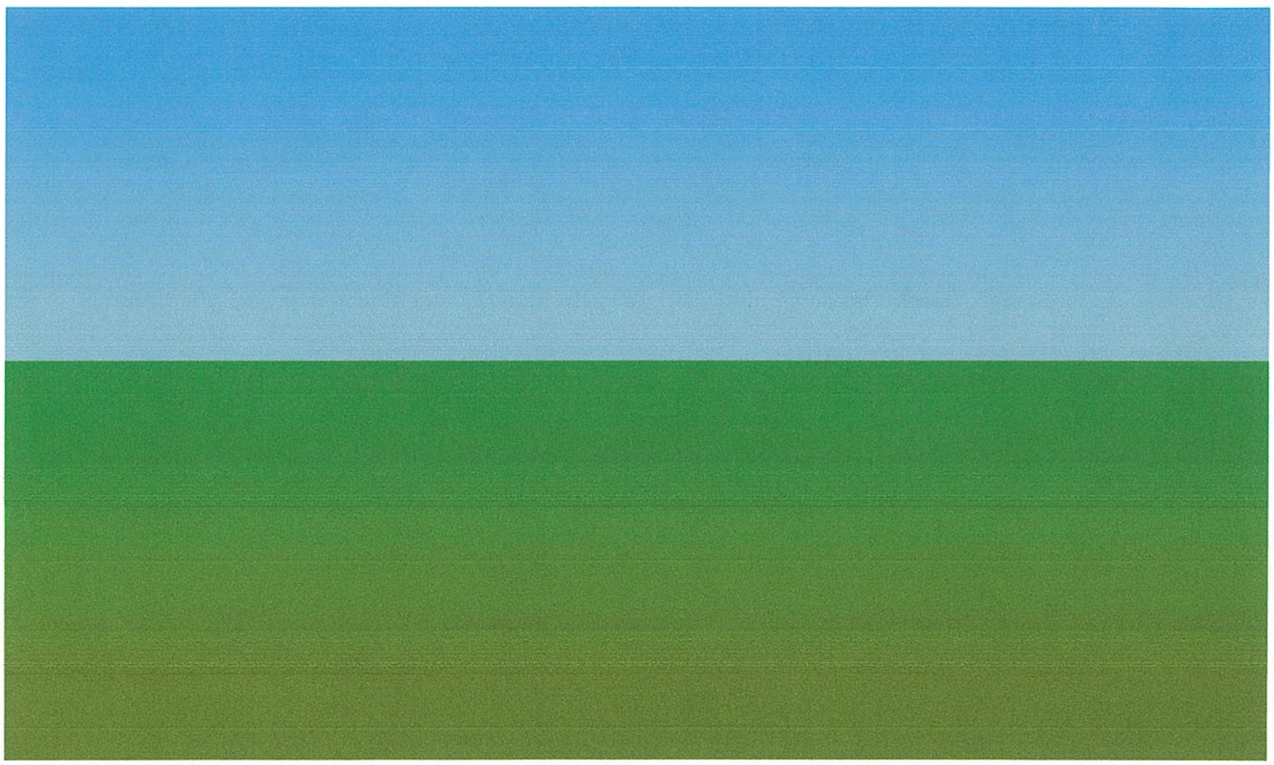
Appendix G

Understanding Perspective

Compositing: Understanding Perspective

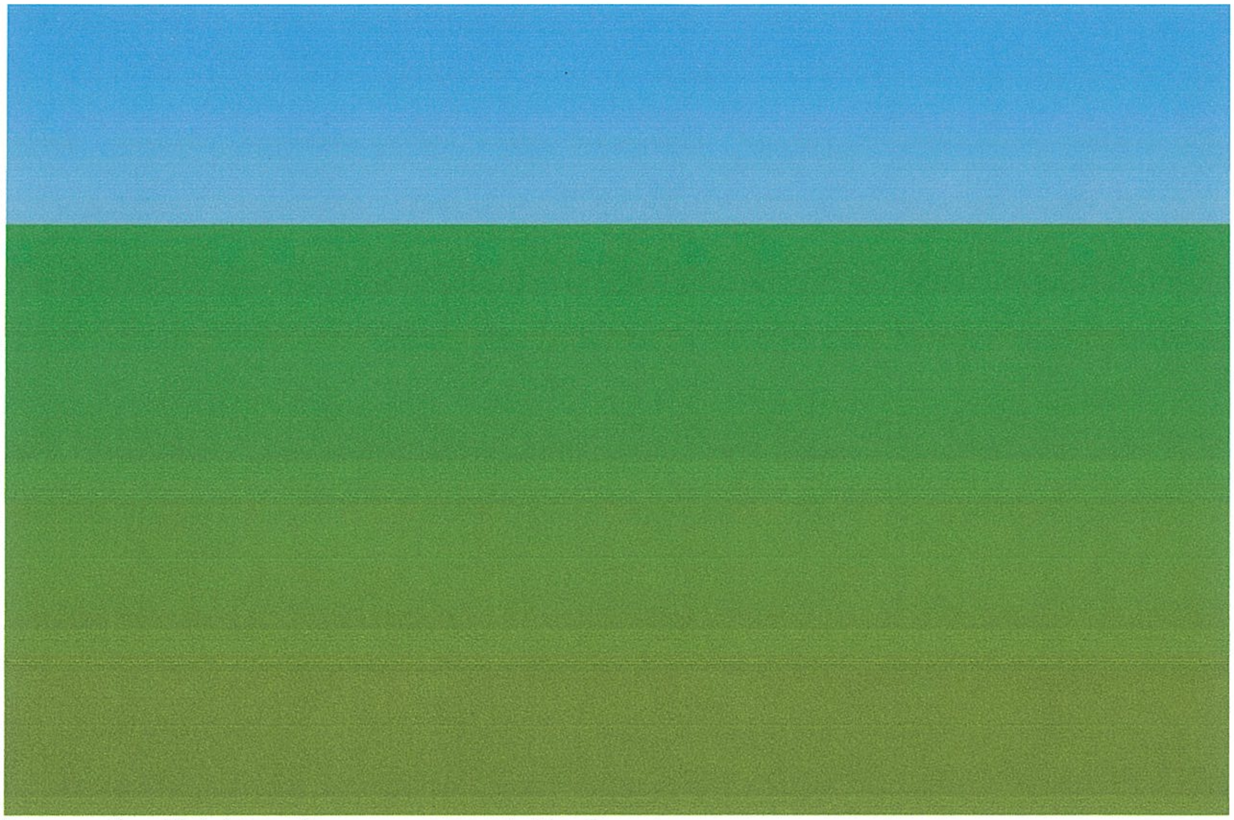
There are various ways of understanding perspective in compositional imagery. Below is a statement about the basics of drawing or rendering in depth and matching a panoramic scene. Although, there are plenty of variables which make the following examples difficult to see in a real photo, I will spend some time instructing these factors in a flawless perspective, and later explain the variables.

The first thing which must be understood about a true perspective is its **horizon line**, or simply put, the horizon. In a typical photo, this line would be drawn at the center if the cameraman was facing straight forward. Also called **eye-level**, this is the most basic type of shot. Some examples of seeing this horizon in photos include the line where far away mountains seem to rest on, or where the sky meets the ocean. In a city scene, we would best see this line in a situation where there was a long stretch of road that seemingly meets in the center of where the sky starts.

