**Executive Summary**

**The Frederick College of Cardiology**

Arlington Heights, IL

September 9, 2013

Advisor Kevin Houser

This report more clearly defines criteria and considerations I Will applying to the redesign process of The Frederick College of Cardiology's new building. Existing systems are examine to better understand the initial design. From this viewpoint I will seek to improve the lighting objectively through the use of lighting design criteria. In addition, I will seek to address different subjective considerations and perhaps address different areas that the original designers didn't focus upon.

## I. Auditorium

### a. Existing Lighting Systems

The main general lighting for this space is provided by linear recessed T5 fixtures with MR16 halogen lamps at the ends of each fixture. The MR16 are on separate dimming circuits from the T5 lamps allowing for multiple methods of dimming for different auditorium uses. Halogen wall wash fixtures are used on both the east and west walls to create vertical illuminance. Finally adjustable halogen down lights in the ceiling are positioned towards the front of the room to highlight the seminar speaker or demonstration. Lutron Ecosystem dimming ballasts and a Grafik Eye user interface control all lighting devices. All lamping is 3000k.

The auditorium space is split in two by a "skyfold" wall. When the wall is up the Lutron lighting control system controls the entire auditorium as one space. When the wall is down the system senses this condition and separates the control zones for either auditorium space.

There are small oddly shapes windows toward the front of the room which provide a minimal amount of day lighting for only the northwest and south west corners of the auditorium.

#### 1. Luminaires

**SH** HALOGEN PAR 38 WALL WASH

**SF** LINEAR FLOURESCENT T5 WITH HALOGEN MR 16

**SAJ** HALOGEN DOWNLIGHT FULLY ADJUSTABLE

*(Plans and Sections as PDF attachment)

**b. Qualitative and Quantitative Performance Design Criteria**

**1. Light Levels** (IES The Lighting Handbook pg. 24.4)

| SETTING | Illuminance Horiz. | Height | Illuminance vert. | Height | Uniformity |
|---|---|---|---|---|---|
| Lecture Setting A/V with notes | 50lux | @ 2' a.f.f. | 15lux | @ 4' a.f.f. | 2:1 Avg:Min |
| Lecture Setting A/V without notes | 10lux | @ floor | 6lux | @ 4' a.f.f. | 2:1 Avg:Min |
| Lecture Setting no A/V | 100lux | @ 2' a.f.f. | 40lux | @ 4' a.f.f. | 2:1 Avg:Min |
| Demonstration | 1000lux | @ 3' a.f.f. | 500lux | @ 4' 6" a.f.f. | 3:1 Avg:Min |
| Screen Feature Presentation | N/A | N/A | 10lux | N/A | 2:1 Max:Avg |
| Screen Periodic Reference | N/A | N/A | 50lux | N/A | 2:1 Max:Avg |

**2. Energy**

ASHRAE/IESNA 90.1-2007

Classroom / Lecture / Training - 1.4 Watts/sq.ft.

**3. More Criteria and Considerations**

- Lighting controls must be useful for many different activities in the space but also simple for use by educators and students. (IES The Lighting Handbook, pg. 24.3)

- Control system must be able to control the auditorium in full mode and in separate sections. The sky fold wall system will divide the larger auditorium space into two individual control zones.

- Windows to the northwest and southwest will be considered for day lighting as well as automated shading.

- Higher concentrated light levels specifically for lighting surgical demonstrations in the front of the auditorium will be necessary. Spot lighting should create high illuminance on the demonstration area while not causing additional glare on the projector screens.

**c. Existing Conditions Performance Analysis**

AGI calculation results:

Avg. illuminance @ 3 feet – 280lux

Max illuminance – 430lux

Min illuminance – 70lux

Max/Min – 6.14

(Flourescent LLF's = .8, LED LLF's = .7)

## II. Entrance Lobby

### a. Existing Lighting Systems

Ceramic metal halide down lights are recessed in the large wooden ceiling which dominates the two-story section of the entrance lobby. Ceramic metal halide wall-mounted asymmetrical up lights illuminate the wooden ceiling. The one story areas of the lobby are illuminated by compact fluorescent down lights and wall washers. Lutron Ecosystem dimming ballasts and a Grafik Eye user interface control all lighting devices. All lamping is 3000k.

Day lighting is a huge component of the entrance lobby illumination system. The west and east walls are almost exclusively transparent glass and a clerestory window surrounds the top of the space.

#### 1. Luminaires

**SAC 2** CERAMIC METAL HALIDE T6 WALL-MOUNTED, SEMI-RECESSED ASYMMETRICAL UPLIGHT WITH REMOTE ELECTRONIC BALLAST. ALL FINISHES ARE WHITE.

**SAB** CERAMIC METAL HALIDE T6 SQUARE DOWNLIGHT WITH NOMINAL 4 IN. X 4 IN. APERTURE, MEDIUM DISTRIBUTION, CLEAR ALZAK WITH A MATTE DIFFUSED FINISH, AND INTEGRAL ELECTRONIC BALLAST

**SA** COMPACT FLUORESCENT SQUARE DOWNLIGHT WITH NOMINAL 4 IN. X 4 IN. APERTURE, CLEAR ALZAR MATTE DIFFUSED REFLECTOR, AND INTEGRAL ELECTRONIC BALLAST

**SB** COMPACT FLUORESCENT SQUARE WALLWASHER WITH NOMINAL 4 IN. X 4 IN. APERTURE, CLEAR ALZAK REFLECTOR WITH A MATTE DIFFUSED FINISH, AND INTEGRAL ELECTRONIC BALLAST

*(Plans and Sections as PDF attachment)

**b. Qualitative and Quantitative Performance Design Criteria**

**1. Light Levels** (IES The Lighting Handbook pg. 22.29)

| SETTING | Illuminance Horiz. | Height | Illuminance vert. | Height | Uniformity |
|---|---|---|---|---|---|
| Lobby @ building entrance DAY | 100lux | @ floor | 30lux | @ 5' a.f.f. | 4:1 Avg:Min |
| Lobby @ building entrance NIGHT | 50lux | @ floor | 20lux | @ 5' a.f.f. | 4:1 Avg:Min |
| Lobby distant from entries | 100lux | @ 2' a.f.f. | 30lux | @ 5' a.f.f. | 4:1 Avg:Min |
| Lobby desk top | 150 | @3 6" a.f.f. | N/A | N/A | 4:1 Avg:Min |

**2. Energy**

ASHRAE/IESNA 90.1-2007

Lobby - 1.3 - Watts/sq.ft.

**3. More Criteria and Considerations**

- Day lighting should be used as a large component of lighting the space during daytime hours.

- Transitional brightness at entrances should be considered to aid adaptation.

- Exterior stonework extends to the interior and should be highlighted by grazing.

- Lobby should exemplify the character of the occupant through referencing the work of the college in the lighting design.

- Slanted wooden ceiling should be highlighted and used as a main architectural focal point of the space

- Large stair leading to the upper level balcony should be highlighted.

- Pool under stairway was included in original design but was rejected for budgetary reasons. This pool could become a great opportunity for interesting lighting design in the space.

