Introduction

Transparency

A transparent surface produces both reflected and transmitted light.

In most cases, the transmitted light is generated from reflecting objects in back of the surface.

Reflected light from these objects passes through the transparent surface and contributes to the total surface intensity.

Both diffuse and specular transmission can take place at the surfaces of a transparent object.

Diffuse effects are important when a partially transparent surface, such as frosted glass, is to be modeled.

Light passing through such materials is scattered so that a blurred image of background objects is obtained.

These refractions can **be** generated by decreasing the intensity of the refracted light and spreading intensity contributions at each point on the refracting surface onto a finite area.

When light is incident upon a transparent surface, part of it is reflected and part is **refracted**. **Because** the speed of light is different in different materials the path of the refracted light is different from that of the incident light.

The direction of the refracted light specified by the angle of refraction, is a function of the **index** of **refraction** of each material and the direction of the incident light.

$\sin\theta r = \eta_i/\eta_r \sin\theta i$

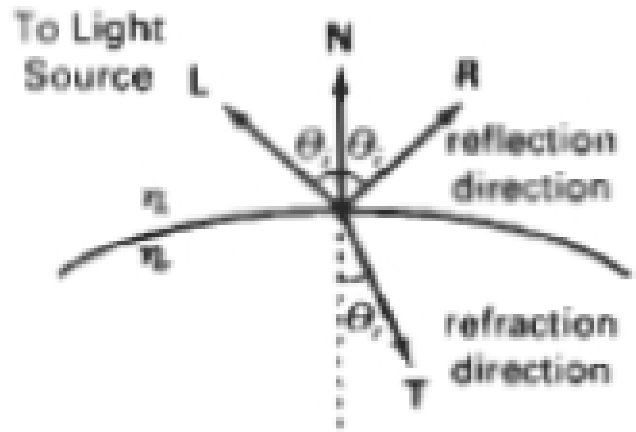

Figure 14-27
Reflection direction **R** and refraction direction **T** for a ray of light incident upon a surface with index of refraction η_r.

From Snell's law and the diagram in Fig. 14-27, we can obtain the unit transmission vector **T** in the refraction direction θ_r as

$$\mathbf{T} = \left(\frac{\eta_i}{\eta_r} \cos \theta_i - \cos \theta_r \right) \mathbf{N} - \frac{\eta_i}{\eta_r} \mathbf{L} \qquad (14\text{-}18)$$

Figure shows the changes in the path direction
for a light ray refracted through a glass object. The overall effect of the refraction
is to shift the incident light to a parallel path.

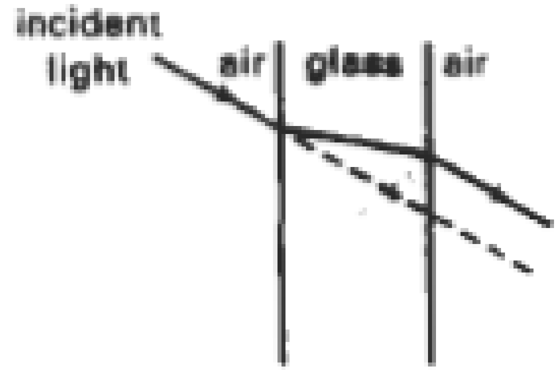

Figure 14-28
Refraction of light through a glass object. The emerging refracted ray travels along a path that is parallel to the incident light path (dashed line).

Transparency effects are often implemented with modified depth-buffer **(z**buffer) algorithms.

A simple way to do this is to process opaque objects first to determine depths for the visible opaque surfaces. Then, the depth positions of

the transparent objects are compared to the values previously strored in the

depth buffer.

If an; transparent surface is visible, its reflected intensity is calculated

and combined with the opaque-surface intensity previously stored in the

frame buffer.

This allows depth values for the transparent surfaces to be compared to

each other, as well as to the depth values of the opaque surfaces. Visible transparent surfaces are then rendered by combining their surface intensities with those of the visible and opaque surfaces behind them.

Shadows : Hidden-surface methods can be used to locate areas where light sources produce

shadows. By applying a hidden-surface method with a light source at the view position, we can determine which surface sections cannot be "seen" from the light source.

These are the shadow areas. Once we have determined the shadow areas for all light sources, the shadows could be treated as surface patterns and stored in pattern arrays.

Generation of shading patterns for two objects on a table and a distant light source. All shadow areas in this figure are surfaces that are not visible from the position of the light source

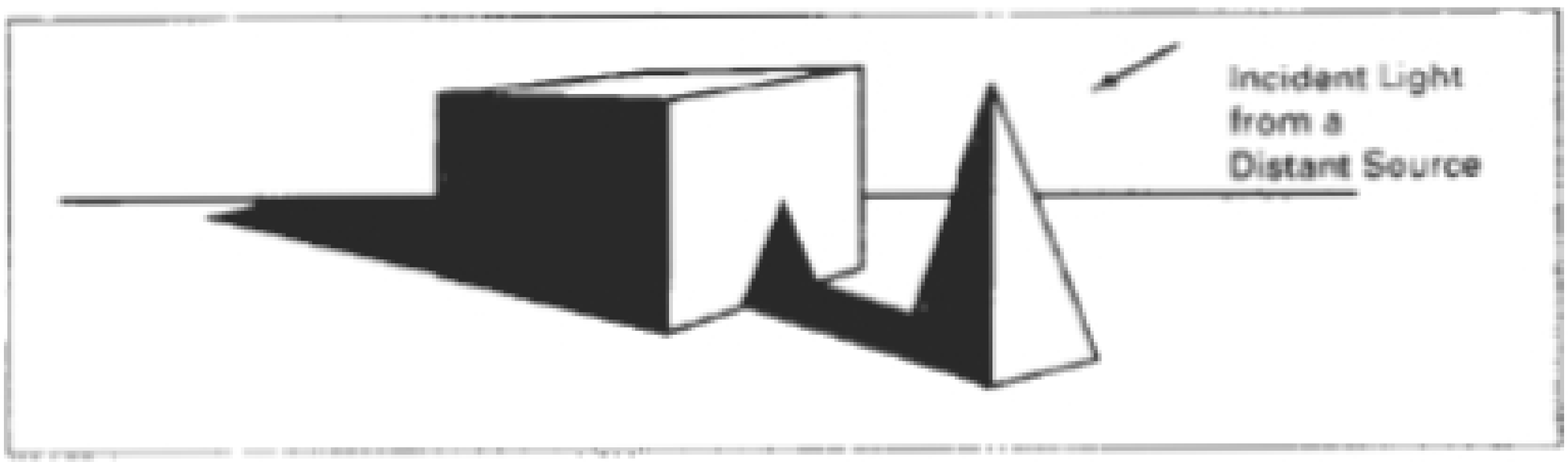

Figure 14-30
Objects modeled with shadow regions.

Application

In photography, which is essentially recording patterns of light, shade, and colour, "highlights" and "shadows" are the brightest and darkest parts of a scene or image.

Photographic exposure must be adjusted (unless special effects are wanted) to allow the film or sensor, which has limited dynamic range, to record detail in the highlights without them being washed out, and in the shadows without their becoming undifferentiated black areas.