# THE BASICS OF STAGE LIGHTING

A basic knowledge of stage lighting may be the most useful “technical theatre” tool that an actor or director can acquire. Lighting can seem hugely complicated and intimidating to the neophyte, and it has a lingo and procedure all its own. But it’s not as hard as all that, and once you learn how to use it you can make a lot of magic with a little light .

One needs to comprehend the principles of a few “systems.” You need to have a basic understanding of the lighting fixtures themselves and what they do, a basic understanding of the distribution and control systems (that is – where lights get plugged in and how they are controlled), and a basic understanding of how choices and decisions about lighting are made.

**STAGE LIGHTS**

Stage Lights are just lighting fixtures. They are built to be durable, portable (more or less), and bright. Most of them have some device or system that allows the beam of light to be “shaped” and “directed.”

The earliest stage lights were candles and oil lamps, and these were sometimes outfitted with a reflector, in order to “aim” as much light as possible at the stage.

Light is a complex physical phenomenon. Fortunately - for beginning stage lighting, one can make a few simple assumptions about it, and act as if the assumptions were true:

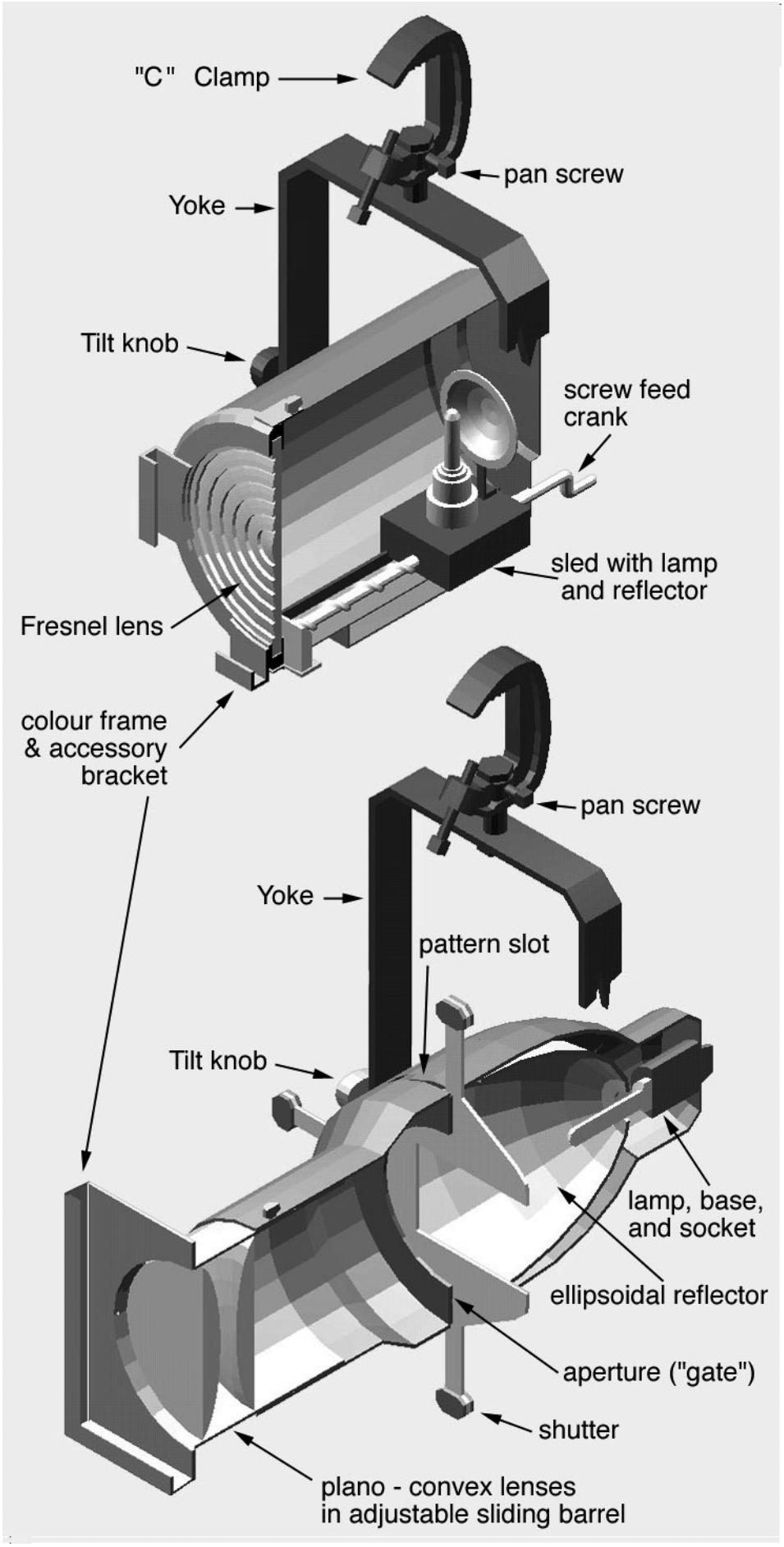
1) Light travels in straight lines.
2) When light hits an “opaque” surface it bounces off – this is called **reflection**. We see because light is reflected from objects and some of the reflected light enters our eyes and triggers retinal cells to send messages to the brain.
3) Light bounces off of bumpy surfaces at many different and apparently chaotic angles. Light bounces off of smooth surfaces at consistent angles, and such a surface is called a mirror.
4) A mirror that is shaped like some form of bowl will “aim” the light that it reflects in a predictable way.

