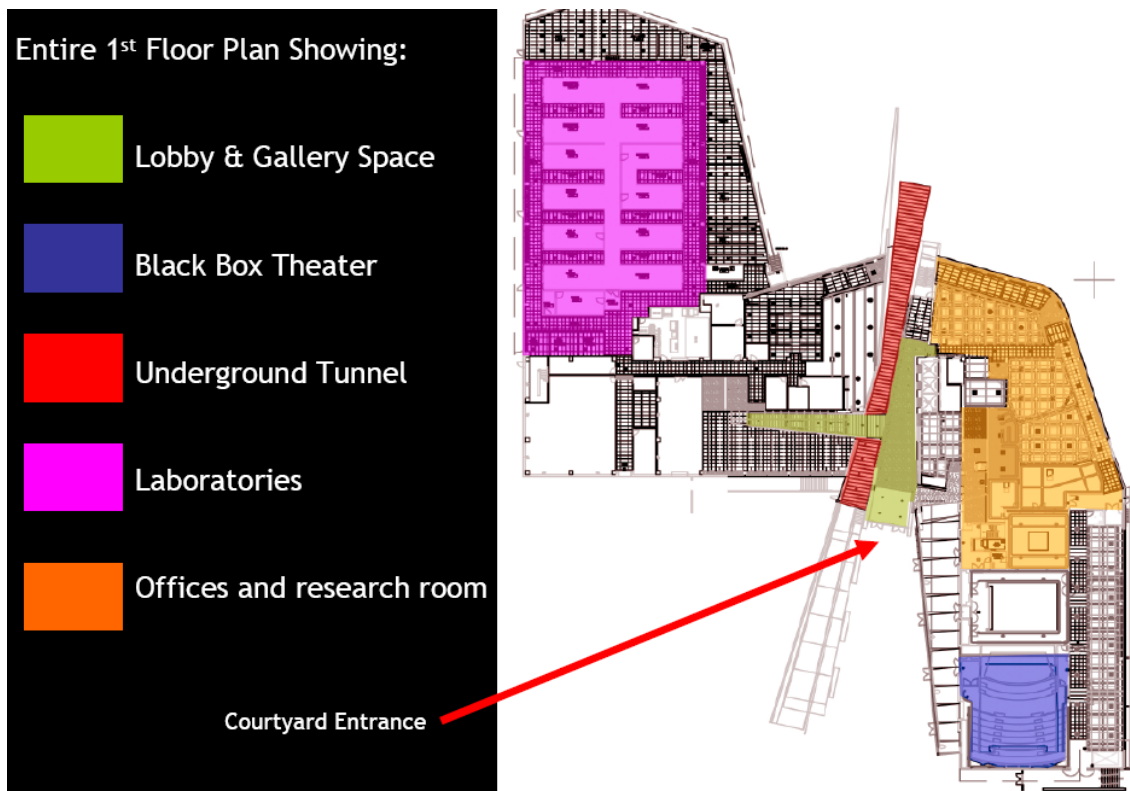


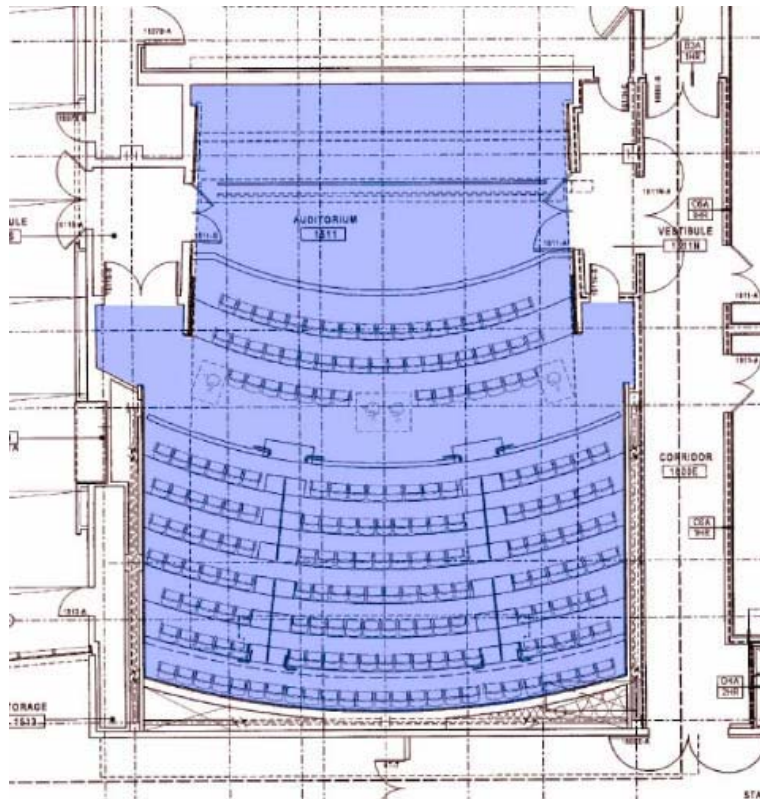
Black-Box Theater

The black-box theater of Cal IT² is located on the first floor of building section C. A black box theater by definition is a small educational theater with moveable parts, black walls, black ceiling, black floors, and dark furniture. For the purpose of Cal IT², the theater brings many different aspects. This theater, all in black, is intended for educational purposes as well as small student performances, guest lecturers, and audio/visual movies and presentations. This makes the black-box theater of Cal IT² one of the more unique spaces in this large technological building. The 50 ft x 58 ft space has a two-story ceiling and seats 200 people at a time. The walls are covered with acoustic diffuser panels painted black. The front curtains to the stage are a black heavyweight material with the seats upholstered in a dark grey fabric. The ceiling contains acoustically reflective ceiling clouds made of plywood, also painted black, to reflect the sound effectively within the space. A catwalk also runs around the ceiling for theater lighting equipment, ceiling adjustments, and maintenance.

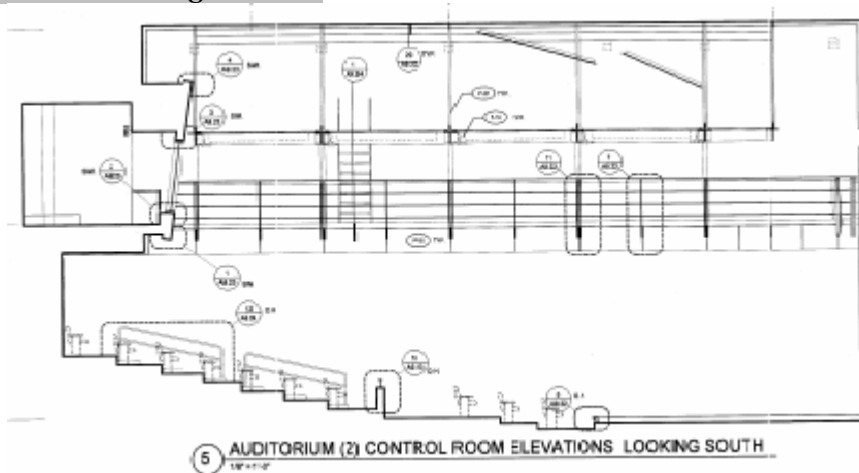


This plan shows the location of the theater relative to the courtyard and other entities of the building. Directly next to the theater is a large multipurpose room for various events sponsored by the college of telecommunications.

