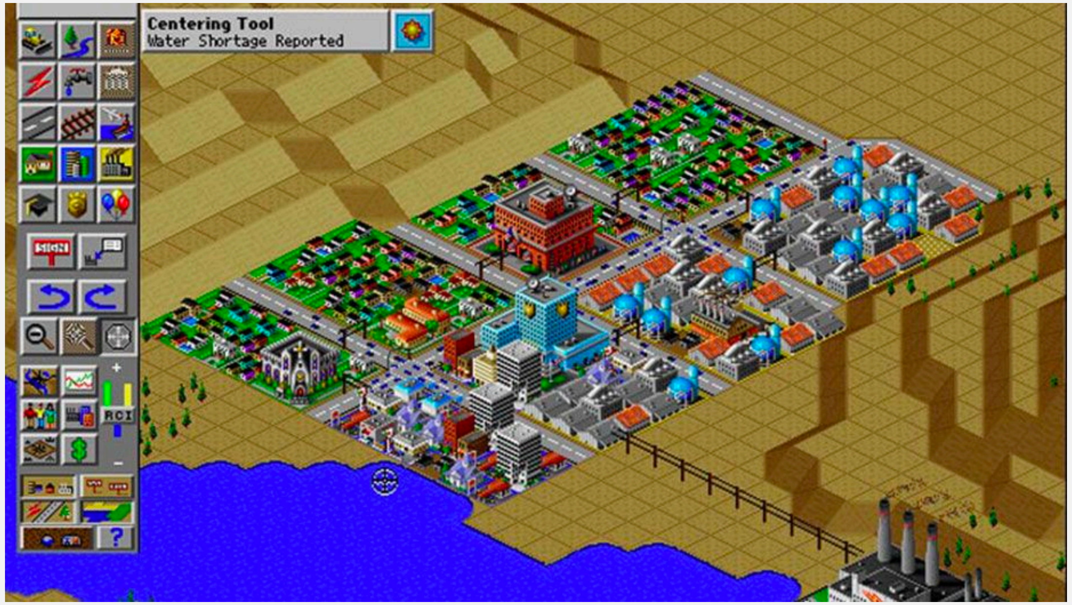
2.5D Systems

- Building 2.5D Systems
- Introduction to the Camera Layer

What Is 2.5D?

2.5D Renderings are pseudo-3D scenes that attempt to appear 3D to the viewer, but are actually constructed of 2D components.

> The scene itself is 3D with **restricted perspective**. From user specified angles, the scene appears 3D, thus giving the camera **constraints**.
>
> **Perspective divide** is a common 2.5D rendering technique in 3D computer graphics where the depth component of individual pixels are thrown out when processing a scene. This restricts the perspective to which the scene can be looked at.



Centering Tool
Water Shortage Reported

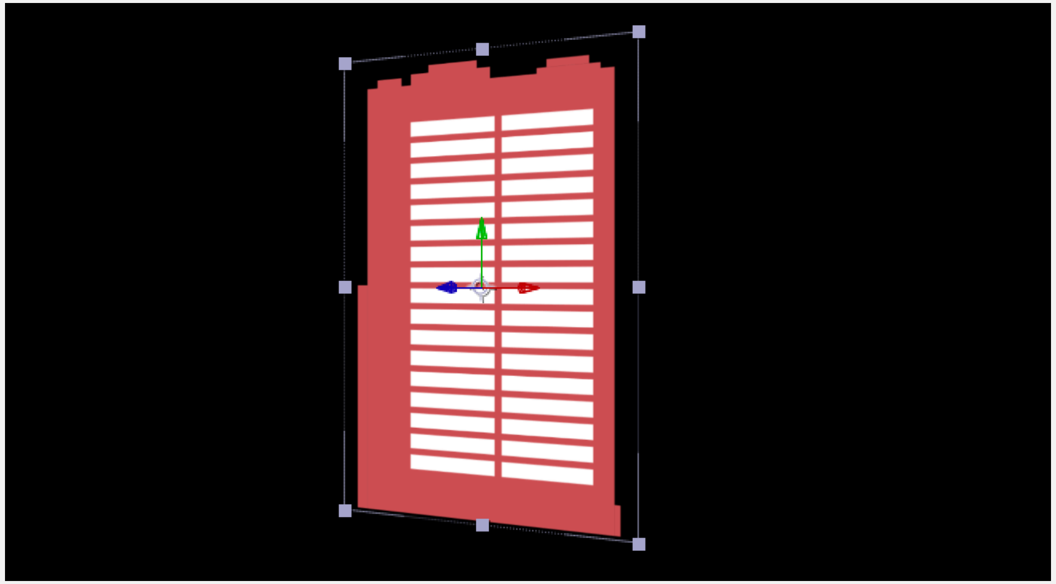
Sims City

2.5D Systems in Animation

2.5D Animation Systems take advantage of 3D transformations to make 2D layers appear as though they are 3D, creating a 3D scene.

