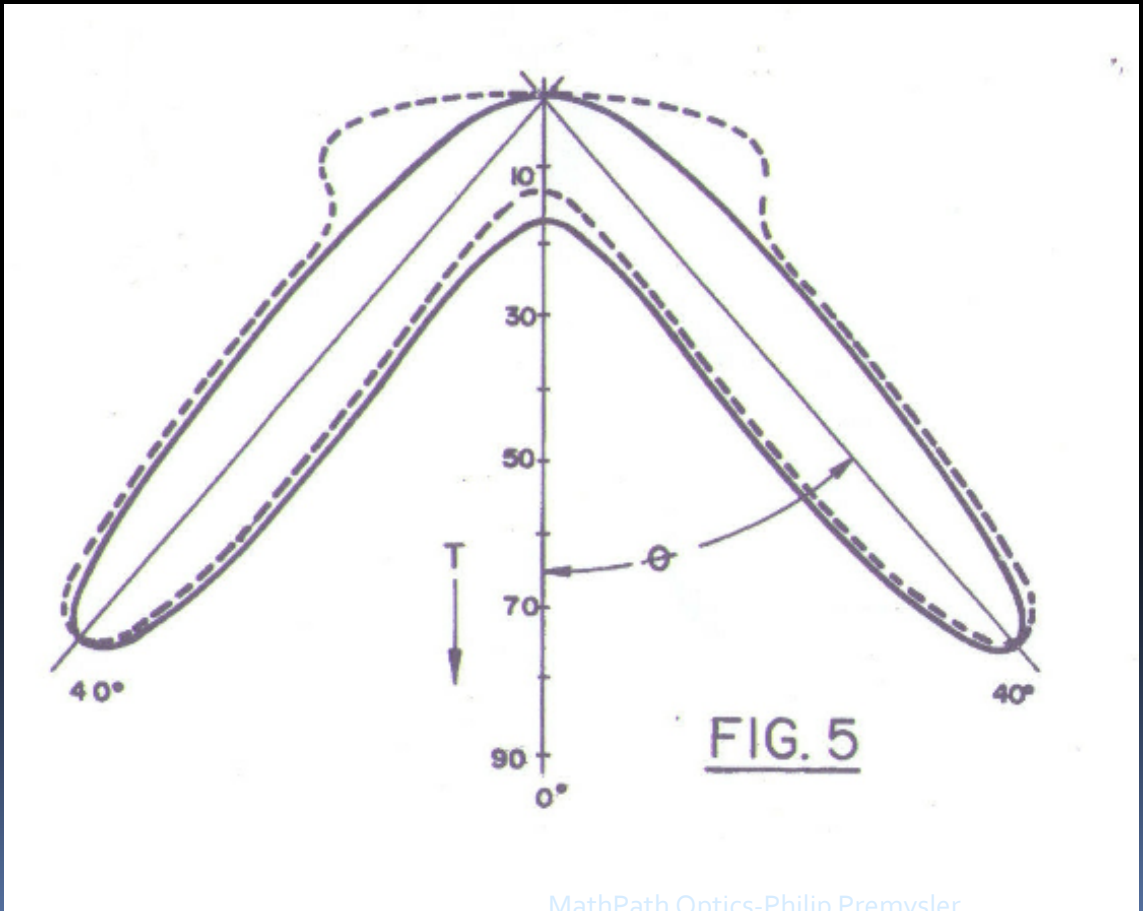


FIG. 5

Common to both older approaches to batwing:

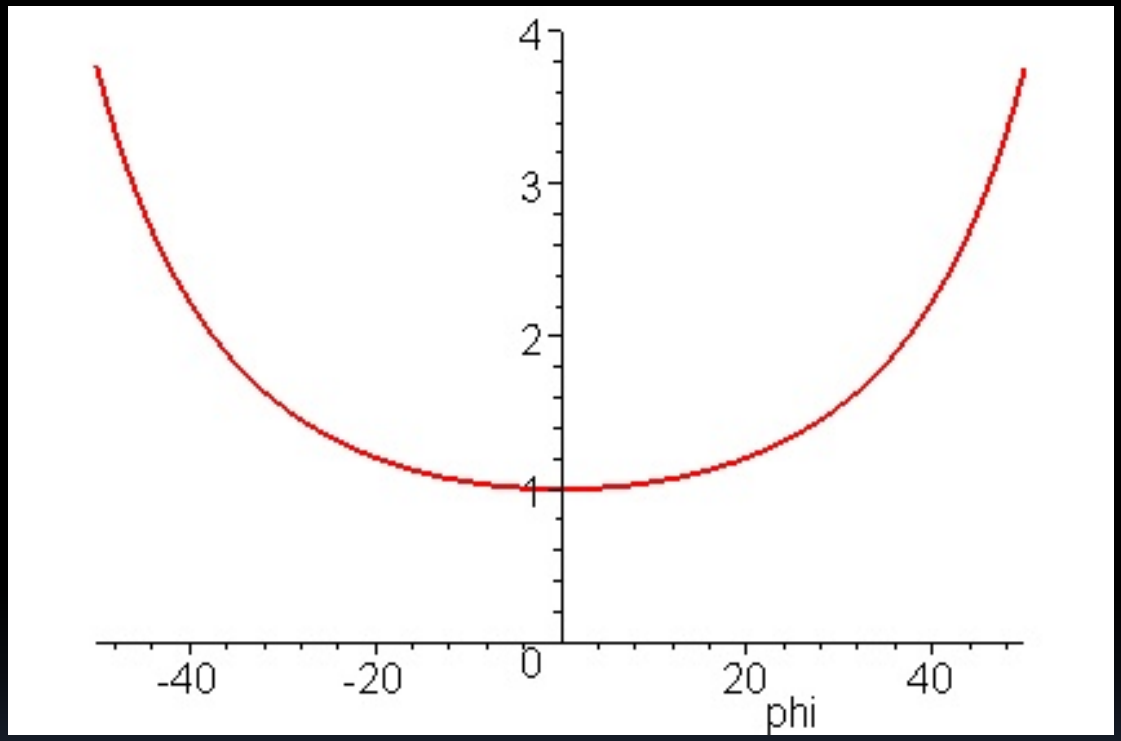
- Reflect certain portion of light reaching aperture back into reflector. Some of retro-reflected light will be absorbed leading to decreased 'optical luminaire efficieny' = 'Light Output Ratio'