Theater Furniture Plan



Theater Section Showing Catwalk



Design Criteria

Reflectances

Side and Back Walls: 22% (Carnegie Xorel Fabric Wall Coverings)
Ceiling: 20% (Dark black paint on mesh acoustical ceiling and plywood)
Flooring: Assumed 20% (Collins & Aikman's Sequence ST320 -17 Carpet)
Chairs: 10% (Dark grey upholstered auditorium seating)

System Controls

Controls are going to be a major impact on the design of this space. With the many tasks that will be occurring in the theater, multiple scenes must be made with-in the space to accommodate the changing atmosphere and clientele. Since I will be using the Lutron Grafik Eye 4000 to control this space as specified in the control section of my electrical depth, I will preset scenes to accommodate 5 different atmospheres before the building is occupied. These scenes will consist of 2 pre-performances, performance, educational, and a general ambient atmosphere. All fixtures in this space will have dimming capabilities for personal preference control over the lighting.

Ceiling characteristics

The ceiling is designed as a grid with small steel beams running up and down, left and right. Above the steel grid is a black painted plywood acoustical system designed to reflect the sound back to the audience with minimal reverberation time. The panels behind the mesh are angled toward the stage and reflecting sound onto the crowd. The ceiling is 16 feet above the catwalk. The catwalk along the sides of the theater also creates a cove-like atmosphere around the seating where lighting will be installed. I will be using light above and below the mesh grid to create layers of light through the ceiling.

Theme

The theater setting is created to be very dark and intimate with only 200 seats available and minimal lighting on the audience. The mood I want to place in this room is one of comfort, but also technologically advanced. Most of the performances and presentations will be for entertainment purposes, so minimal light needs to be cast on the audience for visual tasks. The audience should be very comfortable to be able to sit and listen and gather knowledge from the presentations without a feeling of sleepiness or an overwhelming atmosphere. Using many different layers of light, I will be using the floor, walls and two levels of the ceiling to light the theater. One main feature that will be implemented is walk-over floor box luminaires. These will act as guiding lights to seats as well as create a modern technological feel.

Facial appearances

The shadows placed on the presenter or cast of people on the stage is a strong issue for the angles at which the light is aimed at the people. Since theatrical fixtures will be casting all the light on the stage area, this scenario is not in my scope of work.

Horizontal Illuminance

Theater during performances: emergency lighting needed at 0.2 fc

Theater in between performances: 5 fc for circulation

Theater during educational sessions: 30 fc

Light levels should be minimal due to the highlighting of the stage area with the theatrical fixtures. Only path-lights and low-voltage ambient lighting should be used for egress.

Vertical Illuminance

Vertical illuminance is not really an issue in the black-box theater.

Glare Consideration

Glare should be considered in this space because of the illuminated floor boxes. Bright glowing steps can cause a problem if too bright. Since this is a college campus, the crowd will be of a younger age, and distracting light on the floor shouldn't be a huge problem.

Lamping Criteria

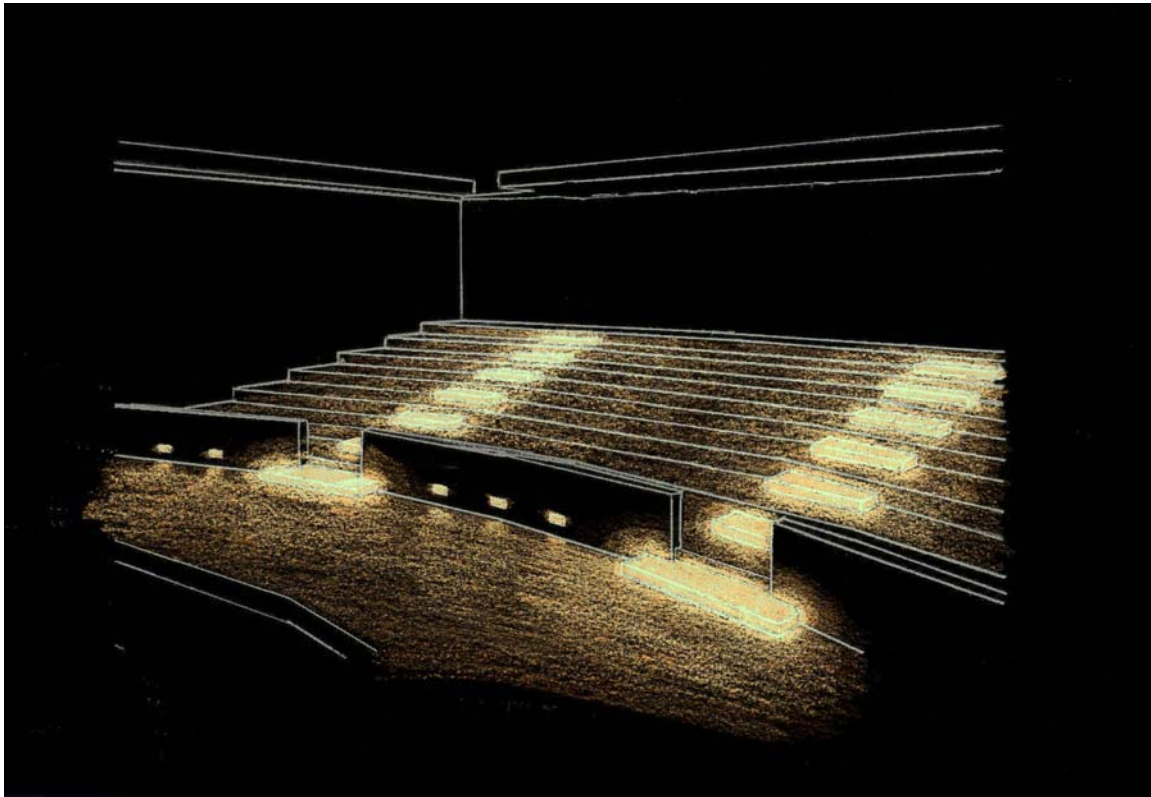
A uniform CCT of 3500K will be used in these areas with a CRI of about 82. Since this is a theater, I did not want to use a very cold source, but wanted to keep in tune with the technological feel. A 3500K lamp is a good neutral CCT for this space. A color rendering index of 82 is going to be uniform throughout the whole building.

Power Density

According to California Title 24 Energy Standards, a small theater's power density should be < 1.4 W/SF.

