Auditorium Lighting Design.

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تصميم الأضاءه للقاعـــــــات

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Abstract:

Designing an auditorium is to deal with complex issues. Auditorium lighting design is one of these issues. This paper discusses the requirements of both the house and stage lighting. It also outlines the general techniques for creative lighting. Moreover, it discuses the necessary schemes for serving the different activities within each zone of the auditorium space.

House lighting was investigated. Five different schemes were pointed:

During Intervals, During the show,

Panic, Emergency lighting,

Cleaning Lighting.

The visual needs for each scheme was discussed. Recommendations were concluded in terms of lighting directions, Intensities, and transition between schemes.

Stage lighting was investigated. Sub functional lighting divisions were defined. Stage and back-ground lighting introduced in terms of zoning, directions, positions and colors. Actor lighting investigated as well in terms of shading, uniformity and stability for the actor over all the stage area.

Key words:

Architecture, Auditorium, Lighting,

الملخص العربي للبحـث:

يتناول البحث الاضاءه داخل القاعات. حيث تم تقسيم القاعة من حيث الوظيفة إلي فراغين رئيسيين:

- الفراغ الأول وهو صالة الجمهور فتتم أضاءته من خلال عده نظم:

الاضاءه أثناء الاستراحة: ويستخدم قبل العرض و بعده و أثناء الاستراحات و يتيح للجمهور رؤية فراغ الصالة بجميع عناصرها من ديكورات وفرش وممرات للحركه.

الاضاءه أثناء العرض: يستخدم لأتاحه حركه بعض أفراد الجمهور للخروج و الدخول أثناء العرض و يتم تشغيله بالتبادل مع النظام السابق و يراعي في تصميم هذا النظام أن لا يشتت تركيز المتفرجين عن العرض.

أضاءه الطوارئ و الهروب: ويتم استخدامه في حاله الطوارئ و يكون مصدره للطاقه منفصل عن مصادر التيار الكهربي العادية.

- الفراغ الثاني و هو منطقه العرض فتختلف أضاءته باختلاف نوع العرض و كذلك تختلف أثناء نفس العرض بحيث تساعد في خلق الجو الدرامي للعرض. ويعرض البحث القواعد العامه لأضاءه منصة العرض و ذلك من حيث انقسامها إلى جزئين:
  - إضاءة الديكورات و الخلفيـــة.
  - إضاءة الممثليـــن.

حيث يجب أن تسقط الاضاءه علي منطقه العرض من أكثر من اتجاه و ذلك لتوفير السطوع الكافي للرؤية و منع وقوع ظلال غير مرغوبة للأجسام علي بعضها إضافة إلي الإحساس بالبعد الثالث.

و يختتم البحث بتحديد القواعد العامه لاستخدام الاضاءه داخل القاعات بالاضافه إلي دراسة أماكن توزيع تلك الإضاءات.

1. Introduction:

The luminous environment for any space must relate to the activity and biological needs of its users. A good visual environment is the one in which all visual information is received with minimum relevant-visual noise. This happens when the illumination for each activity comes from an environment that simultaneously serves both activity and biological needs. An auditorium represents a space with necessary facilities to present live performances, and may include extra facilities to house activities as lectures, concert halls, motion pictures, and sports arenas. Simply, the objectives of auditorium lighting are controlled visibility, composition, movement and atmosphere (or mode) no matter what the form of the auditorium or the type of its production. The technical lighting designer needs complete flexibility as to the choice of lighting instrument, location, wattage, color, intensity, beam shape, direction and movement of light.
Auditorium design is a specialized form of architecture that requires special assistance. The scope and complexity of each project will determine the needs. Auditorium lighting may be designed by the architect, theatre lighting consultant, consulting electrical engineer, or the architectural lighting consultant.

2. Lighting Properties:

2.1. Lighting Style: the term *style* is used here in its broadest sense. At the most basic level, there are two styles of lighting: motivational and non-motivational.

- *Motivational lighting* will attempt to reinforce a specific source or sources as well as be concerned with actual environmental conditions such as time of day, weather, time of year and locale.
- *Non motivational lighting* will ignore the above rationale as a base for color selection, instrument choice, and lighting angle.