5) Light passing through a “transparent” object will change direction slightly. This change of direction is called **refraction**, and it happens (for instance) when light passes through a glass of water.
6) When light passes through a transparent object that has a 3 dimensional shape, that shape will affect the direction of the light in a predictable way. A lens is such an object.

Stage lighting fixtures take advantage of these simple principles of optics in order to shape and direct the beam of light. Some contain a lamp and a reflector (there are many shapes, and each affects the beam of light differently). Some contain a lamp, a reflector, and one or more lenses, which allows the beam of light to “project” an image.

All fixtures (well – nearly all) have “bulbs.” In an automobile headlight, the bulb (lamp) is permanently sealed inside of a reflector. There are stage lights like this, called “PAR” lights. PAR stands for Parabolic Aluminized Reflector, and means that the bowl of the reflector has a parabolic shape. Most fixtures have a reflector that is separate from the bulb.

Shown on the next page are two very common examples. Remember that the fixtures shown are only two of many commonly used stage lights.




## BASIC SPOTLIGHTS

**FRESNEL SPOTLIGHT**
**NAMED FOR ITS LENS**

A Fresnel spot is a can with a lamp, a reflector, and a lens. The lamp and reflector move back and forth on a "sled." The reflector is a "bowl" cut from a sphere, and the lens is a "plano convex" lens that has been specially shaped to save weight and reduce heat.Because of the shape of the reflector and lens, the light from a Fresnel is always soft edged. Fresnels will have some knob or crank or lever that moves the sled. Moving it will make the blob of light bigger or smaller.

**"AXIAL" ELLIPSOIDAL REFLECTOR SPOTLIGHT:**
**NAMED FOR ITS REFLECTOR AND IT'S LAMP ORIENTATIO**N

Light from the lamp is reflected through the aperture (or "gate"), and passes through the lenses, so it can be "focused" to have a "hard" edge. Slide the lens barrel to accomplish this.

One can put a metal cutout in the aperture and see a distinct shadow cast on the floor. A slot called the "pattern slot" holds this "gobo" "template", or "pattern." The fixture also has 4 "shutters" that can block the beam and cast a shadow.

Some may have an iris that makes a variable size circle of light.

An ERS may have lenses that move relative to each other as well as to the reflector . In this case it is a "zoom," meaning that the circle of light can be bigger or smaller as well as soft or hard edged.

The "C" clamp is so the light can hang on a pipe.

