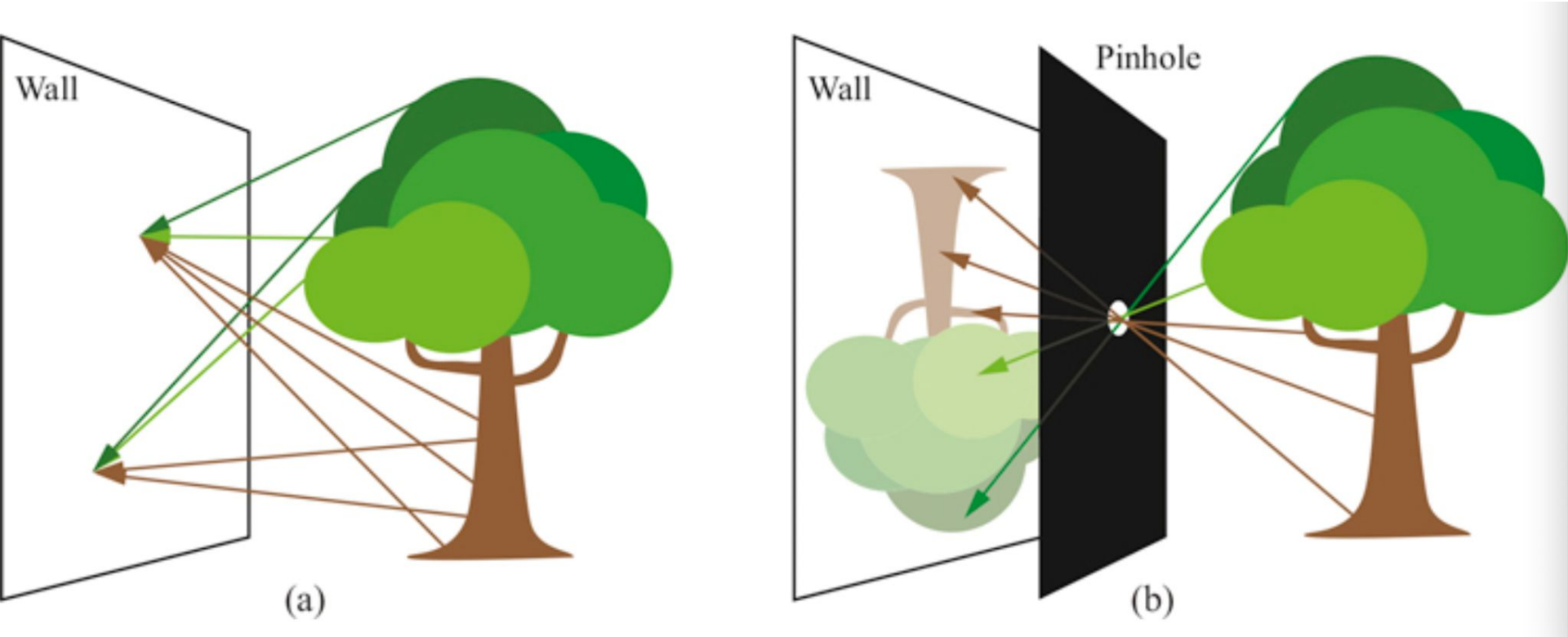
Image Formation

Pinhole Camera

Pinhole camera - Perspective Projection



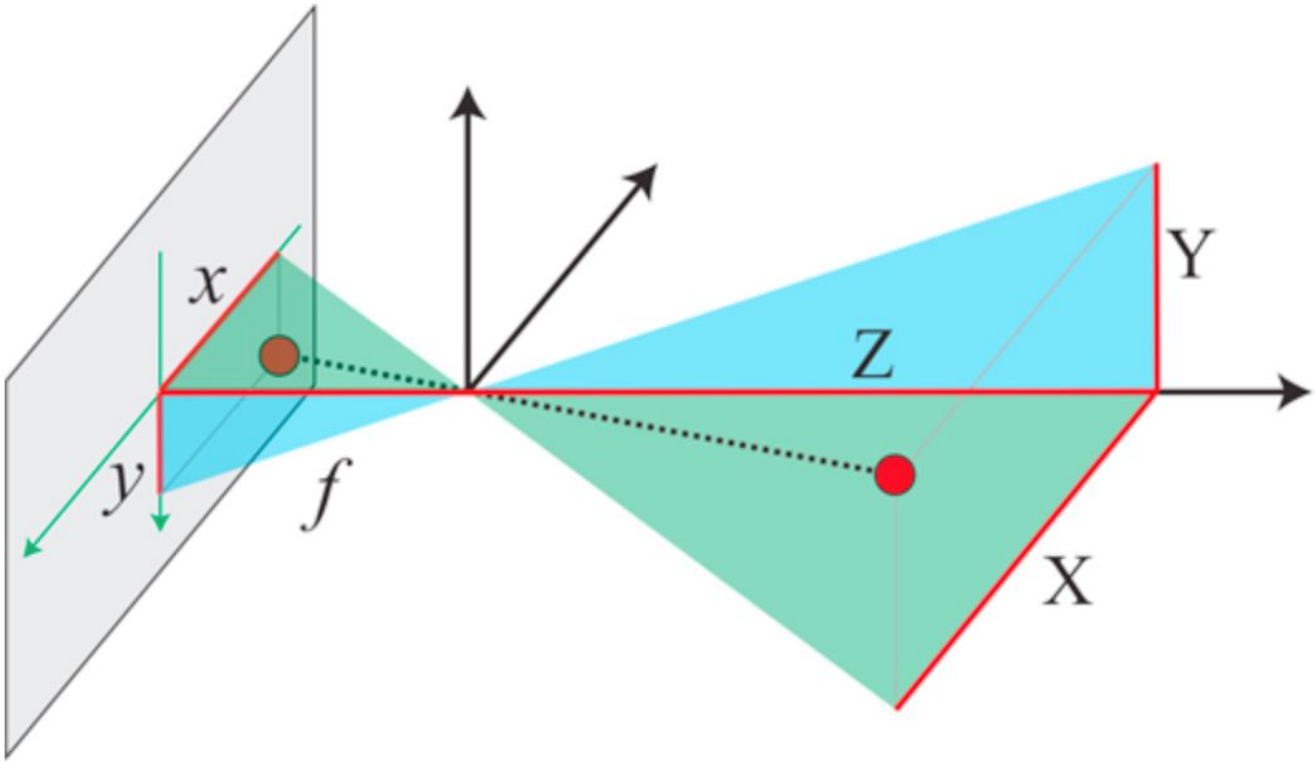


Figure 5.9: Perspective projection equations derived geometrically. From similar triangles, we have $x/f = X/Z$ and $y/f = Y/Z$. Similar triangles are indicated by the same color.