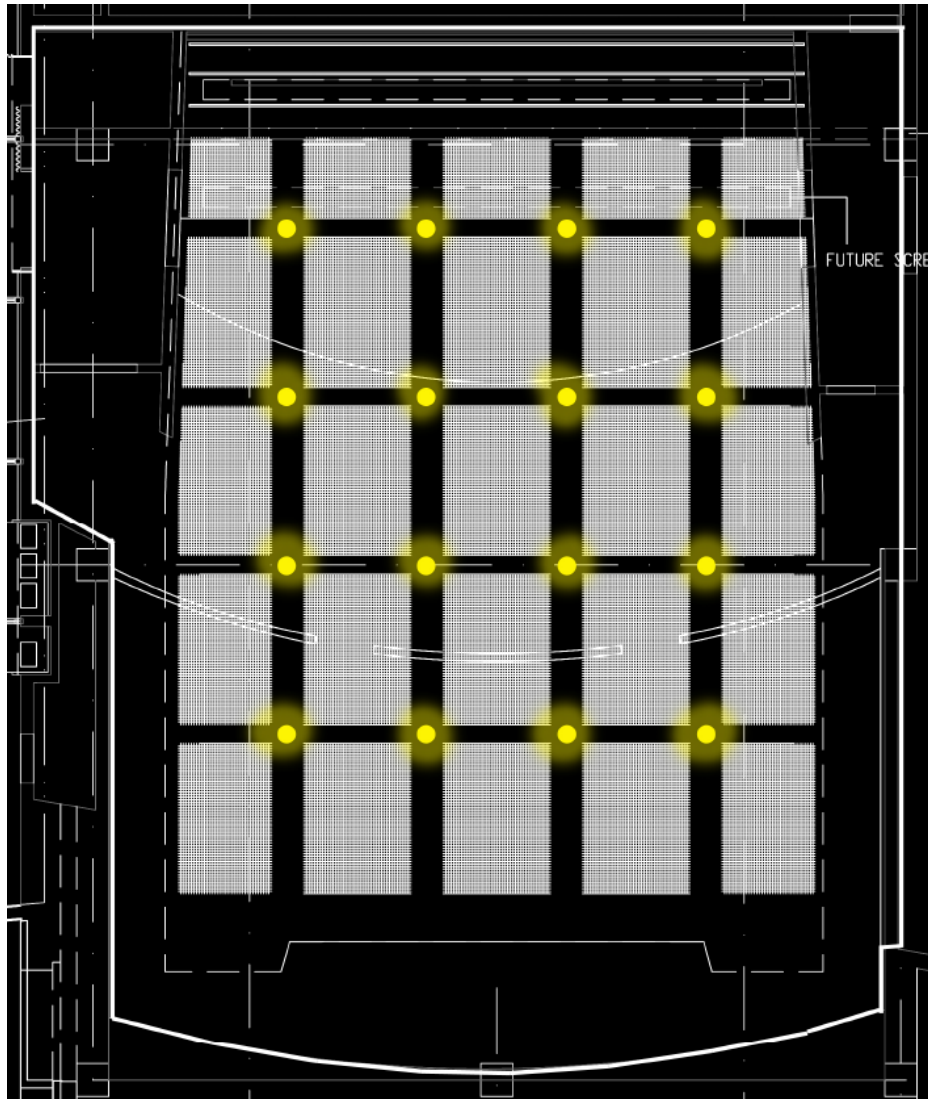
Schematic Design

In my redesign, I intend to provide multiple layers of light to convey the complexity and technological feel of the building and the theater's purpose. The first layer will entail my custom walk-over floor box luminaires. The intention with these boxes is to provide enough light for vision and circulation, but also to feel the anticipation of a great performance. With the slight dimming and brightening of these fixtures, a great sense of space and technology can be accomplished. My future intention with these luminaires is to program these dimming lights to go with a performance or musical piece in sequence. This is dependent upon a technological manager and the creativity of the staff at Cal IT².




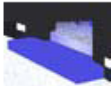





The next layer I will be using is washing the walls with light. By grazing the fabric walls with either blue or white light, this will add depth to the space as well as avoid dark shadows in the corners of the theater which can often happen. The next two layers involve the two tiered ceiling. The metal mesh grid at the 2nd floor level creates a smaller enclosure. By adding lights above and shining light through the metal mesh, it creates an added height to the theater as well as an intriguing effect on the source and position of the lights. Downlights will be added in between the grids to add in more effective lighting for the educational purposes as well as emphasize the mesh grid border between the catwalk and the public space as seen in the diagram on the next page. The final layer of light is purely criteria and safety based. For exiting and entering the space, steplights and dimmed downlights guide people to their destinations.

Diagram of Mesh Grid Downlights



Lighting Fixture Schedule

University of California, San Diego Cal IT2

Type	Mfr/Catalog #	Lamping	Notes
B7	 <p>Bega 2286P Description: Recessed compact fluorescent step light with 1-CFT13W lamp. Optics: grill louver , tempered glass diffuser.</p>	1-CFT13W lamp	Location: Black Box Theater
B8	 <p>Zumtobelstaff Custom Fixture Description: Floor surface mounted as steps. Walk-over fixture with blue gelled lamp and 3form acrylic glass overlay.</p>	(1) 17W UT8	Location: Black-Box Theater
B9	 <p>Lightolier CS8242HUCL 42W Description: 9" surface-mounted compact fluorescent downlight with 2-CFTR42W lamps. Optics: anodized aluminum parabolic reflector.</p>	2-CFTR42W lamps	Location: Black Box Theater
B10	 <p>Lithonia WW-ST-1-32-277-IRLS-1/4 Description: 4' linear recessed wall-washer with 1 32W T8 fluorescent</p>	1 32W T8 FL	Location: Black Box Theater
B11	 <p>Lightolier 1108 / 1104F1** Description: 6" recessed compact fluorescent downlight with 1-CFQ13W lamp. Optics: painted or anodized aluminum cone reflector.</p>	1-CFQ13W lamp	Location: Black Box Theater
B12	 <p>Cooper Ltg - Metalux 2M-XRD-2-U6T8-PBIS-*277-EB81-* Description: 24" surface-mounted fluorescent downlight with 2-F31T8/U (22.5in) lamps. Optics: acrylic prismatic lens.</p>	2-F31T8/U (22.5in) lamps	Location: Black Box Theater
B13	 <p>Cooper Ltg - Metalux RWW-2-32-MI-277-EB81-* Description: 1x4" recessed fluorescent wallwasher with 2-F32T8 (48in) lamps. Optics: anodized aluminum reflector , single.</p>	2-F32T8 (48in) lamps	Location: Black Box Theater

All fixture cut-sheets can be found in the appendix.

