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Laboratory for structural testing of resilient and sustainable systems (STReSS Laboratory)

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- *Ryan Hutchins, Peter Menke (Project Manager), and Sam Nehamkin (Project Superintendant), Gilbane Building Company*
- *Al Spagnolo, Steve Cunningham, Peter Darby, and Keith O'Reilly, Spagnolo Gisness & Associates, Inc., Architects*
- *Mark Aho, McNamara/Salvia, Structural Engineer*
- *Paul Fimian, AHA Consulting Engineers, Mechanical, Electrical, Plumbing Engineer*
- *Peter Cheever, Eric Hines, Strong Floor Design Engineer*
- *Tim Harvey, Concrete Contractor, Francis Harvey and Sons, Inc., Concrete Contractor*

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ABSTRACT

This report summarizes the features and specifications for the Laboratory for Structural Testing of Resilient and Sustainable Systems (STReSS Laboratory). The laboratory was constructed as part of the George J. Kostas Research Institute for Homeland Security on the Burlington Campus of Northeastern University. The laboratory is used for coupled experimental, computational, and field investigations across several disciplines of civil engineering, mechanical engineering, engineering mechanics, biomechanics, materials science, architecture, and related fields. Drawings of the facility and ancillary test results from the construction of the strong floor are included in appendices.

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LABORATORY FOR STRUCTURAL TESTING OF RESILIENT AND SUSTAINABLE SYSTEMS (STReSS Laboratory)

1. Introduction

The Laboratory for Structural Testing of Resilient and Sustainable Systems (STReSS Laboratory) has been constructed on the Burlington Campus of Northeastern University as part of the George J. Kostas Research Institute for Homeland Security. The laboratory is used for coupled experimental and computational research required across several disciplines including civil engineering, mechanical engineering, engineering mechanics, biomechanics, materials science, architecture, and related fields.

The STReSS Laboratory has the capability to conduct multi-scale experimental testing and coupled computational simulations on innovative materials, components, and systems. These capabilities include static, dynamic, and hybrid (integrated experimental and computational) simulation.

The project team who designed the laboratory from Northeastern University included, from the Department of Civil and Environmental Engineering, Jerome F. Hajjar, Professor and Chair, Mehrdad Sasani, Associate Professor, David Whelpley, Laboratory Manager, and Michael MacNeil, Laboratory Technician; from the College of Engineering, David Luzzi, Dean, and David Navick, Associate Dean for Administration and Finance; and from Facilities, Nancy May, Vice President of Facilities, and Ed Duffy, Project Manager. The project team for the Kostas Institute included:

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2. Specifications

The specifications for the laboratory are presented below in two categories: Structural and Building Facility, and Basic Equipment. See the drawings of the facility in Appendix 1 for further information. In addition, more detailed as-built drawings and specifications are available from the Department of Civil and Environmental Engineering.

2.1. Structural and Building Facility

The STReSS Laboratory comprises the following facilities:

1) **Strong Floor** (Appendix 1, Drawing TS1.1, TS2.1): The strong floor is a 2000 ft^2 (approximately 60' by 35') 4' thick solid concrete slab. The strong floor is reinforced with #11 bars at 12" spacing in both directions; #4 bars at 12" spacing above the top layer of #11 bars are used to establish a positioning grid for initial placement of the strong floor anchors. There is a regular grid of tie-down anchors (26 anchors labeled A through Z running east to west, and 16 anchors labeled 1 to 16 running south to north) that permit the attachment of fixtures to the floor for conducting a wide range of tests. Each anchor point comprises a single threaded hole with a center-to-center spacing of 24" in both directions (see Figure 1). Each threaded hole has a 4½" diameter removable top cap. This removable cap screws into a 1¾" thick double threaded removable coupler from Williams that sits in a 4" diameter, 10½" long steel can. The length of the steel coupler is 10". A 1¾" diameter threaded Williams bar extends from the base of the slab into the steel can with an engagement length of 5", or approximately half the length of the coupler. This arrangement allows the coupler to be changed, so long as a coupler can be manufactured that has half of the threads suitable for the 1¾" Williams bar with a 5" embedment length. Couplers up to 2" diameter are possible, thus allowing lower strength bars such as ASTM A193 Grade B7 bars to be used (e.g., ¾" diameter for hand tightening, 1¼" diameter for torque wrench tightening, and 2" for supernut tightening). On the underside of the steel can there is a ¼" thick neoprene gasket surrounding the Williams bar and a 1¾" lock nut beneath the neoprene gasket. The Williams bar extends 2'-8 3/8" into concrete and sits in a positioning device anchored to mud slab at the bottom of the strong floor to allow aligning of the tie-downs during construction. One inch above the connection with the positioning device there is an anchor nut attached to a 1¾" thick square bearing plate that is 9"x 9". This bearing plate withstands uplift when the bar is pulled in tension. Detailed drawings of this anchor assembly are given below. During an experiment, fixtures are connected to the Williams bar. As the test is performed, the bar stretches and distributes the force acting on it to the concrete slab via the square bearing plate. As the bar stretches, the neoprene gasket contracts; this provides enough additional length to the bar for stretching without damaging the steel can. In addition, the upper 12" of this bar, just below the steel can, has a plastic pipe around it to ensure no contact with the concrete. This enables the bar to stretch in tension without damaging the concrete immediately below the steel can and around the neoprene gasket. Each hole is capable of withstanding 200 kips in tension on a regular basis (with a 280 kip maximum strength). Florhard was used on the concrete floor surface to ensure a coefficient of friction above 0.5 to 0.6. Assuming a coefficient of friction of 0.5, the allowable design strength is 100 kips in shear in any direction. A 6" square distribution of compressive load is

sufficient to resist a 200 kip compressive load in bearing. Therefore, to ensure that any tension load does not start to disengage with the floor, if a bar is assumed to be tensioned to 200 kips, then the allowable resistance of each hole may be taken as 100 kips in shear, tension, and compression, with larger loads in tension and compression permissible via appropriate calculations.

Horizontal displacement tolerance and tilt tolerance of the anchors are given as 1/8" and 0.1° respectively. Section 3 documents how the accuracy of these anchor locations was checked. The positioning devices on the mud slab were placed by the contractor to achieve accuracy with respect to position and tilt. Concrete pouring was completed in three layers in the strong floor area. During this process, the horizontal displacement tolerance was checked several times by the contractor to ensure that horizontal displacement measurements were within tolerance limits. The placement of the grid of holes was achieved by first installing wood boards around the perimeter of strong floor area. Strings were attached to nails that were nailed into the wood boards such that the strings formed a grid over strong floor area, with the strings being placed 2' on center within 1/32". The crossing point of any two strings in two perpendicular directions was thus intended to correspond to the center point of matching anchor. Any anchors that moved during the pouring were adjusted by the contractor at the conclusion of the pouring of the second concrete layer. Workers adjusted the anchors by wrapping wire around them and attaching the wire to the nearby reinforcing grid until the center of the anchors were aligned with the crossing point of strings..

For pouring of the first, second and third layers, 11, 12 and 6 concrete trucks were used, respectively. The first layer was poured in 1½ hours, the second layer was poured in 2 hours, and the third layer was finished within an hour. Concrete test cylinders were prepared by using a small batch of concrete from each concrete truck. These cylinders were later tested at 7, 14, 28, 56, 90 and 360 days. Average values for completed compressive strength test and split tensile test are given in Table 1 and Table 2.

Appendices 2 and 3 present the ancillary tests of the concrete cylinders for the strong floor and staging area. The cylinder tests were conducted by Briggs Engineering & Testing Company according to ASTM standards. The cylinders had 8" of height and 4" of diameter and were either lab-cured or field cured. A summary of these results is included in Table 1.

Table 1. STReSS Laboratory Strong Concrete Material Strengths

a) Compressive Strength Test Results:

Curing (psi)	**7 day**	**28 day**	**56 day**	**90 day**	**180 day**
Lab cured	3051	4715	5414	5596	6805
Field cured	3404	5551	5883	5699	5852

b) Split-Cylinder Tensile Strength Test Results

Curing (psi)	7 day	28 day	56 day	90 day	180 day
Lab cured	307	426	495	495	623
Field cured	347	518	525	468	570