The non-motivational approach will be considered through this study. Lighting has certain proprieties that affect the overall environment of the space. The following section demonstrates those proprieties. [1]

2.2. Qualities of light:

Light has certain inherent qualities that become characteristics of the light medium. The separate study of light in its application to stage lighting involves these qualities: intensity, distribution and hardness with the addition of direction.

Intensity: The first and most obvious quality of light is its intensity or brightness, which may be actual or comparative brightness. Varying intensity of a light source is achieved by means of a dimmer. Group of dimmers working together can direct audience focus as well as alter the stage composition.

Distribution: The most common way to see light is through its reflection off various surfaces. The manner in which it is distributed upon these surfaces is dependent upon the source direction and quality Direction: A change in lighting direction can alter the perception of shape and size of any form.

Hardness: The concept of ”Quality” is related to the texture and dependent upon a source’s intensity and diffusion. Diffused light is perceived as soft and lacking in intensity. More coherent light is harsher, more intense and has hard edges.

Direction: Depth perception is influenced by the lighting angle. Figure (1) illustrates how the direction of light can be assumed. Identical rectangles each contain five convex domes. With lighting from below as in the left rectangle of the figure, the domes appear to be concave; while lighting from above as in the right rectangle of the figure, they appear convex. [1]

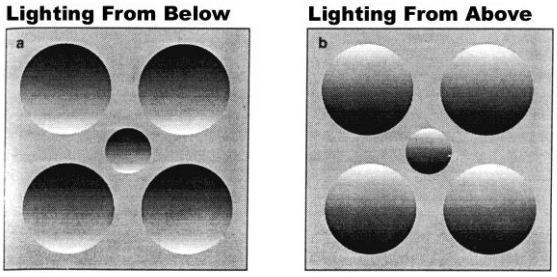


Figure (1) Lighting Direction

3. Auditorium Lighting:

Good lighting should tie together visual aspects of the stage. The primer concern of stage lighting is visibility. Lighting equipment and related hardware can be either completely visible to the audience, completely concealed, or in any combination, depending upon the desire of the architect or the client. If equipment is mounted in visible locations, consideration should be given

to instrument spill light and glare from the instrument and nearby reflective surfaces. If instruments are concealed, care must be taken in the design of the openings through which they are focused, to minimize the spill light from instruments that may fall on surfaces visible to the audience. Architectural finishes within the theatre should minimize objectionable reflections. Surfaces subject to spill light from instruments should be dark in color and matte finish. In general, the darker the architectural surfaces, the more they recede from audience consciousness. [2]

Functionally, the auditorium is divided into two spaces; the first, which is the house or the spectators area, while the second one is the stage area. It is a common practice that each of them is studied separately. The following sections cover lighting each of these two zones separately.

3.1. House Lighting:

An auditorium must appear very different during the performance than during the intermission. Successful illumination of space needs to be simple, effective, and economical. It also can be accomplished from totally concealed sources, and when the room definition can be combined with the creation of a desired local focus.

Experiments with illuminated ceilings have not proved very successful specially in lecture rooms since the ceiling surface can throw distracting reflections into the eyes of the audience. [3]

3.1.1 Visual Tasks: The nature of the auditorium can prepare the audience for the performance. Frequently the theatrical lighting designer incorporates the house lighting into the show lighting design. In cases where the auditorium is also a lecture room, the lighting must be provided for critical viewing tasks such as note taking, writing examinations, etc. Lecture platform and chalkboard lighting is often incorporated into the house lighting rather than the stage lighting system to permit its use by non-theatrical personal. [3]

3.1.2. Lighting Schemes: When activities with very different needs take place sequentially, as in the auditorium, then the luminous environment must be adaptable to those changing needs. Five different schemes of lighting are used to facilitate the different activities within the hall:

3.1.2.1. Interval lighting: It is that part of the seating area lighting, which operates before the show starts and during the intervals. During intermission, the needs of audience shift to relaxation, social stimulation, perhaps the sense of "event", orientation within the space and to others in the building, reading of programs, leaflets, etc. Usually this scheme displaces the show lighting scheme. The Illuminating Engineering Society (IES) recommends, regarding the shift between these two schemes, that:

"Dimmers should be fitted to the main lighting circuits for the auditorium and demonstration area, and should give full control between full-out and full-up, with at least one, and preferably two, set intermediate levels. The essential intermediate level is about 5 Lux. This is just sufficient for the audience to take notes, but bright enough to interfere with visual aids.

