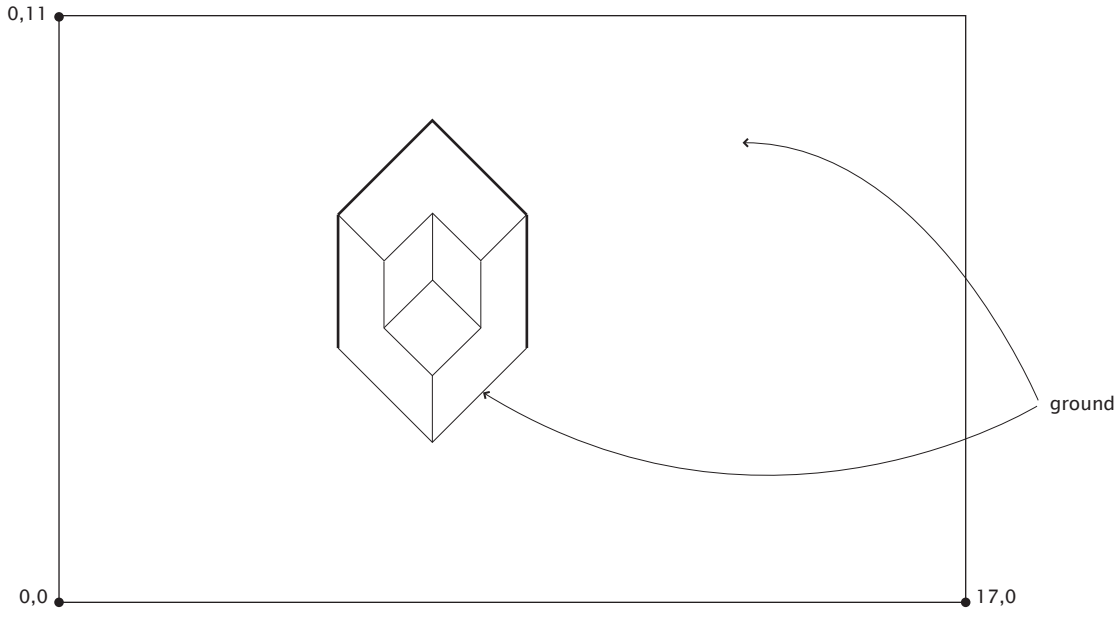
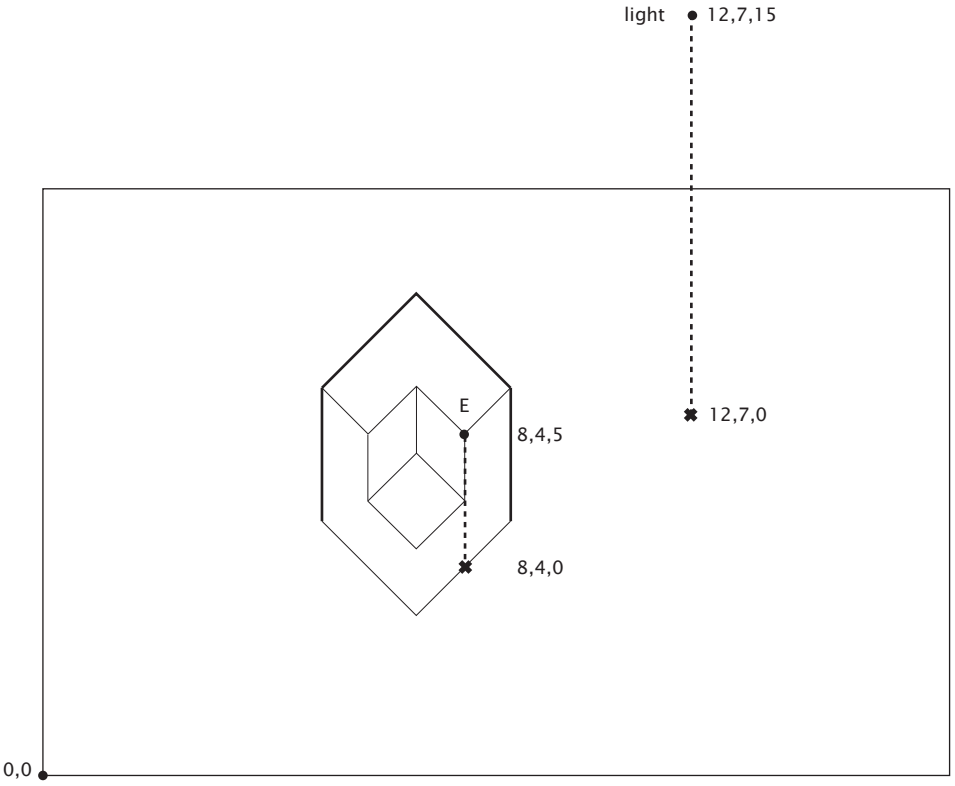
Shadows

Shadows are the result of a light source illuminating an object. Not only are they important for making a drawing easier to understand, but they can also help as 'connectors' (similar to color, texture, or extension lines, shadows can make several objects seem to be part of the same scene, if they are illuminated by the same light source). In interior design, shadows and lighting are even more important, since they determine potential program layouts, based on use (places for reading, places for computer work, places for sleeping,...).