- Design element could be hung in center of space to create a visual interest for exterior viewing.

**c. Existing Conditions Performance Analysis**

AGI calculation results:

Avg. illuminance @ 5 feet – 120lux

Max illuminance – 170lux

(Flourescent, CMH LLF's = .8, LED LLF's = .7)

## III. Open Office

**a. Existing Lighting Systems**

General ambient illumination is provided by suspended Indirect/Direct troffers installed 7'-6" above finished floor. This fixture will house two T5 lamps in cross section. This is the main lighting for the workspaces. Compact fluorescent down lights illuminate the supporting spaces and the north/south hallway which passes along the cubicle sections. Compact fluorescent wall washers create vertical illumination on selected walls. Lutron Ecosystem dimming ballasts and a Grafik Eye user interface control all lighting devices. All lamping is 3000k.

Windows along the western wall provide natural daylight. Automated Lutron blinds control glare and sunlight penetration. The office space is flanked by single offices on the eastern side which block most natural light from that direction. All lamping is 3000k.

**1. Luminaires**

**SB** COMPACT FLUORESCENT SQUARE WALLWASHER WITH NOMINAL 4 IN. X 4 IN. APERTURE, CLEAR ALZAK REFLECTOR WITH A MATTE DIFFUSED FINISH, AND INTEGRAL ELECTRONIC BALLAST

**SA** COMPACT FLUORESCENT SQUARE DOWNLIGHT WITH NOMINAL 4 IN. X 4 IN. APERTURE, CLEAR ALZAR MATTE DIFFUSED REFLECTOR, AND INTEGRAL ELECTRONIC BALLAST

**SK** LINEAR FLUORESCENT T5 PENDANT WITH NOMINAL 28 FT. LENGTH, TWO (2) LAMPS IN CROSS SECTION, INDIRECT/DIRECT DISTRIBUTION, PERFORATED HOUSING, FIELD ADJUSTABLE AIRCRAFT CABLE SUSPENSION, AND INTEGRAL ELECTRONIC BALLAST

*(Plans and Sections as PDF attachment)

**b. Qualitative and Quantitative Performance Design Criteria**

**1. Light Levels** (IES The Lighting Handbook pg. 22.29)

| SETTING | Illuminance Horiz. | Height | Illuminance vert. | Height |
|---|---|---|---|---|
| VDT Screen and keyboard + polarity | 300lux | @ 2’ 6” a.f.f. | 150lux | @ 4’ a.f.f. |
| VDT Screen and keyboard - polarity | 150lux | @ 2’ 6” a.f.f. | 50lux | @ 4’ a.f.f. |
| Reading 12 point font | 200lux | @ 2’ 6” a.f.f. | 50lux | @ 5’ a.f.f. |
| Handwritten Pen | 300lux | @3 6” a.f.f. | 75lux | @ 4’ a.f.f |
| Circulation Corridors: Breakout Passageways | 100lux | @ floor | 30lux | @ 4’ a.f.f. |
| Circulation Corridors: Independent Passageways | 50lux | @ floor | 30lux | @ 5’ a.f.f. |

**2. Energy**

ASHRAE/IESNA 90.1-2007

Open Office - 1.1 - Watts/Sq.Ft.

**3. More Criteria and Considerations**

- Visual rest from typical tasks of reading and writing should be provided
- Day lighting and views should be incorporated into a successful design
- Day lighting automated shades and dimming control implemented
- Proper illuminance for comfortable screen viewing and long term desk work
- Direct glare from luminaires should be avoided

**c. Existing Conditions Performance Analysis**

AGI calculation results:

Avg. illuminance @ 3 feet – 360lux

Max illuminance – 750lux

(Fluorescent, CMH LLF's = .8, LED LLF's = .7)

## IV. Exterior Façade

### a. Existing Lighting Systems

The exterior façade system is minimally illuminated. The main point of interest is the balcony off of the south end of the building. The underside of the roof overhang is made of wood and is illuminated by linear LED asymmetric up lights. The fixtures mount to the mullions of the southern wall of glazing for a continuous aligned appearance. All lamping is 3000k.

#### 1. Luminaire

**SS** - LINEAR LED FIXTURE WITH NOMINAL 3.5 IN X 3.5 IN CROSS-SECTION, MOUNTED ON WINDOW MULLION FOR CONTINUOS, PERFECTLY ALIGNED APPEARANCE, ASYMMETRICAL UPLIGHT

*(Plans and Sections as PDF attachment)

### b. Qualitative and Quantitative Performance Design Criteria

#### 1. Village Ordinance

The town of Arlington Heights, IL requires all buildings to meet certain light level requirements summarized below:

- Horizontal Cutoff fixtures must be used to eliminate vertical light trespass

- Building mounted wall packs must be fully shielded

- Canopies must be matte to reduce reflected glare

- Canopy lighting to be fully recessed

- Office parking lot levels @ ground level – avg. 25lux, max 150 lux, 4:1 uniformity

- Office categorized as medium activity location type

**2. Light Levels** (IES The Lighting Handbook pg. 26.6)

Due to the semi-commercial residential nature of the surrounding areas I believe the college should be categorized as LZ2, medium activity.

| SETTING | Illuminance vert. | Uniformity |
|---|---|---|
| Lighter toned façade material | 20lux | 3:1 |
| Darker toned façade materials | 40lux | 3:1 |

**2. Energy**

ASHRAE/IESNA 90.1-2007

Decorative - 1.0 Watts/Sq.Ft.

**3. More Criteria and Considerations**

- Determine lowest acceptable light level

- Control light levels to operate between dusk and curfew hours

- Select luminaires for specific optical control to reduce glare

- Target unique area of interest on façade such as stone work, southern terrace, and wrap around metal finish edge

- Illuminate wooden ceiling of southern terrace

- Create “the lantern effect” with the considerable amount of designed exterior glazing

**c. Existing Conditions Performance Analysis**

The only current designed exterior lighting seeks to illuminate the ceiling of the southern terrace. It seems that the type of fixtures and magnitude of lighting power should be sufficient to accomplish this goal. To be installed are 3000k linear LED strips which will be mounted to the mullion of the southern glazing and will be aimed up to the ceiling.

