Fixture Placement

When designing lighting for the camera, place and aim fixtures to achieve vertical illumination on the subject. Avoid traditional down lighting approaches that create facial shadows. If there is to be only one light on a subject, the light from the fixture should be as close as possible from the same direction as the camera. Moving the fixture "off axis" will create a more dramatic effect, at the expense of facial visibility. .

Multiple frontal light sources will provide much more attractive facial lighting. This is particularly true if the "talent" is being shot from multiple cameras from different angles. Mixing fixture types and intensity levels may create a "key -fill" effect, providing more three-dimensionality to the face.

Backlighting will help to make the body stand out in front of a background. By lighting the top of the head and the shoulders, it will create a "halo" effect providing three-dimensionality to the figure, and creating a sense of depth between the figure and whatever is behind it. Multiple backlights are also useful in situations where not as much light on the top of the head is desired.

In the T -Series environment, the preferred arrangement for lighting the face is two diagonal fixtures from the front and one from the back. The front lights should be arranged so that they are approximately at 90° from each other, so that their light may "wrap" the face and provide visibility from all sides.

The ideal vertical angle for TV lighting is 35°- 40° above horizontal for the front lights. If the angle gets steeper than that, i.e. closer to vertical, there will be unattractive shadows on the face. On the other hand, an angle that is too shallow may cause the light from the fixture to spill onto the wall behind the person. The backlight is usually at a much steeper angle; it can be from as high as 75° and as low as 60°.

Doing the Math

It is possible to use the guidelines above along with a little math do determine where the fixtures should be placed. First, you need to determine whether the individual on camera will be normally standing or sitting. Determine the height above the floor for that person's face; a good rule of thumb is that on a sitting individual the eyes are about 4' from the floor, and for someone standing, between 5' and 5'-6". Measure the height of the T -Bar ceiling grid and subtract the face height from it; that will determine the distance between the face and the fixture plane (the grid). Using these figures, the proper horizontal distance from the face to the fixture location can be determined. Next determine trigonometrically the proper horizontal distance from the fixture to the individual. Finally, if a determination of fixture brightness is needed, use the Pythagorean Theorem to calculate the true fixture distance in 3D and use the inverse square law to calculate the resulting light level.

Here's an example of how this works: let's assume that you are lighting a seated individual in a room that has a 10' ceiling; and you would like to use a 35° horizontal angle. Given that a seated person's face is approximately 4' above the floor, there will be 6' between the face and the ceiling. Using a pocket scientific calculator, you can easily perform the calculations: First, subtract the desired angle from 90 (90° -35° = 55°) and determine the Tangent of that angle (tan 55° = 1.43). Next, multiply that number by the face-to- ceiling distance; that will be the optimal distance horizontally. In our example, 1.43*6=8.58', which is about 8'-7". In practice, the actual distances that are possible will normally be limited by the location and spacing of the T -Bar grid, and by obstructions such as the walls of the room, sprinkler heads, speakers, other fixtures, etc.

The distance from the fixture to the face determines its brightness. Here's where you use the Pythagorean Theorem. Using the numbers from the above example: square both distances (62= 36, 8.582=73.6). Add these numbers together (36 + 73.6 = 109.6) and determine the square root of the result (the square root of 109.6 = 10.47). The fixture is approximately at a 10'-6" distance. (Your calculations need to be done in feet, not inches.)

The inverse square law uses the candela output of the fixture, divided by the distance in feet squared, to determine the intensity in foot-candle. If your fixture has an output of 3800 cd, at the distance determined above, use the formula ($3800/10.47^2 = 34.7$ foot-candles).

Contrast Ratios

Today's solid-state chip cameras require less light than the ones available previously. In most video-teleconferencing situations, it is not necessary to provide more than 50 to 60 (vertical) foot-candles of light on the face of the subject. Providing more than that will consume more energy, but will not necessarily provide for better video lighting. Remember, if multiple fixtures are used from the front, as recommended above, each will be contributing to the total lighting level. Another factor to be considered is the desired f-stop of the lens, and whether through-the-lens teleprompters are to be used.

In addition to required vertical foot-candles, the contrast ratio between the subject and the background needs to be considered. The contrast range that should be used is dependent upon a number of factors, the most important of which is how the camera image will be "distributed."

For most video teleconferencing applications, there is a high-speed Internet (H.323 standard) or telephone (ISDN 128,384,or 512) connection between the participants. Video images are difficult to send compared to voices. There is much more of a premium set on high speed and/or large bandwidth. For those reasons, many VC images are compressed or otherwise manipulated to make them faster to send and receive. The result is images that have fewer dropouts, and have a higher frame rate. However, to accomplish this, often the contrast ratio (the ratio between the brightest object in the picture and the darkest object) is reduced.