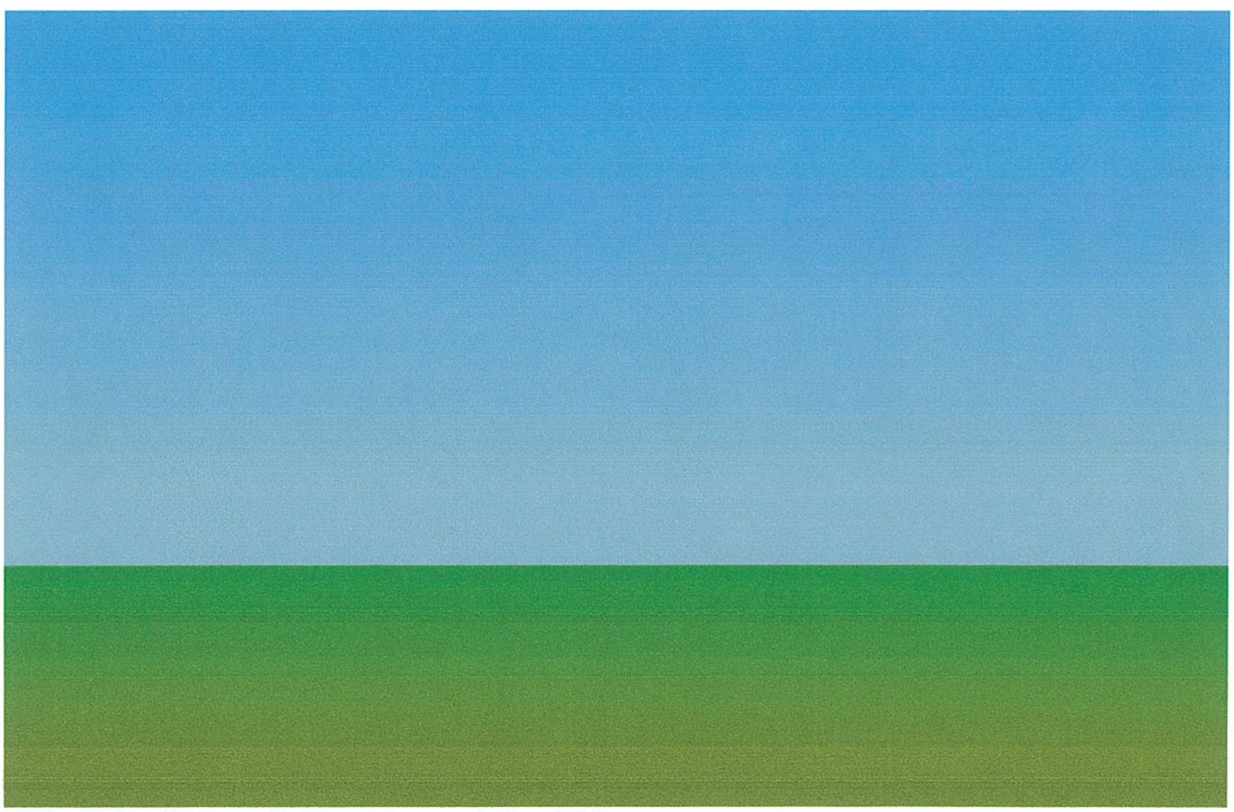


The above shows a center horizon, or eye level horizon where the green grass meets the blue sky.

The next two images (below) show a high-angle and low-angle shot. **High-angle** would be any time the camera man is below the object of focus pointing up, or pointing high. **Low-angle** is any time the camera man is above the object of focus pointing down, or pointing low. Another way of imagining this is comparing a high-angle as if a child took the photo, whereas a low-angle as if someone took it from a ladder or an airplane.



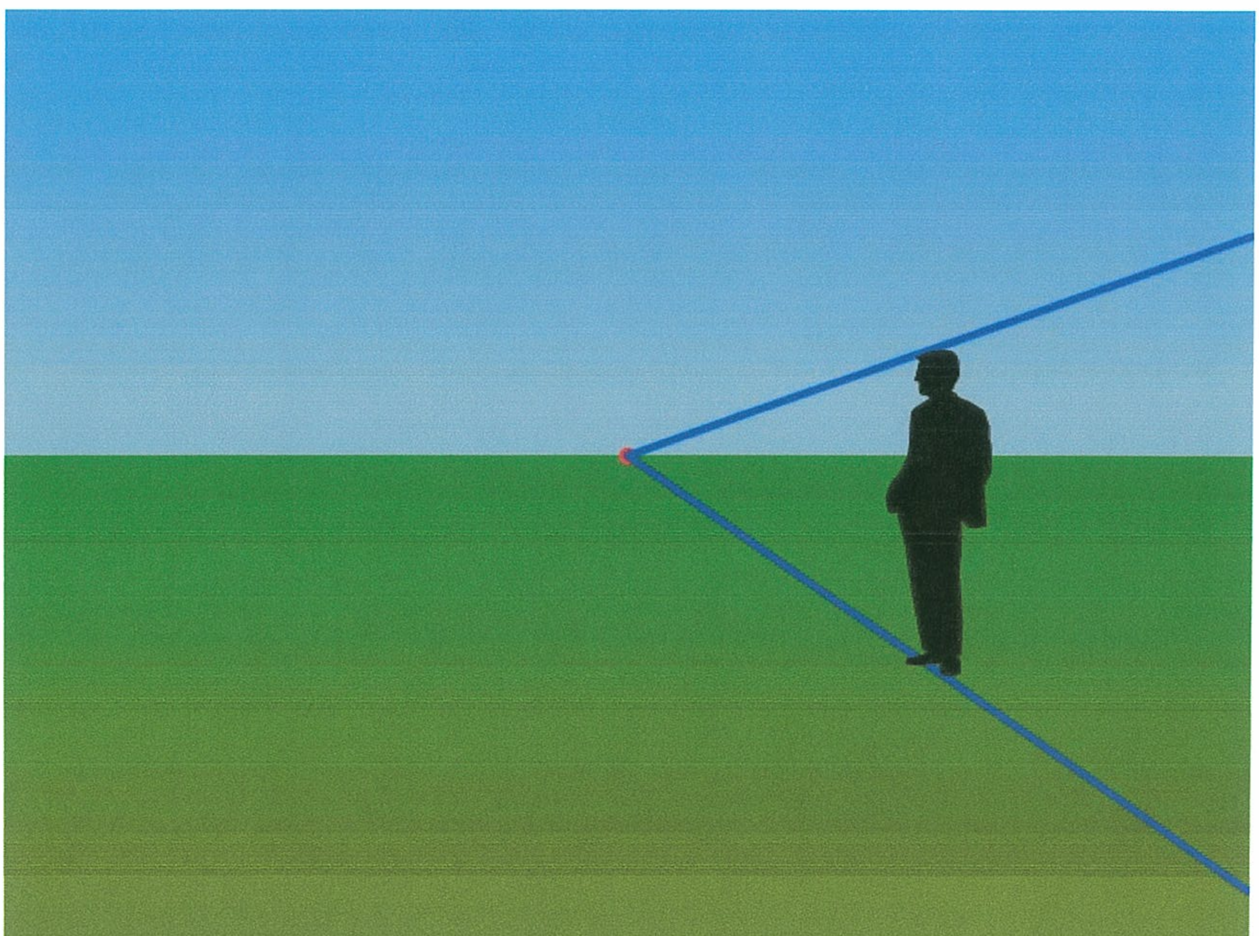
Low-angle. Heightened cameraman pointing low.