Southern Terrace ^

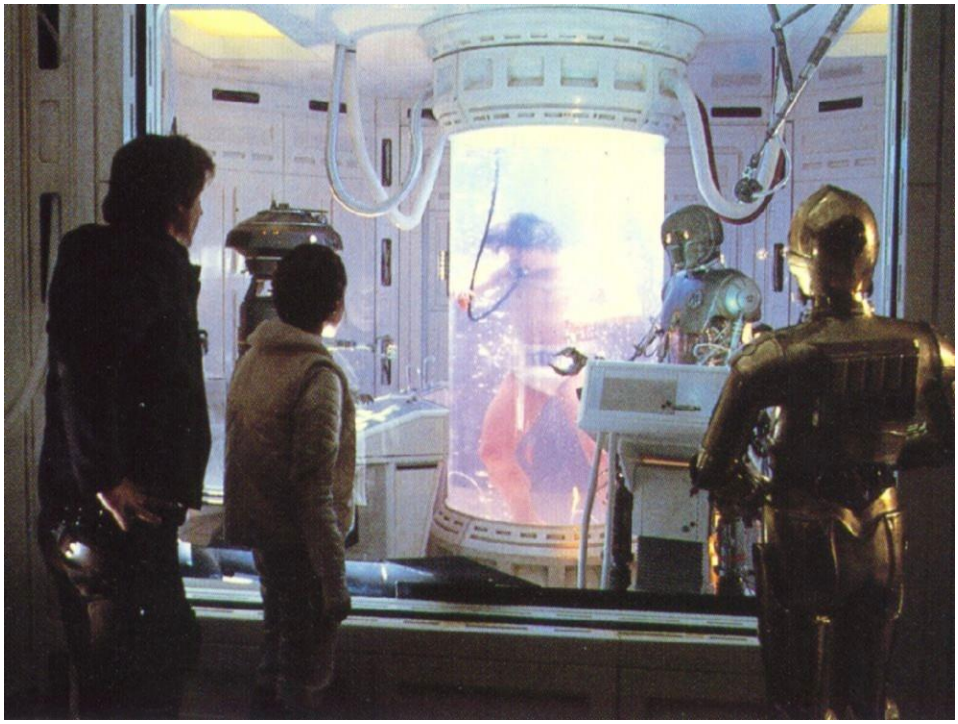
Southern Glazing ^

**V. Theme**

My intent is to create a lighting design that represents the use of the space to help connect the occupants to the architecture. I think the strongest aspect of what the college is doing is the surgical demonstrations and mock-up lab testing. The eastern training facility contains mock surgical rooms where doctors are trained in new procedures. To test the doctors, the college uses life-like manikins to perform surgery on. The manikins contain all of the insides of a human complete with blood vessels, organs, and fluids. Even the skin is realistic in that they must cut it open to get inside.

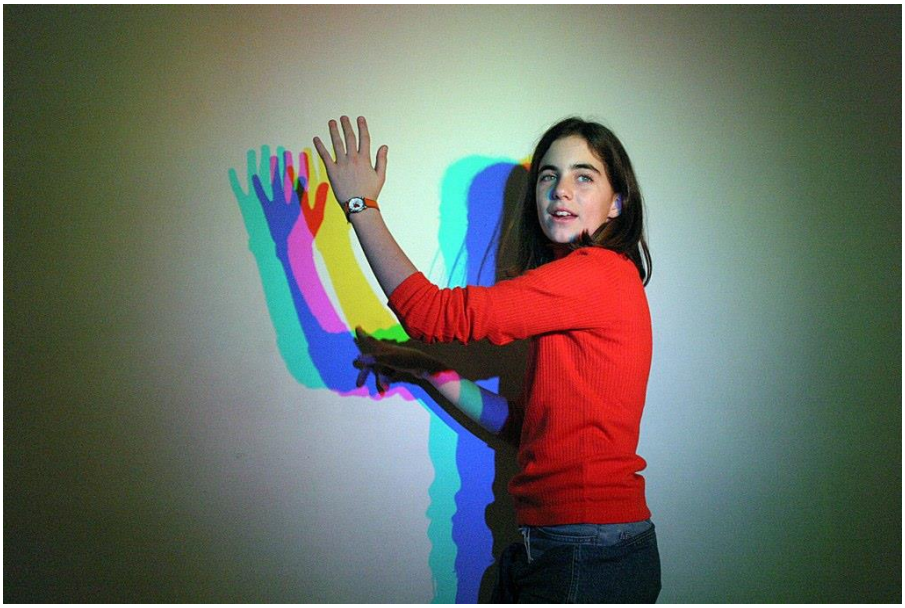
Furthermore, the surgical rooms have an adjacent room with a one way window connecting them visually. This allows the college professors to observe how well the training physicians are doing with their practice. There is a computer in the dark room which controls the manikin's bodily functions and can trigger cardiac arrest or a variety of other complications which the doctor in training must respond too. At the end of the session the professors provide feedback and a pass/fail. This training facility is one of the most realistic training environments for physicians.

I would like to use the idea of fluids and tubes in other areas of the building. I feel like the manikin figure is really the center point of the college facilities and can be related closely to the college's goal of training expert physicians. I think I could implement tubes with fluid in different parts of the building specifically the lobby.



These could even be made visible from the outside and illuminated by daylight for part of the day. The tubes could have different colors of fluid inside which would cast interesting shadows on the floor. The idea of these tubes sounds futuristic and sci-fi, but I think that the human body is quite unknown and complex and the tubes would convey that very well.

In some way I also want to incorporate the multiple shadow effect of which many LED fixtures cause. Using an RGB LED strip light one can create multicolor shadows caused by the many different color point sources. I think this is a interesting property of LED lighting that should be embraced and not eliminated. The use of multicolored shadows could be used to highlight how different parts of the body come together to form the individual person. Also, they could represent how we are all the combination of many different backgrounds but still we are all human. I think since this is a college for human physicians it makes sense to highlight the human shadow.




1 LEVEL 01 LIGHTING RCP - AREA A
SCALE: 1/8" = 1'-0"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THIS DRAWING INDICATES GENERAL LAYOUT AND DESIGN OF LIGHTING SYSTEMS. REVIEW BY A QUALIFIED ENGINEER IS NECESSARY TO ASSURE SAFETY AND CODE COMPLIANCE.

| REVISION | | DATE |
|---|---|---|
| 1 | ISSUED FOR PERMIT | 01/11/2013 |
| 2 | FOR BID AND PREPARE GMP | 02/15/2013 |
| 3 | GMP SUPPLEMENTAL | 03/08/2013 |