**Before stage lights can be used they must be hung, circuited, patched, and focused.**

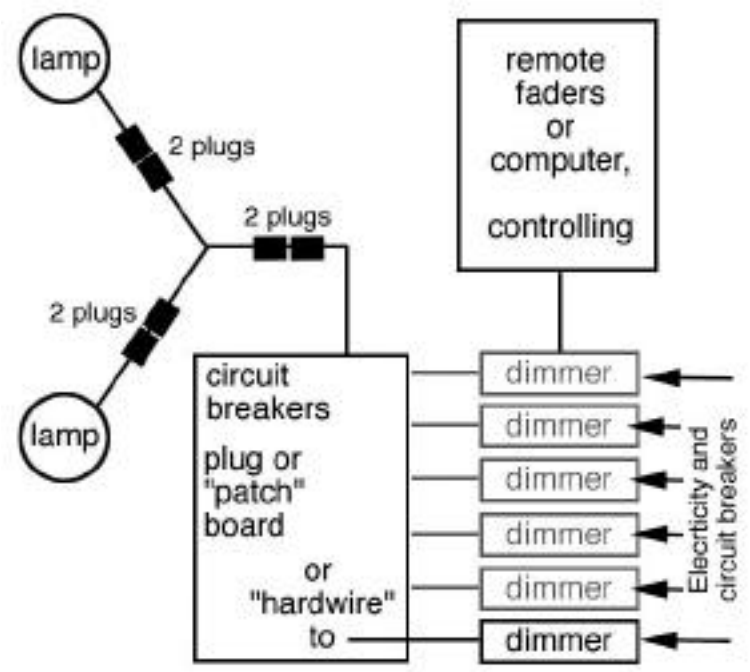
To “hang the lights” means: put them on the pipes in the Theatre according to the light plot, and tighten their “C” clamps. Aim them approximately where they are supposed to point, and make sure that they are right side up (adjusted so that a piece of gel - a colored plastic filter - will not fall out of the gel frame clips) and any shutters are pulled. Plug them in and write down the plug (circuit) number of each light. Install framed color (gel in cardboard or metal frames) if specified. Install any patterns.

To “focus the lights” means turn them on one by one, and aim each where it should point. The lighting designer decides in advance where the lights are supposed to point. The lighting designer (or assistant) should be present for focus. Sh/e (or someone) stands onstage where an actor will stand. Turn on the light intended to light that area. Adjust the fixture so that the centre of the blob of light is on the head and shoulders of the stand-in. Adjust the size of beam, sharpness of edge, position of shutters, etc, etc. until satisfactory. For a Fresnel, start with the smallest possible spot, for an Ellipsoidal start with the hardest possible edge - this way its easy to find the centre of the light. Once the light is correctly pointed, adjust size of beam and hardness of edge as desired.. When finished, lock the pan, tilt, barrel, and any other lockable adjustments. Don’t overtighten.

If you have to change a lamp: never touch a stagelight lamp with your bare fingers (the dirt and oil from your hand causes them to burn out sooner). When you have a burnt out lamp, take it out of the light, carry it with you to the lamp stock, and replace it with an identical lamp: there are hundreds of varieties. Be careful when dismantling lights, and always restore all the fixture parts as you found them.

To “circuit” and “patch” the lights you need to understand and use the:

**DISTRIBUTION AND CONTROL EQUIPMENT:**
This means: “the wiring and devices that affect the path of electricity in the lighting system.”




**CIRCUITS AND WIRING**
Light bulbs glow because electricity heats their filaments (thin metal coils) until they give off light (in fact, they burn, but very slowly – which is why they eventually burn out) The schematic at left shows a simplified version of a fairly standard distribution and control system. (Imagine that the lamp and wiring part is repeated many times)

A circuit is the path that electricity takes to get to the lamps. The circuit includes switches, plugs, extension cords, dimmers, controllers, and “in-wall” wiring.

Circuits are <u>rated</u> according to their capacity to carry electric current measured in amperes (amps). Calculate the capacity of a lighting circuit with this formula: Watts (the total wattage of all the light bulbs in the circuit) = volts (the voltage of the line) x amps (the amp rating of the plugs and wire).

Circuits are numbered so that you can keep track of what you are doing. When hanging lights always write circuit numbers down so that you have a record for later – in the UBC Theatres each number corresponds to a circuit (including a dimmer). So in the Freddie Wood: (Watts) = 115volts x 15 amps comes to 1,725 watts per circuit. In the BC Tel Watts = 115 volts x 20 amps is 2300 watts per circuit. All you need now is the wattage of the lamps you wish to plug to the same circuit. The wattage is stamped on the base of the bulb. Common lamp wattages are 500w, 750w, 1000w: a safe rule of thumb - max 2 lamps in any circuit in either the FWT or The Telus Studio at UBC. Be sure its not two 1000 watt lamps in the FWT. If you need to "gang" two lights into the same circuit, you can use a "2-fer" ("two for one"). Don't ever plug more lights into a circuit than its rating will allow: the resulting "overload" will be troublesome and can be dangerous. Circuit breakers and fuses "trip" or burn out when there is an overload. An electrical "short circuit" (current going where it shouldn't) also causes overloads.