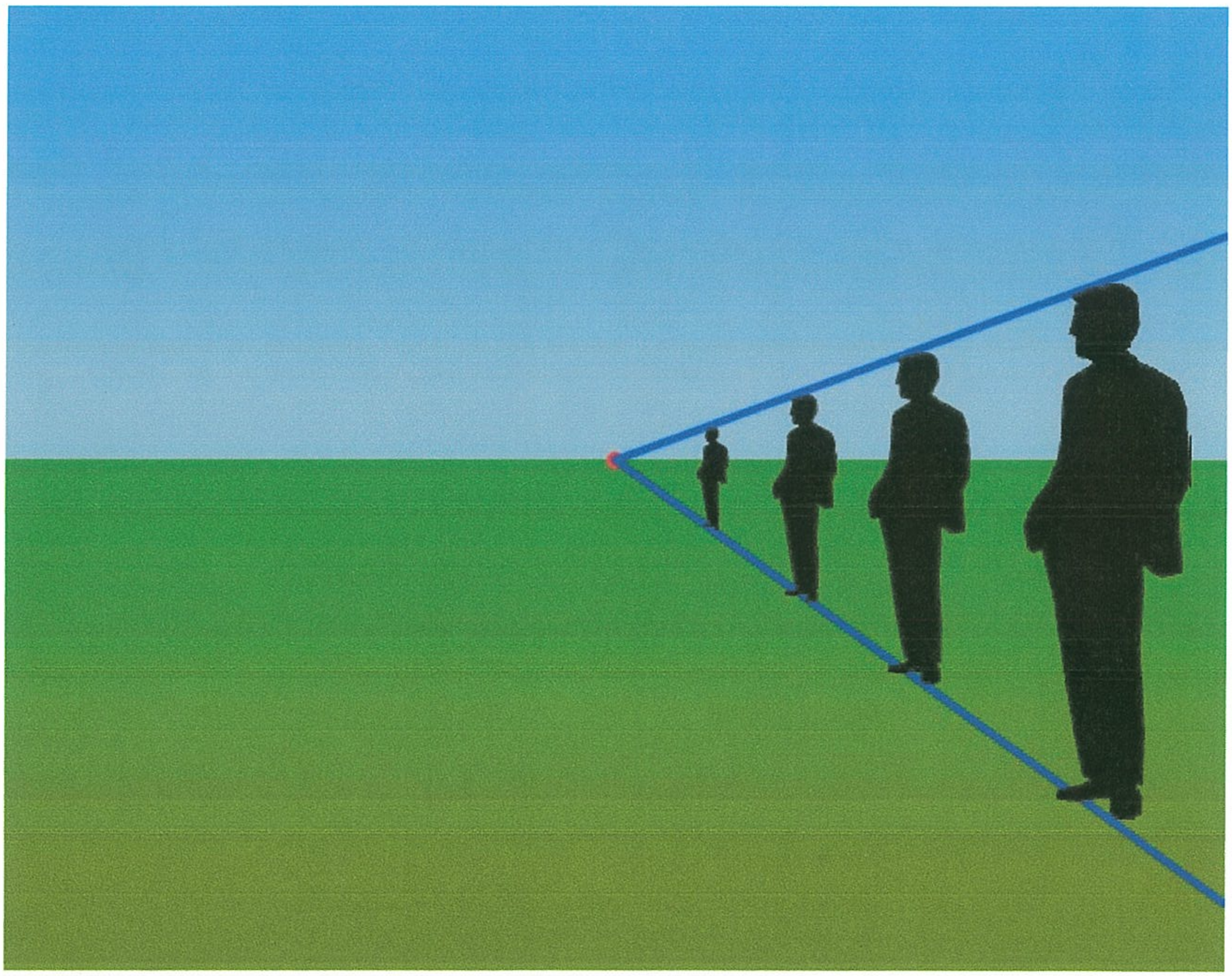
High-angle. Lowered cameraman pointing high.

This is an important factor, and should begin the explanation to a client about a project. Are we looking into the scene in the eyes of a child, or looking up at the focus to make it seem larger than us (high-angle)? Are we focusing straight on for simplicity and scale (eye-level)? Or are we comparing it to its surroundings in such a way as to make it seem smaller, or establishing it with surrounding reference (low-angle)? Eye-level and High-angle are often shot on foot or in a boat. Low-angle shots are often done from high places, with a crane or helicopter, or taken by satellite, and can be considerably more costly. Once this has been decided we can move forward. A majority of the examples below are shot as if the cameraman was average height, or between 5'6" and 6'.

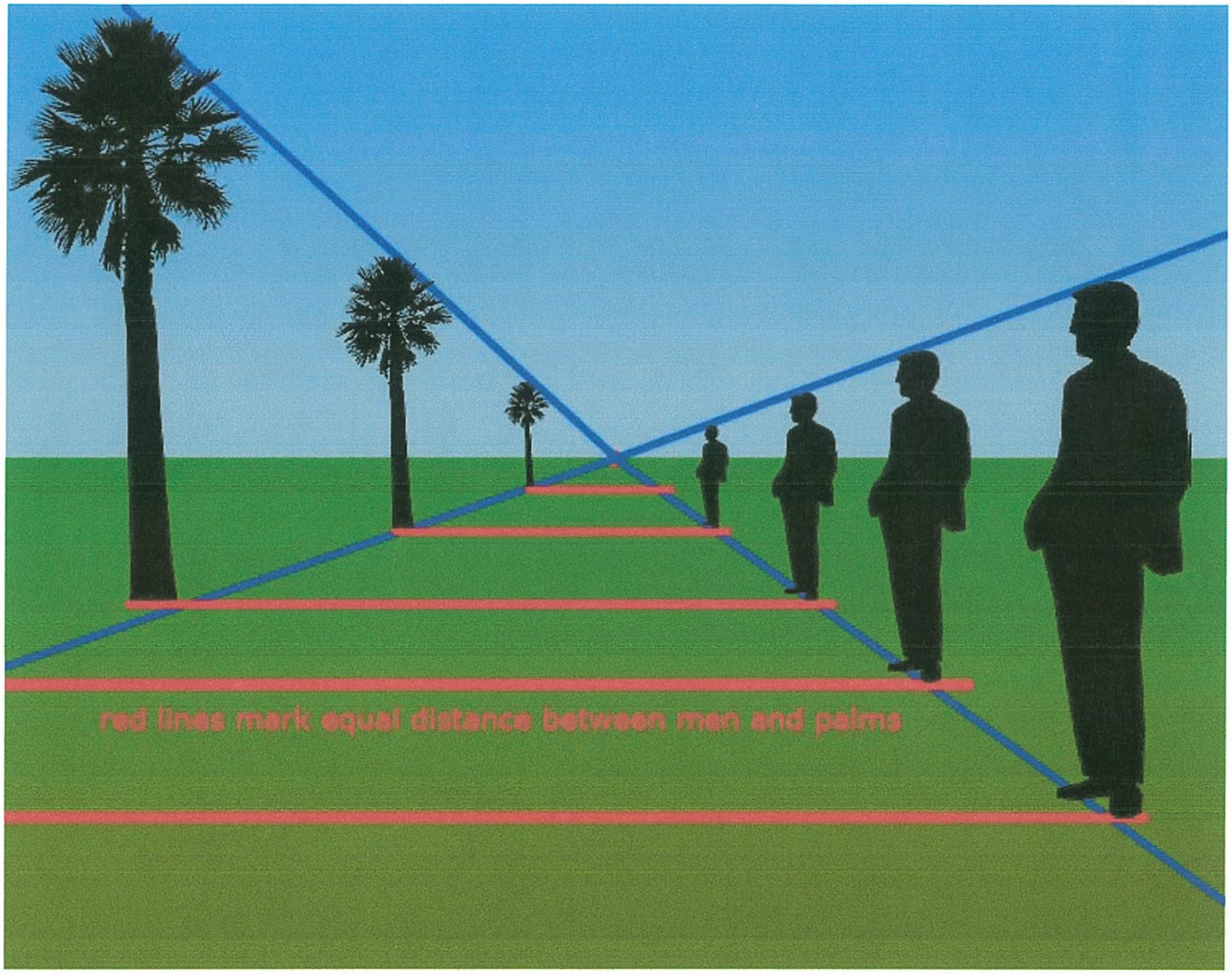
The next thing to consider in a photo real composite is where to place the vanishing point. The **vanishing point** - using the city example from above - is the point where the road, and buildings, and trees, and anything else seem to meet together seemingly microscopically. Put simply, it is where everything "vanishes" into the horizon. In the tutorials I am showing, these points will always be placed on the horizon line. There are circumstances in dramatic photos where a third point would be used away from the horizon line, but this type of imagery is not recommended for architectural visualization purpose due to the feeling of discomfort or superiority it naturally portrays. As seen below, I have placed a man in the scene at eye level looking straight on. I have marked the vanishing point as a **red** dot, and drawn **blue** lines referencing the man's highest and lowest points on the green landscape. The example below represents a **one-point perspective**.