DATE: 11 JAN 2013
SCALE: AS NOTED
DRAWN BY: GK/ES
APPROVED BY: GP
PROJECT #: 1240.00

# LEVEL 01 LIGHTING RCP AREA A

LD05-01A


DRAWING NAME: LD1-10 PLOTTED BY: ERIC SISCO DATE PLOTTED: 8-Mar-13 SCALE: 0.998004


1 LEVEL 01 LIGHTING RCP - AREA B
SCALE: 1/8" = 1'-0"


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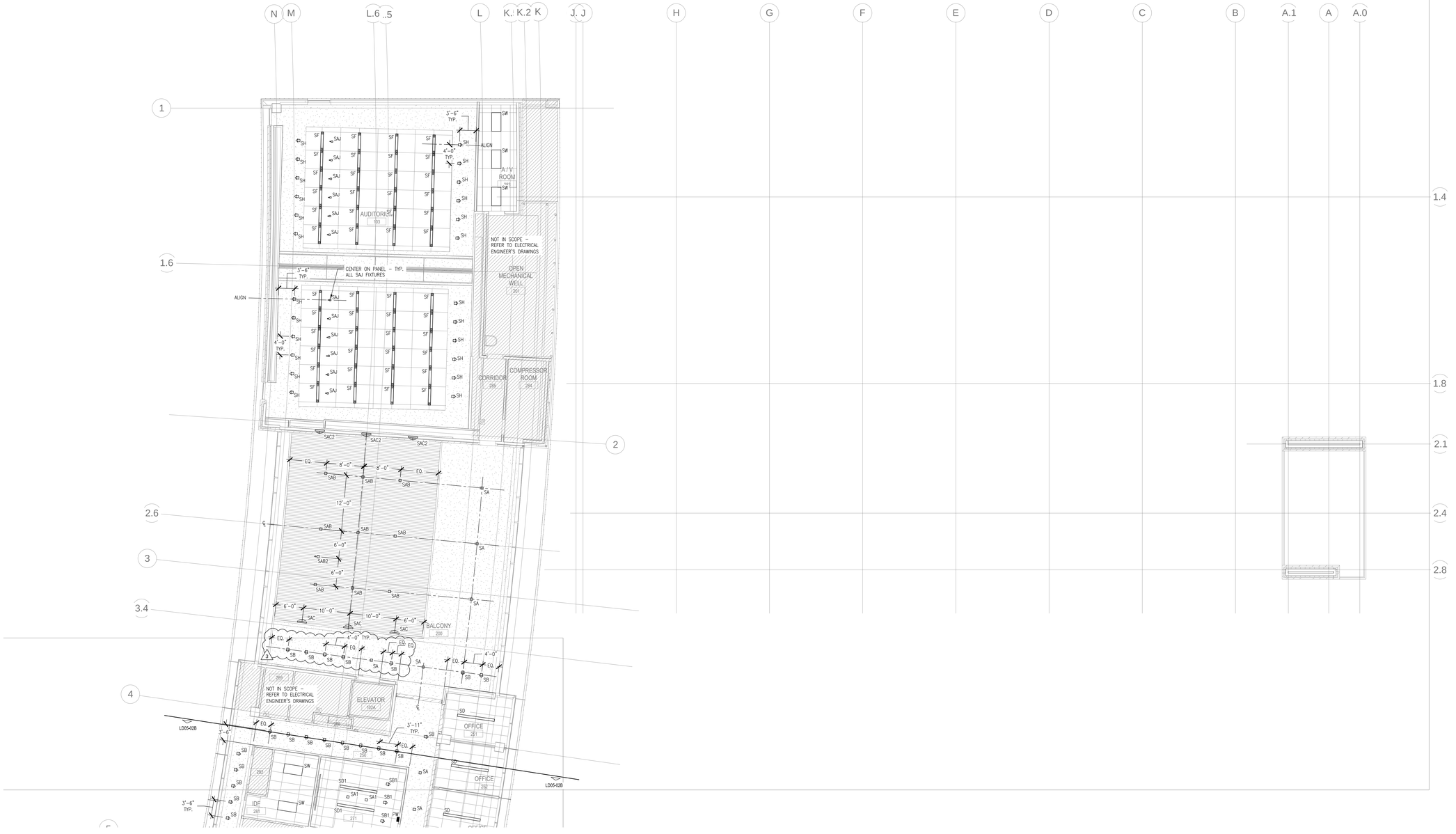
DATE: 11 JAN 2013
SCALE: AS NOTED
DRAWN BY: GK/ES
APPROVED BY: GP
PROJECT #: 1240.00

# LEVEL 01 LIGHTING RCP AREA B

LD05-01B


DRAWING NAME: LD1-10 PLOTTED BY: ERIC SISCO DATE PLOTTED: 8-Mar-13 SCALE: 0.598158




1 LEVEL 02 LIGHTING RCP - AREA A
SCALE: 1/8" = 1'-0"

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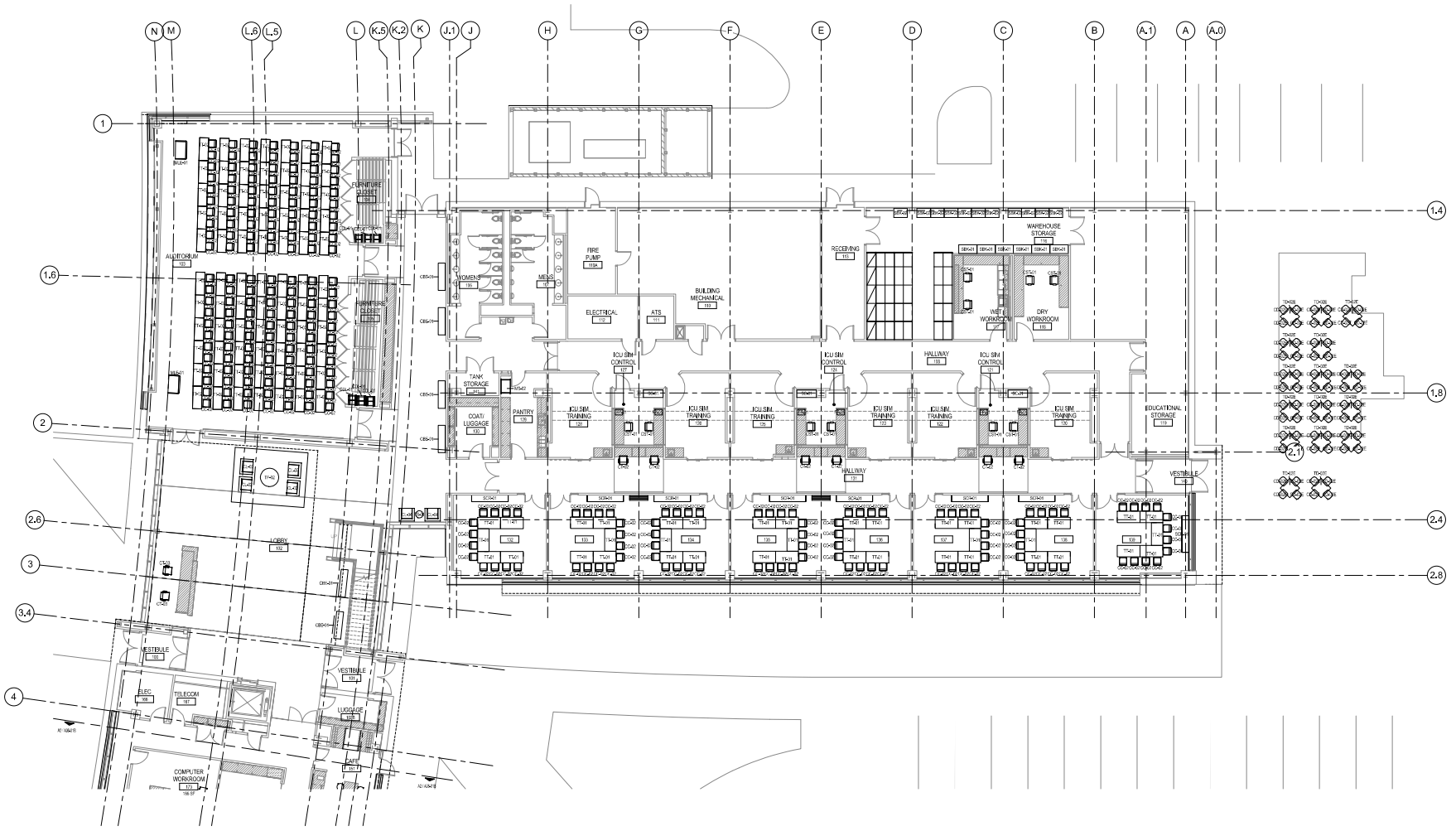
DATE: 11 JAN 2013
SCALE: AS NOTED
DRAWN BY: GK/ES
APPROVED BY: GP
PROJECT #: 1240.00