The brightest objects in the picture should normally be the faces of the participants, and the darkest objects, the furnishings of the room, particularly whatever is directly behind the faces. For teleconferencing applications, the ideal value range is between 3:1 to 2:1 ratio of light hitting the face vs. light on the background. In order to achieve this, it is usually necessary to use a controlled video lighting source, that not only puts light where you need it to be but keeps light off the areas where it is not desirable. However, in a few cases, it may be useful to add fixtures to "punch up" backdrops that are too dark.

Fixtures that have variable beam spreads, variable beam angles, and dimming are the preferred tools for this task. A fixture that has a narrower beam spread is useful for instances where the "subject" is sitting close to a fairly reflective wall; the tighter angle will increase the contrast ratio between the face and the backdrop. On the other hand, if the walls are dark and/or at a distance from the participants, a wider angle fixture will put more light on the surroundings.

To demonstrate this, a sample room was setup in a Lighting Levels program. A single figure was illuminated with three fixtures: two diagonal front lights, and one backlight. Vertical light levels were measured at a point in front of the "face" and on the wall behind the figure. The measurement values are in foot-candles. The light levels on the face and the wall are shown; with a rendering that shows the comparative differences between the fixture layouts.

Figure 1 was laid out with the front light fixtures using prismatic lenses and the backlight using a broad field fixture screen.

Figure 2 was laid out with the front and the back lights using broad field fixture screens.

Figure 3 shows the front lights with medium field screens; the back light has a broad field screen.

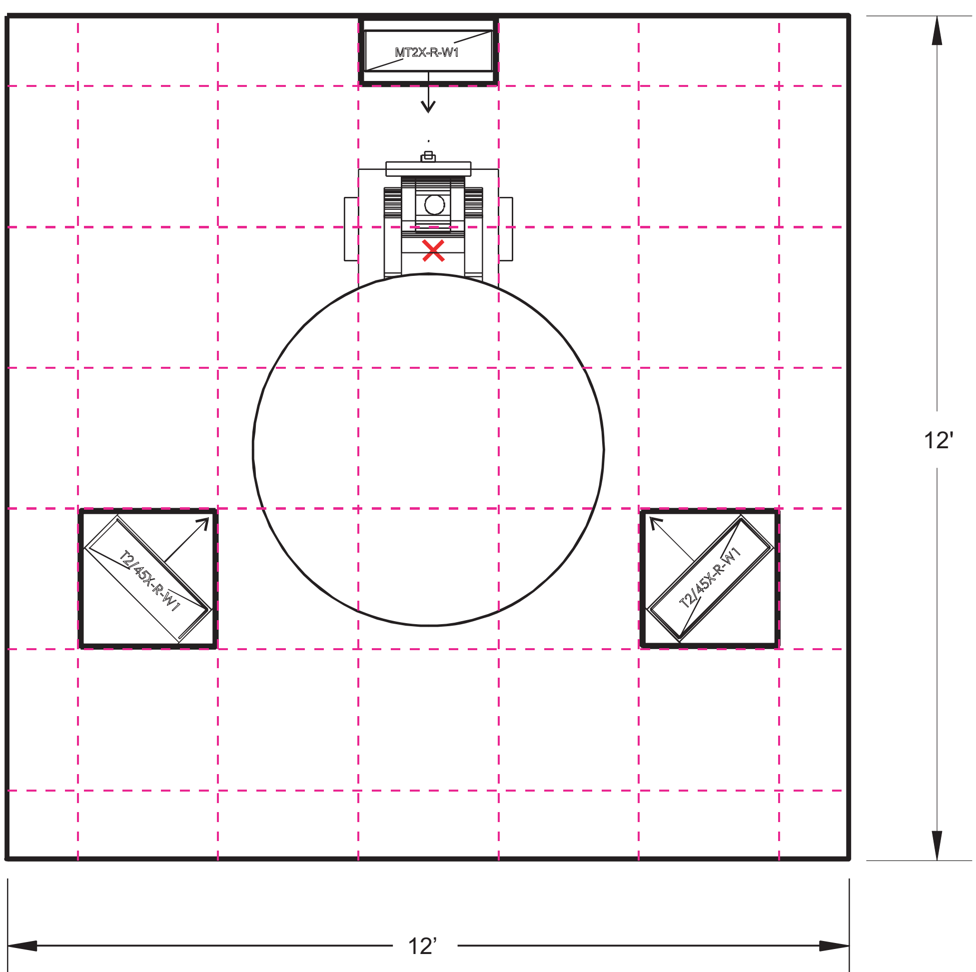
Figure 4 has narrow field screens in the front lights and a medium field screen in the backlight.

You will notice that while the layout using the lenses provides the most light on the subject, it has the lowest contrast ratio (1.4: 1). The layout using the broad screens has a better contrast ratio (1.66:1) but more importantly, has a much lower level of light on the sidewalls and the ceiling. The layout using the medium screens has the optimal ratio (2.4: 1). The one with the narrow screens would provide for too much contrast (5.9:1) for a typical VC situation, but might be utilized when a subject is near a flat screen monitor or projector screen.