A second set level of about 8 Lux will allow notes to be taken more easily without seriously affecting the use of overhead projectors and other equipment giving similar screen brightness." [2]

3.1.2.2. Show lighting: During the show, the hall is totally focused. The information needs of the audience being entirely related to the stage activities. However, a pure single need for visual information almost never exists. Even in the theatre, for instance, the audience needs to know how to escape in case of fire-hence, the computing Exit sign, the aisle lights, etc. This means that, this scheme could be defined as, It is that part of emergency lighting, which may be provided to ensure that the means of escape can be safely and effectively used at all times and normal activities to continue during the show.

For theatrical purpose, the general house lighting must dim from full intensity to a complete blackout. Special curtain screen lights or "curtain warmers" may be provided. Double doors, dark vestibules or tunnel entrances should be provided to protect against light spills caused by late arrivals. Within the limits of safety, aisle and exit lights should be unobtrusive. [4]

3.1.2.3. Panic lighting: This scheme control transferring the house lights immediately to full intensity in the event of a panic situation.

3.1.2.4. Emergency lights: provide lighting during power failures through a sensing device

that transfers the light to an emergency supply. These can be sleeted house lights or independent emergency lighting luminaries.

3.1.2.5. Cleaning lights: This scheme provides light for cleaning the theatre. Separate luminaries may be provided, or selected house lighting circuits may be turned on.

3.1.3. Lighting intensities within seating area: The Theatre Lighting Subcommittee of the IES recommends that during the period of use, the horizontal illuminance measured on the centerline of any escape route should never fall below 0.2 lx in halls and corridors. This value should be measured at floor level. This illumination level quoted, of 0.2 lx, is roughly equivalent to moonlight. It is also recommended that the ratio of the minimum to the maximum illuminance along the escape route should not exceed 1:40 and care should be taken to avoid abrupt alternations of excessive dark and light areas on the floor. Arrangements should be taken to operate the emergency lighting systems within 5 seconds of the failure of the normal lighting installation. This allowed five seconds before the emergency lighting must be in operation is based upon practical tests that indicated that after 15 seconds of darkness, people begin to move irrationally. The minimum illumination level allowable within seating areas should be between one-tenth and one-fifth of the normal lighting level with a minimum value of 0.1 lx. The transmission between fall-out and roll-up of any of the lighting schemes must be on one or two seta to avoid temporary blindness. [2,5]

3.2. Stage Lighting:

Visibility is defined, as the amount of light needed for a moment of recognition deemed appropriate for that point in the action of the play. Through the manipulation of light in all its aspects intensity, hardness, distribution, and movement the lighting designer assists in creating an environment for the play. The general tasks of the lighting designer could be pointed in the following:

Composition: Composition lighting means lighting one form and not another; Lighting Two-

dimensional forms to make them look three-dimensional; Keeping shadows off background; and the most important of which is the compositional lighting of the actor.

Revealing the form: The three-dimensional form of the actor must be shown in a consistent and predictable manner while moving through space something better not to be left to chance.

Establishing the mood: The word mood tends to suggest dark and gloomy surroundings, but bright comedy or nonsensical farce also indicates a type of mood. A color impression comes from the mood as well as a suggestion of the intensity and distribution of light.

Reinforcing the theme: The lighting design is concerned with compositional revelation of the thematic forms of the setting the word reinforcing comes here because the visual expression of the theme depends on the scene designer's interpretation of the playwright's message. [6]

3.2.1. Lighting the Acting Area:

Lighting a figure from various positions and angels is easy, but lighting a moving actor on the stage needs the lighting designer to produce the same uniformity of coverage as on a stationary figure over the entire playing area. By providing the playing portion of the setting into convenient areas with the same number of spotlights, the acting area is covered with a balanced illumination. Although the area method was first developed for the proscenium theatre it has been readily adapted to other theatre forms such as thrust and arena.