What would be the "IDEAL" Batwing distribution ?

- In addition to the criteria discussed above, it provides UNIFORM illumination on plane surfaces, the generally accepted goal for general illumination.
- What is it exactly:

$Cos^{-3}(\phi)$ (This can be proved simply as a corollary to the "cosine cubed law" that relates illuminance to luminous intensity")

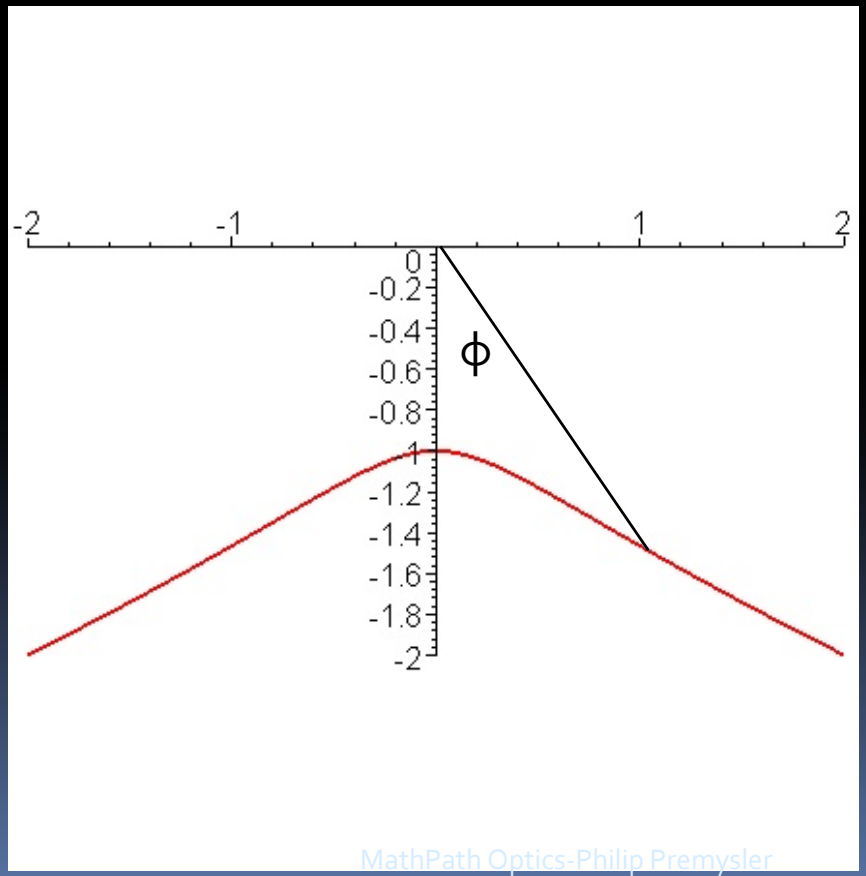
1/Cosine Cubed Distribution

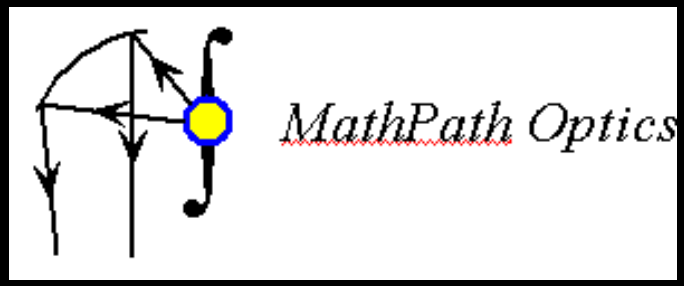


It expresses the relation between the differential area of an annulus on a plane and a differential solid angle both described by a differential of polar angle.

1/Cosine Cubed Distribution

- Polar Style Plot:





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