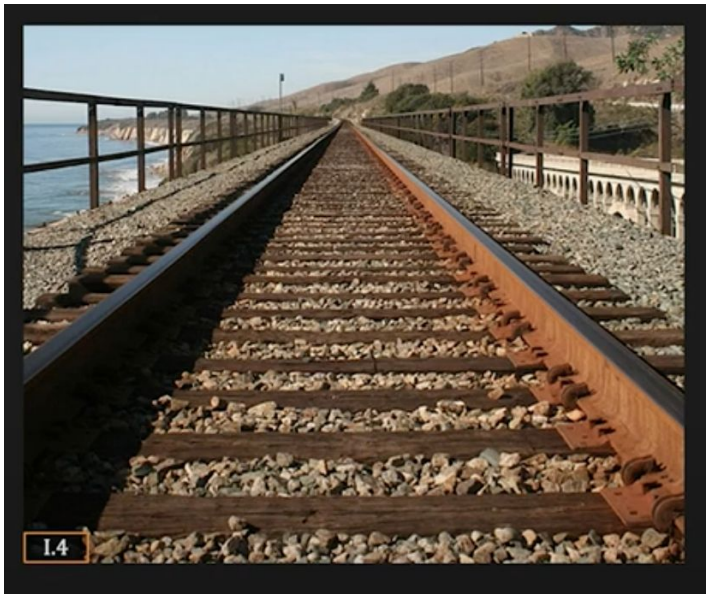
Perspective Projection

1. Perspective equations $$x = f\frac{X}{Z} \quad (5.6)$$ $$y = f\frac{Y}{Z} \quad (5.7)$$

2. “Under perspective projection, distant objects become smaller, through the inverse scaling by Z.”
3. Magnification = f / Z