# LEVEL 02 LIGHTING RCP AREA A

LD05-02A

DRAWING NAME: LD1-20 PLOTTED BY: ERIC SISCO DATE PLOTTED: 8-Mar-13 SCALE: 0.598158




A2 LEVEL 01 FURNITURE - AREA A
1/8" = 1'-0"

**FOR REFERENCE ONLY**

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KEYPLAN

**ISSUED FOR CONSTRUCTION**

**20 MAR 2013**

| NO | ISSUE | DATE |
|---|---|---|
| 3 | ISSUED FOR CONSTRUCTION | 20MAR13 |
| 2 | ISSUED FOR SUBMITTAL PERMIT & CNP | 23JAN13 |
| 1 | CD REVIEW SET | 21DEC12 |

Level 01 Finish Floor Elevation of 0'-0" = 10828 National Geodetic Vertical Datum (NGVD29) of 641.52'

**Sheet Information**

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| Job Number | 021920.000 |
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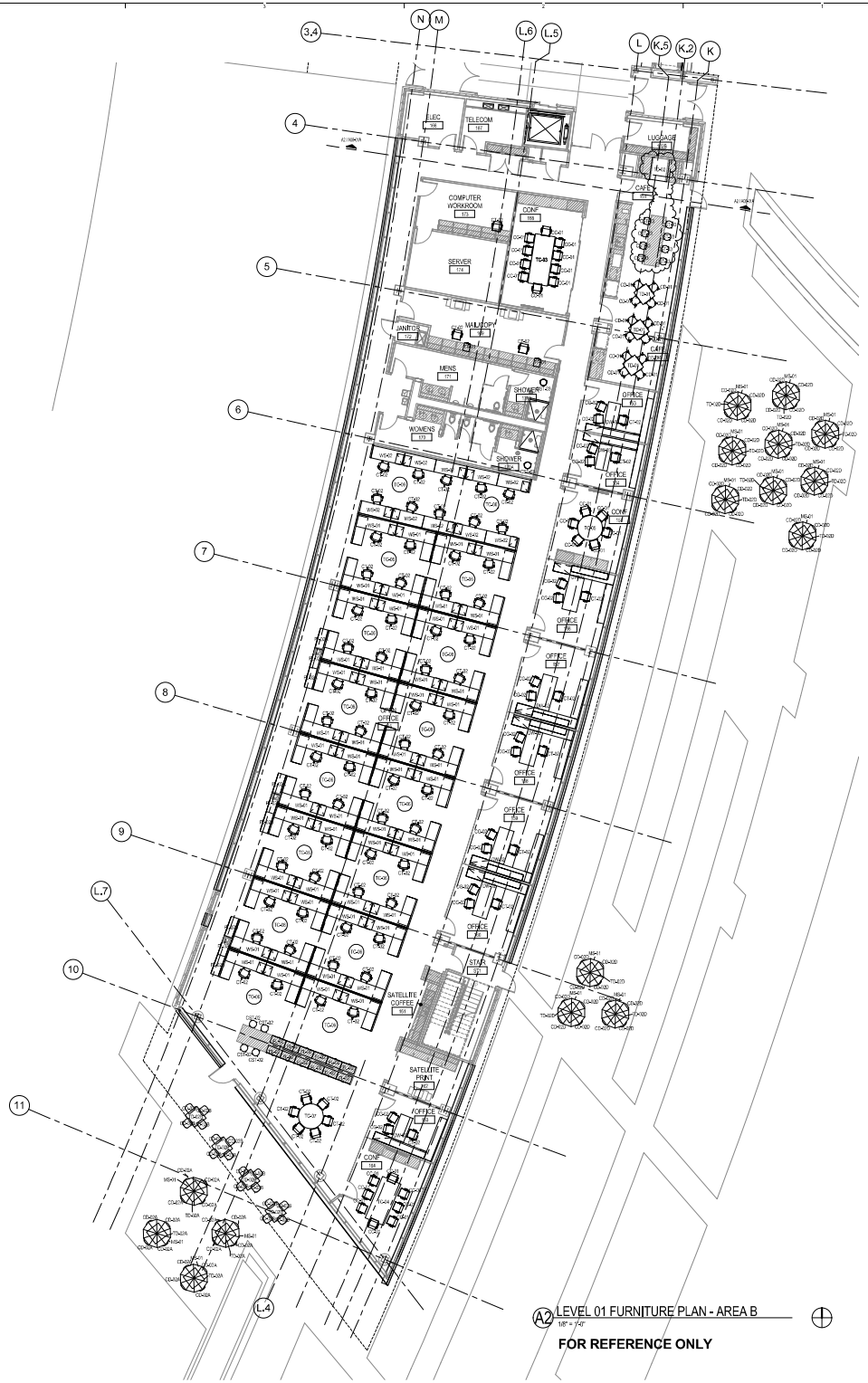
| Checked | Checker |
| Approved | Approver |

Title

**LEVEL 01 FURNITURE PLAN - AREA A**

Sheet

**A08-01A**




A2 LEVEL 01 FURNITURE PLAN - AREA B

1/8" = 1'-0"

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KEYPLAN

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| NO | ISSUE | DATE |
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| 5 | ISSUED FOR CONSTRUCTION | 20MAR13 |
| 4 | ADDENDUM NO. 3 | 08FEB13 |
| 3 | ISSUED FOR BUILDING PERMIT & GMP | 23JAN13 |
| 2 | CD SET REVISIT | 21DEC12 |
| 1 | DESIGN DEVELOPMENT | 14DEC12 |

**Level 01 Finish Floor Elevation of 0'-0" = 10928 National Geodetic Vertical Datum (NGVD29) of 641.50'**

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**LEVEL 01 FURNITURE PLAN - AREA B**