Fixture Relevant Schedules

Ballast Schedule								
Ballast	Voltage	Lamp	Input Wattage	Input Current	Fixtures	Dimming	Elec/Mag	Manufacturer
BAL1	277V	(2) 32W T8	68	0.25	B1, B2, B13	Yes	E	Advance
BAL2	277V	(1) 32W CFTR	36	0.13	B3, B5, B6, B16	No	E	Universal
BAL3	277V	(1) 13W CFT	20	0.26	B7	No	M	Advance
BAL4	277V	(1) 17W U T8	17	0.08	B8	Yes	E	Lutron
BAL5	277V	(2) 42W CFTR	80	0.36	B9	Yes	E	Advance
BAL6	277V	(1) 32W T8	35	0.13	B10	Yes	E	Advance
BAL7	277V	(1) 13W CFQ	18	0.07	B11	Yes	E	Advance
BAL8	277V	(2) 32W U T8	65	0.25	B12	Yes	E	Lutron
BAL9	277V	(2) 32W T8	59	0.21	B14, B15, E7, E11, E12	No	E	Advance
BAL10	277V	(1) 28W T5	30	0.11	B18	No	E	Advance
BAL11	277V	(1) 135W LPS	135	0.2	E1	No	M	Advance
BAL12	277V	(1) 39W T6 MH	44	0.16	E2, E9	No	E	Advance
BAL13	277V	(1) 9W CFT	14	0.17	E3	No	M	Advance
BAL14	277V	(1) 13W CFQ	24	0.24	E4	No	M	Advance
BAL15	277V	(2) 28W T5	60	0.22	E6	No	E	Advance
BAL16	277V	(1) 70W T6 MH	79	0.29	E10	No	E	Advance
BAL17	277V	(1) 32W CFTR	32	0.28	B19	Yes	E	Advance

All ballast cut-sheets can be found in the appendix.

Lamp Information							
Designation	Manufacturer	Type	Bulb	Wattage	CCT	CRI	Relevant Fixtures
A	Philips	Fluorescent	T8 FL	32W	4100K	86	B1,B2,B10,B13,B14,B15,E7,E11,E12
B	Philips	Compact FL	CFTR	32W	4100K	82	B3,B5,B6,B16
C	Philips	Compact FL	CFT	13W	3500K	82	B7
D	Sylvania	Fluorescent	FBT8 FL	17W	3500K	82	B8
E	Philips	Compact FL	CFTR	42W	3500K	82	B9
F	Philips	Compact FL	CFQ	13W	3500K	82	B11
G	Philips	Compact FL	CFQ	13W	3000K	82	E4
H	Philips	Fluorescent	FBT8 FL	32W	3500K	85	B12
I	Philips	Fluorescent	T5 FL	28W	4100K	85	B18,E6
J	Philips	Halogen	MR16	50W	3050K	100	B17
K	Philips	Low Pressure Sodium	SOX	135W	1700K	NA	E1
L	Philips	Metal Halide	T6	39W	3000K	81	E2,E9
M	Philips	Compact FL	CFT	9W	3000K	82	E3
N	Philips	Incandescent	PAR20	50W	NA	100	E5
O	Sylvania	LED	LED	1W	NA	NA	E8
P	Philips	Metal Halide	T6	70W	3000K	82	E10

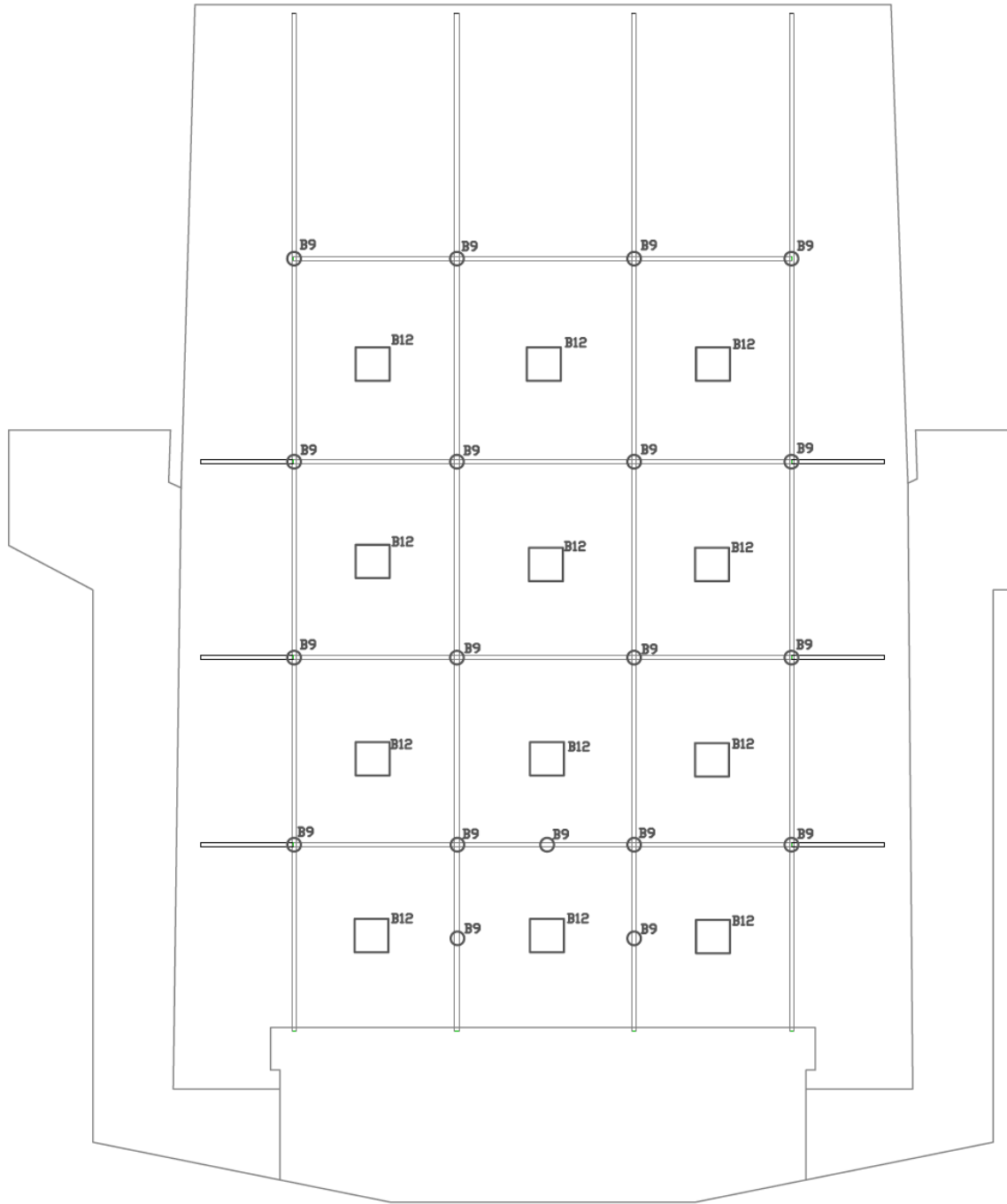
Light Loss Factors								
Type	Cleaning Interval	Category	BF	LLD	LDD	RSDD	LLF	Location
B7	12 Months (Clean)	IV	1.00	0.85	0.88	0.96	0.72	Black-Box Theater
B8	12 Months (Clean)	VI	0.88	0.85	0.86	0.93	0.60	Black-Box Theater
B9	12 Months (Clean)	IV	1.00	0.85	0.88	0.96	0.72	Black-Box Theater
B10	12 Months (Clean)	IV	1.00	0.95	0.88	0.96	0.80	Black-Box Theater
B11	12 Months (Clean)	IV	1.00	0.85	0.88	0.96	0.72	Black-Box Theater
B12	12 Months (Clean)	IV	0.88	0.85	0.88	0.96	0.63	Black-Box Theater
B13	12 Months (Clean)	IV	0.88	0.95	0.88	0.96	0.71	Black-Box Theater

I assumed a 12 month cleaning interval for all fixtures since the building is located on the University campus. I also assumed a clean environment in the theater since the room will be used intermittently and cleaned after every performance by janitorial staff.

