

## Theater Engineering Conference

### *Auditorium Design*



# Seating Arrangements, Sight Lines, and Seating Design\*

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*Summary*—This discussion will not be an attempt to consider, from a technical point of view, the problems of theater design as the author is neither an architect nor an engineer. Rather, it will be an attempt to call attention to some of the problems and advancements regarding the seating layout and the design of seating areas for visibility as they have been observed during twenty-three years' association with the American Seating Company as a technician.

**I**N THE PAST, the only part played by the seating company was the preparation of the seating plan to show the quantity and sizes of the chairs. Then, as motion pictures became more popular, the need for comfort and better visibility became evident, and architects and builders looked to the seating companies for better design and comfort of the seating equipment.

Reluctantly, the "legitimate theater" accepted the motion picture. With the growth of motion pictures it became apparent that the factors of design for these two separate fields of entertainment had to be approached differently. The "legitimate" had to be designed for clear visibility of the stage, a horizontal field of vision, while for motion pictures the field of vision is the vertical plane of the screen. Because of the functional difference of the legitimate theater and the motion picture theater, the combination of these two functions proved to be costly and unsatisfactory, with the result that a new approach to the design of the functional form of the motion picture theater had to be considered.

Important factors in theater design are clear and unobstructed

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sight lines to the screen, the vertical position of the screen being one of the controlling factors. In the past, the screen position was influenced by the stage level, and the physical conditions of the theater, such as the projection of the balcony over the orchestra floor, the height of the proscenium, and the projection angles. In other words, the location of the screen was a compromise to give the occupants of the orchestra floor and balcony the best possible vision under the existing conditions. Naturally, since the design was basically for a stage view someone had to suffer as vision to the top of the screen was obstructed for those seated under the balconies because of the balcony overhang. This screen location on the stage somehow became a fixed rule and notwithstanding the fact that the function was different many motion picture theaters came to be built still holding on to the traditional stage of the "legitimate" along with the rule of thumb that the screen should be located 12 to 24 inches above the stage.

It was in the early thirties that Ben Schlanger presented, at one of your conventions, his studies of floor-slope factors for sight lines for motion picture theaters as distinguished from theaters designed exclusively, or at least primarily, for stage performances, and the reverse slope then came into being. Like all new theories, at first it was belittled. However, this new method, like all new ideas, went through a series of improvements and steadily has been gaining recognition. This recognition is evident by the fact that our factory reports the need for manufacturing chair standards in a greater quantity for reverse incline than ever before, and this type of chair is now considered standard equipment.

Most of you will say you know all this but how does one go about designing a theater floor to obtain clear, unobstructed sight lines? First, there is no set rule that will give a standard floor slope for all theaters. Each theater must be studied and designed to meet the varying conditions of the site, capacity, and number of seating tiers desired, and the building code.

The ideal sight line is one that will give unobstructed vision to the screen over the heads of occupants of the row directly ahead. This has been termed "first-row vision." This would result in a floor slope that would exceed maximum floor pitches as defined by most building codes and would present practical difficulties in construction. Therefore, it becomes necessary to take advantage of being able to see the width of the screen between the heads of the occupants of the row directly ahead, with clear vision assured over the heads of all other rows,

and requires the viewer to shift himself in the chair to one side or the other. This has been designated as "one-row obstruction," the row directly ahead being the obstructing row. To overcome this objection, methods for staggering the chairs have been developed. The staggering of chairs requires careful study. Each chair must be taken into consideration as the visual angle changes with each chair position. When the chairs are properly staggered the result is the same as "one-row vision" and is the nearest approach to the ideal condition. In the side or wall banks of chairs the stagger is automatic for over 50 per cent of the chairs, while in the center bank very few seat positions are automatically staggered.

The following methods for staggering the chairs are now in use:

1. All chairs of the same size, with a half-chair stagger every other row; for example all odd rows having 14 chairs per row, all even rows 13 chairs. This would mean the loss of one chair every other row, and would result in a half-chair aisle indent at each side. This method is only partially corrective. It is completely corrective when not more than 10 chairs per row are used.

2. Varying chair widths for all rows with a varying aisle indent and sometimes no indent at all. This method is more corrective but requires special chair widths.

3. By using three chair sizes in each row and alternating the order of the chair sizes every other row, for example, five 19-inch, four 20-inch, five 21-inch in all even rows; with five 21-inch, four 20-inch, five 19-inch in all odd rows. There would be no aisle indent as all aisle standards would be in alignment, nor would there be any loss of chairs. This also is only partially corrective.