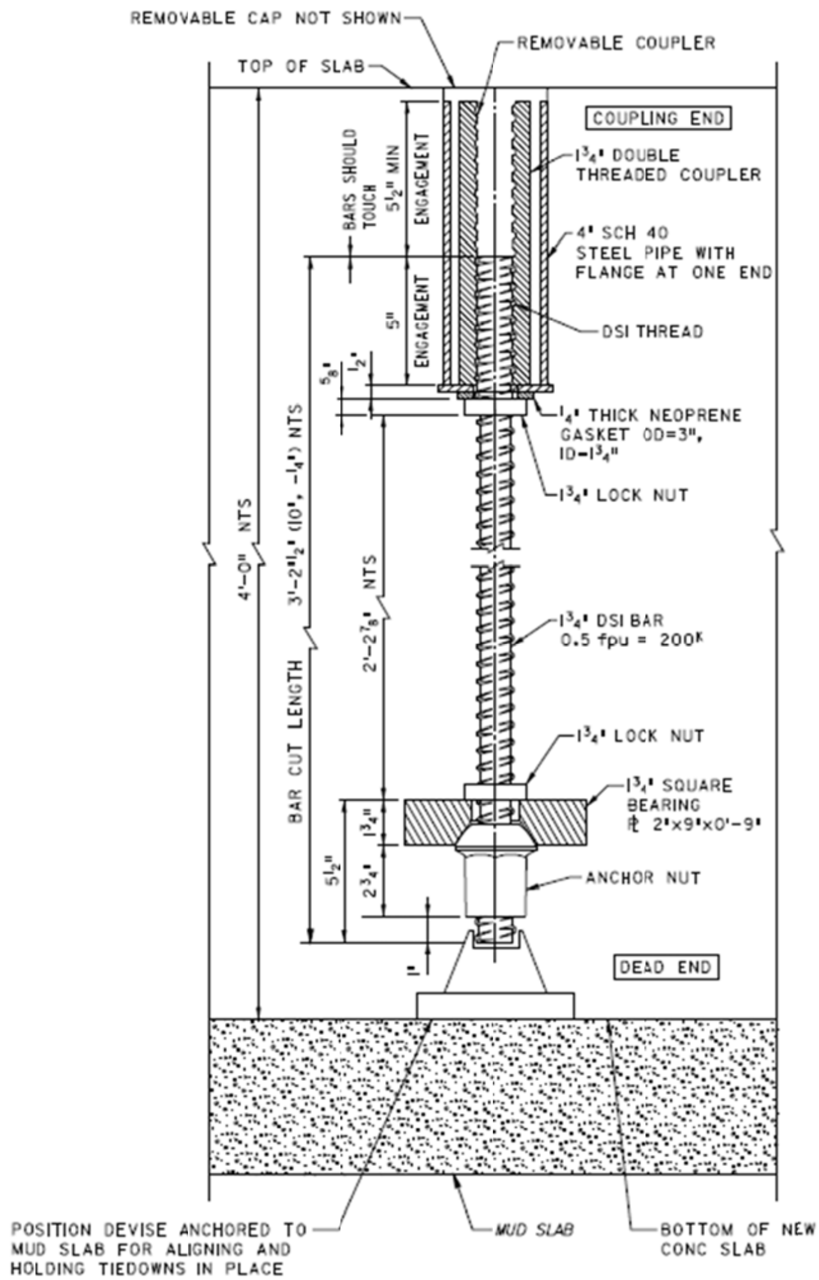


Figure 1. Detail of Strong Floor Tie-Down Anchor

2) **Staging Area** (Appendix 1, Drawing TA2.0, TA11.0): The 1000 ft^2 (approximately 30' by 35') staging area is provided as a specimen preparation area and storage area, including for use in mixing of concrete and welding of steel. The area has a stainless steel sink for washing tools, a water supply (hose), compressed air access, a sediment pit that may be dried by evaporation and cleaned out, and related facilities. The specimens may be carried into this area from the outside by a crane from the adjacent loading dock. There is a regular grid of anchor points that permit the attachment of fixtures to the floor (7 anchors running east to west, and 8 anchors running south to north). Each anchor point comprises a single threaded hole with a center-to-center spacing of 48 in. in both directions. Richmond SAE Ductile Embed (6/80) headed female anchors with a substantial bearing flange are used for the staging area. Each hole is capable of withstanding typical overturning moments and forces from fixtures or specimens attached during staged construction. The results of concrete cylinder tests are available in Appendix 2.

3) **Pump Area:** An area of 160 ft^2 is available near the southeast corner of the strong floor to house a hydraulic pump required to power hydraulic actuators and testing machines. There is a closed loop cooling water system for the pump, with the cooling system on the roof. The cooling system consists of a 1" make-up water line that connects to a capped connection in the pump area. There is also another ¾" make-up water line off a 1" pipe connected to the hydraulic pump cooling pipes with a valve for system refill.

4) **Truck Access / Loading Dock:** A 14'wide by 16' tall loading dock door coupled with the interior staging area offers semi-truck trailers the capability of loading and unloading directly into the staging area using the crane. There is sufficient space for maneuvering a 40-50 ft long specimen into the building. The loading dock is at the same elevation as the laboratory floor.

5) **Ventilation**: The laboratory's ventilation system is able to accommodate several continuous hours of arc welding or torching and allows the use of a propane-fueled fork lift.

6) **Shop:** There is a 260 ft^2 machine shop off the strong floor for structural, mechanical and electrical needs. This is adjacent to an electric utility room, in which the air compressor is housed.

7) **Control Room:** There is a control room off the strong floor with space for several tables for data acquisition equipment, controllers, computing equipment, and work areas for the staff, students, and faculty.

8) **Utilities:** Utilities on site include water, sewer, heating and cooling systems, electric power (with up to a 480 volt line for specialized power needs), and data and voice

communication lines. The panel board and special purpose receptacle schedules along with the associated drawing are available with the as-built drawings from the Department of Civil and Environmental Engineering; the schedules are shown below. Receptacles marked 2 and 5 are located at several locations around the south wall.

PANELBOARD SCHEDULE									
PANEL	VOLTAGE	MAINS	MLO/ MCB	MTG	BRANCH CIRCUIT BREAKERS		SPACES 1 P.	A.I.C. (RMS)	REMARKS
					ACTIVE	SPARE			
HDP411	277/480V 3ø,4W	800A	MLO	SURF	(2)250A-3P, (1)125A-3P (1)350A-3P	-	12	65K	
HP411	277/480V 3ø,4W	250A	MLO	SURF	(1)175A-2P (4)20A-1P, (3)15A-3P	-	27	65K	
HP412	277/480V 3ø,4W	250A	MLO	SURF	(1)100A-3P, (2)50A-3P (2)30A-3P, (2)20A-3P	-	21	65K	
HP212	120/208V 3ø,4W	250A	250A	SURF	(8)30A-2P, (8)30A-1P (10)20A-1P	-	8	10K	

SPECIAL PURPOSE RECEPTACLE SCHEDULE				
SYMBOL	NEMA	DESCRIPTION	CIRCUIT BREAKER	BRANCH CIRCUIT
(1)H	5-20R	20A - 125V, 2P, 3W	20A-1P	2#12 & 1#12G., - 1/2"C.
(2)H	5-30R	30A - 125V, 2P, 3W	30A-1P	2#10 & 1#10G., - 1/2"C.
(3)H	5-50R	50A - 125V, 2P, 3W	50A-1P	2#6 & 1#10G., - 3/4"C.
(4)H	6-20R	20A - 250V, 2P, 3W	20A-2P	2#12 & 1#12G., - 1/2"C.
(5)H	6-30R	30A - 250V, 2P, 3W	30A-2P	2#10 & 1#10G., - 1/2"C.
(6)H	6-50R	50A - 250V, 2P, 3W	50A-2P	2#6 & 1#10G., - 3/4"C.
(7)H	14-20R	20A - 125/250V, 3P, 4W	20A-2P	3#12 & 1#12G., - 1/2"C.
(8)H	14-30R	30A - 125/250V, 3P, 4W	30A-2P	3#10 & 1#10G., - 1/2"C.
(9)H	14-50R	50A - 125/250V, 3P, 4W	50A-2P	3#6 & 1#10G., - 3/4"C.
(10)H	14-60R	60A - 125/250V, 3P, 4W	60A-2P	3#6 & 1#10G., - 3/4"C.
(11)H	15-20R	20A - 250V, 3ø 3P, 4W	20A-3P	3#12 & 1#12G., - 1/2"C.
(12)H	15-30R	30A - 250V, 3ø 3P, 4W	30A-3P	3#10 & 1#10G., - 1/2"C.
(13)H	15-50R	50A - 250V, 3ø 3P, 4W	50A-3P	3#6 & 1#10G., - 3/4"C.
(14)H	15-60R	60A - 250V, 3ø 3P, 4W	60A-3P	3#6 & 1#10G., - 3/4"C.
(15)H	L5-20R	20A - 125V, 2P, 3W, TWIST LOCK	20A-1P	2#12 & 1#12G., - 1/2"C.
(16)H	L5-30R	30A - 125V, 2P, 3W, TWIST LOCK	30A-1P	2#10 & 1#10G., - 1/2"C.
(17)H	L6-15R	15A - 250V, 2P, 3W, TWIST LOCK	15A-2P	2#12 & 1#12G., - 1/2"C.
(18)H	L6-20R	20A - 250V, 2P, 3W, TWIST LOCK	20A-2P	2#12 & 1#12G., - 1/2"C.
(19)H	L6-30R	30A - 250V, 2P, 3W, TWIST LOCK	30A-2P	2#10 & 1#10G., - 1/2"C.

9) **Safety Equipment**: There is an emergency eye wash station in the staging area. Showers are also provided next to recycling area.

2.2. Basic Equipment

1) **Crane:** There is a double girder overhead crane by with a 20 ton (40,000 lb) capacity. It moves in two directions with remote control and variable speeds. The crane rail columns are braced off the building structure. The crane can access the edges of the laboratory and it has full access to the loading dock.

2) **Hydraulic Pump:** There is a hydraulic pump with a capacity of 120 GPM to power hydraulic actuators.

3) **Compressed Air:** A compressed air supply at 120 psi is available. The equipment that uses the compressed air includes jackhammers, impact wrenches, vibrators, and sandblasting equipment.

   Associated equipment includes:
   1. Minimum 75 CFM at 120 psi compressor.
   2. Compressed air lines and access manifolds at two locations.
   3. Hose reels, oiler and pressure reducer at each manifold.

3. Checks for Out-of-Tolerance and Out-of-Tilt Anchors

The strong floor of the STReSS Laboratory is shown in Figures 2 and 3.