Theatre wiring may be permanently in the walls of the building, or just heavy duty extension cord. either way, each circuit will have 3 wires: 2 for alternating current, one for "ground." The ground wire is a safety device to carry away to the ground any electricity that goes to the wrong place. In the UBC Theatres you'll find both in-wall wiring and extension cords. In the Freddie Wood there are long pieces of "multiconductor" (more than one circuit) that live in the grid and can be dropped anywhere above the stage: these are called "drop boxes.".

When dealing with plugs: Follow any color coding religiously. Green is always a "grounding" circuit. 15 amp plugs are smaller than 20 amp plugs: the more metal, the more current it can carry, same with wire. So if you have a light with a small 15 amp plug and you want to plug it into a 20 amp circuit you will need to either put a bigger plug on the light or find an adapter. There is a multitude of plugs (sometimes called "connectors") in the world. The stage lighting plugs at UBC are mostly "twistlock" - plug and twist – (it keeps the connectors locked together). The plugs resembling those in your house are called "Edison" or "U-ground" plugs.

**DIMMERS AND CHANNELS**

A dimmer is a device that varies the amount of current which reaches a lamp, hence its brightness. There are many varieties. In some systems, each circuit is wired directly to a dimmer. In others, the circuits have to be plugged into dimmers: a temporary outdoor show, for instance, might use a box of dimmers, into which you would plug lengths of extension cord. The circuits in the UBC theatres are each wired directly to a dimmer, and this wiring is in the walls of the theatre. The Telus Theatre has over 150 dimmers, the FWT has over 200: each controls a separate circuit, and some of the circuits have more than one plug for lights.

Pre 1960s dimmers were controlled by sliders or levers attatched directly to the dimmer. You are unlikely to encounter any of these. You will encounter dimmers that are controlled from remote boxes with sliders and switches, attatched to the dimmers by a bundle of thin wire. The sliders and switches on the remote boxes control the dimmers which control the lights.

Contemporary dimmers are controlled by computers. The controllers in the FWT and BC Tel are computers; although they have sliders, a computer is issuing instructions to the dimmers (which control the lamps). You issue instructions to the computer with a keypad, or sliders/faders, or both. Once you have told the computer to memorize these instructions, it can repeat them any time you push the "GO" button.

On a "computer board" the individual controls are called "channels." Any control channel can be assigned to any dimmer. This assignment is called the "soft" (for software) patch. To do a soft patch, you must know which channel

number you wish to assign to which dimmer. In the FWT and the BC Tel the circuit number and the dimmer number are the same (one reason why you record the circuit number).

In some older systems, the circuits are not “hardwired” to the dimmers – that is, there are fewer dimmers available than there are circuits. In these systems, an additional “hardpatch” step is required. You have to plug the circuits that you want to use into the dimmers that are available. In temporary or portable systems, the dimmers are probably contained in a box with plugs on the back, and you need to plug the extension cords from the lights directly into these connectors.

**Review**: Stage lights are fairly complicated lighting fixtures engineered to make relatively bright shafts of light that can be variously shaped. To set them up, you need to “hang” them, “circuit” them (that is plug them in to the distibution and control system and do whatever “patching” is required), and “:focus” them.

A Lighting Designer decides where the lights will hang, what lights will be used, what colour they will be, and (generally in collaboration with the stage director) – why, when, and how they will turn on or off during the show.

**LIGHTING DESIGN (part 1)**

A thumbnail sketch of how to design lights:

1) Read the play / treatment / scenario, or whatever it is, and anaylze it in terms of light. Are there textual references to the light? When does / would the text require the light to change? What moods or atmosphere in the piece might be created or supported with light?