The **blue** lines above now give us a good idea as to the location he is on the landscape, and more importantly, how tall he would be from farther away. Below, we can see the same 6' foot man, as well as his height when he is closer or farther away from the camera. Note his entire scale is changing the closer he is to the vanishing point.



To further explain this idea, I have placed some palm trees, which are naturally taller than the man. In a perfect perspective, everything no matter the height scales smaller and smaller until it becomes close to the same height then disappears. Note the **red** lines drawn across to mark the distance of the trees and men. Also note the palm tree and man closest to the vanishing point are close to the same height.



I have drawn a couple of figures to represent an object in its simplest state, a box. Everything taken objectively can be represented as a series of spheres, cylinders, or boxes, whether it be a basketball, a person's arm or leg, or a building. Looking objectively in this manner makes the perspective process much easier to see in a photo-real perspective.

Figure 1.1 shows the horizon line in **blue**, vanishing point in **red**, and lines drawn from the vanishing point in **cyan**. The **black** lines represent the walls or edges of the boxes. In a one-point perspective, any lines representing the height of something at its boundaries, or the bottom and top of the edges facing the camera directly are drawn at 0° or 90°. In other words, any line going up and down, or left and right remain the same. Any lines representing the sides of the object in reference to the camera are drawn toward the vanishing point. These particular boxes are see-through, so we can visualize how the top, bottom, and back faces of the boxes would be represented. The **yellow** lines are the bridges from the cyan vanishing (perspective) lines which show how the edges of the object are connected to complete the 3-Dimensional shape. Note the difference between the higher box placed in the middle of the horizon, essentially eye level to the camera, and the box below the camera is looking down on. As viewers, we can see more of the top side of the lower box. Imagine if the boxes were not see-through. We would only see the front and the right side of the higher box, whereas we would see the front, right, and top side of the lower box.

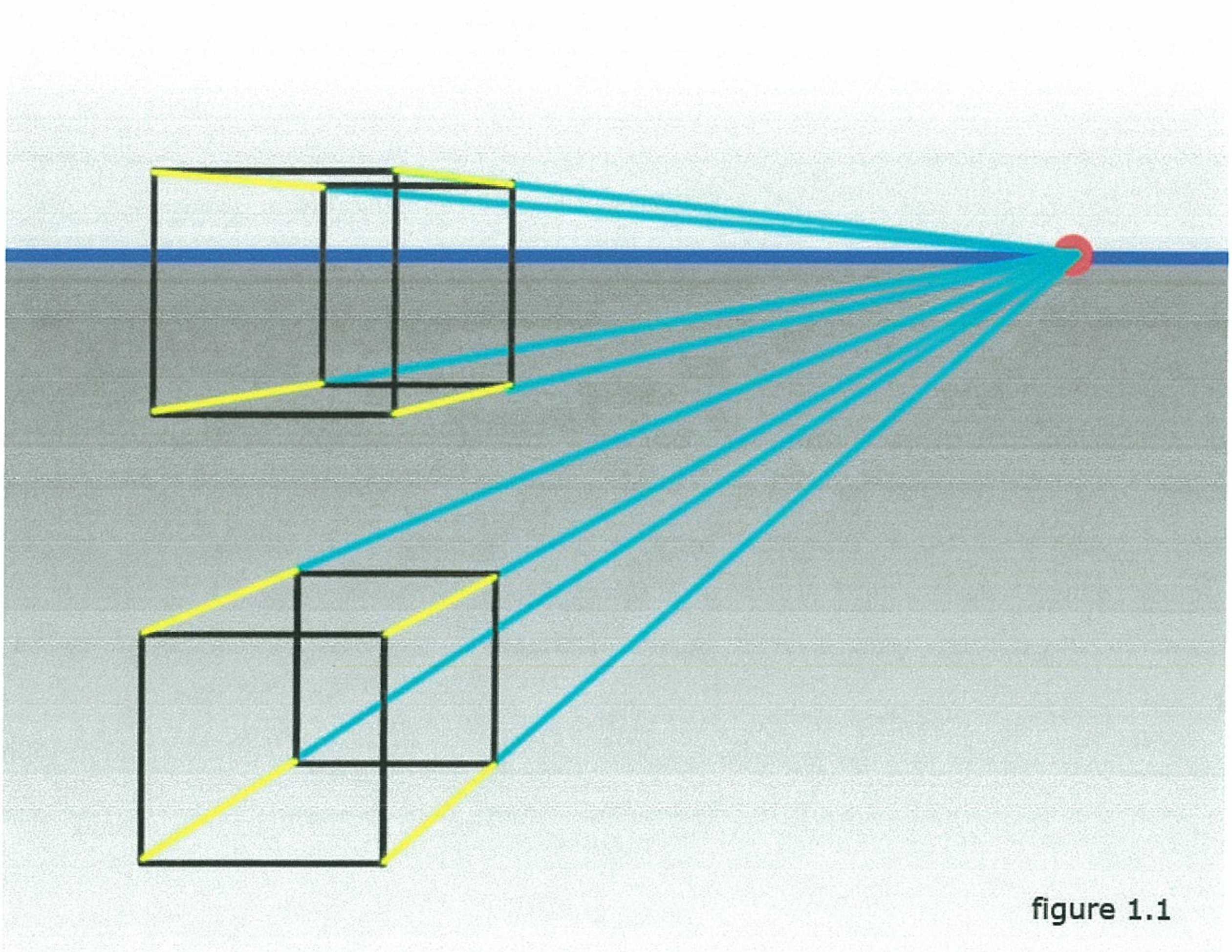
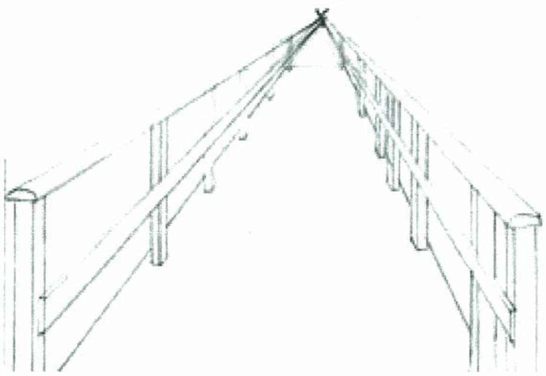


figure 1.1

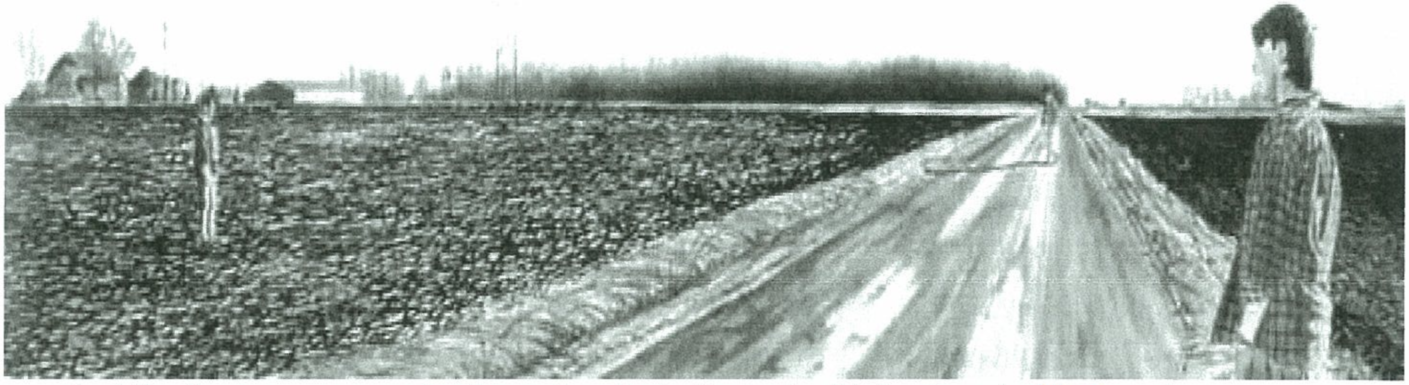
Here are a few more examples of one-point perspective.