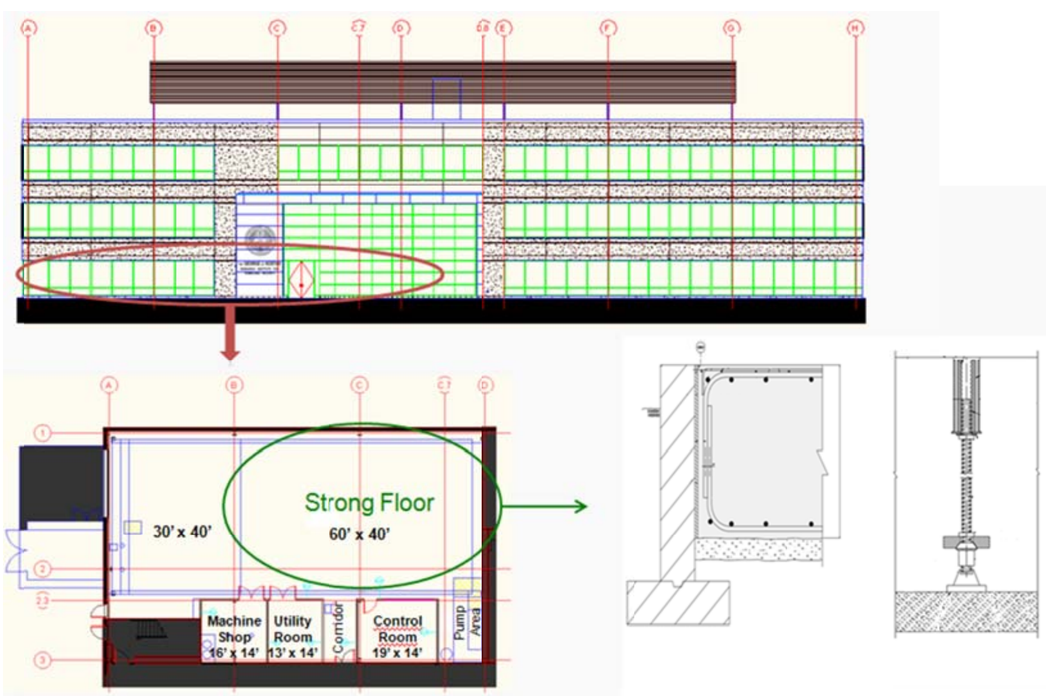


Figure 2. STReSS Laboratory Strong Floor Location

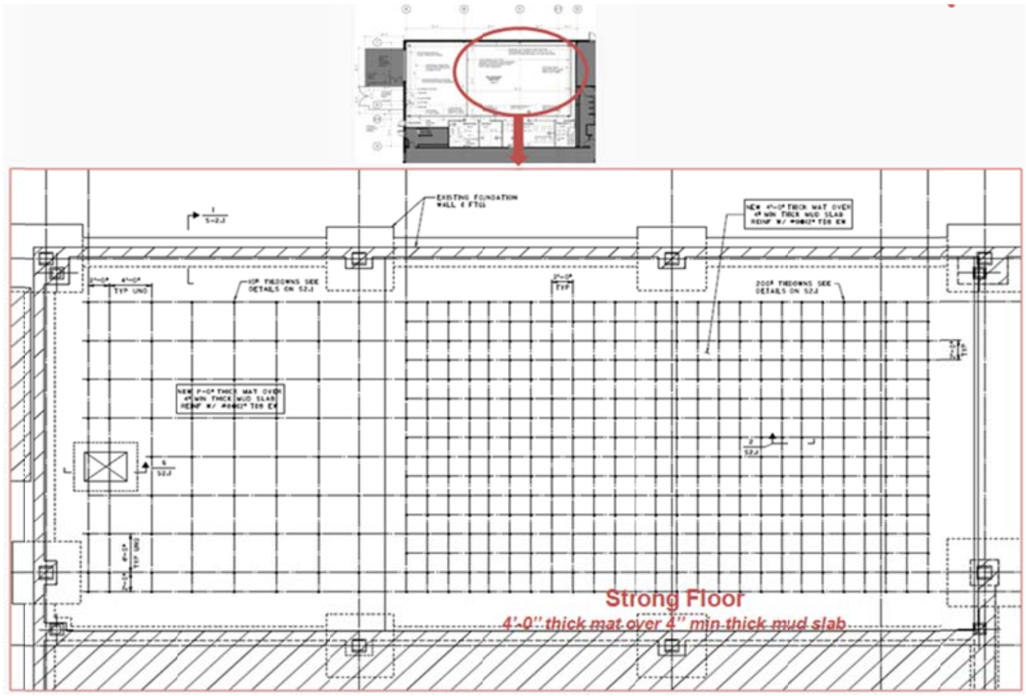


Figure 3. Strong Floor and Staging Area Grid Patterns

The accuracy of the anchor point location in the strong floor was checked after construction, addressing both the location and the tilt of the anchors. For the center point check, the anchors were labeled as shown in Figure 4.

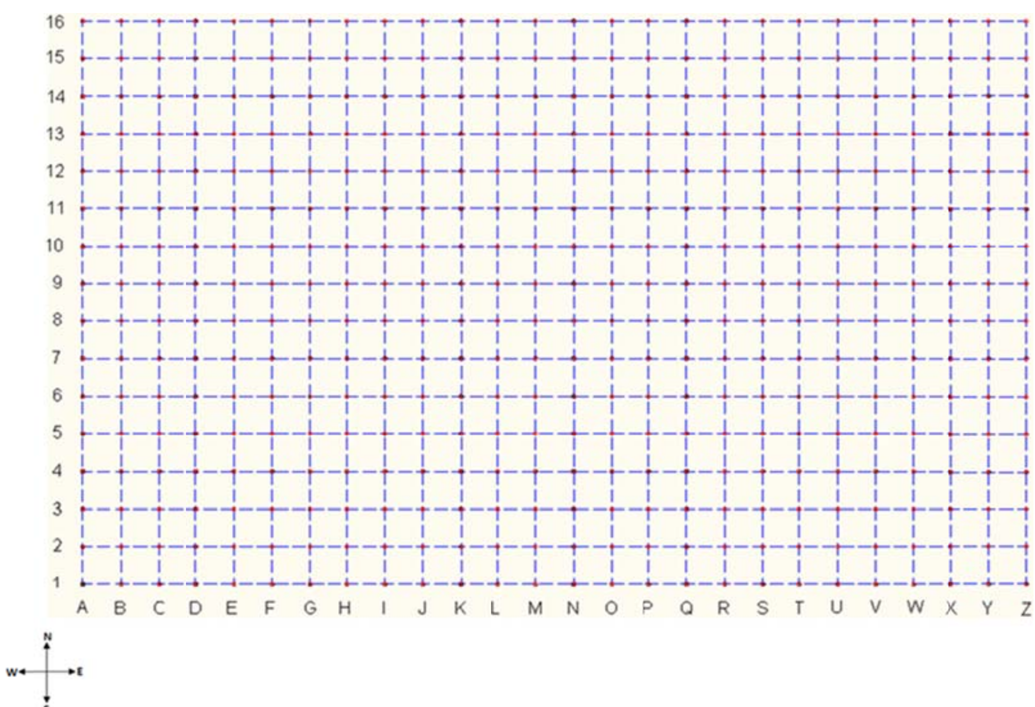


Figure 4. Label of the Grids

Reference lines were established by running string less than 1 mm in diameter from nails attached to the perimeter of the strong floor. The position of the strings was validated through repeated measurements to be 2' on center with an accuracy of less than 1/32". The benchmark string lines were the center two lines in each direction, with measurements being made from that point towards the perimeter of the strong floor. The benchmark lines themselves were set to minimize any out-of-tolerance errors on the holes along those lines.

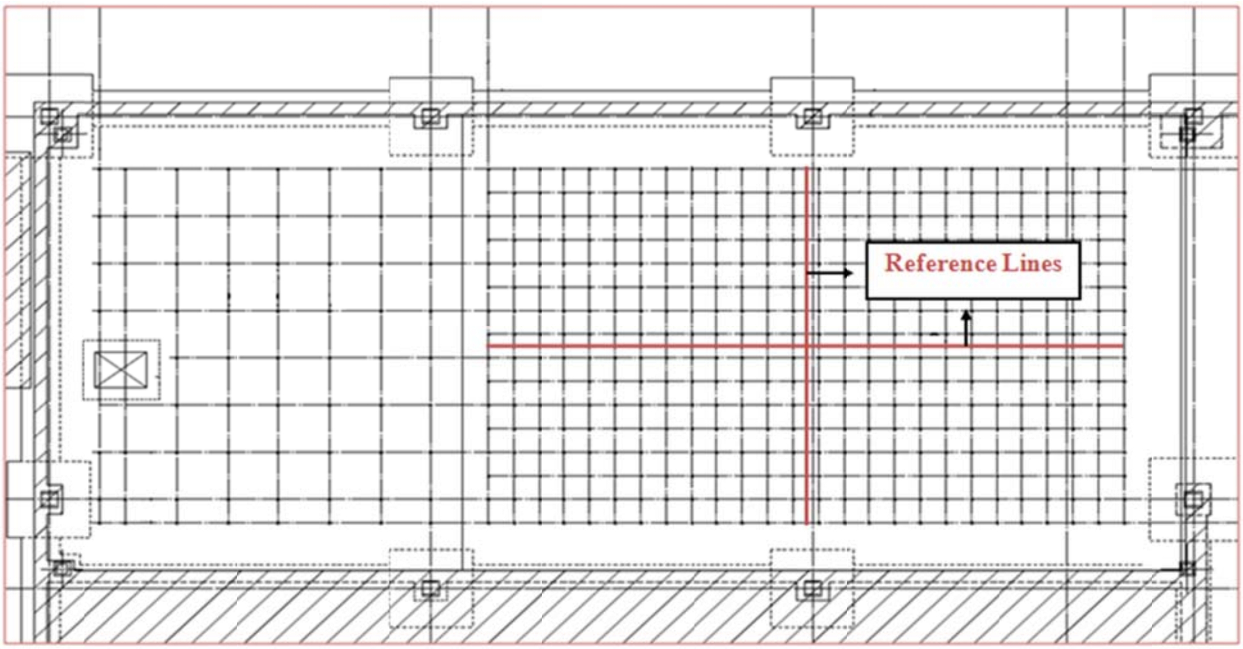


Figure 5. Benchmark Lines for Centerpoint Check of Anchor Holes

After the grid of strings was established, a 6.5" long Williams bar was placed in each hole. A centerpoint tip was screwed into the end of the Williams bar; the location of the hole for this centerpoint tip was machined by the university machine shop within approximately 1/1000" of the center point on the bar. The centerpoint location of each whole was then checked relative to the string. This check was made independently by two different teams, and the two benchmark lines in each direction were checked twice by each team to ensure the nails were positioned to minimize the error of these benchmarks. Readings were made within 1/64". If measurements between the two teams were off by more than 1/32", the holes were rechecked one more time, discrepancies were resolved, and a final measurement was determined.