2) Confer with the other artists doing the piece: what ideas and plans does the stage director have regarding the light? What will the set look like, and will it present opportunities / impose restrictions for the lighting? What colours will the costumes be?

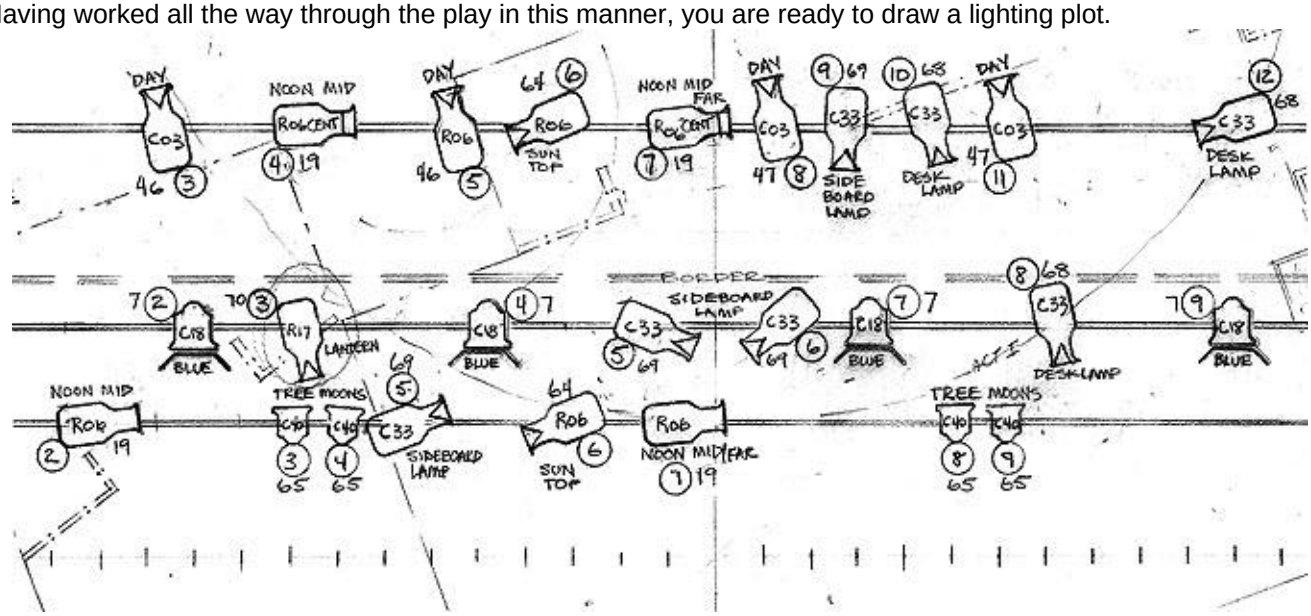
3) See rehearsal, ideally several runthrus as late in the process as possible. Where are the actors in the space? What additional moments or events (if any) can be created or supported by lighting? What spaces and events need to be defined or enhanced by the light?

4) Having come up with answers to all of the above questions, and beginning to visualize how “moments” in the show might look onstage, make a preliminary list of lighting states (called a cue preliminary or cue synopsis) that briefly describes the lighting changes. An example is given below

| page | Q # | purpose | notes |
|---|---|---|---|
| | | | |
| 3 | 1 | preshow, house | |
| 3 | 2 | blackout (?) | |
| 3 | 3 | Midnight, Tobruk | stars, acting area is DC and DL near box? Blue stuff, stars? |
| | | | |
| 9 | 4 | light becomes club stage as Mac's dance changes | 2 slides on slider panels (backwards), moving lights on Mac |
| 9 | 4.1 | | |
| 9 | 5 | 4.1 thru 6 reserved for moving light stuff | if needed |
| 9 | 6 | | |

| | | | |
|---|---|---|---|
| 9 | 7 | Some kind of lighting for short dialogue with announcer after dance | probably no moving lights. “backstage” look? |
| | | | |
| 10 | 8 | Club "reverses" as Mac leaves "stage" | SR slide (?) only, now right-reading. Acting area is SR stairs and floor |
| 10 | 9 | Focus to Esther, dance school, Mac and Man in club elsewhere on stage | Esther is DL, dance school slide is UL on wall. Light remains on Mac and Man SR. School is cold and harsh in a mini mall |

5) Having worked all the way through the play in this manner, you are ready to draw a lighting plot.