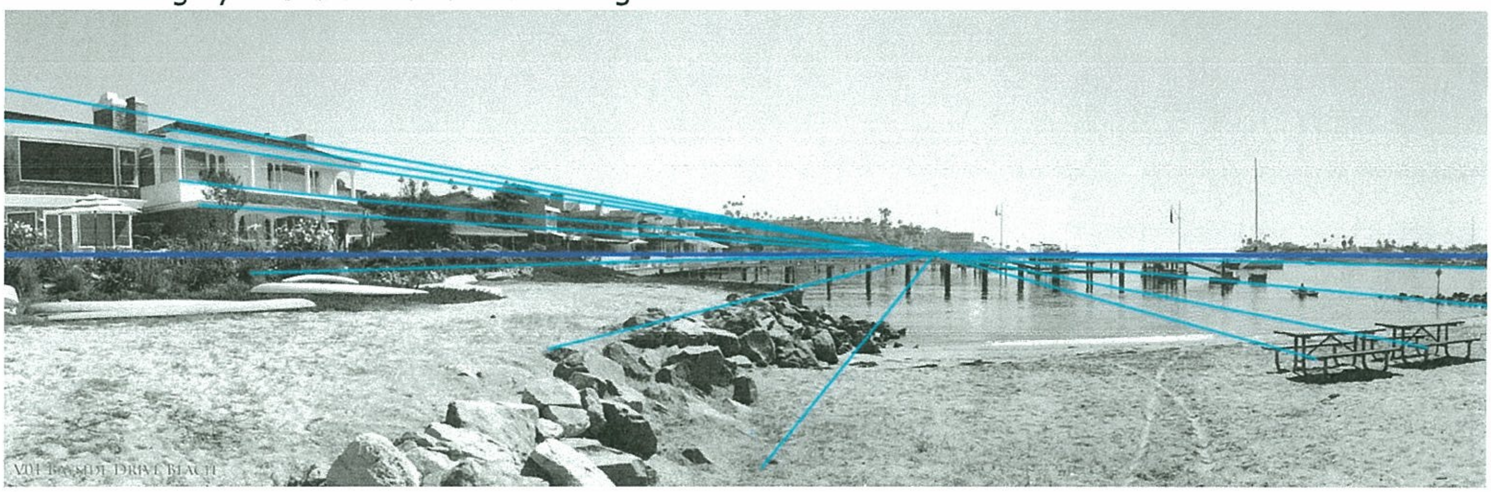
Left: Low-angle shot of a dock. Note the high horizon line where the bottom of the land meets the sea and the smaller size occurring on the railing.

Middle: Sketch of homes in perspective at eye level. Note the horizon at center, and the vanishing point far off to the right. This is an ideal shot for a street view of homes. Our focus is toward the front doors of each home and suggest depth without showing too much street.

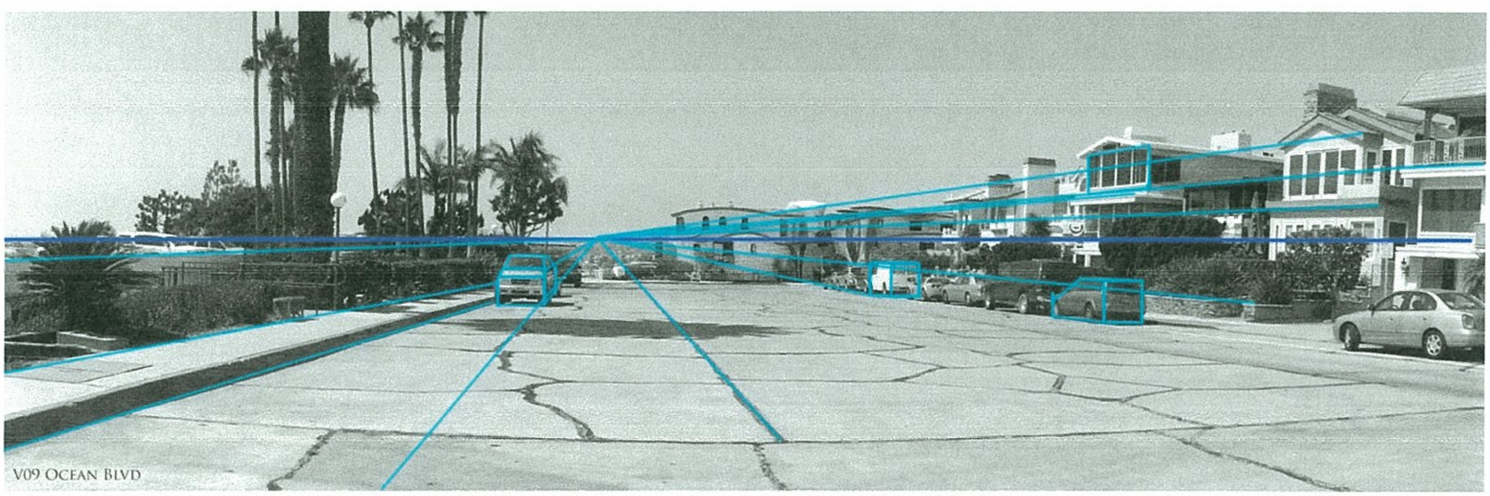
Bottom: Sketch of farm road meeting at one central vanishing point. Note that the buildings to the far left are flat above the horizon. Because these elements are directly facing the camera and blocking the perspective elements behind them, they appear flat and act to break up the sky. The closer the camera gets to them, the more we would see the one-point perspective effect. This represents one of the variables I will explain later.



And finally some examples from the Aerie Project with horizon in **blue** and reference "perspective" lines in **cyan**. Note the horizons and vanishing point meet roughly in the center of each image.