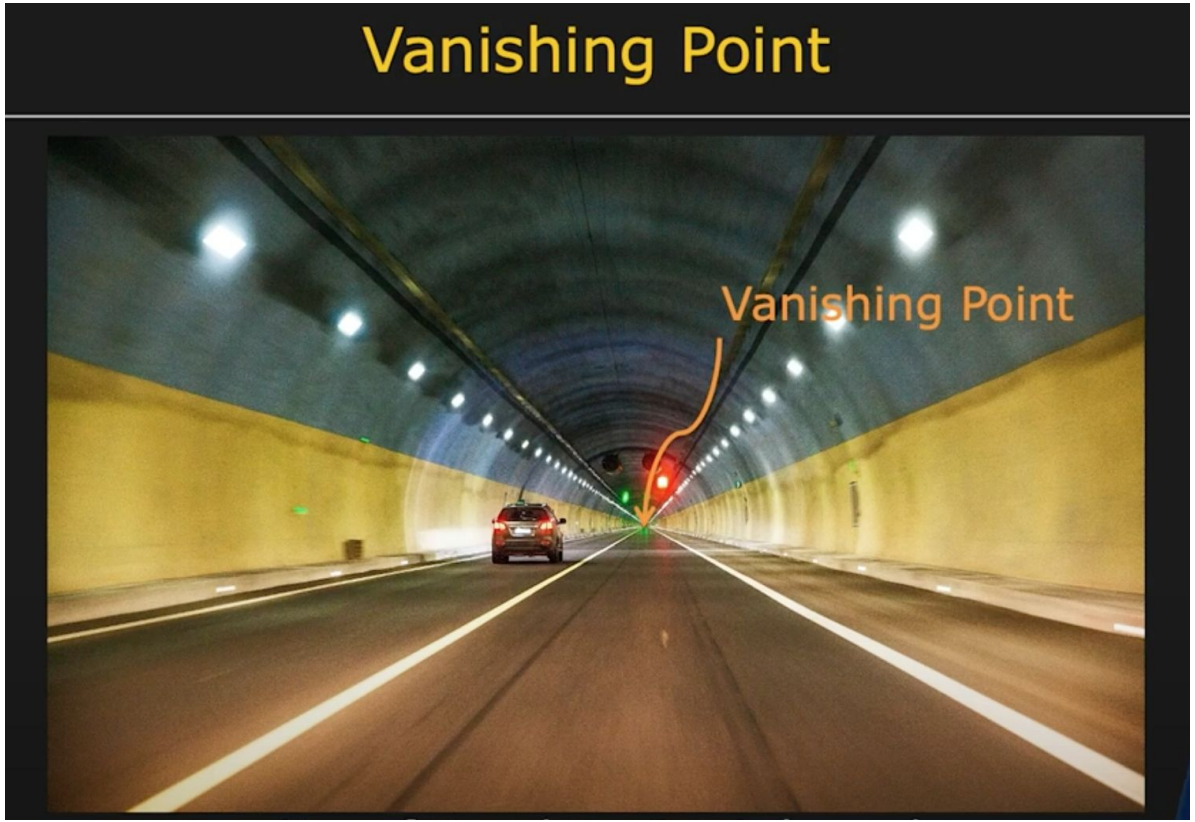
Perspective Projection - Magnification

1. Magnification $m = f / Z$
2. $Area_{image} = Area_{object} * m^2$



Vanishing Point