This allows 2D layers to have 3 **position**, **scale**, and **rotation** dimensions to operate in.

Easiest to think of the 2D layer as a **paper-thin drawing** with no depth attribute, thus still making it 2D, but accessible to 3D transformations.



2D Layer With 3D Transformations

Building 2.5D Systems

After Effects allows layers to be **toggled** between 2D and 3D. 2D layers will have their regular attributed while 3D layers will have added transformation dimensions and be able to interact with 3D object such as lighting and cameras.

Unexpected behavior can occur in a composition with both 2D and 3D layers. It is preferred that everything in a composition be either 2D or 3D.

A composition with 3D components will act as a 2D layer when imported into other compositions. That same composition can also be toggled to be a 3D layer itself.

(Place Finished City Vectors Here)

- ~~Building 2.5D Systems~~

- Introduction to the Camera Layer

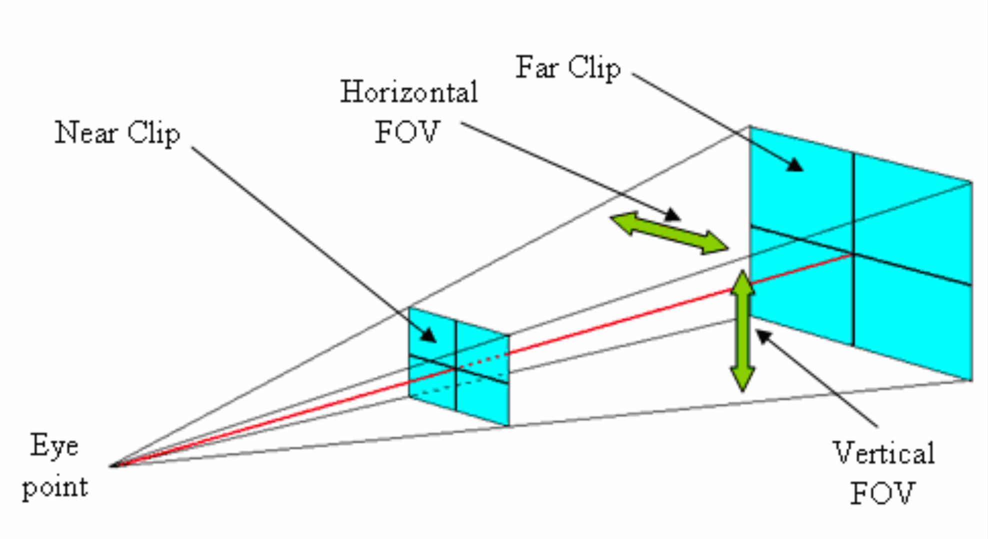
Camera Properties

In a general sense, cameras can be defined using 6 degrees-of-freedom, 3 of which define the 3D position of **origin** of the camera, and 3 of which define the 3D **outlook**, or direction of viewing.

These 6 values come together to form an **orientation vector** of the camera. Is there a way to cut down on the number of variables?

Use a **unit vector** where the outlook are defined using **phi** and **theta**

Additional parameters include the **horizontal** and **vertical field-of-view**, **near** and **far clip plane depths** **focal length**, and more.