In this exercise, we continue from the layout produced in page #3 of the sketchbook, also in 3 weights of black ink, on a sheet of bristol (same as before, 17 x 11 inches; the difference is that it should be 4-ply bristol, and not 2-ply). Once you have finished inking the 4 geometric primitives, we are ready to start on the cast shadows. The shape and position of the shadows is based on the position of the light source. this could get pretty complicated, with more than one light source, but we will deal with just one light source for now). Before anything, the important things to remember are that the 4 boxes are sitting on a 'ground plane', and that we can measure the X and Y coordinates for every point on that plane, if we designate one point as 0,0 (in this case, it will be the lower-left-hand corner of the page):



Apart from X and Y coordinates, we will also need to measure heights (Z coordinates). Begin by figuring the XYZ coordinates of the top corners of each geometric primitive, one at a time, together with the coordinate of their 'ground projection' (the point on the ground immediately below them). Also do this for the light source. Here we begin with a point we will call 'E':



Note that the light source can exist outside of the page (it probably will have to), and the height of the light should be greater than the tallest cube in the scene (so that the light can cast shadows DOWN from all cubes, onto the ground). For each corner of each cube, once you have the 4 coordinate locations (corner, ground projection of corner, light, ground projection of light), it's just a matter of connecting light to corner and extending towards the ground, where a 'shadow corner' can be drawn. This is all done with some geometry (extending triangles). Fortunately, the shadow corner is on the ground, so it does not require a separate 'ground projection' (and this also means that the shadow point will only have an X and Y coordinates, no Z).

The following formula works for finding a shadow corner from the 4 points we currently have:

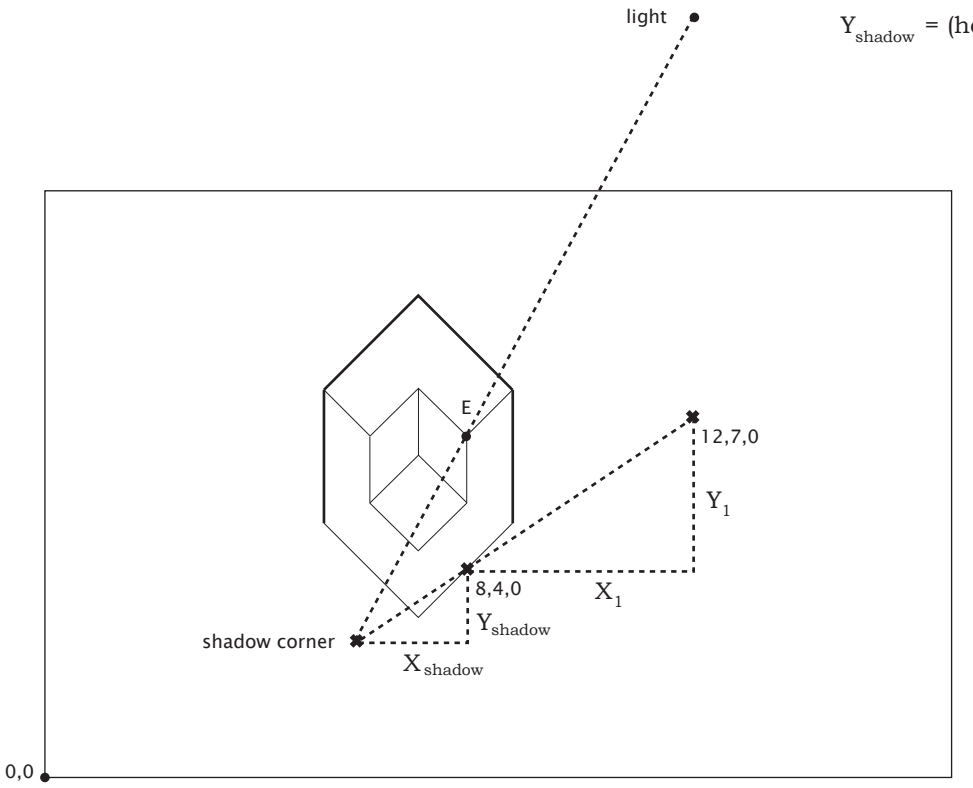
$$\text{height ratio} = Z_E \Big/ Z_{light} - Z_E$$

$$X_1 = \left| X_{light} - X_E \right|$$

$$Y_1 = \left| Y_{light} - Y_E \right|$$

$$X_{shadow} = (\text{height ratio})\ (X_1)$$

$$Y_{shadow} = (\text{height ratio})\ (Y_1)$$



For this particular example:

$$X_1 = \left| 12 - 8 \right| = 4$$

$$Y_1 = \left| 7 - 4 \right| = 3$$

$$\text{height ratio} = 5 \Big/ 15\text{-}5 = 5 \Big/ 10 = 0.5$$

$$X_{shadow} = (0.5)\ (4) = 2$$

$$Y_{shadow} = (0.5)\ (3) = 1.5$$

The final step is simply to subtract X_{shadow} from X_E and Y_{shadow} from Y_E, to get the XY coordinate of the shadow corner (6, 2.5). If you do this for every corner that will cast a shadow, soon enough you will have all of the corners of the shadow, and ALL you have to do is 'connect the dots'!