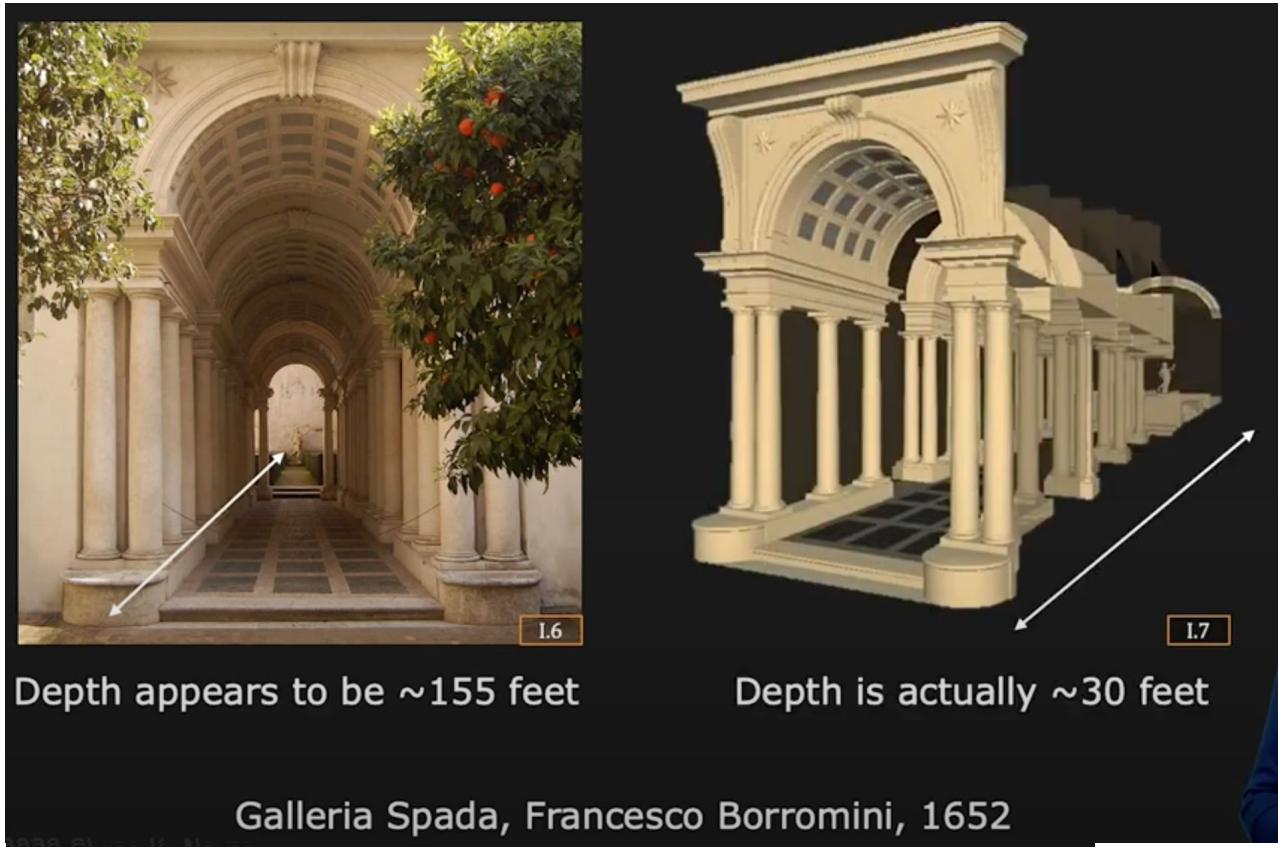
All parallel lines share the same vanishing point



Vanishing Point in Art

Vanishing Point in Art

False Perspective



What is the Ideal Pinhole Size?