A lighting plot is a map that shows the location of every light to be used and gives information about it.

As you decide where to hang a light and which light to use, you consider several factors: your cue synopsis and what it suggests and requires – the inventory of fixtures, dimmers, and hanging positions available – and what light will be produced by each fixture that you are using.

Usually, the most basic question about fixtures is how much area of the stage will each light cover? Each variety puts out a different amount of light with a different amount of “coverage.” All manufacturers provide “spec – sheets” with this information, and lighting designers begin to memorize it from constant reference. As beginning designers you should memorize this: An ellipsoidal reflector spotlight puts out a cone of light, and the size of the cone is related to the focal length of the lens, the size of the lens, and the distances between the reflector, the lamp, and the lens(es). Some ellipsoidal fixtures are “named” according to their focal length and lens size: 6” (lens) x 6” (focal length), or 6” (lens) x 12” (focal length). The bigger the second number, the narrower the cone of light. Others are “named” according to the angular measure of the cone of light: 10 degree, 36 degree, etc. In this case, the bigger the number the wider the light.

Fresnels cast light everywhere, but generally an 8” Fresnel (diameter of lens) makes a bigger blob than a 6” Fresnel and a smaller blob than a 10” Fresnel, etc.

as you place lights on your map, (which you do guided by your knowlege of your purpose in using the light, your knowlege of what a particular light will do (obtained from spec sheets and experience), the availability of lights, and guesswork - you also record information about them in a number of lists.

THE INSTRUMENT SCHEDULE lists all the lights according to their hanging position

| HANGING POSITION NAME | | | | | | |
|---|---|---|---|---|---|---|
| fixture # | type of light | circuit / Dimmer # | channel # | purpose | color | other notes (like watts) |
| fixture # | type of light | circuit / Dimmer # | channel # | purpose | color | other notes (like watts) |
| fixture # | type of light | circuit / Dimmer # | channel # | purpose | color | other notes (like watts) |

THE CHANNEL HOOKUP lists all the lights according to the channels that control them

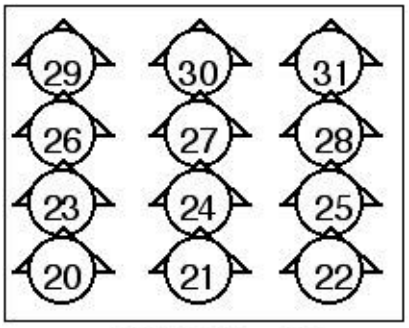
| channel # | Dimmer # | fixture #(s) | type of light(s) | where located | purpose | color | other notes (like watts) |
|---|---|---|---|---|---|---|---|
| channel # | Dimmer # | fixture #(s) | type of light(s) | where located | purpose | color | other notes (like watts) |
| channel # | Dimmer # | fixture #(s) | type of light(s) | where located | purpose | color | other notes (like watts) |

THE DIMMER HOOKUP lists all the lights according to the dimmers that control them

| Dimmer # | channel # | fixture #(s) | type of light(s) | where located | purpose | color | other notes (like watts) |
|---|---|---|---|---|---|---|---|
| Dimmer # | channel # | fixture #(s) | type of light(s) | where located | purpose | color | other notes (like watts) |
| Dimmer # | channel # | fixture #(s) | type of light(s) | where located | purpose | color | other notes (like watts) |

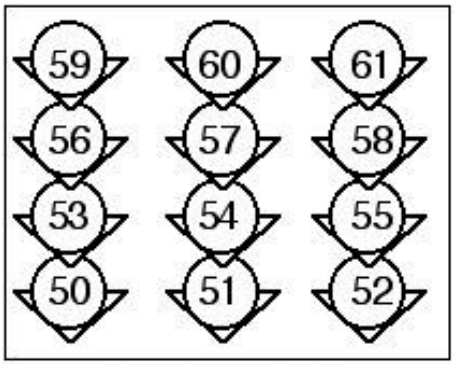
THESE LISTS (plus the lighting plot) are THE "DESIGN PAPER WORK.". If you are designing in a Repetory situation, you will need to be able to interpret and use the lists/drawings that someone else has created. Instead of starting from scratch, you will use lights that are already hanging. In order to do this intelligently, you have to know where the lights are and what they do, and what small changes you might make to them.