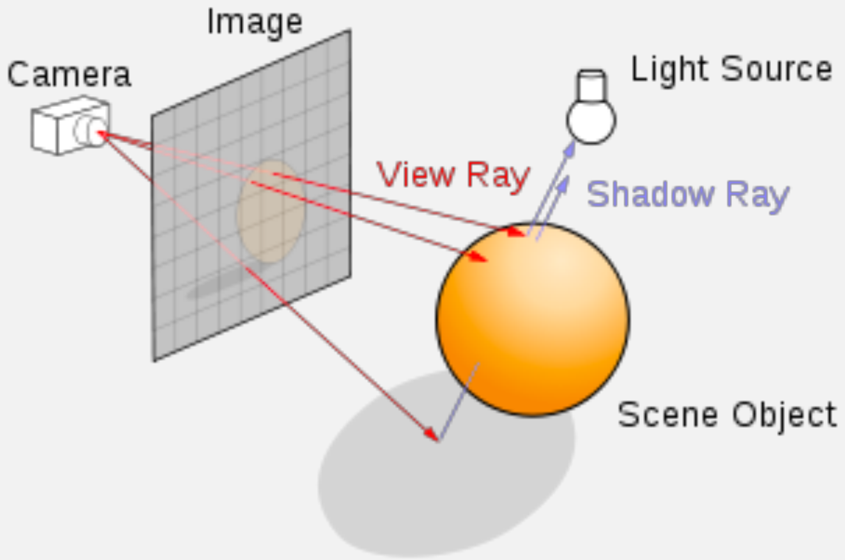


Camera Key Properties

How The Camera Sees

Imagine a **grid** in front of the camera **one unit away** in the direction of the camera's orientation vector. The number of regions on that grid represents the render **resolution**. For each cell in the grid, a **ray** is formed from the camera origin to the center of that cell, and the ray is traced out into the scene until it hits another object. Once the first object is **hit**, its **color** is sampled and **saved** at that location in the grid.

> This is referred to as **0-depth ray-tracing**, where we only consider the **local illumination** of a scene. Computing additional depths increases runtime **exponentially** and can be very costly for higher resolutions.



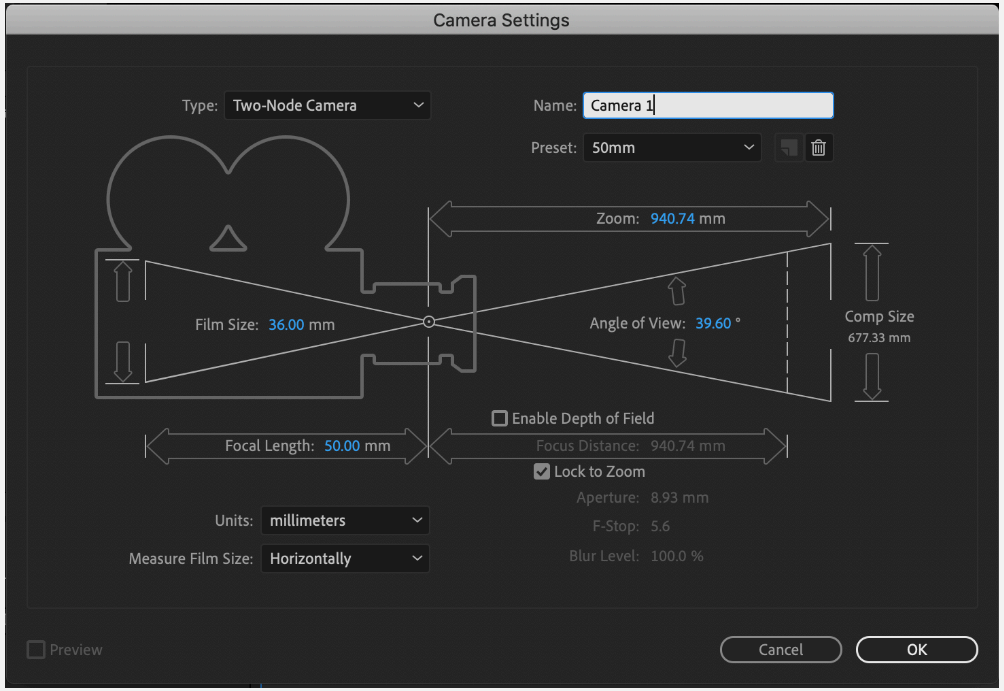
The Camera Layer

Type is **one-node** or **two-node**. One-node cameras **orient around themselves**, while two-node cameras **orient around a point of interest**. Easier to think of the anchor point at the camera's center for a one-node, and free to move around for a two-node.

Zoom is the **distance** between the **camera** and **image plane**. These parameters are **inversely proportional**, so doubling zoom halves image size.