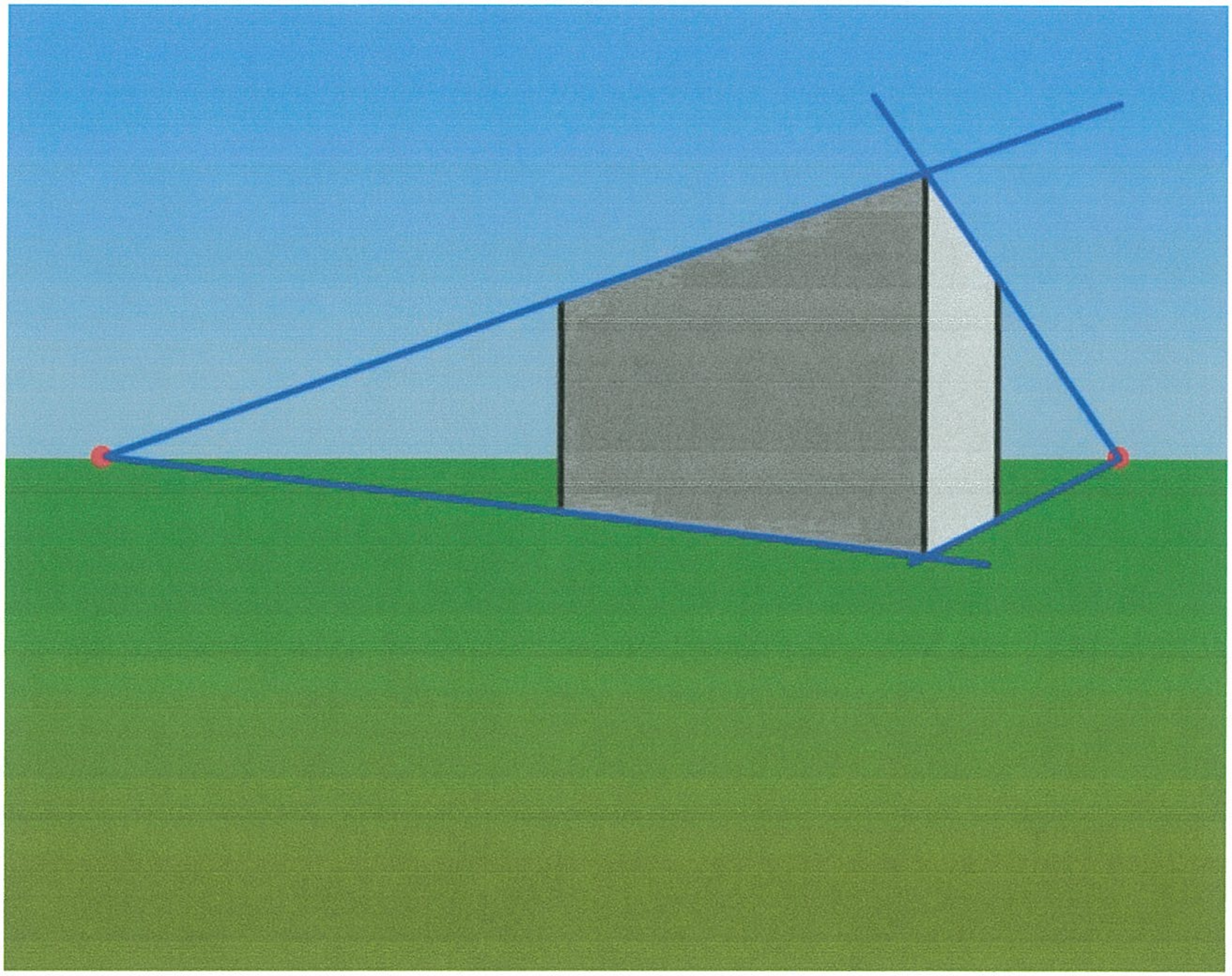
V01



V09

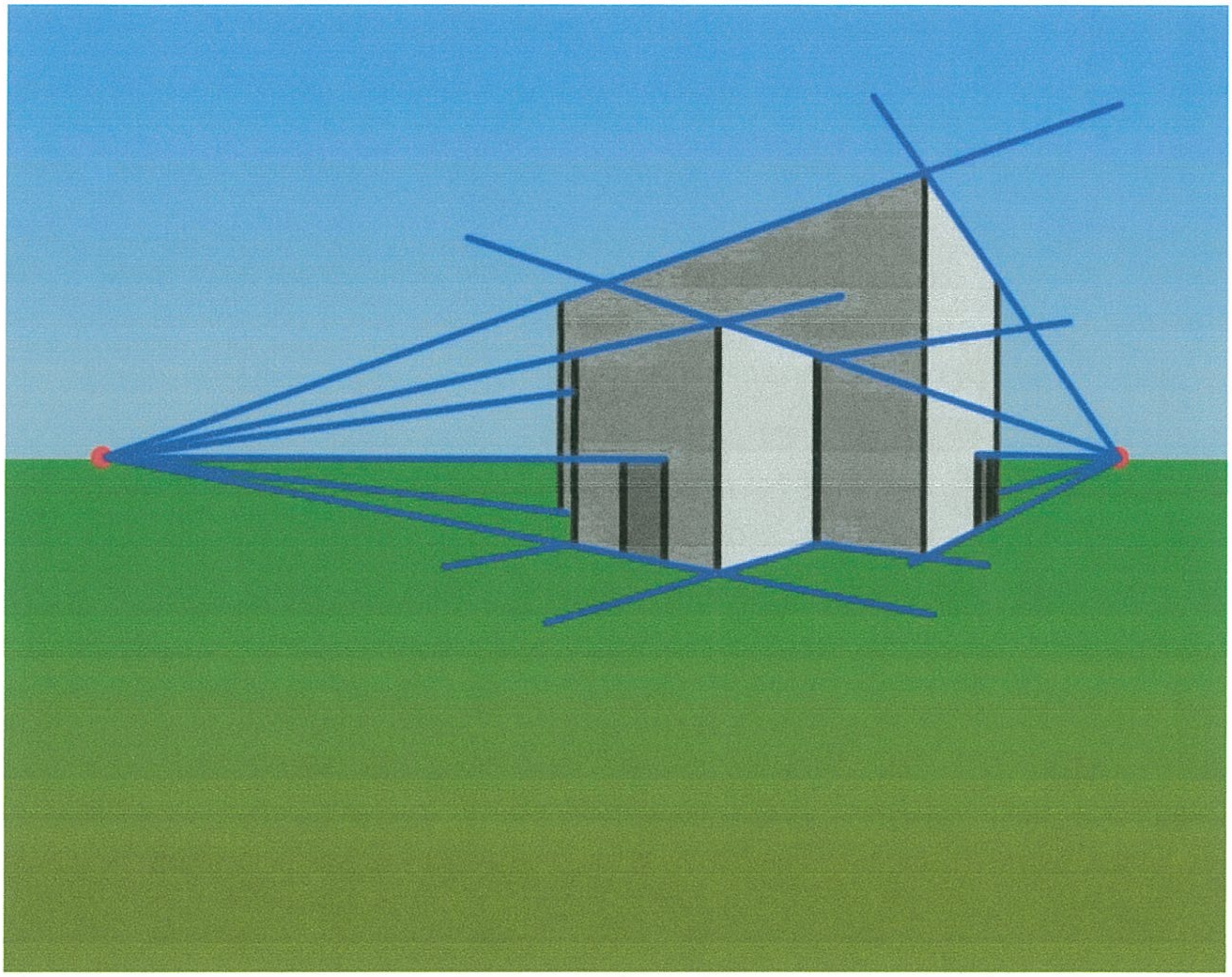
Let's move onto a concept a little tougher, **two-point perspective**. Of the two types of perspective I'm showing in this tutorial, this is the more commonly used. It is used more often because of its photo accuracy while holding on to a linear designed feel. One-point perspective tends to look too Science Fiction. Vertical lines are still related as 90° and all other lines meet at one of the two vanishing lines placed on the horizon line at either side of the object focus. The easiest way to think of this type of perspective is imagining the camera is placed facing the corner of an object. In the case with a building, the camera would typically face the front and left side wall's edge. The distance between the two vanishing points depends highly on the size of the camera's lens and the aspect ratio of the final photo image. Knowing the distance from the object assists, but in the end, the decision of these points requires educated assessment.

Below is an example of a two-point perspective box. It has been made solid with basic shading in this case because two-point perspective lines can create confusion even among experts in the field. Establishing lines at the highest and lowest points is ideal in the beginning of this type of design. The **blue** lines are perspective lines, the **black** are the vertical or 90° lines, and the **red** are the two vanishing points.