Sheet

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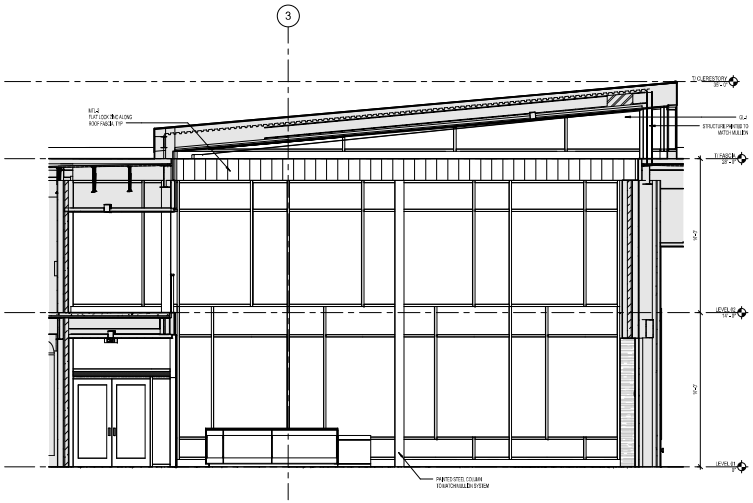
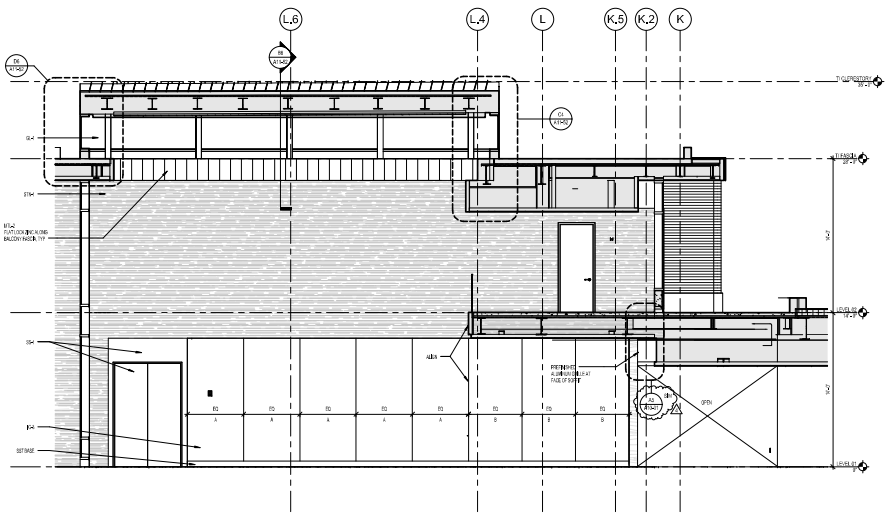



C5 WEST LOBBY ELEVATION
1/4" = 1'-0"




C3 NORTH LOBBY ELEVATION
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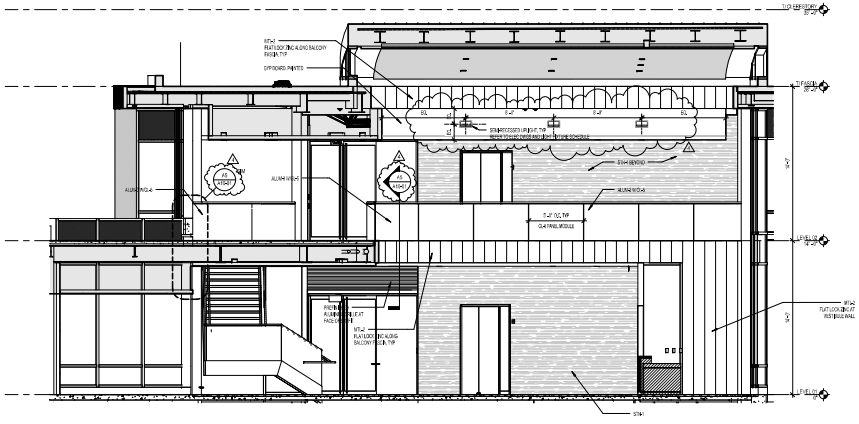


A5 SOUTH LOBBY ELEVATION
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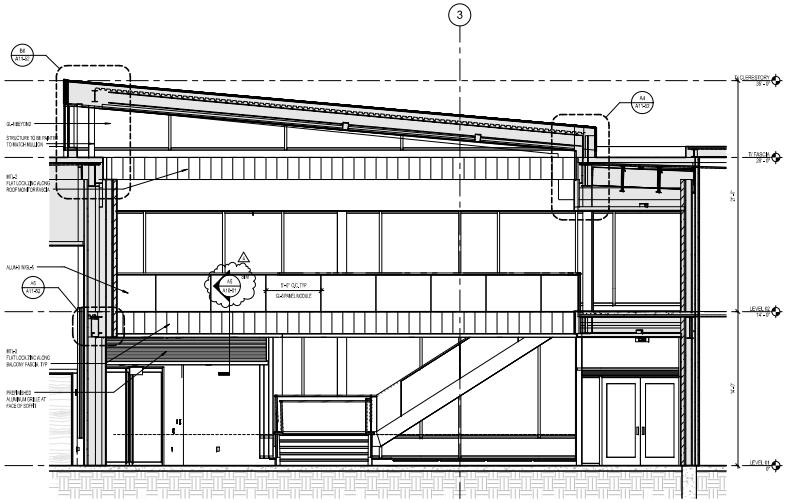


A3 NORTH / SOUTH LOBBY SECTION
1/4" = 1'-0"

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**20 MAR 2013**

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| 1 | CD REVIEW SET | 21DEC12 |

Level 01 Finish Floor Elevation of 0'-0" = 596'8 National Geodetic Vertical Datum (NGVD29) of 641.50'

**Sheet Information**

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|---|---|
| Job Number | 121002.000 |
| Drawn | BT |
| Checked | BT |
| Approved | JG |