Angle of View is the **width** of the **image plane** captured. Given the aspect ratio, we can calculate the height angle of view. Cameras often share the same aspect ratio as the composition.

Film Size is the size of the **exposed area of film**. This parameter impacts **zoom**.



Camera Settings

Type: Two-Node Camera

Name: Camera 1

Preset: 50mm

Zoom: 940.74 mm

Film Size: 36.00 mm

Angle of View: 39.60 °

Comp Size 677.33 mm

□ Enable Depth of Field

Focal Length: 50.00 mm

Focus Distance: 940.74 mm

☑ Lock to Zoom

Aperture: 8.93 mm

F-Stop: 5.6

Blur Level: 100.0 %

Units: millimeters

Measure Film Size: Horizontally

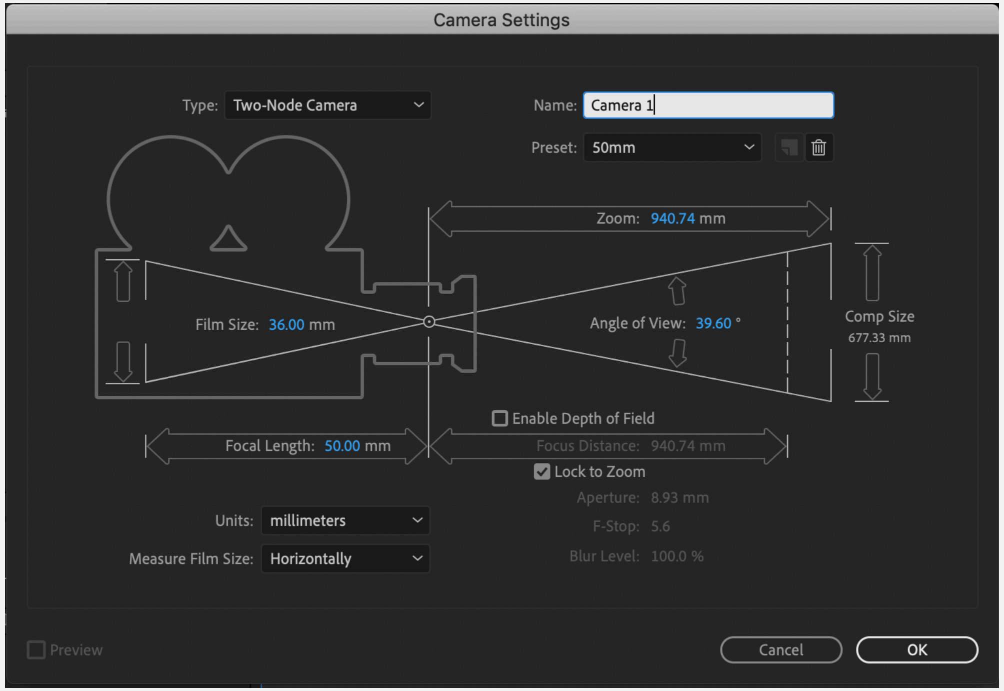
Camera Layer in After Effects

The Camera Layer

Focal Length is the **distance** from the **film plane** to the camera **lens**. This parameter impacts **aperture** and **angle of view**.

Aperture is the size of the lens. This parameter impacts **depth of field**.

> In conventional cameras, aperture is directly correlated to the rate of light entering the camera. Since light carries information from a scene into the camera, the camera needs a significant amount of light to form an image, or else the image will be dark and under-exposed. Smaller apertures require longer exposure times, and are more vulnerable to motion blur artifacts.



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Measure Film Size: Horizontally

□ Preview

Camera Layer in After Effects

> This is not an issue with simulated cameras in animation 🙃

Adobe keeps great documentation on how all these properties work in more depth: https://helpx.adobe.com/after-effects/using/cameras-lights-points-interest.html