3.2.1.1. Typical Layouts: Typical positions for theatrical lighting layouts for proscenium, thrust and arena theatres are almost the same. Figure (2) illustrates those typical lighting positions.

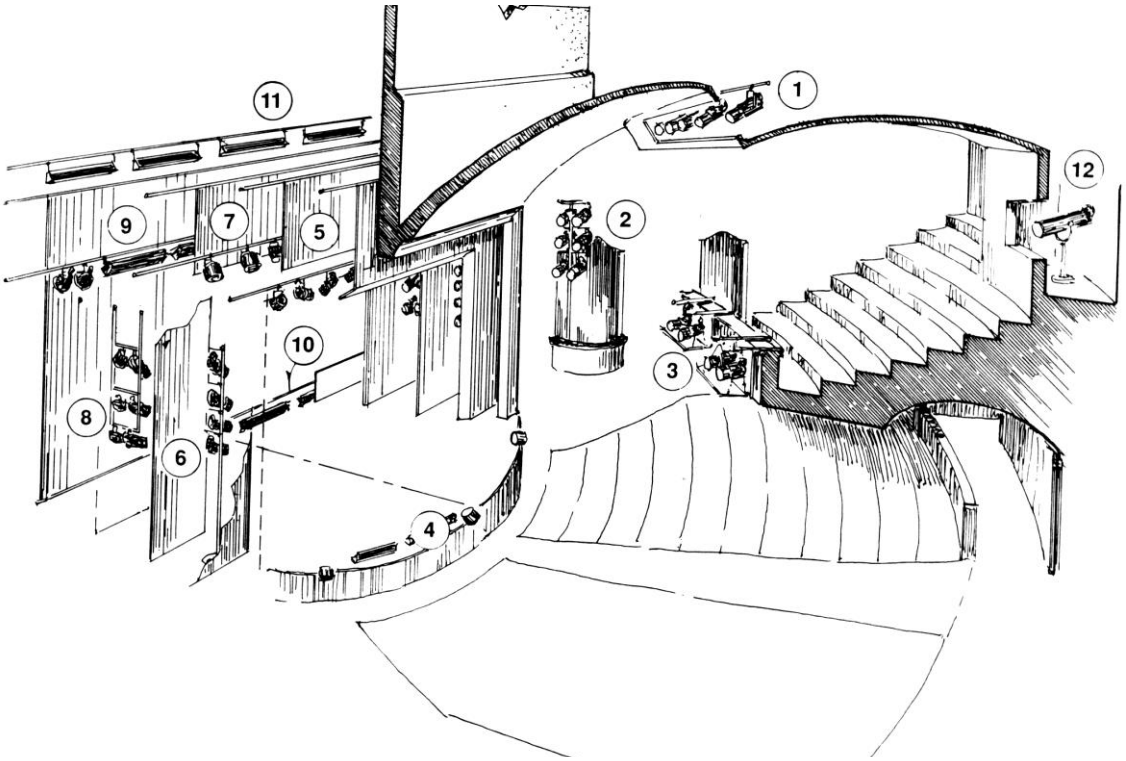


Figure (2) Lighting positions for stage area [7]

1. Ceiling beams or ports,
2. Box booms or coves.
3. Balcony front or balcony rail,
4. Apron or footlights.
5. First electric or bridge.
6. Boom.
7. Second electric (mid-stage back light position).
8. Ladder.
9. Third electric (backdrop or cyclorama lighting).
10. Cyclorama base or horizon lights.
11. Translucent drop back-light.
12. Follow-spot.

3.2.1.2. Area alignment: Using the area system, areas must overlap considerably or the actor will pass through dark spots *dips* in lighting, when moving from one area to another. Stage-lighting instruments shine a light that has maximum intensity along the center line of its beam and falls-off towards the edge. If the light beams are overlapped so that the fall-off of one beam is compensated by that of an adjacent light, a smooth and even 0 coverage is achieved. [7]