While you need all the information and numbers that are on the plot and paperwork in order to design or understand or hang and focus the lighting, you don't actually want all that paper when you are trying to devise lighting cues. Instead, you want a simple single piece of paper with just the numbers that will actually turn on a fixture: the control channel numbers. This is called a "magic sheet."



Pink ERS "fronts"

Imagine that each box represents the entire stage of the Telus, and that you are sitting under the booth. So if an actress is standing in the "upstage right" position (relative to you) - you would turn on channel 61 to light her with a blue "backlight" and channel 31 to light her with a pink "frontlight"



Blue ERS "backs"

"Magic" (or "Cheat" Sheets) are what you use when devising cues: you need to know which channel will light a performer in a particular area of the stage using a particular angle and color. The format shown is my favorite for relatively simple shows: divide a piece of paper into "blocks" - each block represents the stage. Label the blocks

according to purpose and direction - “green footlights” - “rows of soft toplight blobs” - leafy breakup front wash.” A circle goes in the center of each area in which a performer might stand. The number names the control channel that turns on a light which will light a performer in that location. The arrow indicates where the light is coming from. Again: circle is location onstage, number is channel to turn on, arrow is direction of light, and label is purpose or grouping of similar lights.

Different designers use different formats for magic sheets, and when you design you should invent your own. You need to be able to look up numbers quickly and in the dark, so keep it simple.

**LIGHTING DESIGN (part 2)**

The lights are hung, focused, and you are ready to compose lighting cues for the show.

(Remember - Before a channel number will actually control the light that you want it to control, the light must be plugged in, must be working, must be focused in the place you want it, and ITS DIMMER MUST BE SOFT PATCHED TO THAT CONTROL CHANNEL. When many people are using a computer board, patch (dimmer @ channel) assignments may be messed up. In the “Patch” screen in the FWT, dimmers are called “dimmers” but in the BC Tel they are called “MUX.” Its wise to do a “channel check” before a cueing session, and it's imperative before a show: in a channel check, you step through each working channel and observe that it turns on the correct fixture. If it doesn’t - search for: burnt out lamp, unplugged plug, and incorrect softpatch (particularly if a channel turns on the wrong light). And - don’t mess with the patch!)

A lighting cue is “a state of light onstage, and how long it takes to appear.” Lighting cues are created during level-set sessions with the lighting designer, the stage director, and the electrics operators (as well as “light-walkers” to stand in for the actors). They are refined and edited during technical and dress rehearsals. Before computerized lighting boards, each control setting had to be recorded by the electrician on paper. With a computer board, the computer simply memorizes the settings when instructed, and can repeat them anytime.

THE BASIC PRINCIPLES OF CUEING WITH COMPUTERIZED LIGHTING CONTROLLERS ARE:
1) Turn lights on or off until you like the “look” onstage.
2) Decide how long the fade into this “look” will take
3) Record the the channels you see onstage and the “time” (which you enter) as a “cue number”
4) Do this until you have a “cue number” for every lighting change.
5) Playback your cuesheet ( the most common method is to push a “GO” button, and the computer will fade lights up or down in whatever time you recorded.
6) Edit, change, delete, rename, etc etc etc etc these cues: you can do usually do this in a “preview” mode as well as live.
7) Always keep track of changes that you make in your fixtures, colors, patterns, circuits, etc.

FINALLY, SOME GOOD ADVICE FOR THE BEGINNING LIGHTING DESIGNER OR DIRECTOR:
Never turn a light on or off unless you have a reason. Use light to help focus the audience attention - use the light to support the story telling. 1/2 of light is darkness. Never light any more of the floor than you need. Light the performer FIRST, then the set, and use different fixtures for each. If you don’t want to notice a lighting change, have it happen when performers are moving. Don’t have cues you don’t need. Be adaptable: often the best stuff is accidental. Lighting design actually happens between tech rehearsal and opening - everything else is just setting up the sandbox. When in the rehearsal hall, don’t forget to plan for light.