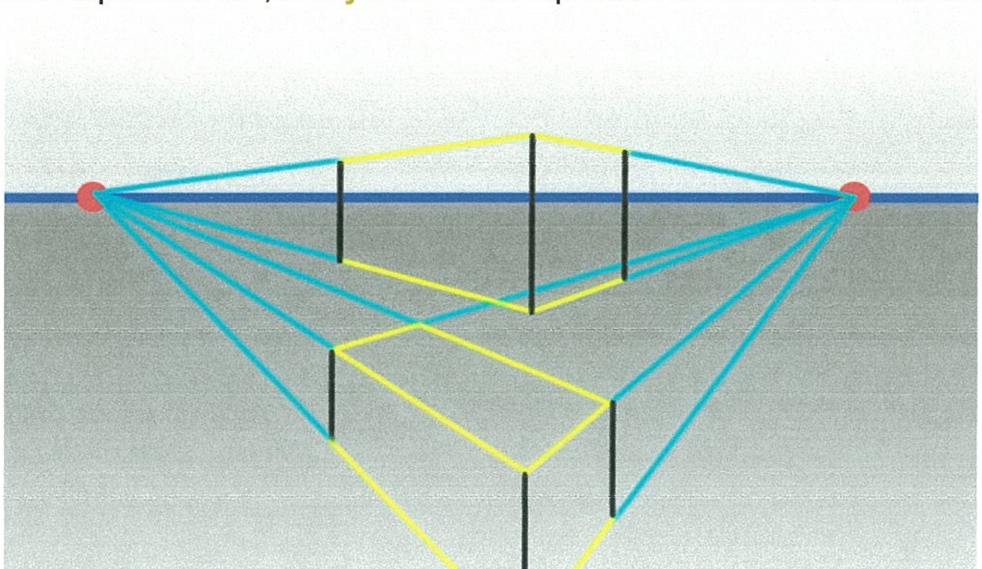


Though it seems like the lighter gray side is smaller, this is not necessarily true. Depending on the angle of the camera, this side can get wider if we turn more toward it, but not at the expense of making the darker grey side thinner. This factor is called **fore-shortening**. As an example, if one was to place their palm directly facing them, the palm would look wide, while they couldn't see the side of their hand at all. But, upon turning the hand towards the side, they will witness two things happening. One, the palm will get thinner-looking to the point of not seeing it at all; and Two, the side of the hand will get wider.

Below I have added more architectural detail to the building. I've added a façade and doors to further illustrate two-point perspective. What we are looking at is actually pretty close to the camera. Because the two points are so close together compared to the height of the building, there is a lot of "skewing" or "fore-shortening". Professional cinematographers call this a "pushed perspective", in the way of saying we are "pushing" the believability of the scene.



Figures 1.2 and 1.3 further represent two-point perspective. Again, **blue** lines represent horizon, **red** dots are vanishing points, **cyan** lines represent perspective lines, **black** lines represent 90°, and **yellow** lines represent the connections between verticals



to create the 3-Dimensional objects. Note in figure 1.2 the lower box's top side can be seen, while the higher box on the horizon can only see the sides. Note in figure 1.3, the skewing mentioned above and its relation to the height of the building and the distance between the two points. The building on the right is more believable because of these factors.

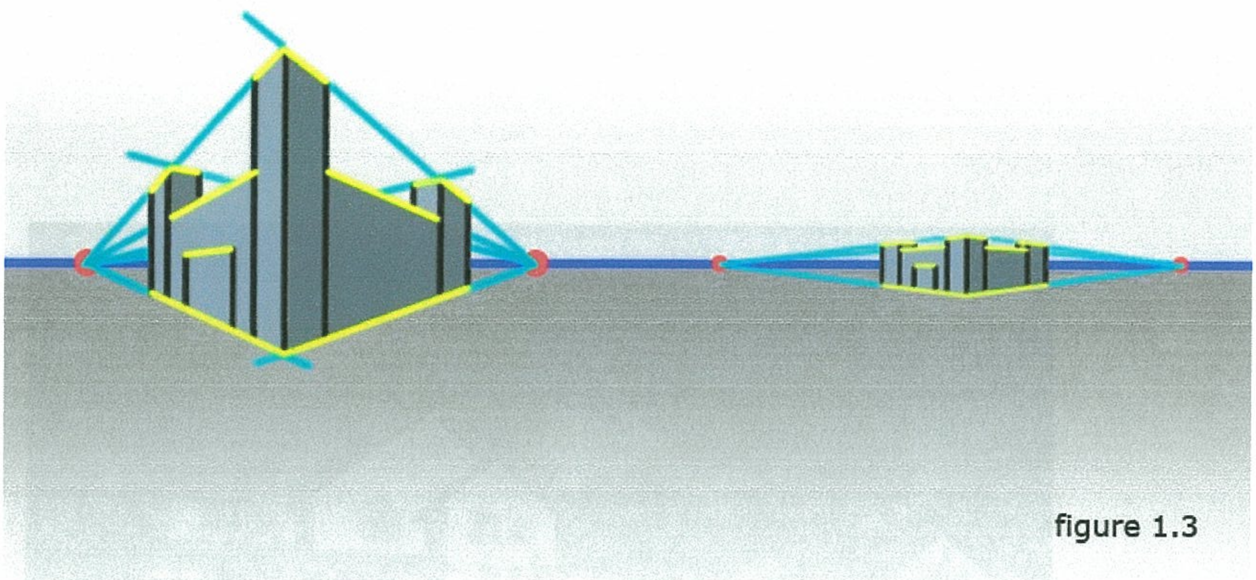


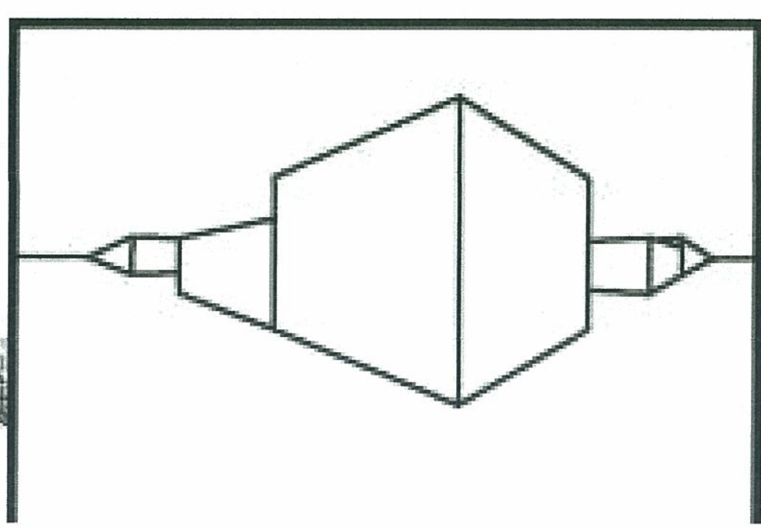
figure 1.3

Below are some examples of two-point perspective.