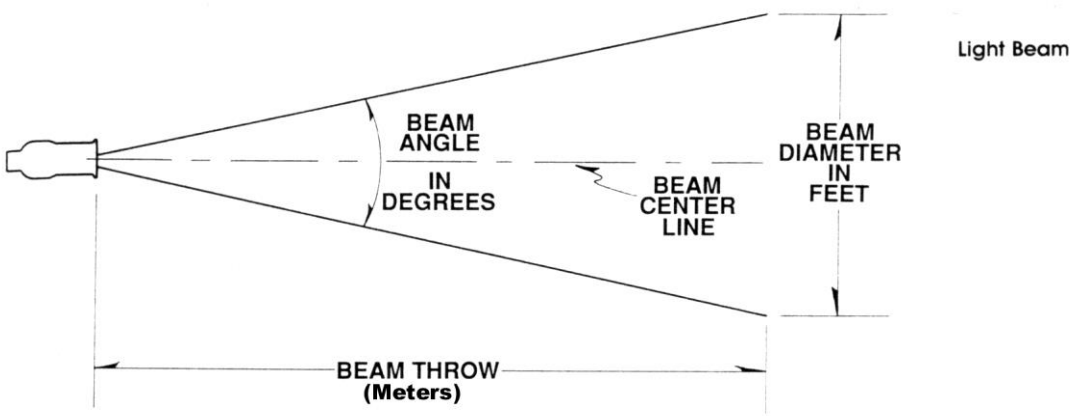


Figure (3) the lighting beam of spotlight [8]

3.2.1.3. Area Placement: The placement and the number of areas vary with the size and shape of the setting. However, areas will vary from 1.5 to 2.5 meters in diameter. Each lighting instrument produces a pre-determined size beam of light. The diameter of a light beam when it strikes a surface will be determined by the throw distance as well as the beam angle or spread. Normally using front light as a basis, the designer determines lighting area size by specifying instruments with certain beam spreads. [7]

The illustration in figure 4-a and 4-b demonstrates the lighting distribution over the stage area. The total number of areas varies with the shape and number of settings in the production as well as the desired tightness of control. Figure 5-a presents an irregularly shaped interior setting and figure 5-b presents a complicated set. Various levels often require the use of more lighting areas. [7]

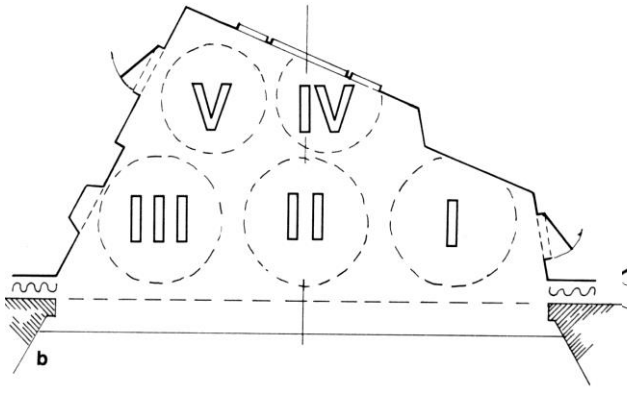


Figure (4-a) [7]
Area placement for irregular stage.

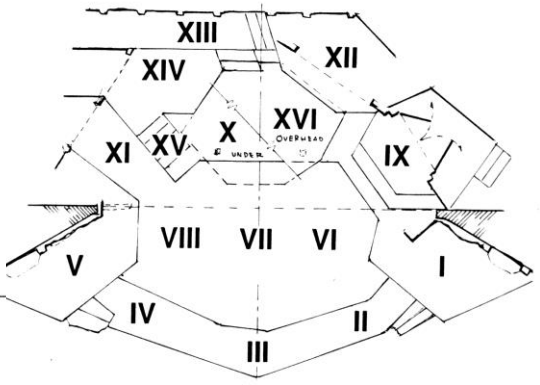


figure (4-b) [7]
Area placement for multi level stage.

3.2.1.4. Lighting the background: The mood of the environment surrounding the action of the scene is often so fully expressed in the intensity, color, and distribution of the area lighting that the area lights provide the major portion of the illumination of the setting. In case of a conventional interior or box setting, the area light will usually suffice light the walls of the set. However instruments lighting the walls of a box should be softly focused in order to blend well and reduce shadows.