4. Varying chair widths for all rows and varying aisle indent similar to the second method described, except that the chair row or section would be broken up into two or more sections by the use of a double middle standard. In this way the varying chair width would be kept within the standard chair size eliminating the need of special sizes as would be required by the second scheme. This method is more corrective.

There have been a considerable number of staggered seat installations in recent years. As a matter of fact, at this time there are more installations coming in with staggered seating than previously. This is true especially in the case of reseating where it has been found that the introduction of staggered seating improves the sight lines while maintaining the existing floor slope. It may be well to note

that not all building departments have approved the staggered plan which results in an indented or jagged aisle. However, ways and means are being considered to overcome this objection.

The staggered-seating arrangement does not look so well on paper, nor when the empty theater is viewed from the stage. However, from the important point of view of the entrance end of the auditorium, appearance does not suffer. The irregular pattern formed by the line of the chair backs gives the impression that the chairs were just thrown in, in comparison to the nonstaggered plan where all the chairs are in alignment. Since the main consideration, however, is to have the best possible sight lines for the greatest percentage of seats any objection as to appearance should be secondary.

If the chairs do not fit the floor properly all careful calculations will have been of no avail. Since the chair standards for a downward and upward pitch are manufactured in increments of  $\frac{1}{4}$  of an inch up to 2 inches per foot for the downward pitch, with a recommended maximum of  $1\frac{1}{2}$  inches per foot and a recommended maximum of  $\frac{3}{4}$  inch per foot for the upward slope, the best result can be achieved when the floor slope is designed to these inclines. This will result in a slightly greater total pitch in the floor than required but it will be on the safer side both in chair comfort and in viewing comfort.

There are times when the design conditions call for an all-downward slope, while in other instances a floor slope, having an upward as well as downward slope, is desirable. In such a case, a careful study of the position of the screen must be made so that the downward viewing angles from the balcony, and the upward viewing angles from the main floor seats are balanced out to create the most comfortable angles of the greatest number of seats. In a vertical plane the ideal viewing angle is one that requires the least physical exertion to eye and neck muscles of the viewer. The ideal viewing angle would be zero degrees formed by a horizontal line from the viewer's eye to the center of the screen.

The floor slope should be designed to place all of the rows as closely to this ideal angle as possible, taking into consideration, however, the contour of the site and other factors. The possibility of having seating depths as much as 44 rows, because of the ability to see the enlarged screen from such a distance, has created the need for a departure from the conventional downward slope. The all-downward slope, in such instances, would become excessive and would present difficulties in meeting grade conditions. Then again, the pitches of

balcony floors become needlessly excessive when a completely downward floor slope is used. The ability to make floors generally flatter to meet these conditions has been made possible by the positive, careful seat staggering now developed and tested, and the flexibility in floor-slope treatment which takes advantage of the fact that the screen is a movable element in the vertical plane, the latter factor being the key point in differentiating between the necessarily fixed position of the stage in a legitimate theater and the optional position of the screen in a motion picture theater.

It is no longer necessary to impress the theater public with over elaborate decoration or gilded gingerbread, but by keeping the design simple and by spending the time and money on the essential features of planning for the best sight lines and chair comfort, the departure from the old orthodox way will lead to better motion picture theaters and greater enjoyment from this type of entertainment.

#### DISCUSSION

**CHAIRMAN JOHN EBERSON:** Our speaker has talked about the most important things in theaters, spacing and staggered seating. He has covered a very important item in modern theater construction—out with gingerbread, in with the idea which makes a moving picture theater a place to relax and see a picture with the utmost comfort—staggered seating will do it.

**MR. LEONARD SATZ:** Would you mind repeating, Mr. Alexa, the second plan which you mentioned for staggered seating?

**MR. FELIX ALEXA:** The second plan is to vary chair widths for all rows with a varying aisle indent and sometimes no indent at all. This method is more corrective, but it does require special chair widths. In this case you would have to use chair widths that would range anywhere from 19 to 26 inches in width.

**MR. SATZ:** Do you not agree that the extra width as you mentioned, 26 inches, would allow the occupant to slide back and forth, and would not be in keeping with proper seating?

**MR. ALEXA:** It has been found that this is not the perfect solution. There is a tendency for the occupants to move from side to side in their chairs. Furthermore, it is costly to use special size chairs since most manufacturers have standard size equipment. They set up their equipment to certain widths and when you go beyond those standard widths, the maximum of which is 22 inches, it requires special handling. In most cases those chairs would have to be made by hand and would be very expensive.