Camera Parameters

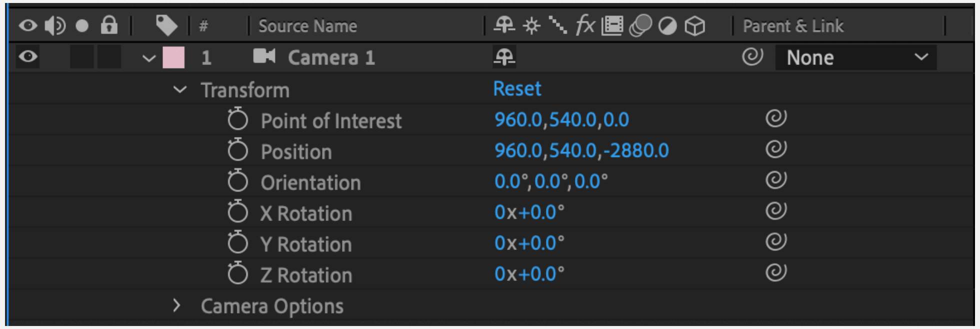
Camera layers have most of the same transformation properties as regular layers. All available parameters are keyframe-able and can be modified using the motion editor.

Point of Interest is only available with two-node cameras. This specifies the viewing direction and acts as an origin for camera orientation changes.

Position is the point in space of the camera.

Orientation is where in space the camera is oriented relative to the camera position or point of interest depending on the number of nodes.

Rotation parameters are the same as other 3D layers.



#	Source Name		Parent & Link
1	Camera 1		None
	Transform	Reset	
	Point of Interest	960.0,540.0,0.0	
	Position	960.0,540.0,-2880.0	
	Orientation	0.0°,0.0°,0.0°	
	X Rotation	0x+0.0°	
	Y Rotation	0x+0.0°	
	Z Rotation	0x+0.0°	
	Camera Options		

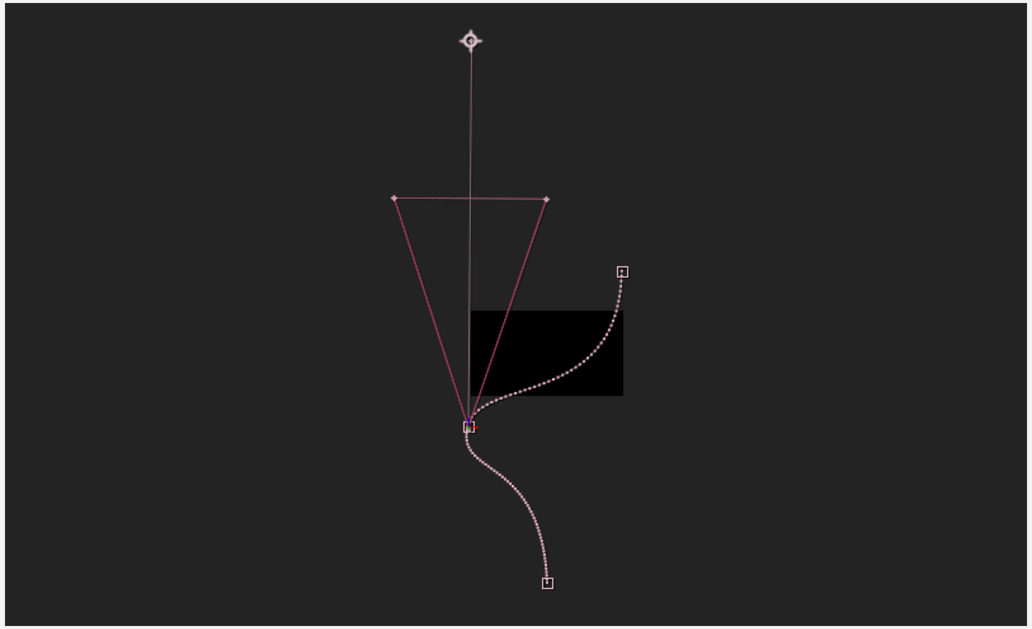
Camera Transformation Properties

Working With Cameras

In 2.5D systems, scene elements will stay in place. Rather than moving around the entire scene, move the camera around to show different parts of the scene.

This makes it easier to create **local** and **global** animations. Individual layers can have their own animation cycles, while the camera can direct global animations such as pans and zooming in.

Cameras are also configured to render m**otion blur** and depth **parallax** automatically. Parallax is generated by default, while motion blur has to be enabled by the composition.



After Effects Camera Path

Homework

- ❑ Construct a 2.5D system using vectored assets.
- ❑ Populate the system with foreground elements or typography.
- ❑ Create a camera layer and animate it around the scene.
- ❑ Allow elements in the scene to have their own animation cycles.
- ❑ Render as H.264 and upload to course Drive.

Questions?

Live Demo