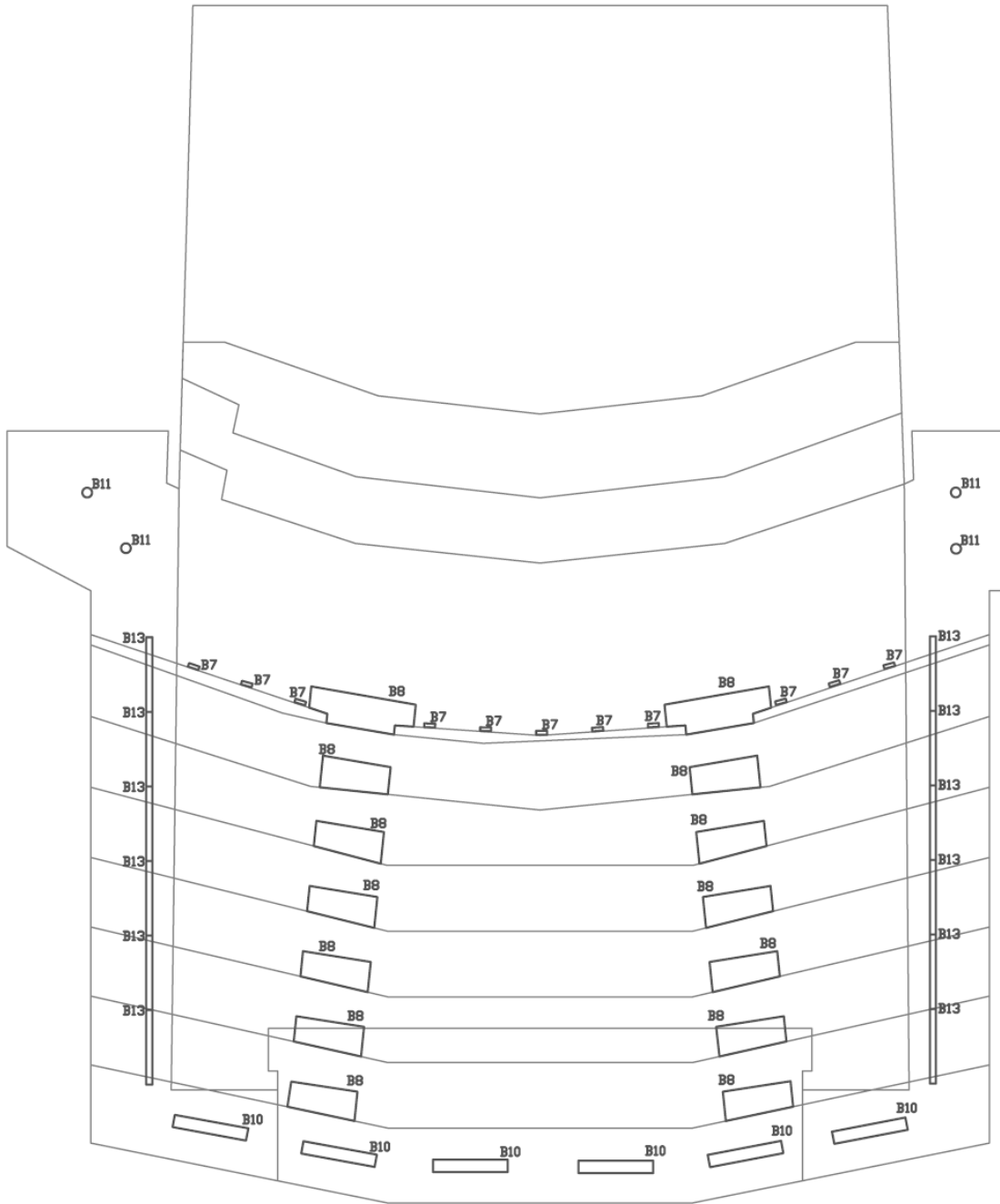
Power Density					
Fixtures	Fixture Count	Watts	Total watts	SF	W/SF
B7	11	13	143		
B8	14	17	238		
B9	19	80	1520		
B10	6	36	216		
B11	4	18	72		
B12	12	65	780		
B13	12	35	420		
			3389	2845	1.19

Using the input wattage from the specified ballasts and lamps, the power density came in under the maximum allowed of 1.4 W/SF which meets California Title 24 standards.

Lighting Plan – 2nd Story



Lighting Plan – 1st Story



Preset Control Scenes

Theater Scenes				
Scene	Name	Zones	Fixtures	Dimming
Scene 1	Performance Entrance	D, F, G, I	B7, B8, B10, B11, B12, B13	D(10%)
Scene 2	Educational	D, E, F, H	B7, B9, B10, B11, B12, B13	
Scene 3	Performance	G, F	B7, B8, B11	G(1%), F(1%)
Scene 4	Educational 2	D, E, H	B9, B10, B12, B13	
Scene 5	Performance Entrance 2	D, H, F	B7, B10, B11, B12, B13	D(10%), H(10%)

Scene 1

This scene will be used for entering the theater for a performance or possibly a guest speaker. The custom blue floor boxes are turned on with a white wall wash on the back acoustical panels and a blue wall wash on the side walls. The square pendants above the mesh ceiling are dimmed 25% while the circular downlights are turned off completely. The entrance downlights and steplights will be turned on for circulation around the theater.

Scene 2

This scene will be used educational purposes during classes and demonstrations. The floor boxes will be turned off. All the wall-washers will be turned on with white light along with the pendants on full capacity and the circular downlights. The steplights and entrance/exit lights are also turned on in this scene.

Scene 3

This scene is used during a performance or speaker where note taking is not needed. The blue floor boxes, steplights, and entrance/exit lights are dimmed to 1%. This provides enough light for entering or exiting only. In case of more light being needed, the wall washers can easily be turned on.