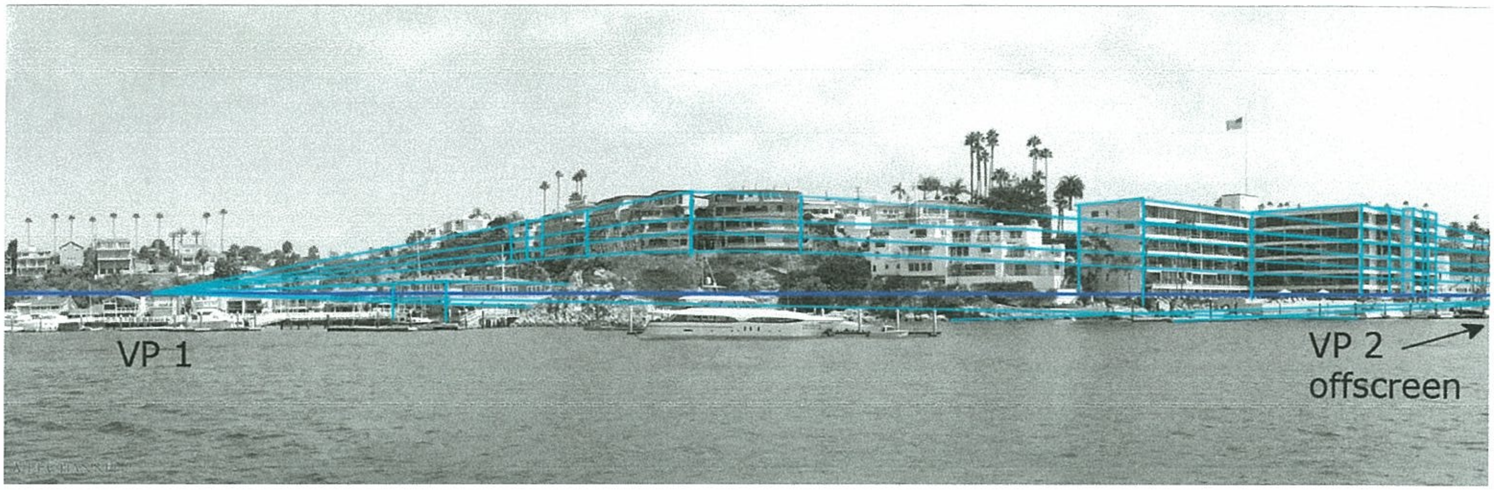
Left: sketch of commercial buildings with curb as the foreground. Note the horizon is on center at eye level. Note also the ways the buildings on either side seem to get small and eventually vanish.

Middle: simplified geometry representing a group of buildings on a street.

Below: 3D rendering of a house. Note the vanishing points are at such a distance, they can't be seen, unless drawn beyond the boundaries of the image based on the angle of the non-vertical lines.



V02



V14

Now that we are more familiar with the rules of one- and two-point perspective, I would like to take a bit of time explaining **variables** which make true perspective invalid in a compositing scene. Not to say the images would never be visually accurate, but more on a point of explaining the impossibility of absolute accuracy.

1. Camera distance versus camera lens. A majority of the time, images are taken from a frame of reference not controlled by the compositor. Factors such as height of cameraman, distance from the focus point, zoom percentage, and lens size can vary widely from camera to camera, and from cameraman to cameraman. In this case reference heights, distance, zoom factor, camera, and lens have been included for each shot on shot spec sheet document provided.

2. Angle of the shot, and relation in elevation to the focus. In particular settings, this variable can be drastic to the accuracy of a shot. If the cameraman is on an elevation even 2' higher or lower than he/she is shooting, that person would likely angle the camera up or down for a better framed shot. The question

becomes what angle did they take the shot at? This changes the horizon line; and in turn changes the angle, position, and orientation of the object in focus. Reference angles have also been included on shot spec sheet document provided.

3. Far-away vanishing points. Because the farther away the vanishing points in a two-point perspective image are, the more accurate; it becomes a typical variable to have limiting reference for vanishing points. A professional compositor is aware of this limitation, and is experienced in accurately working with it.

4. Creating non-existent terrain and/or street elements or details. As is common for a type of composite where existing elements are erased or "matted" out, often new elements are added in a way dependant on existing angles at separate reference points. For example, adding a driveway or landscaping the existing image did not have. Or, in some cases, cutting out of hill, cliff, or mountain terrain to place focus object.

5. Panoramic image sets. As seen in figure 1.4, when a camera is set on a tri-pod (best) or a person stands with advanced motion reduction lens alone (not recommended), and shot at a slightly different angle to encompass the focus and/or a large area around it, there can be image skewing. 1.4a shows what is necessary for the camera in **blue** to achieve a panoramic shot. A 360° would require a complete clockwise turn to meet back at the original point. **Yellow** lines reference the angle at which 5 images were taken. 1.4b shows the object in focus. 1.4c shows how the images are collected absolutely. 1.4d shows what

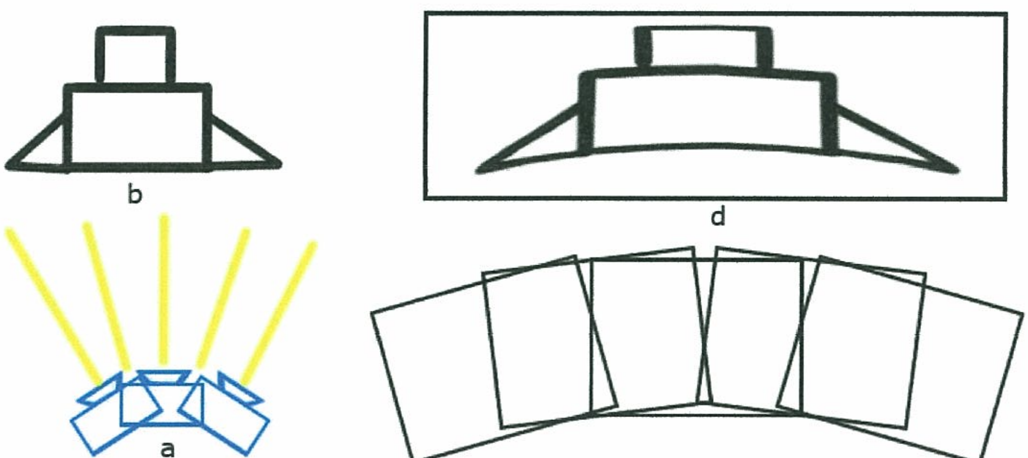


Figure 1.4

occurs with the image once combined into a single shot. Though normally subtle, professional compositors have the tools, accuracy, and experience to resolve the natural stretching which takes place at this point.

In summary, perspective shows depth in an image or photo based on the human eye and in this case taken by a camera. The distance, height, and angle of the camera can change the orientation of whatever object is in focus. One-point perspective is often seen in long corridors or streets and is usually taken with one side of the object to focus on at eye level. It can establish great distances, and in many ways it can allow the viewer to see the world in an open and free way. All objects in a one-point perspective seem to converge in the center, unless a building or object blocks the way such as a turn in a street or a large cliff or mountain. Two-point perspective is a much more realistic and common way to view photos or renderings due to the accurate 3-Dimensional angles, while holding onto vertical lines for design accuracy. The camera is often placed looking on a corner of the focus object to better show at least two sides of the object. This is the preferred viewing angle for people without the intimidating factor of Three-point perspective. Three-point perspective, while not explained in this tutorial, places the viewer seemingly either extremely high looking down, or extremely short looking up, and is naturally intimidating and/or superior-feeling in nature. It has caused vertigo among people sensitive to such things, and therefore is not recommended for architectural visualizations. This being true, none of the renderings have used this type of perspective. A natural thing which occurs in any perspective is the concept of fore-shortening. Refer back to the tutorial about holding a person's palm in front of their face, noting the width of the palm and the lack of sight of the side of the hand. Then turn the hand and witness the palm getting thinner while the side of the hand widens, until the palm can't be seen. Note objects turned at certain angles won't necessarily show their proper scale unless viewed directly.

This packet contains helpful compositing solutions, and includes a basic lesson in perspective, including variables and solutions such as placement, scale, and orientation. Each shot was designed specifically to exclude as many of the above variables as possible, and has ensured the most optimal conditions for the highest level of accuracy in each view simulation.

SOIL

Sampling Point: 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-14	10YR 2/1	100	NONE				Loamy Sand	Smells very fresh i.e. good garden soil – no hydric indicators of any kind

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Plowed Soils (C6)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Thin Muck Surface (C7)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: