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Final Report

Acoustical Breadth

The reverberation time in a live theater is very critical to a patrons experience during a performance. My lighting design has affected an architectural element in the theater space, so I deemed it necessary to see how this change may effect the reverberation time. I proposed to change the length of horizontal hanging clouds at the ceiling. For my lighting design I planned to have the ceiling dark with the exception of the hanging down lights. My reducing the length of the clouds by a total of 6' this allows the light to upright the towers without interfering with the dark ceiling I had planned for the lighting design. By leaving an extra 3' on each end there isn't spill light from the plighting accent fixtures.

The following lighting study to determine the new length of the ceiling clouds:

Existing design

Study #1: A 6' length reduction on all three ceiling clouds.

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Study #2: From left to right 6', 8' and 10' length reductions.

Study #2 was used to compare the reverberation time, because the light spill is minimal and suitable to work with the tower accent plighting.

To calculate the reverberation time Sabine's formula can be used. To determine the value "a" you must compile the quantities of surface area for each type of material within the space. The details for Sabine's calculation are on the following page. The absorption coefficients used to calculate the reverberation time, T, were taken David Egan's Architectural Acoustics textbook.

$$T = 0.05\frac{V}{a} \qquad (16)$$

where T = reverberation time, or time required for sound to decay 60 dB after source has stopped (s)

V = room volume (ft^3)

a = [see formula (11)]

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Reverberation Time Calculation:

Surface Name	Surface Area
Floor	14,976 sf
Seating	5147 sf
Towers, Clouds	5,690 sf
Ceiling	14,976 sf
Walls	12,626 sf
Volume	724,672 cf

Coefficients for absorption used for Sabine's Reverberation calculation:

		Sound Absorption Coefficients					
Description	**Surface Name**	**125**	**250**	**500**	**1000**	**2000**	**4000**
Concrete Floor	Floor	0.01	0.01	0.02	0.02	0.02	0.02
Audience, seating	Seating	0.39	0.57	0.8	0.94	0.92	0.87
Acoustical Reflectors	Towers, Clouds	0.15	0.1	0.05	0.04	0.07	0.09
Concrete Ceiling	Ceiling	0.01	0.01	0.02	0.02	0.02	0.02
Concrete Block	Walls	0.01	0.02	0.04	0.06	0.08	0.1

Existing Calculation:

S * alpha						
125	**250**	**500**	**1000**	**2000**	**4000**	
149.8	149.8	299.5	299.5	299.5	299.5	
2,007.4	2,933.9	4,117.8	4,838.4	4,735.5	4,478.1	
896.0	597.3	298.7	238.9	418.1	537.6	
149.8	149.8	299.5	299.5	299.5	299.5	
126.3	252.5	505.0	757.6	1,010.1	1,262.6	
3,329.2	4,083.3	5,520.5	6,433.9	6,762.7	6,877.3	
				Sum of S* alpha		**33,006.9**
				Reverberation time (T)=		**1.098**

With cloud length reductions:

S * alpha						
125	**250**	**500**	**1000**	**2000**	**4000**	
149.8	149.8	299.5	299.5	299.5	299.5	
2,007.4	2,933.9	4,117.8	4,838.4	4,735.5	4,478.1	
853.5	569.0	284.5	227.6	398.3	512.1	
149.8	149.8	299.5	299.5	299.5	299.5	
126.3	252.5	505.0	757.6	1,010.1	1,262.6	
3,286.7	4,055.0	5,506.4	6,422.6	6,742.9	6,851.8	
				Sum of S* alpha		**32,865.4**
				Reverberation time (T)=		**1.102**

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Discussion

The line plotted below shows where both calculations would fall on the reverberation time scale. The change in reverberation time was so small on the scale shown below that the change in reflector length is recommended. This will enhance the lighting design while maintaining acoustical performance.