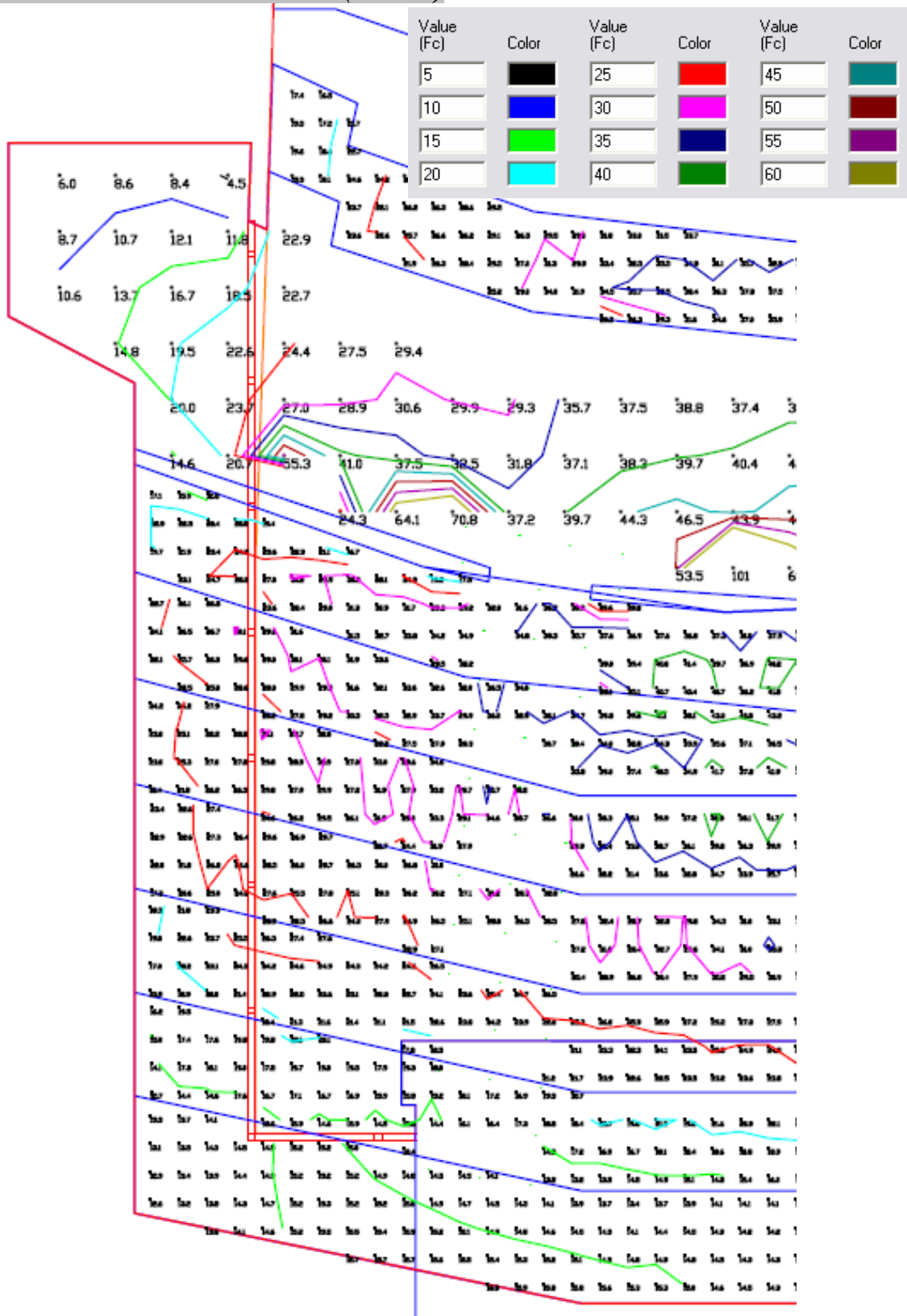
Scene 4

This scene is used for general ambience or educational purposes. All the lights are on in white light except the floor boxes, steplights, and the entrance/exit lights. This is used for clean-ups, general tasks, and educational reasons.

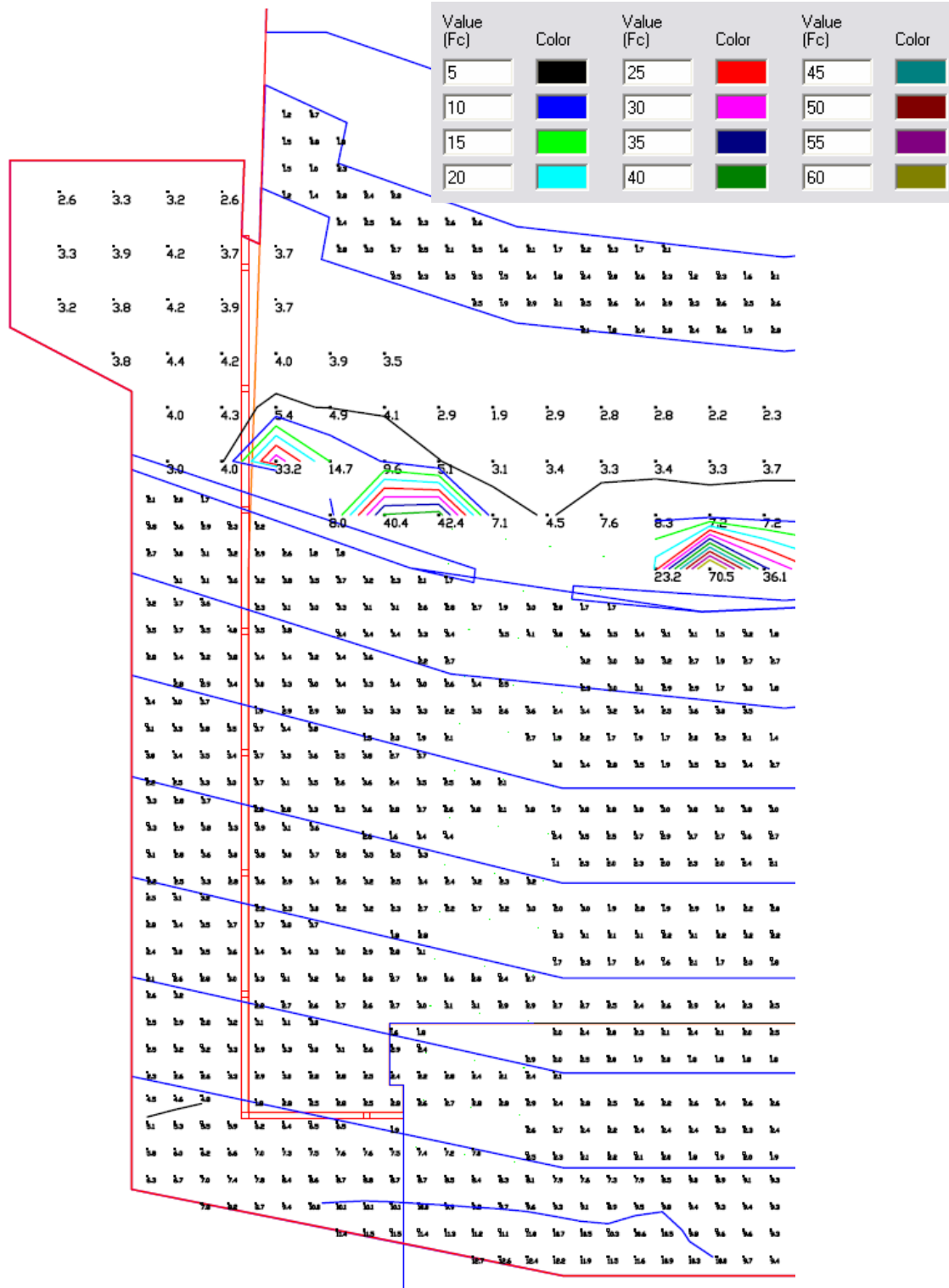
Scene 5

This scene is used for entering the theater for a performance or guest lecturer. This entails all the aspects of Scene 1 without the blue floor boxes. This also includes the wall-washers being dimmed to 10% for a more intimate setting possibly to let the audience know the show will be starting momentarily and to be seated.