**MR. SATZ:** In the average installation which of the three methods, in your experience, have you found will give the least number of dead seats or obstructed seats?

**MR. ALEXA:** The fourth method would give the least number of obstructed seats. There would be some bad seats in front, but you could still work out the scheme with standard size chairs.

MR. SATZ: Would you suggest that the indented row be illuminated for perfect aisle illumination?

MR. ALEXA: In the case of an indented aisle, I would recommend that the aisle be illuminated as much as possible. It might be a good idea for every standard to have a light on it so that people coming down the aisle could see these indented rows. The building departments in some cases claim that indented aisles form a hazard and that people walk into the projecting rows. If the aisle standards are equipped with aisle lights they no longer would be a hazard as the people coming down the aisles would be guided by the line of the lights.

MR. SATZ: Do you think that illuminating the indented rows would outline the aisle seats sufficiently to prevent that? It is much more expensive to wire up every row than it is every other row.

MR. ALEXA: That could be the solution. There would at least be enough light to indicate the back of the chair in front of the indented row and, I think, that is what is desired.

MR. BEN SCHLANGER: With the occasional double-arm-block system, the indent is minimized to such a point that it may amount only to about an inch or two in about 80 or 90 per cent of the cases. In some cases it will be about three or four inches. You are practically doing away with the indent if you take advantage of a double-arm block here and there. You are able to have center-to-center seating per person of almost any width you want, to make up the difference, so that the indent at the end can be eliminated.

However, it is desirable to light up the aisle as much as possible. In that case every other row would be sufficient; that is, every other row you diagonally skip across from one side of the aisle to the other. So, actually, you have light every row with an every-other-row lighting.

MR. A. L. TREBOW: Do I understand that you advocate not having the double-arm block on every seat on the main floor in order to take advantage of the staggered seating?

MR. SCHLANGER: It is not exactly advocating it. It is an expedient, the idea being comparatively new. The idea really is not new, that is, we are in the process of perfecting an idea which we see is good. Therefore, the manufacturers have not quite caught up with what they could do for us, although I know they are really working on the problem. As an expedient method, you could use a double-arm block only where needed. Eventually, I believe, instead of a double-arm block they may develop a single-arm block that is wide enough to take up the difference.

MR. TREBOW: What about the primary principle of having 80 per cent of the seating on stepping? I refer entirely to the fact that there are seats on level platforms, and 80 per cent of the seats shall be on level platforms two or three inches above the row preceding it, and the aisles then take the slope. Why would not that take care of a good deal of your sight-line problem?

MR. SCHLANGER: I think it was partly answered, but maybe not amplified enough in the paper that Mr. Alexa gave. We have found, I think, that there are a couple of hundred theaters erected, in which we have eliminated the need for such an excessive slope. Such a slope would cause the necessity for elevated platforms—level platforms—one above the other.

A floor slope is a necessary evil. Theoretically, an absolutely flat floor is better

than a sloped floor if it would give you clear vision. There was a theater built in Paris in the early '30's on an absolutely flat floor. It is usable because the bottom of the picture happens to be about nine feet above the floor, and the seats are very carefully staggered. That is not a complete solution, but it is at least an indication that flat floors are very possible. When I say flat floor, I don't mean a true flat floor, but something that is almost a flat floor.

Let us consider that theater in Paris and improve upon it. First, the screen is too high for the front rows. We shall cure that. The sight lines from the rear part of that theater may be not quite enough, because the floor is flat all the way back. We shall raise that floor up a little bit in the back, until we cure that. In the middle of that theater you will find that the sight lines are good. The objection in the front is that the people are sitting too far below the screen. If you had a curve there that was coming down from the back, going flat, and then coming up a little bit in the front, it would cure all faults.

MR. TREBOW: That is the theory of the upper reverse curve; the reverse curve as you call it.

MR. SCHLANGER: It was originally called a reverse curve, but it does not look like it. If you have seen some of these theaters, they look like flat floors. The layman walking in does not feel any particular slope because it is so flat.

MR. TREBOW: Does that not require staggering just the same?

MR. SCHLANGER: It certainly does. Staggering is an essential part of the design.

MR. TREBOW: What if you have a city code that requires even aisles?

MR. SCHLANGER: That is the thing that Mr. Alexa was discussing—how you can get an even aisle with staggered seats with the occasional double-arm-block system.

MR. TREBOW: Am I to understand you that it must resolve itself in an occasional double-arm-block system?

MR. SCHLANGER: That is the best system I have found so far for evening out the aisle line.