In addition to rechecking the location of the anchors, the tilt of the anchors was checked independently to ensure they were all within a range of +/- 0.1˚. A tilt meter was placed on top of the 6.5" long Williams bar protruding from each anchor, and the tilt as recorded in the at rest position of the coupler. The couplers have significant ability to be moved and so it was then determined whether it was possible to wiggle the couplers such that the Williams bar was within tilt tolerance. All holes were found to be within tolerance except for three. The reason for the high degree of satisfying the tolerance is that there is significant play in the coupler and so it is possible to align the protruding bars to be accurate with respect to tilt.

A second set of horizontal measurements was then conducted simultaneously with a second set of tilt tests. All holes that were found to be out-of-tolerance originally were re-measured by re-setting the strings associated with the holes (based on using markings on the wood support boards around the perimeter of the strong floor, which were marked to identify the strong locations). The 6.5" long Williams bar was first made to be within tilt tolerance and then was held in place by a custom fixture while the horizontal location was measured.

The error in location associated with each anchor was then considered assuming a 1¾" diameter anchor is used with a 5/16" oversize hole. Any out-of-tolerance was identified within 1/32''. An example of how these tolerances were reported is shown in Figure 6.

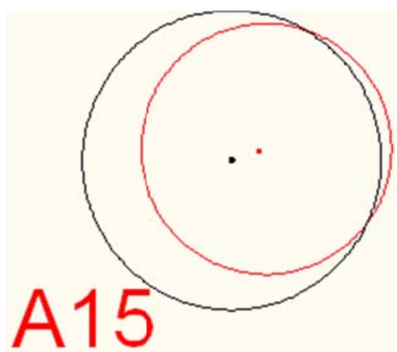


Figure 6. Out-of-tolerance Hole in Strong Floor

The black hole represents a 1.75" + 5/16'' diameter hole and the black point is the center of this hole, assumed to be at dead center for this anchor location. The red line represents a 1.75'' diameter bar protruding from the coupler in the anchor at its measured location. After the first round of measurements were taken to establish hole location, there were 22 out-of-tolerance points by this measurement. The hole diameter was then changed to 1.75" + 6/16", and 3 points were out-of-tolerance. For 1.75"+7/16''diameter holes, there were no anchors that were out-of-tolerance. These results are shown in Appendix 4.

After the second round of measurements were taken to establish hole location simultaneously with tilt, in which only the 22 holes identified as being out-of-tolerance in the first round of measurements were reassessed, there were 17 points out of tolerance by 1.75" + 5/16", as shown in Figure 7. The three holes that were out-of—tile are shown in Figure 8, which shows the best tilt values available for those holes

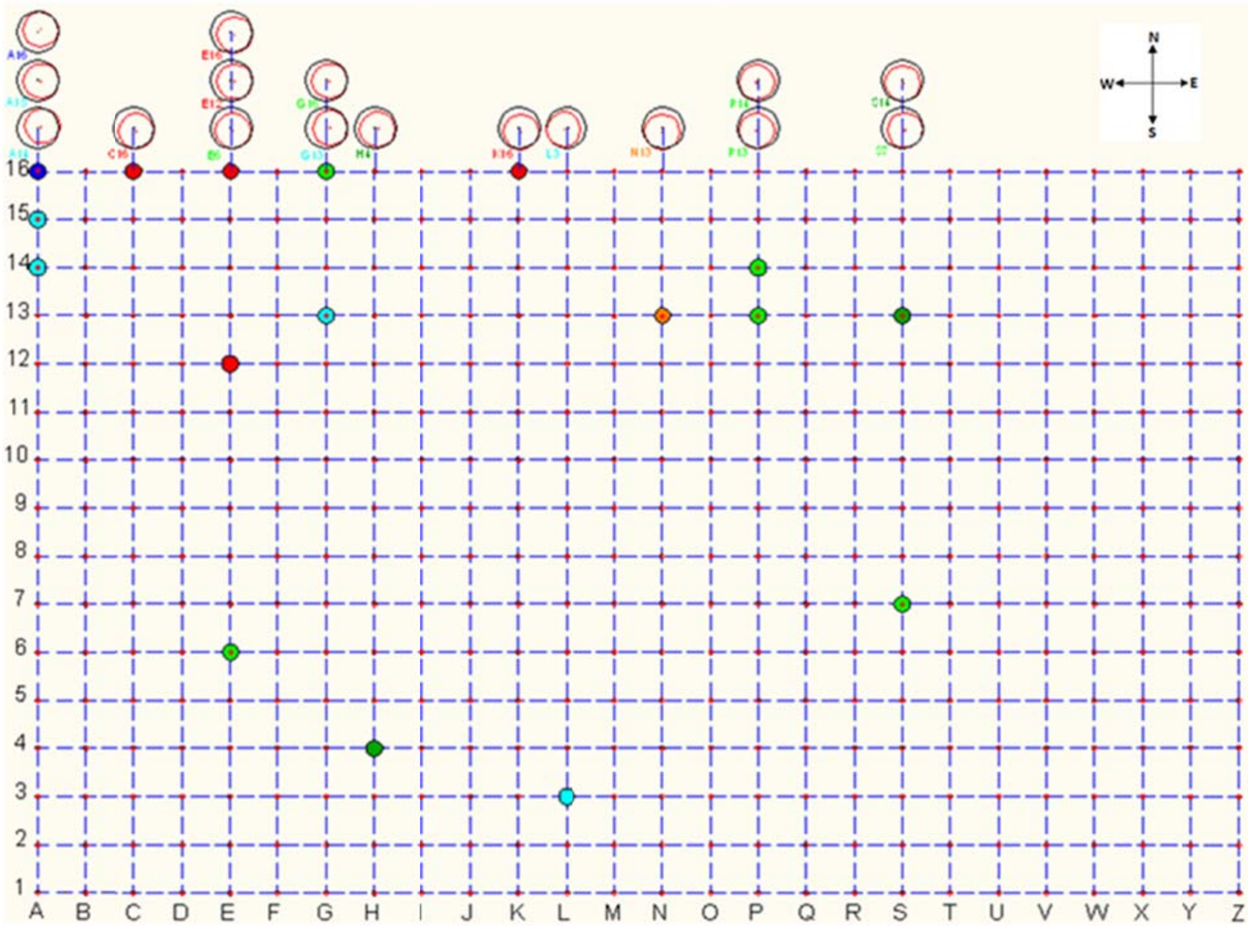


Figure 7. Out-of-Tolerance Holes with Hole Diameter 1.75”+5/16’’ Simultaneously with 0˚ Tilt

Further details are provided in Appendix 4.