Please note that these are illumination values as they "hit" the subject, not as they are reflected back from it. If a room has a darker wall, it might be useful to use the broad screens to help to illuminate it, and if the room has walls with a high amount of reflectivity, the tight beam angle of the narrow screen might be required. In either case designs that utilize dimming fixtures and controls can prove invaluable in the final balancing of all the elements within the room,

Technical Data

A sample room (see the drawing below) was "constructed" in AGI-32 with measurements of 12' x 12', and a 9' ceiling (see the floor plan, below). The walls were set with a 50% reflectance value; the floor, 20%, and the ceiling, 80%. A round table with approximately 30% surface reflectance was in the room, as well as a seated figure in a chair. 2-lamp T -Series fixtures were used; no other units were present. The front lights are at an angle of approximately 50° (with a 0° angle being perpendicular to the floor) and the backlight, at 35°. The levels were calculated measuring not only the direct illumination on the points being measured, but the light that is being reflected from the objects in the room. The "X" shown in the drawing shows where the light on the face was measured, at 4 feet above the floor. No re-aiming of the fixtures took place during the tests.



Test Room

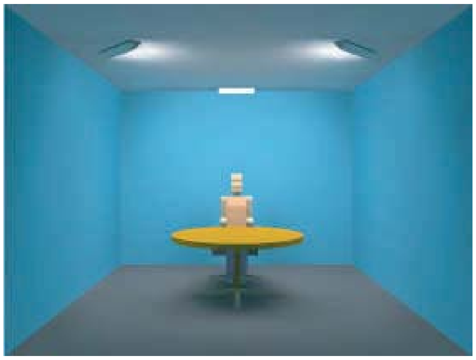
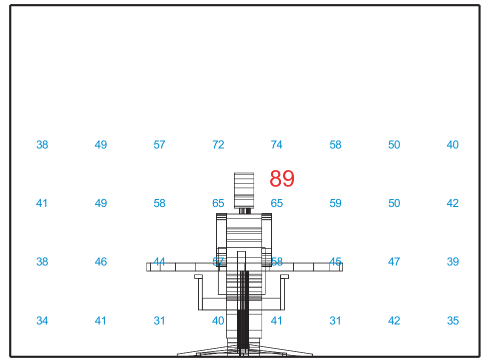


Figure 1



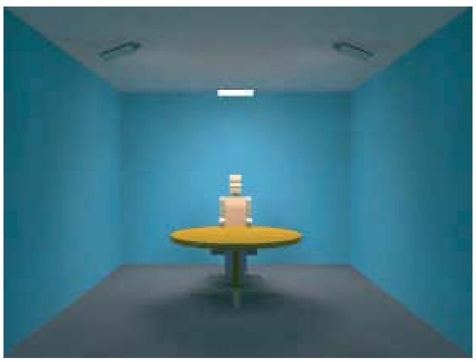


Figure 2

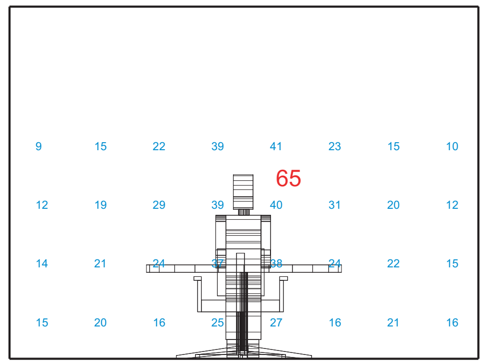


Figure 3

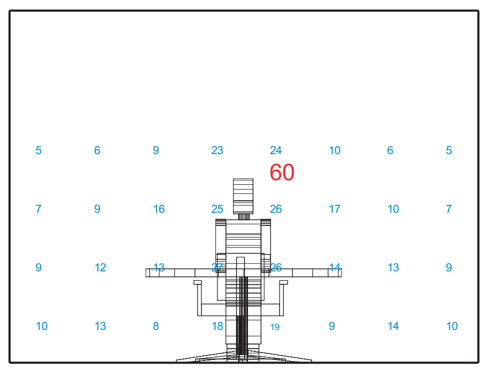
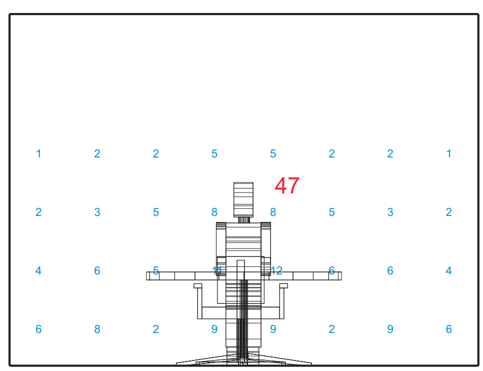


Figure 4



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