2 mm | 1 mm | 0.6 mm | **0.35 mm** | 0.15 mm | 0.07 mm

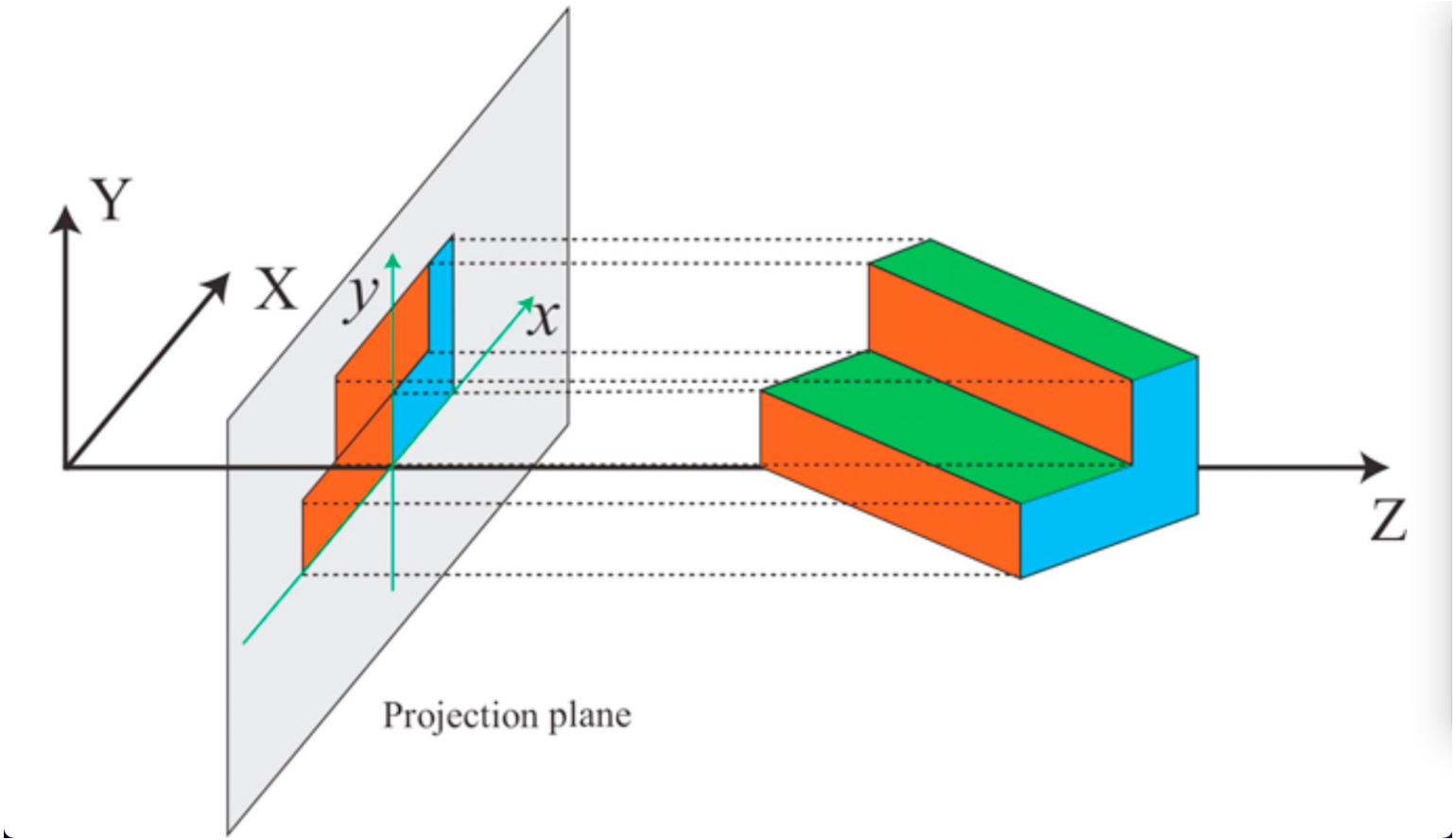
The pinhole must be tiny,
but if it's too tiny it will cause diffraction.

What about Exposure Time?

Pinholes pass less light and hence require long exposures to capture bright images.

$f = 73\ mm,\ d = 0.2\ mm,$
Exposure, $T = 12\ s$

Orthographic Projection



References

1. Foundations of Computer Vision - Chapter 5
2. Columbia University https://fpcv.cs.columbia.edu