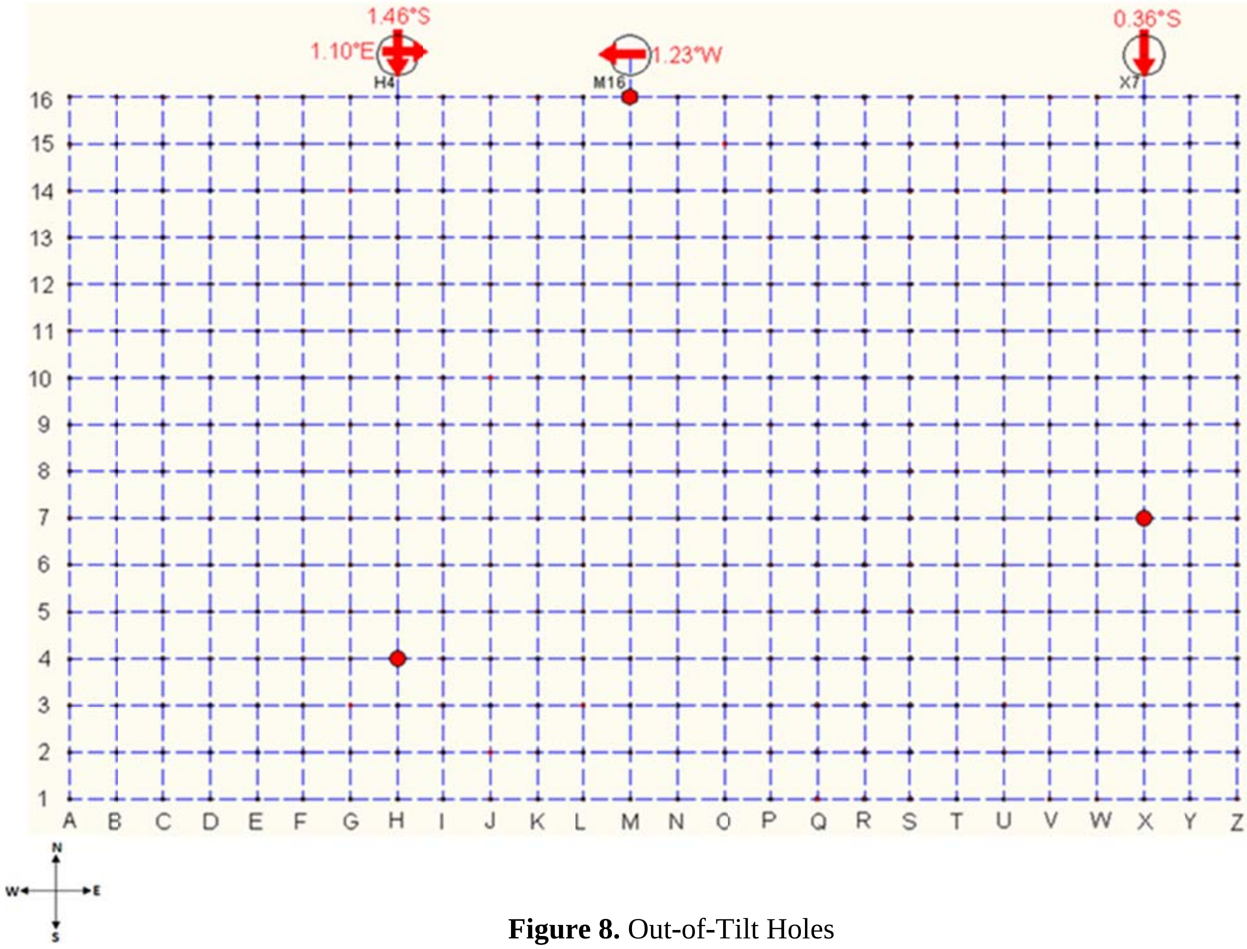
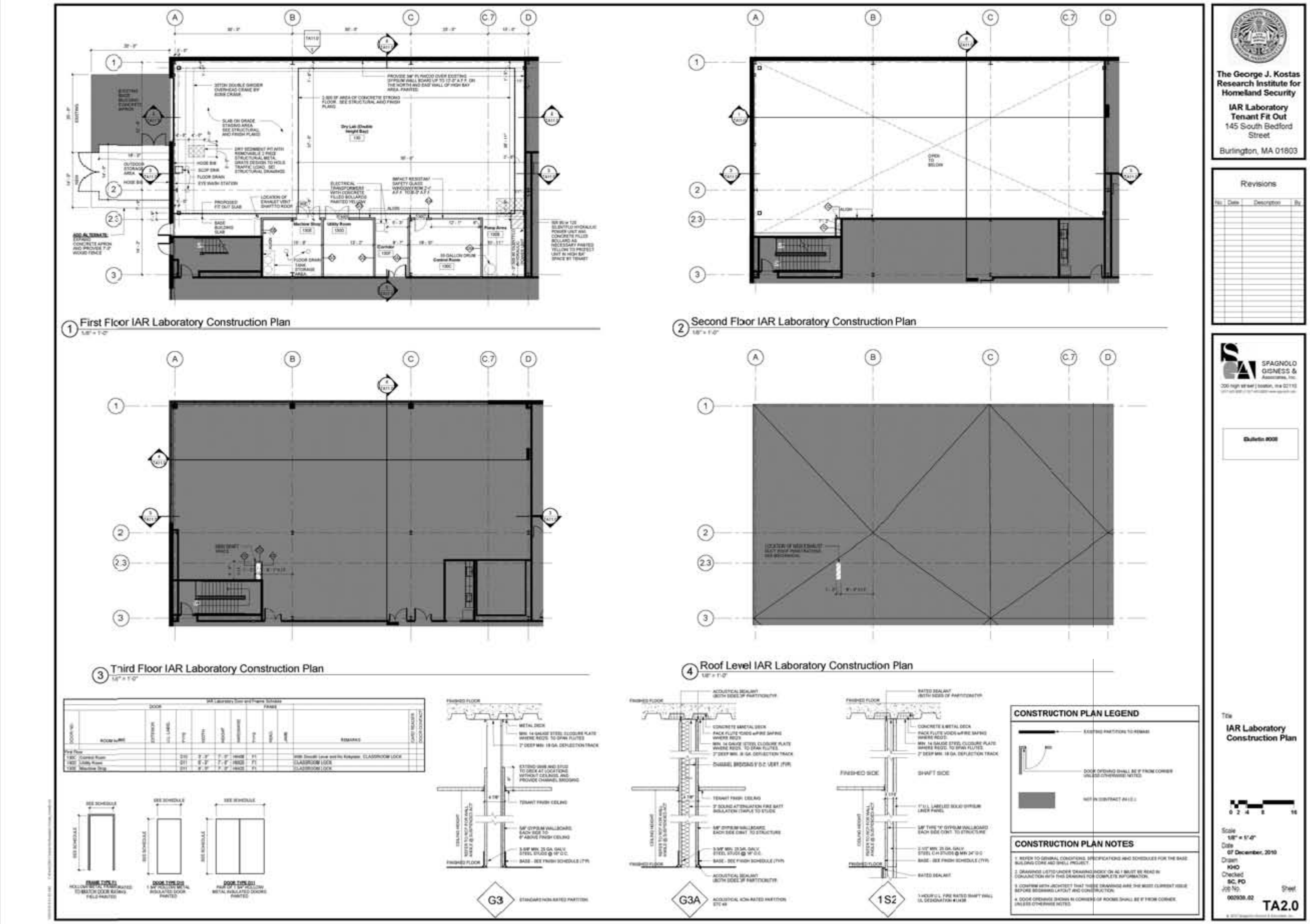


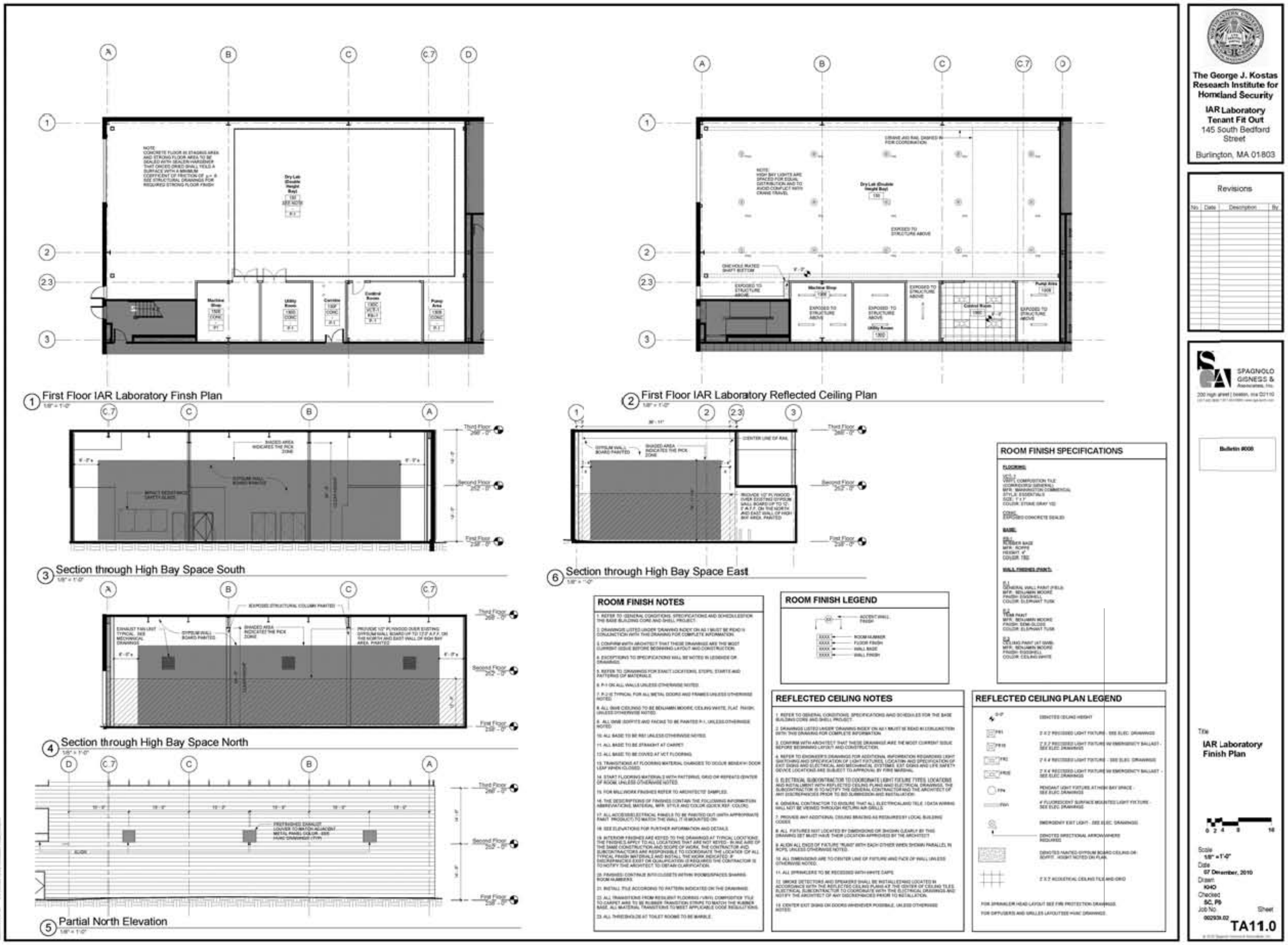
Figure 8. Out-of-Tilt Holes

Appendices

Appendix 1. Facility Drawings

The record drawings of Laboratory for Structural Testing of Resilient and Sustainable Systems are below:


First Floor IAR Laboratory Construction Plan
Second Floor IAR Laboratory Construction Plan
Third Floor IAR Laboratory Construction Plan
Roof Level IAR Laboratory Construction Plan
CONSTRUCTION PLAN LEGEND
CONSTRUCTION PLAN NOTES
The George J. Kostas Research Institute for Homeland Security
IAR Laboratory Tenant Fit Out
145 South Bedford Street
Burlington, MA 01803
Revisions
SPAGNOLO GISNESS & Associates, Inc.
IAR Laboratory Construction Plan
07 December, 2010
TA2.0
G3
G3A
1S2



The George J. Kostas Research Institute for Homeland Security
IAR Laboratory Tenant Fit Out
145 South Bedford Street
Burlington, MA 01803
Revisions
SPAGNOLO GISNESS &
First Floor IAR Laboratory Finsh Plan
First Floor IAR Laboratory Reflected Ceiling Plan
Section through High Bay Space South
Section through High Bay Space East
Section through High Bay Space North
Partial North Elevation
ROOM FINISH SPECIFICATIONS
ROOM FINISH NOTES
ROOM FINISH LEGEND
REFLECTED CEILING NOTES
REFLECTED CEILING PLAN LEGEND
Title
IAR Laboratory Finish Plan
Scale
Date
07 December, 2010
Drawn
KHO
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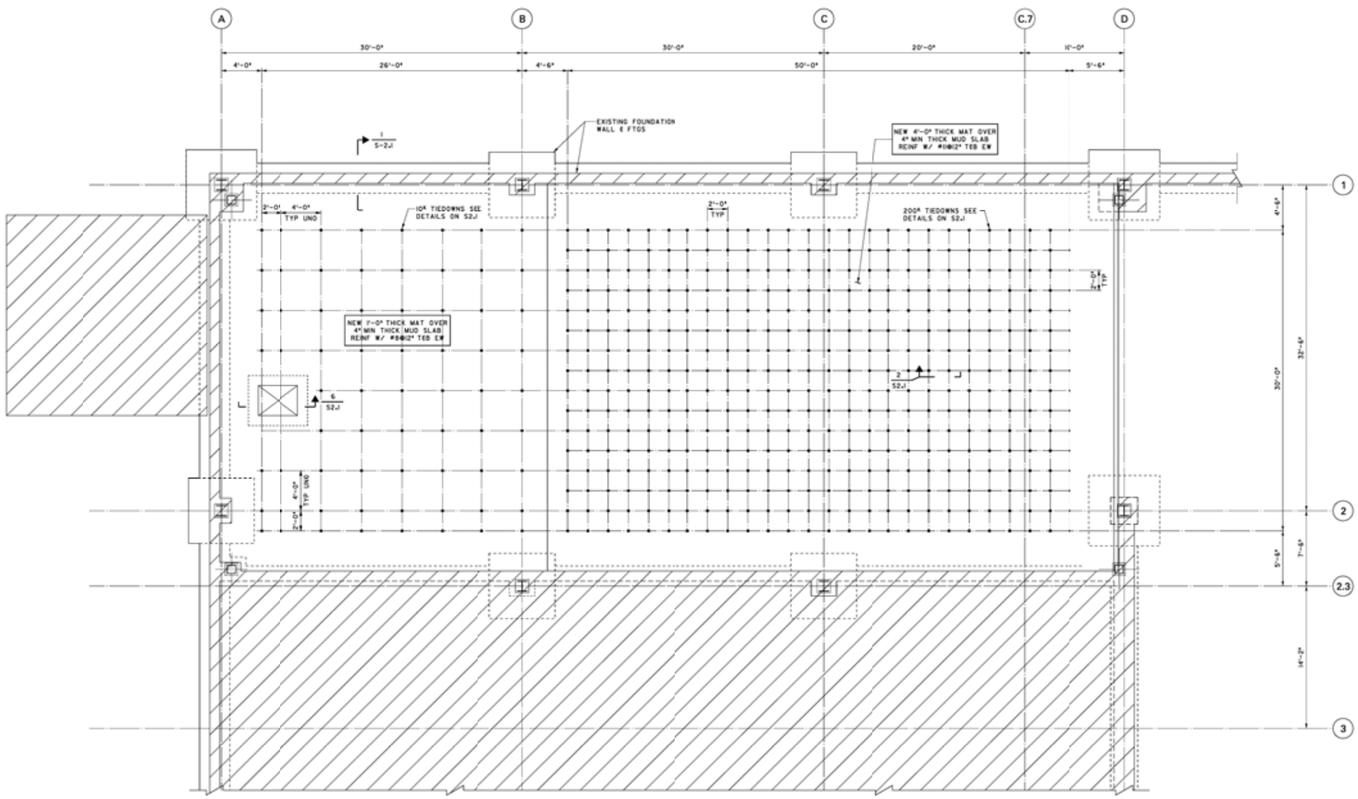


GENERAL NOTES:

1. CONCRETE FOR STRONG FLOOR AND LOADING BAY TO HAVE A 28 DAY COMPRESSIVE STRENGTH =@= 5000 PSI NWC.
2. MIX DESIGN FOR CONCRETE SHALL BE A LOW HEAT GENERATING MIX WITH W/C RATIO < .40.
3. CONCRETE STRONG FLOOR SHALL BE CONTINUOUSLY MOIST CURED FOR 28 DAYS. TIEDOWNS SHALL BE CORROSION CONCRETE STRONG FLOPROTECTED DURING CURING AND CONSTRUCTION, FINISHED TIEDOWNS AND CAPS SHALL BE FREE FROM CORROSION.
4. SUBGRADE FOR STRONG FLOOR SHALL HAVE AN ALLOWABLE BEARING OF 8 KSF.
5. FOR FINISHED FLOOR ELEVATIONS, SEE ARCHT DRAWINGS.
6. CONCRETE SEALER FOR STRING FLOOR AND LOADING BAY SHALL YEILD A SURFACE WITH A MINIMUM COEFFICIENT OF FRICTION μ=.6.
7. INSTALL TIEDOWNS TO ±1/8" HORIZ, ±1/16" VERT, ±0.1 TILT.
8. REINFORCING BARS SHALL BE CONTINUOUS, WITH NO SPLICES.
9. MOCK-UPS REQUIRED FOR SER, ARCHITECT AND OWNER TO APPROVE FINISH AT TIEDOWNS BOTH FOR STAGING AREA AND DRY LAB.

The George J. Kostas Research Institute for Homeland Security

IAR Laboratory
Tenant Fit Out
145 South Bedford Street

Burlington, MA 01803

Revisions

No.	Date	Description	By

SPAGNOLO GISNESS & Associates, Inc.
200 high street | boston, ma 02110

LeMessurier Consultants, Inc.
STRUCTURAL ENGINEERS
675 MASSACHUSETTS AVENUE
CAMBRIDGE, MASSACHUSETTS 02139-3309