A painted backdrop or sky drop lit from above and below (figure 6-a) and lit only from above (figure 5-b). When lighting from below, a masking ”ground row” is necessary. Lighting only from above often requires two sets of lights, one aiming high and the other low (figure 5-b). [4]

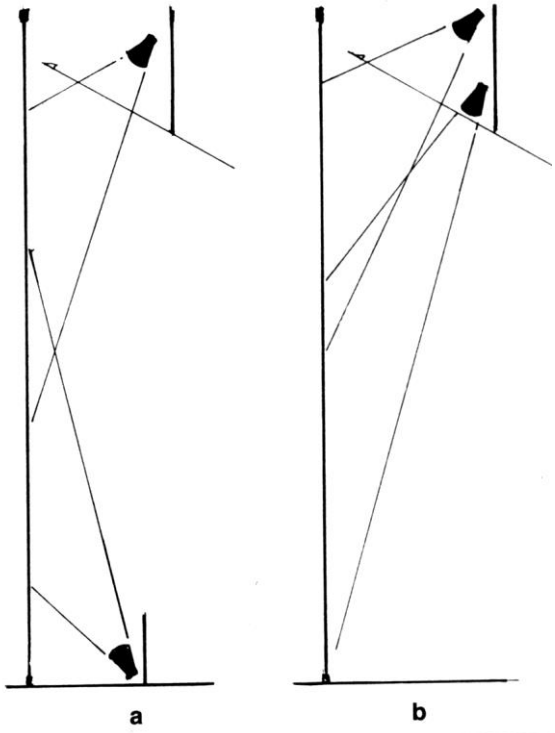


Figure (5-a) **Figure (5-b)** [4]

Back scenery lighting directions

3.2.2. Lighting the Actor: Actors must be seen in proper relationship to their backgrounds. The designer must vary the intensity, distribution, and color of light to match the different (types of plays) dramatic situations. Distribution is very important because it involves the angel and direction of light that reveals the actors, especially their faces, in natural form.

3.2.2.1.Light Angles and Directions: Actor’s face should be seen as it appears under daylight. People are accustomed to seeing the features of a face disclosed by light from an overhead direction. The next figures show effect of the lighting direction on the face.

The primary way to determine the direction of a light source is by the highlight and shadow created. Highlight & shadow, which give dimension to any form, are controlled by the lighting source angle. Shadowless illumination is uninteresting and reduces visibility.

The following section shows the various standard positions available in a simple proscenium house. Those positions on the audience side of the proscenium arch (refereed to as ”front Of

House" FOH), give a good variety of angles from the front. The backstage positions are even more varied including lights from side, top and back as well as front. [7]

- *Front lighting:*

It is common between artists and architects to render their drawings as through light were falling on the subject from over the artist's shoulder at an angle of about 45 degrees from the right to left. A fill-light on one side and an accent or key light on the opposite side disclose the actor. Using such a difference in color and intensity not only improves the visibility of the face but also adds interest to the composition. Another method to achieve daylight is often referred to as "Jewel lighting". This approach, probably developed because of the lack of front of lighting positions, depends on low-angle, balcony rail lights to fill from the front while side and back-light create accent.