Title

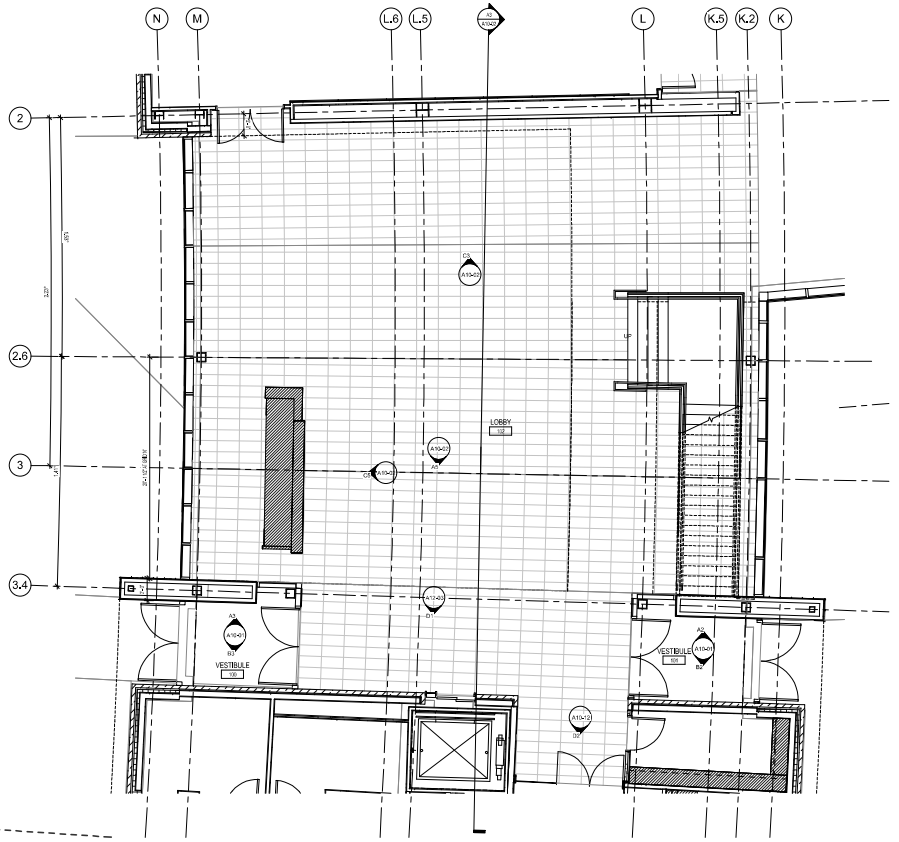
**INTERIOR ELEVATIONS - LOBBY**

Sheet

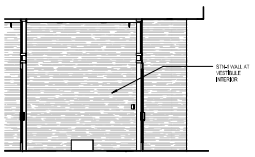
**A10-02**

D5 LOBBY PERSPECTIVE

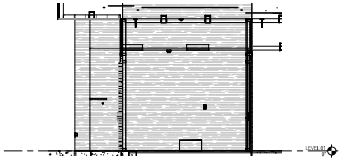
C5 LOBBY PERSPECTIVE



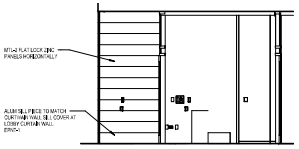

C3 LEVEL 01 LOBBY
1/4" = 1'-0"



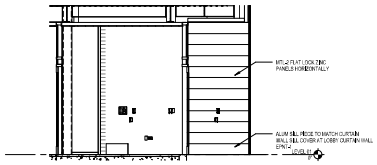

B3 NORTH ELEVATION - VETIBULE 100
1/4" = 1'-0"



B2 NORTH ELEVATION - VESTIBULE 101
1/4" = 1'-0"




A3 SOUTH ELEVATION - VESTIBULE 100
1/4" = 1'-0"




A2 SOUTH ELEVATION - VESTIBULE 101
1/4" = 1'-0"

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**ISSUED FOR CONSTRUCTION**

**20 MAR 2013**

| NO | ISSUE | DATE |
|---|---|---|
| 3 | ISSUED FOR CONSTRUCTION | 20MAR13 |
| 2 | ISSUED FOR SUBMITTAL PERMIT & CNP | 22JAN13 |
| 1 | CD REVIEW SET | 21DEC12 |

**Level 01 Finish Floor Elevation of 0'-0" = 1062ft National Geodetic Vertical Datum (NGVD29) of 641.35'**

**Sheet Information**

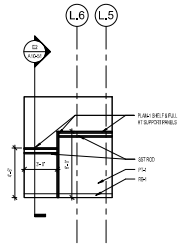
| | |
|---|---|
| Job Number | 021602.000 |
| Drawn | BT |
| Checked | BT |
| Approved | JG |

**Title**

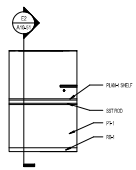
**ENLARGED PLANS & INTERIOR ELEVATIONS - LOBBY**

Sheet

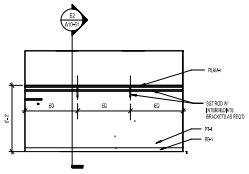
**A10-01**



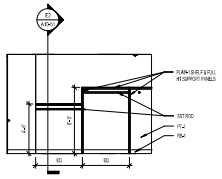

E6 COATS 175 & 268 (SIM) ELEVATION
1/4" = 1'-0"



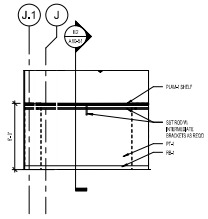
E5 LUGGAGE ROOM 102B EAST ELEVATION
1/4" = 1'-0"



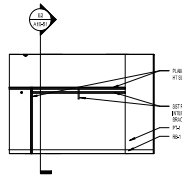
E4 LUGGAGE ROOM 102B SOUTH ELEVATION
1/4" = 1'-0"



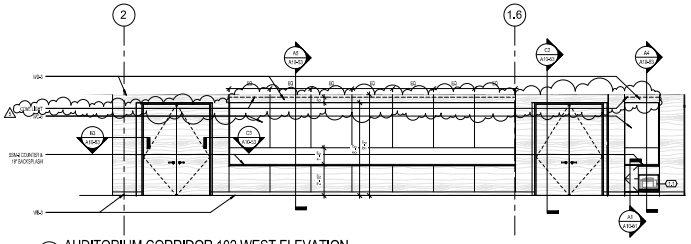
E3 COAT/LUGGAGE 130 WEST ELEVATION
1/4" = 1'-0"



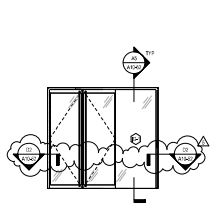

E2 COAT/LUGGAGE 130 NORTH ELEVATION
1/4" = 1'-0"

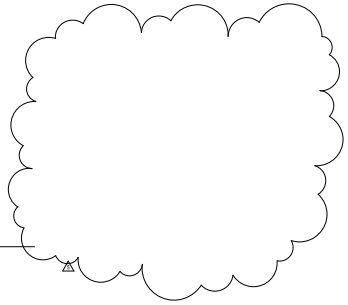


E1 COAT/LUGGAGE 130 EAST ELEVATION
1/4" = 1'-0"

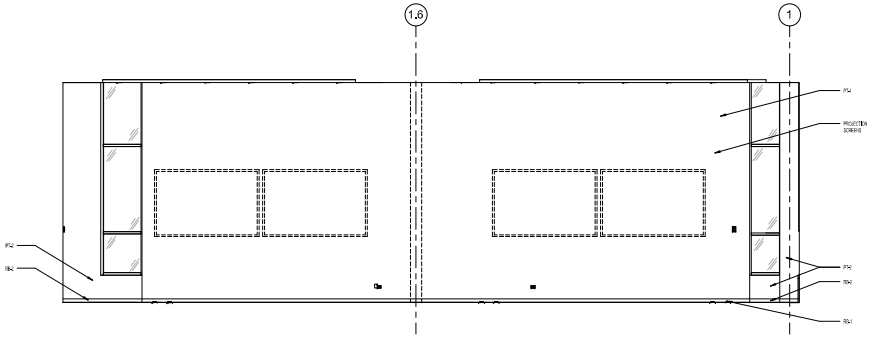



D5 AUDITORIUM CORRIDOR 102 WEST ELEVATION
1/4" = 1'-0"