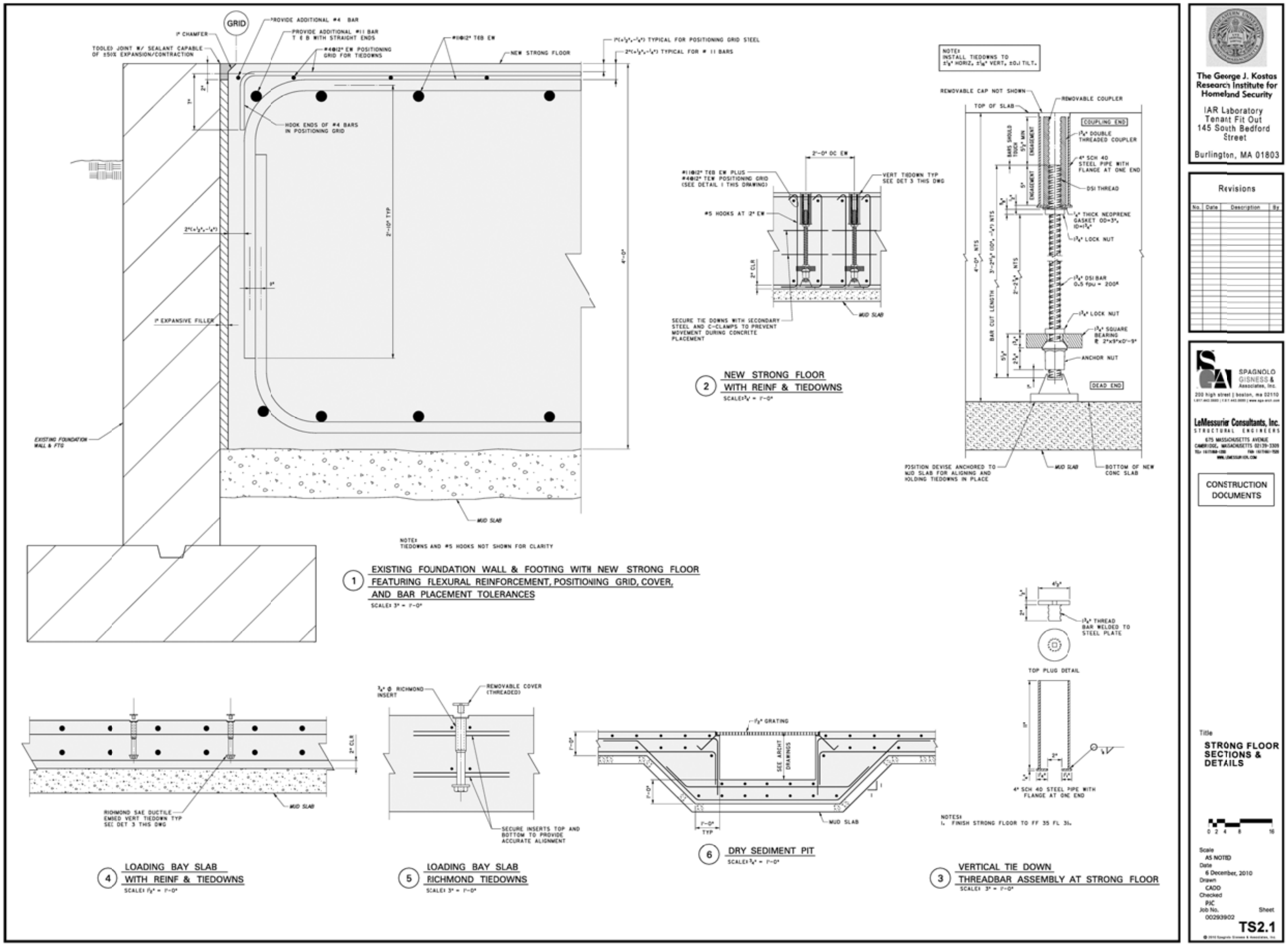
CONSTRUCTION DOCUMENTS

PROJECT NORTH
TRUE NORTH

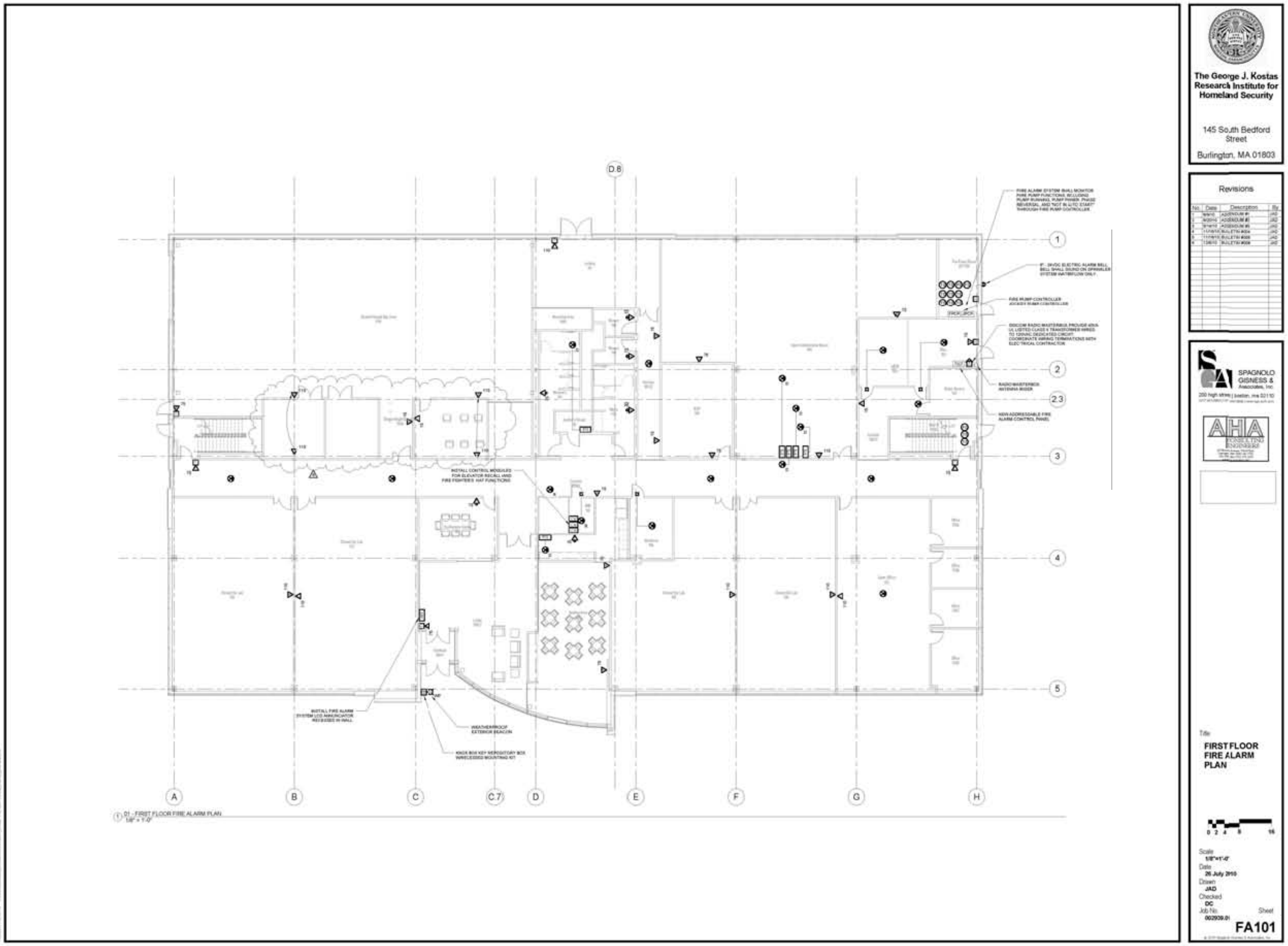
Title
PART-PLAN STRONG FLOOR FRAMING PLAN

0 2 4 8 16

Scale
1/4" = 1'-0"
Date
6 December, 2010
Drawn
CADD
Checked
PIC
Job No.
000939.02
Sheet
TS1.1



GRID
NEW STRONG FLOOR
HOOK ENDS OF #4 BARS IN POSITIONING GRID
1" EXPANSIVE FILLER
EXISTING FOUNDATION WALL & FTG
MUD SLAB
NOTE: TIEDOWNS AND #5 HOOKS NOT SHOWN FOR CLARITY
1 EXISTING FOUNDATION WALL & FOOTING WITH NEW STRONG FLOOR FEATURING FLEXURAL REINFORCEMENT, POSITIONING GRID, COVER, AND BAR PLACEMENT TOLERANCES
SCALE: 3" = 1'-0"
2 NEW STRONG FLOOR WITH REINF & TIEDOWNS
3 VERTICAL TIE DOWN THREADBAR ASSEMBLY AT STRONG FLOOR
SCALE: 3" = 1'-0"
REMOVABLE COUPLER
COUPLING END
DSI THREAD
ANCHOR NUT
DEAD END
TOP PLUG DETAIL
4 LOADING BAY SLAB WITH REINF & TIEDOWNS
5 LOADING BAY SLAB RICHMOND TIEDOWNS
SCALE: 3" = 1'-0"
REMOVABLE COVER (THREADED)
6 DRY SEDIMENT PIT
NOTES: 1. FINISH STRONG FLOOR TO FF 35 FL 31.
The George J. Kostas Research Institute for Homeland Security
IAR Laboratory Tenant Fit Out 145 South Bedford Street
Burlington, MA 01803
Revisions
SPAGNOLO GISNESS & Associates, Inc.
LeMessurier Consultants, Inc.
STRUCTURAL ENGINEERS
CONSTRUCTION DOCUMENTS
Title
STRONG FLOOR SECTIONS & DETAILS
Scale AS NOTED
Date 6 December, 2010
Drawn CADD
Checked PJC
Job No. 00293902
Sheet TS2.1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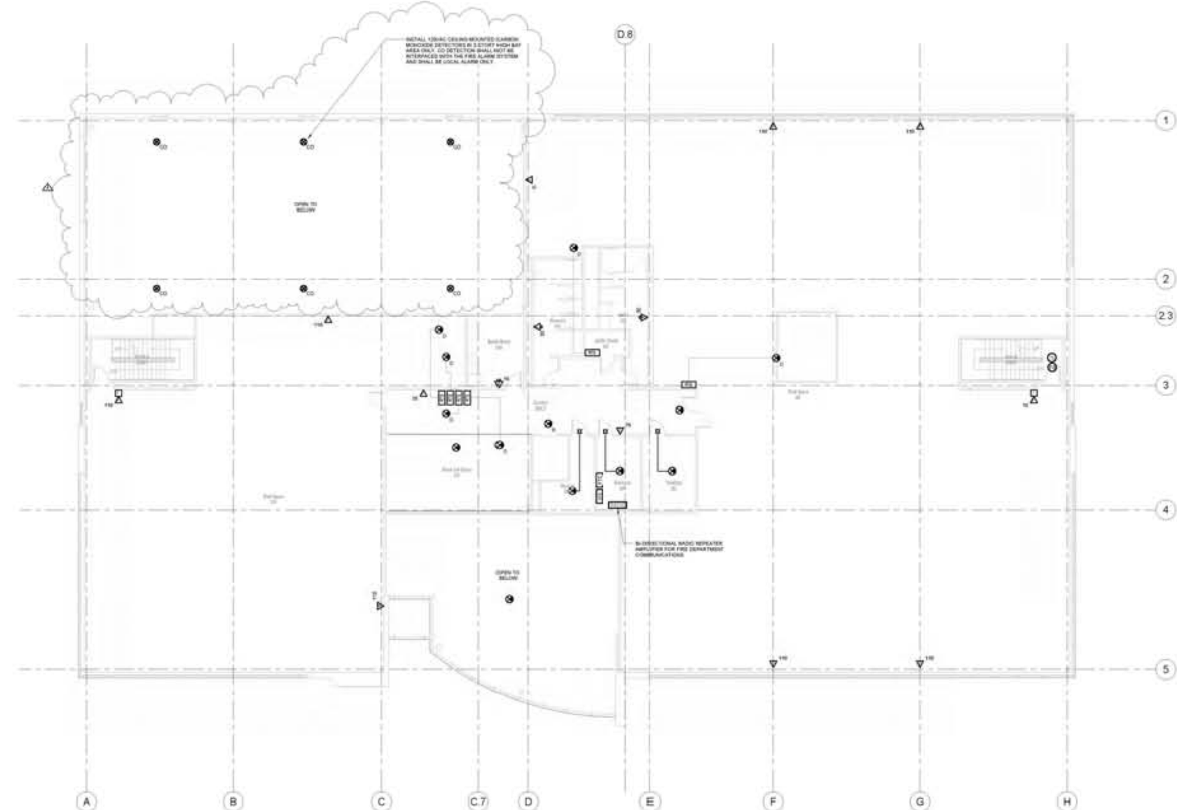
Revisions
FIRE PUMP CONTROLLER
JOCKEY PUMP CONTROLLER
RADIO MASTERBOX ANTENNA RISER
NEW ADDRESSABLE FIRE ALARM CONTROL PANEL
INSTALL CONTROL MODULES FOR ELEVATOR RECALL AND FIRE FIGHTER'S HAT FUNCTIONS
INSTALL FIRE ALARM SYSTEM LCD ANNUNCIATOR RECESSED IN WALL
WEATHERPROOF EXTERIOR BEACON
KNOX BOX KEY DEPOSITORY BOX W/RECESSED MOUNTING KIT
01 - FIRST FLOOR FIRE ALARM PLAN
1/8" = 1'-0"
SPAGNOLO GISNESS & Associates, Inc.
AHA CONSULTING ENGINEERS
Title
FIRST FLOOR FIRE ALARM PLAN
Scale
1/8"=1'-0"
Date
26 July 2010
Drawn
JAD
Checked
DC
Job No.
002939.01
Sheet
FA101



