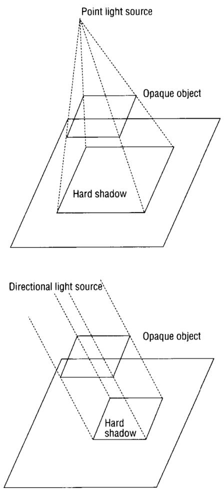
Shadows

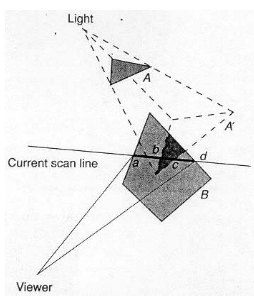
- it's really a visible surface problem from the point of view of the light source
- one strategy: two-pass algorithms

  hard part is to correctly share info from one pass to another



Scanline

- project polygon edges on current scanline's polygons
- build data structure of occluders $O(n^2)$



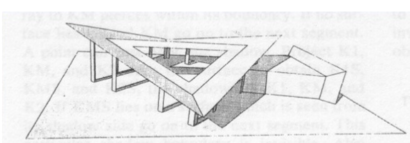
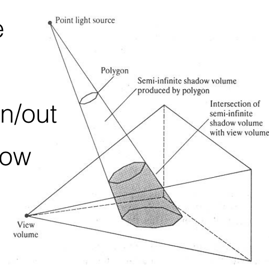


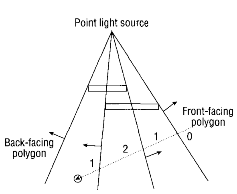
Figure 5 – A higher angle view of the building. 7094 calculation time for this picture was about 30 minutes.

Appel, 1968

Shadow Volumes

- add "shadow" polygons to scene
- cannot be seen
- shadow count, +1, -1 as you go in/out
- if shadow count > 0 then in shadow

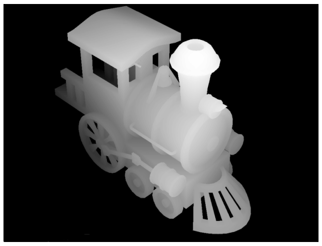




Crow, 1977

Shadow Map 2-Pass Z Buffer

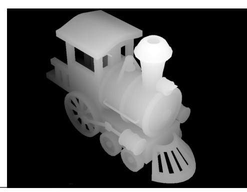
- first pass: VSA from point of view of light src
- save z-buffer as shadow map (distance from light to object)



Williams, 1978

Shadow Map 2-Pass Z Buffer

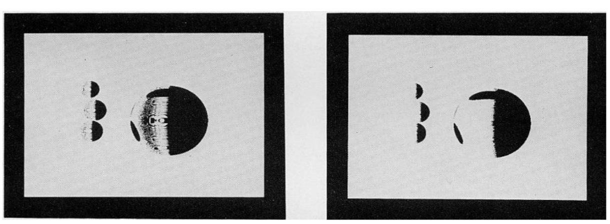
- second pass: VSA from camera
  - during lighting, transform fragment position to light coord system
  - compare fragment distance with shadow map
  - if shadow map value closer than fragment distance then fragment in shadow



Williams, 1978

Shadow Map 2-Pass Z Buffer

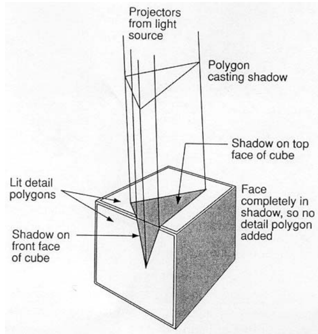
- self-shadowing because of limited depth buffer precision (Z-fighting) -> moire patterns
- solution: add 0.0005
- another problem: low res shadow map



Williams, 1978

2-Pass Weiler Atherton

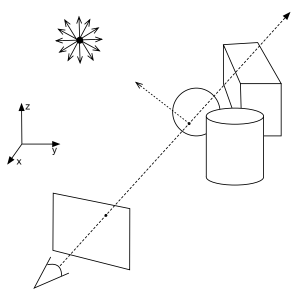
- Object-space
- first pass from light source
- result is lit polygons (not in shadow)
- use these polygons as surface detail polygons
- second pass from camera

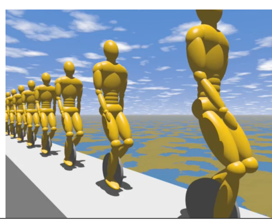


Atherton, Weiler, Greenberg, 1981

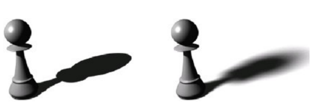
Ray Casting

- during lighting calculation shoot ray towards light src
- if shadow ray hits object then in shadow

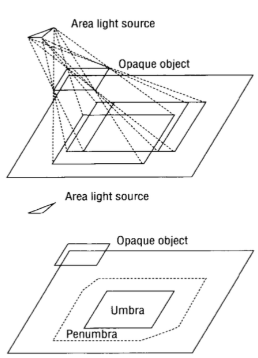


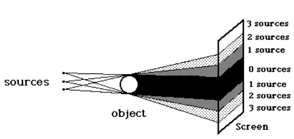


Area Light Sources



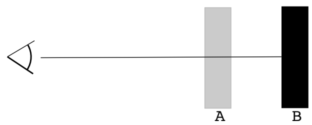
- much harder in general
- array of point lights





Transparency

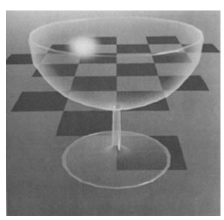
$$I = (1 - K_{t,A}) \cdot I_A + K_{t,A} \cdot I_B$$



- Need to sort polygons, back to front and then draw them (Painters, BSP Trees)
- harder for z-buffer

Transparency

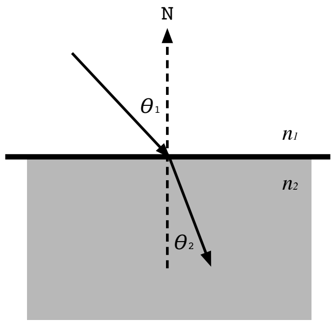
- make transparency $\propto \left(\vec{N} \cdot \vec{E}\right)^n$

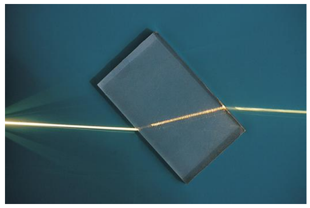


Blinn, 70s

Refraction

Refraction

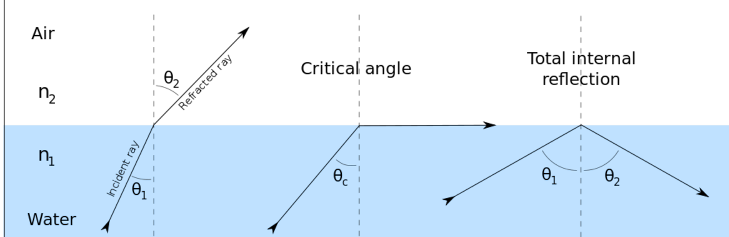




$$\frac{\sin(\theta_1)}{\sin(\theta_2)} = \frac{n_2}{n_1}$$

Ibn Sahl, 984 AD

Total Internal Reflection



Total Internal Reflection