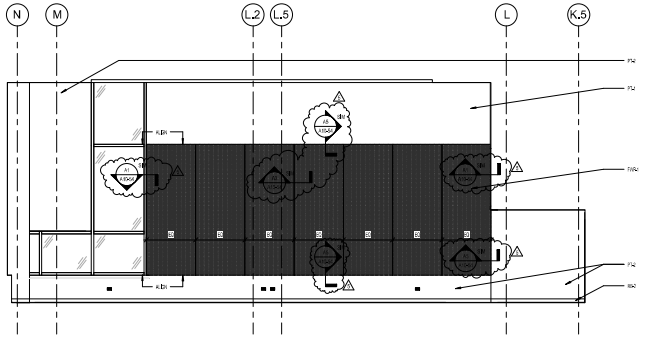




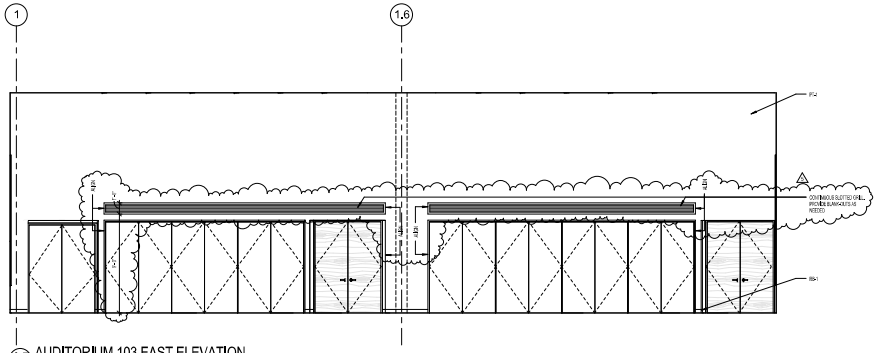
D2 LEVEL 01 & 02 OFFICE WING ENTRY ELEVATION
1/4" = 1'-0"



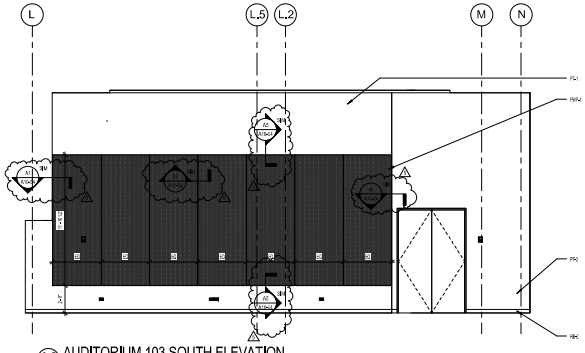

B4 AUDITORIUM 103 WEST ELEVATION
1/4" = 1'-0"




B2 AUDITORIUM 103 NORTH ELEVATION
1/4" = 1'-0"




A5 AUDITORIUM 103 EAST ELEVATION
1/4" = 1'-0"




A2 AUDITORIUM 103 SOUTH ELEVATION
1/4" = 1'-0"

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1.312.944.2207

**ISSUED FOR CONSTRUCTION**

**20 MAR 2013**

| NO | ISSUE | DATE |
|---|---|---|
| 5 | ISSUED FOR CONSTRUCTION | 20MAR13 |
| 4 | ADDENDUM NO. 3 | 08FEB13 |
| 3 | ISSUED FOR BUILDING PERMIT & GMP | 23JAN13 |
| 2 | CD RETAIN SET | 21DEC12 |
| 1 | DESIGN DEVELOPMENT | 14DEP12 |

Level 01 Finish Floor Elevation of 0'-0" = 1062ft National Geodetic Vertical Datum (NGVD29) of 641.52'

**Sheet Information**

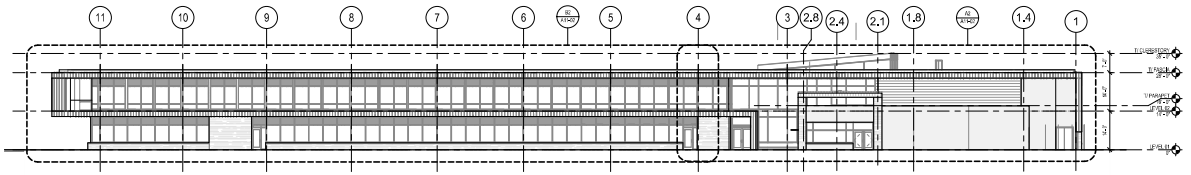
| | |
|---|---|
| Job Number | 071602.000 |
| Drawn | Author |
| Checked | Checker |
| Approved | Approver |

Title

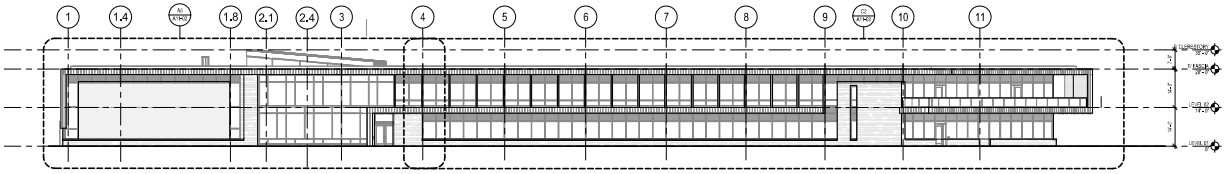
**INTERIOR ELEVATIONS**

Sheet

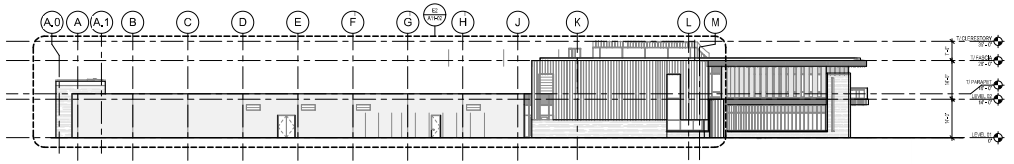
**A10-12**



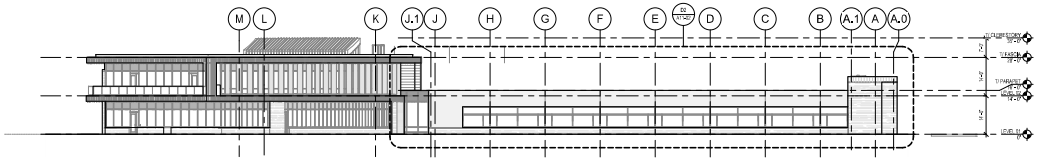

D2 EAST ELEVATION
1/16" = 1'-0"




C2 WEST ELEVATION
1/16" = 1'-0"




B2 NORTH ELEVATION
1/16" = 1'-0"




A2 SOUTH ELEVATION
1/16" = 1'-0"

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GENERAL NOTES :

1. REFER TO SHEET A00-20 FOR GENERAL NOTES.

2. REFER TO SHEET A00-22 FOR EXTERIOR MATERIAL LEGEND AND RELATED NOTES.

**ISSUED FOR CONSTRUCTION**

**20 MAR 2013**

| NO | ISSUE | DATE |
|---|---|---|
| 6 | ISSUED FOR CONSTRUCTION | 20MAR13 |
| 5 | ISSUED FOR BUILDING PERMIT & CNP | 23JAN13 |
| 4 | CD REVIEW SET | 21DEC12 |
| 3 | STRUCT STEEL PKG - FABRICATION MNG | 19DEC12 |
| 2 | ISSUED FOR FOUNDATION PERMITTING | 02OCT12 |
| 1 | DESIGN DEVELOPMENT | 14SEP12 |

Level 01 Finish Floor Elevation of 0'-0" = 1393ft National Geodetic Vertical Datum (NGVD29) of 641.52'

| Sheet Information | |
|---|---|
| Job Number | 071902.000 |
| Drawn | CDP |
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| Approved | JG |

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**EXTERIOR OVERALL BUILDING ELEVATIONS**

Sheet

**A11-01**



3/20/2013 1:05:47 PM