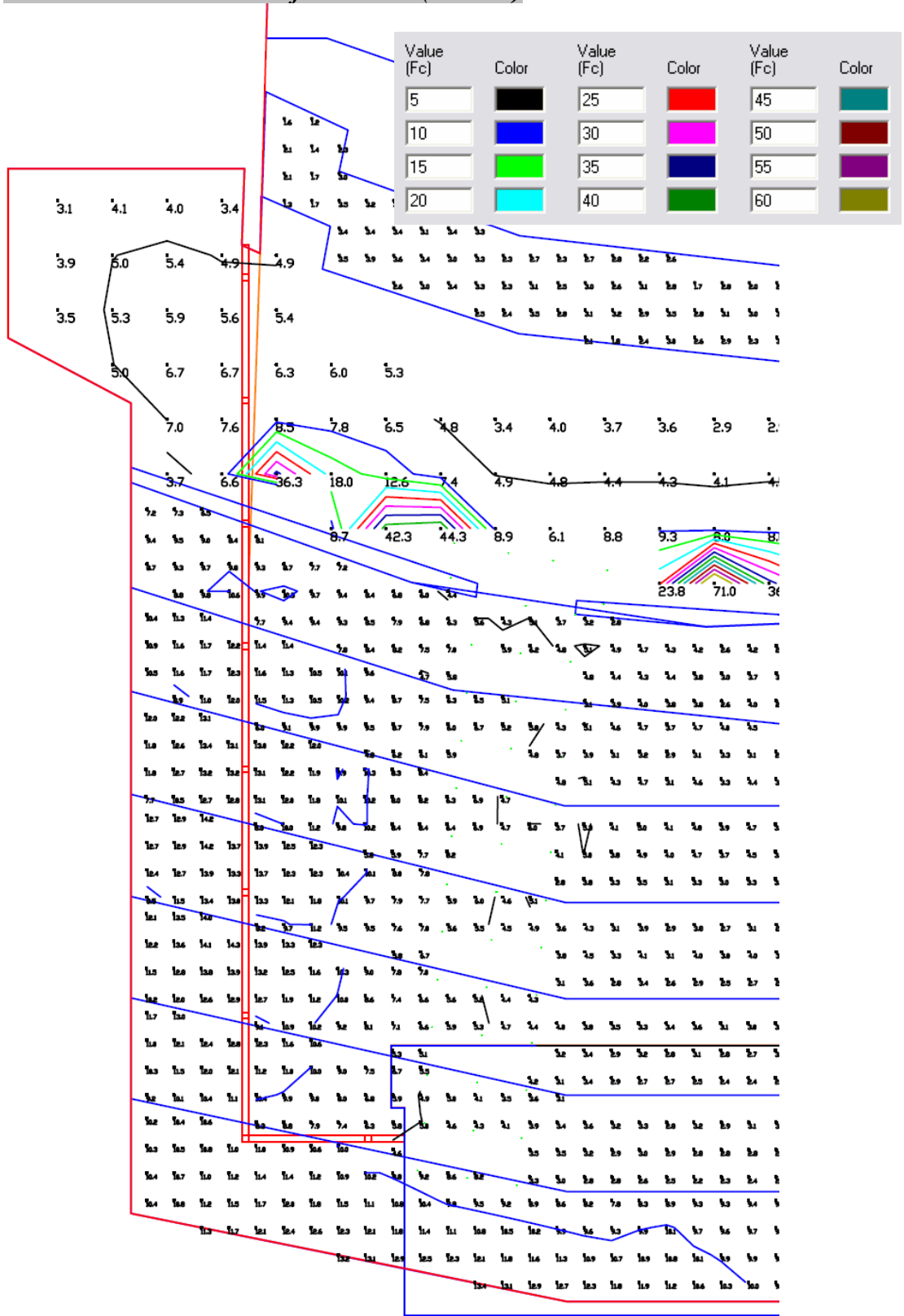
Calculation Grid – Educational 1 (Scene 2)



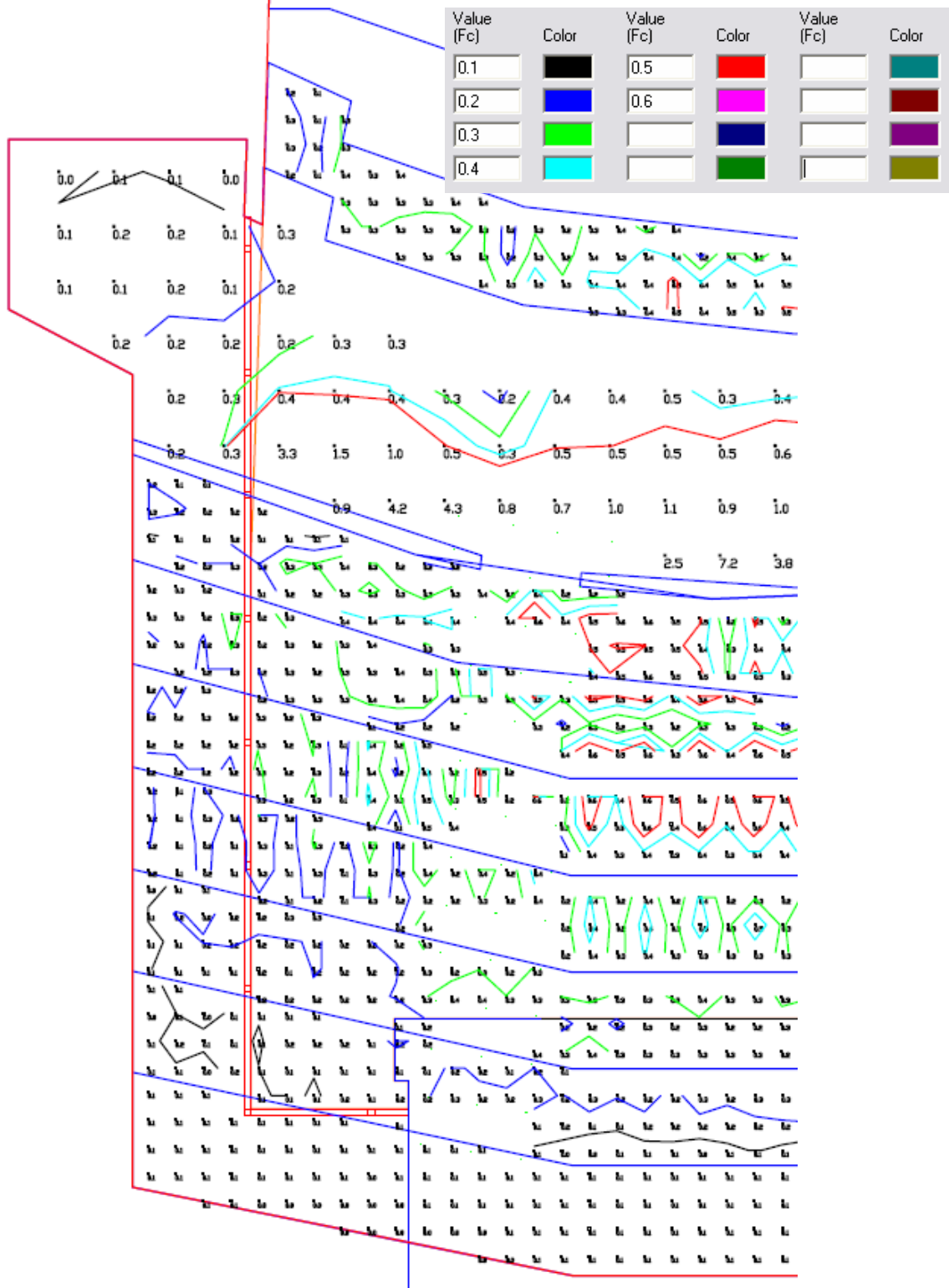
Calculation Grid – Pre Performance 1 (Scene 1)



