SNS COLLEGE OF TECHNOLOGY

Coimbatore-36.

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COURSE NAME : 19CSE308-COMPUTER GRAPHICS AND VISUALIZATION

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UNIT III

Ms.A.Indhuja
Assistant Professor
Department of Computer Science and Engineering

- An illumination model, also called a lighting model and sometimes referred to as a shading model, is used to calculate the **intensity of light** that we should see at a given point on the surface of an object.

- Surface rendering means ***a procedure for applying a lighting model to obtain*** pixel intensities for all the projected surface positions in a scene.

- A surface-rendering algorithm uses the intensity calculations from an illumination model to determine the light intensity for all projected pixel positions for the various surfaces in a scene.

- Surface rendering can be performed by applying the illumination model to every visible surface point

Light Sources

- light sources are referred to as ***light-emitting***
  sources; and reflecting surfaces, such as the walls of a room, are termed ***light-reflecting sources***
- **A luminous object, in general, can be both a light source and a light reflector.**
- The simplest model for a light emitter is a point source.

- When light is incident on an opaque surface, part of it is reflected and part is absorbed.
- The amount of incident light reflected by a surface depends on the **type of material. Shiny materials reflect more of the incident light, and dull surfaces** absorb more of the incident light.
- for an illuminated transparent surface, some of the incident light will be reflected and some will be transmitted through the material

- Surfaces that are rough, or grainy, tend to scatter the reflected light in all directions.

  This scattered light is called diffuse reflection.
- In addition to diffuse reflection, light sources create highlights, or bright spots, called specular reflection.
- This highlighting effect is more pronounced on shiny surfaces than on dull

Ambient Light

- In our basic illumination model, we can set a general level of brightness for a scene. This is a simple way to model the combination of light reflections from various surfaces to produce a uniform illumination called the ambient light, or background light.
- Ambient light has no spatial or directional characteristics. The amount of ambient light incident on each object is a constant for all surfaces and over all directions.

DIFFUSE REFLECTION

- Diffuse reflections are constant over each surface in a scene
- The fractional amount of the incident light that is diffusely reflected can be set for each surface with parameter k_d, ***the diffuse-reflection coefficient***, or diffuse reflectivity.

- Parameter k_d ***is assigned a constant value in the interval*** 0 to 1.

- we want a highly reflective surface, we set the value of k_d ***near 1***. ***This produces a*** bright surface with the intensity of the reflected light near that of the incident light.

- To simulate a surface that absorbs most of the incident light, we set the reflectivity to a value near **0**.

- If a surface is exposed only to ambient light, we can express the **intensity of the diffuse reflection** at any point on the surface as

$$I_{ambdiff} = k_d I_a$$

- we assume that the diffuse reflections from the surface are scattered with equal intensity in all directions, independent of the viewing directions.

- Such surfaces are sometimes referred to as ideal diffuse reflectors. They are also called ***Lambertian reflectors**, **since radiated light energy from any point on the*** surface is governed by Lambert's cosine law.

- If we denote the angle of incidence between the incoming light direction and the surface normal as **θ**, ***then the projected area of a***

  surface patch perpendicular to the light direction is proportional to cos **θ** .

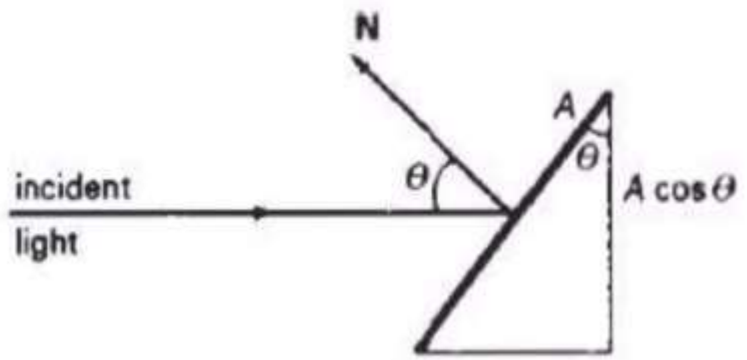

Figure 14-8
An illuminated area projected perpendicular to the path of the incoming light rays.

Thus, the amount of illumination (or the "number of incident light rays" cutting across the projected surface patch) depends on cos θ.

- If the incoming light from the source is perpendicular to the surface at a particular point, that point is fully illuminated.

- As the angle of illumination moves away from the surface normal, the brightness of the point drops off.

- If I_l, is the intensity of the point light source, then the diffuse reflection equation for a point on the surface can be written as

$$I_{l,diff} = k_d \, I_l \cos \theta$$

- A surface is illuminated by a point source only if the angle of incidence is in the range 0° to *90 °* *(cos 0 is in the interval from 0 to 1).*
- *When* cos θ *is negative, the* light source is "behind" the surface.

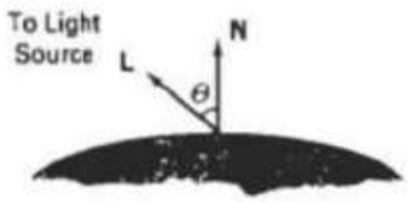

Figure 14-9
Angle of incidence θ between the unit light-source direction vector L and the unit surface normal N.

- If N is the unit normal vector to a surface and L is the unit direction vector to the point light source from a position on the surface, then

$$\cos \Theta = \mathbf{N} \cdot \mathbf{L}$$

and the diffuse reflection equation for single point-source illumination is

$$I_{l,diff} = k_d I_l N . L$$

- We can combine the ambient and point source intensity calculations to obtain an expression for the total diffuse reflection.

- In addition, many graphics packages introduce an ambient-reflection coefficient k_a ***to modify the ambient light*** intensity *I*, *for each surface. This simply provides us with an additional parameter* to adjust the light conditions in a scene.

- Using parameter k_a we can write the total diffuse reflection equation as

$$I_{l,diff} = k_a I_a + k_d I_l (N.L)$$

- where both k_a ***and*** k_d ***depend on surface material properties and are assigned values***

in the range from **0 to 1**