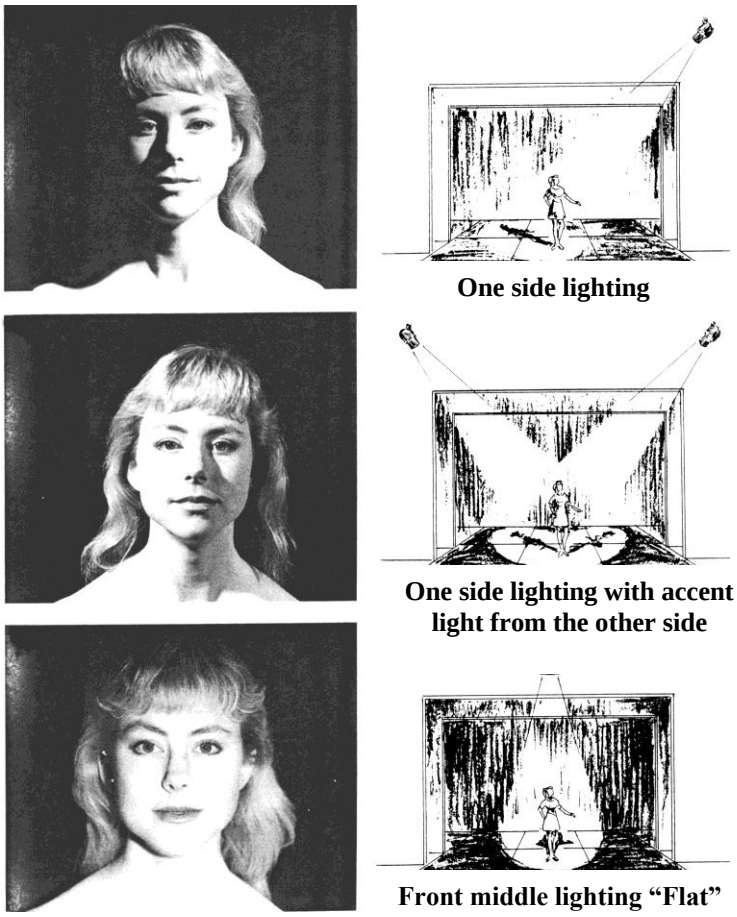


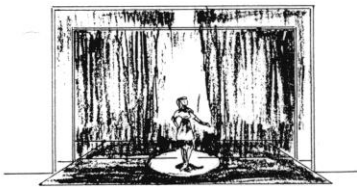
Figure (7): Front lighting [7]

The in-house-box boom positions act more as side light on the apron than front light. However, it is wise not to start with hanging position restrictions, but determines ideal angles based upon desired effect. As a light moves higher in angle toward top light, shadows become steeper and the light appears harsher. Moving a light downward from 45 degrees progressively causes shadows to disappear, a condition called *"Flat"* lighting.

- *Top and back lighting:*

Lighting from overhead and behind are used to separate an actor from the background, adds another dimension to the stage composition. It allows the designer to put a brighter light on the background than would otherwise be possible, and it permits the scene designer to use colors without fear of failure to bring the actor's face into relief. Because back lights tends to edge an actor, stronger colors than those used in front lighting may be employed. Backlights will normally require a more intense source than front light. Care must be taken to keep backlight from shining into the first row of audience seating.

Top rear lighting position



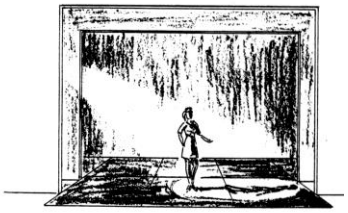
Top front lighting position

Figure (8): Back and down lighting. [7]

- *Side Lighting:*

It gives the designer additional flexibility. Both color and angle add variety, as side lighting is used in combination with frontal sources. Because side lights hit the actor from the extreme right

Side light with 30 degrees



Side light with 45 degrees

Figure (9): Sidelights with 45 and 30 degrees angle. [7]

and left, they may be used with chromatic colors to accent costumes or to add colored highlights to white or neutral costumes.

Like back-light, sidelight also can be used to establish a motivational source through color, angel and intensity. Dramatic lighting effects can be established through the creative use of strong side light.

3.2.2.2. Luminaries: There are common parts that construct most of the lighting instruments.

The following illustration in figure (10) demonstrates a typical light instrument and its structure:

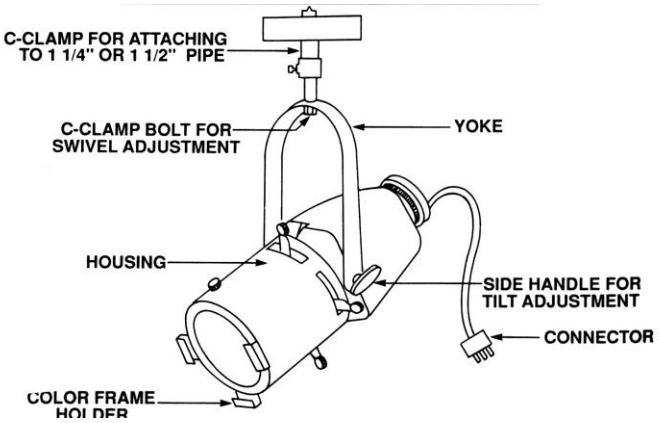


Figure (10) parts common to all lighting instruments [8]

4. Conclusion

Functionally, auditorium is divided into two main spaces. Each one of them has its own activities and lighting needs. Lighting each of them operates through certain schemes. The first space which is the seating area, has the following lighting schemes:

Interval lighting,	The show lighting,
Emergency,	Panic lighting,
Cleaning lighting.	