Calculation Grid – Pre Performance 2 (Scene 5)

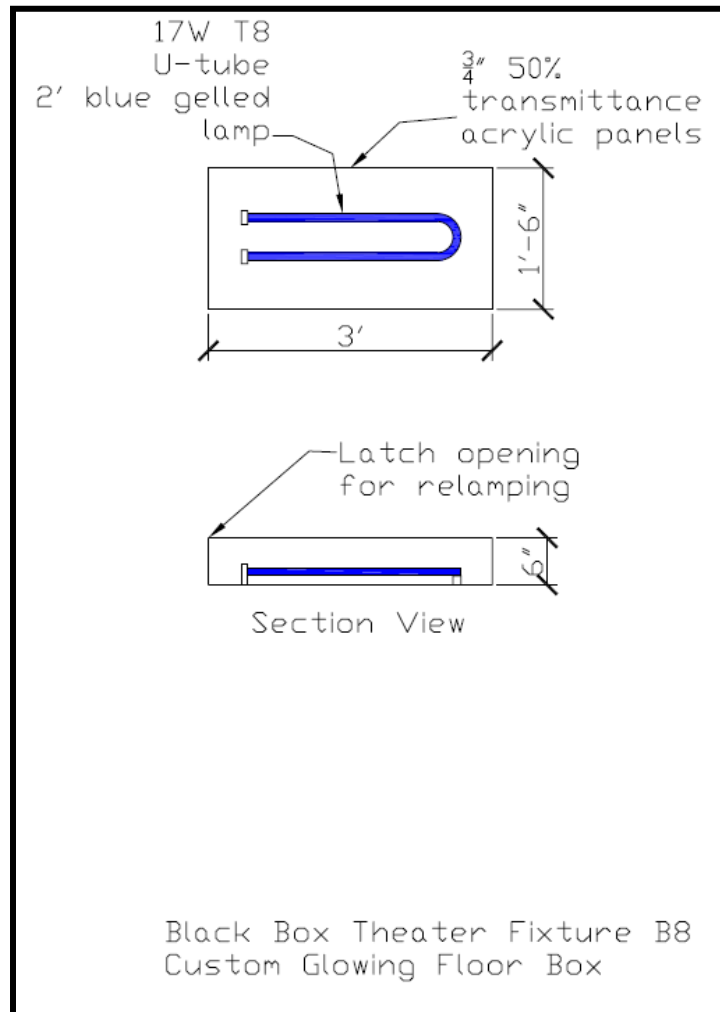


Calculation Grid – Performance (Scene 3)



Theater Illuminance Values										
(in Footcandles)	Values	Bottom Row	Circulation Area	1st Row	2nd Row	3rd Row	4th Row	5th Row	6th Row	Top Row
Educational 1 (Scene 2)	Avg	29.16	33.12	30.05	32.45	31.21	27.56	23.34	17.12	14.54
	Max	39.60	10.10	42.40	44.90	42.10	35.80	29.20	23.10	16.00
	Min	15.30	4.50	12.10	20.20	18.40	17.20	15.90	12.30	12.50
Educational 2 (Scene 4)	Avg	29.16	27.29	30.05	32.45	31.21	27.56	23.34	17.12	14.54
	Max	39.60	44.30	42.40	44.90	42.10	35.80	29.20	23.10	16.00
	Min	15.30	4.40	12.10	20.20	18.40	17.20	15.90	12.30	12.50
Pre-performance 1 (Scene 1)	Avg	2.28	8.94	2.82	2.96	3.04	2.65	2.65	2.54	8.65
	Max	3.30	74.10	4.10	4.00	4.40	3.90	3.80	3.30	12.70
	Min	0.70	1.90	1.50	1.40	1.10	1.50	1.40	1.70	4.20
Pre-performance 2 (Scene 5)	Avg	2.86	10.52	6.40	7.36	7.90	7.61	7.30	6.24	10.56
	Max	4.10	75.70	10.60	12.30	13.40	14.20	14.30	13.00	13.40
	Min	1.20	2.80	2.40	2.40	2.80	2.50	2.00	2.10	7.80
Performance (Scene 3)	Avg	0.33	0.89	0.32	0.33	0.33	0.25	0.22	0.14	0.09
	Max	0.60	7.50	0.60	0.70	0.60	0.50	0.40	0.30	0.10
	Min	0.10	0.00	0.00	0.00	0.10	0.10	0.00	0.00	0.00

Fixture Details



*Renderings for All Scenes in Theater
Performance Entrance Example*





Performance Entrance 1 – Scene 1





Educational Set-up – Scene 2





Conclusion

The Black-Box Theater is a multi-functional space. It can be used for educational purposes, small student performances, lectures, and guest speakers. Because of this broad range of tasks, the lighting must accommodate all of these in one system. I have created a multi-layered system that can be controlled easily using the Lutron Grafik Eye with only two control pads in the theater. With my preset scenes as well as the ability to add more scenes, the flexibility for the lighting of this space is very tangible and works well. Adding the blue light floor boxes adds a technological feel to the space as well as adds aesthetic appeal. The layers of light in the ceiling can be used to either close the space off, or make the space ceiling seem higher for a more dramatic effect. Flexibility was one of my main goals and I have accomplished this using the multiple layers of light with a preset control system.