Lighting second space, which is the stage area, is divided into two schemes:

Scenery Lighting	Actors' Lighting.

While schemes for the spectators' area are used in sequent, the schemes for the stage are used simultaneously. The chart in Figure (11) summarizes these schemes and their relations.

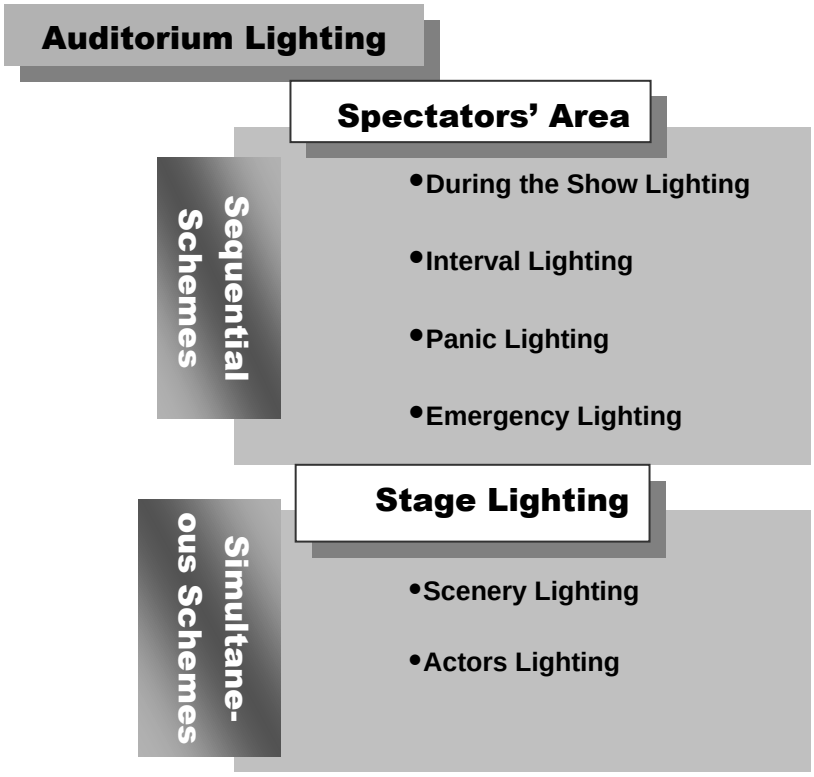


Figure (11) auditorium lighting schemes

Depending on the previous classification, The following concludes the recommendations for each of the two spaces.

1. For Spectators' Area:

In response to the various activities and visual needs within the spectators' area, the lighting designer should take into account the following recommendations:

- In general, it is more economical to combine local lighting on demanding tasks with a much lower level of general illumination adequate for less critical activities elsewhere in the space.
- Minimum light intensity 0,2 Lux measured at task level should be secured.
- Maximum difference between lighting schemes must not exceed the ratio of 1:40.
- The transmission between fall-out and roll-up must be on one or two seta.

- Panic lighting must operate within five seconds of the normal lighting failure.
- Interval lighting should be indirect light.
- During the show footsteps, exit singes and aisle floors must be.

2. For Stage Area:

Stage lighting is a combination of functional and artistic lighting. Lighting designer should provide the show director with suitable equipment in standard positions. These positions for the conventional proscenium-type theatre should be in front, side and back. Additionally, work lights, running lights and orchestra pit lights should be provided. Front lighting is possible from several positions. Follow spots generally located at the rear of the auditorium may accomplish performer highlighting. Foot lighting provides an up-lighting wash that helps to fill in shadows.

The forgoing positions have presumed a proscenium-type theatre; However, many of these positions carry over into thrust, arena and open-arena performing spaces. Thrust theatre spaces may require additional front, side and wrap-around lighting locations. Arenas and open area stages usually wrap-around-high front lighting and overhead stage grid positions. These positions are shown in figure 2.

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