1 02 - SECOND FLOOR FIRE ALARM PLAN
1/8" = 1'-0"

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Title

SECOND FLOOR FIRE ALARM PLAN

0 2 4 8 16

Scale: 1/8"=1'-0"

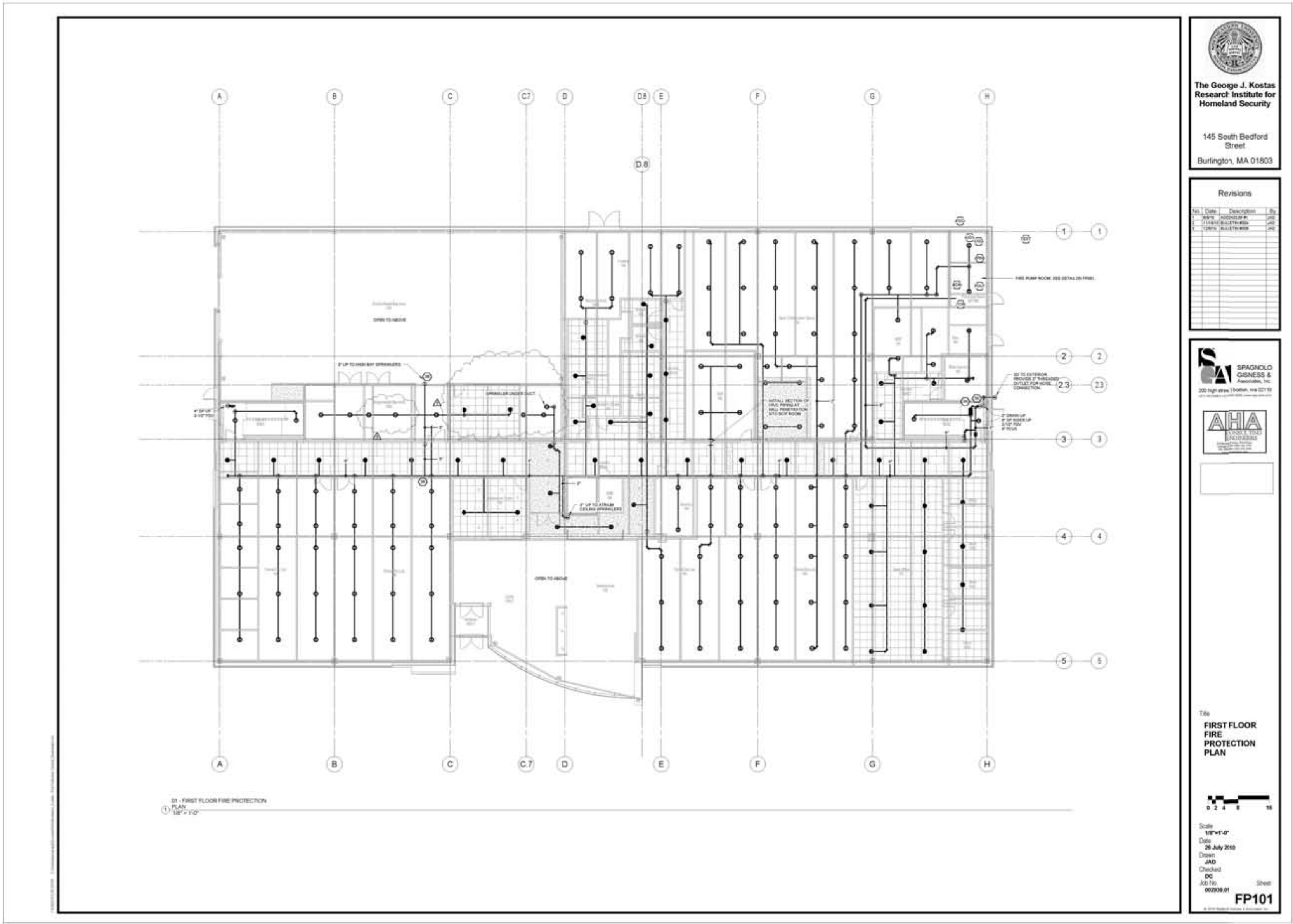
Date: 26 July 2010

Drawn: JAD

Checked: DC

Job No.: 002939.01

Sheet: **FA102**



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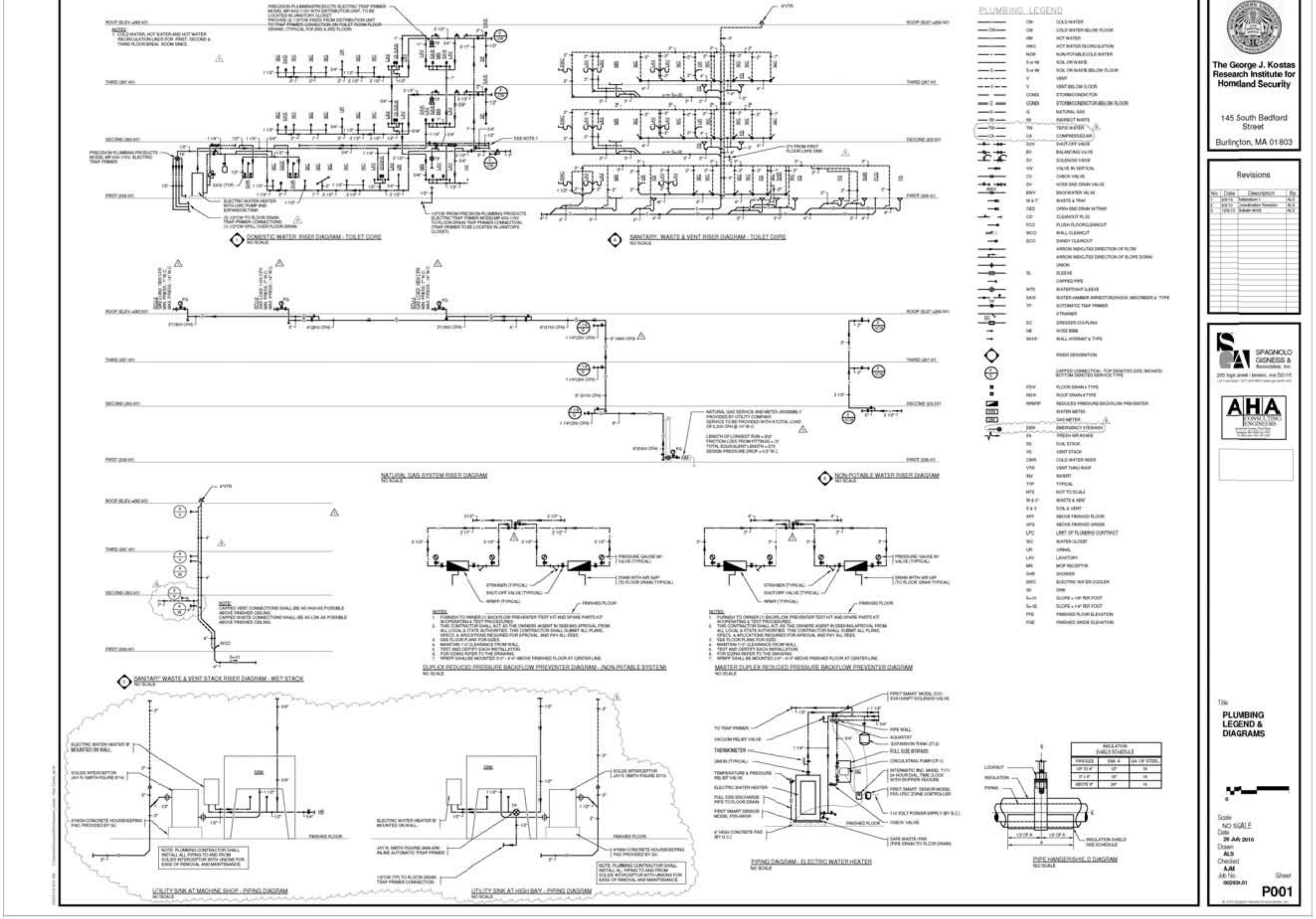
Revisions
SPAGNOLO GISNESS & Associates, Inc.
Title
FIRST FLOOR FIRE PROTECTION PLAN
FP101


PLUMBING LEGEND
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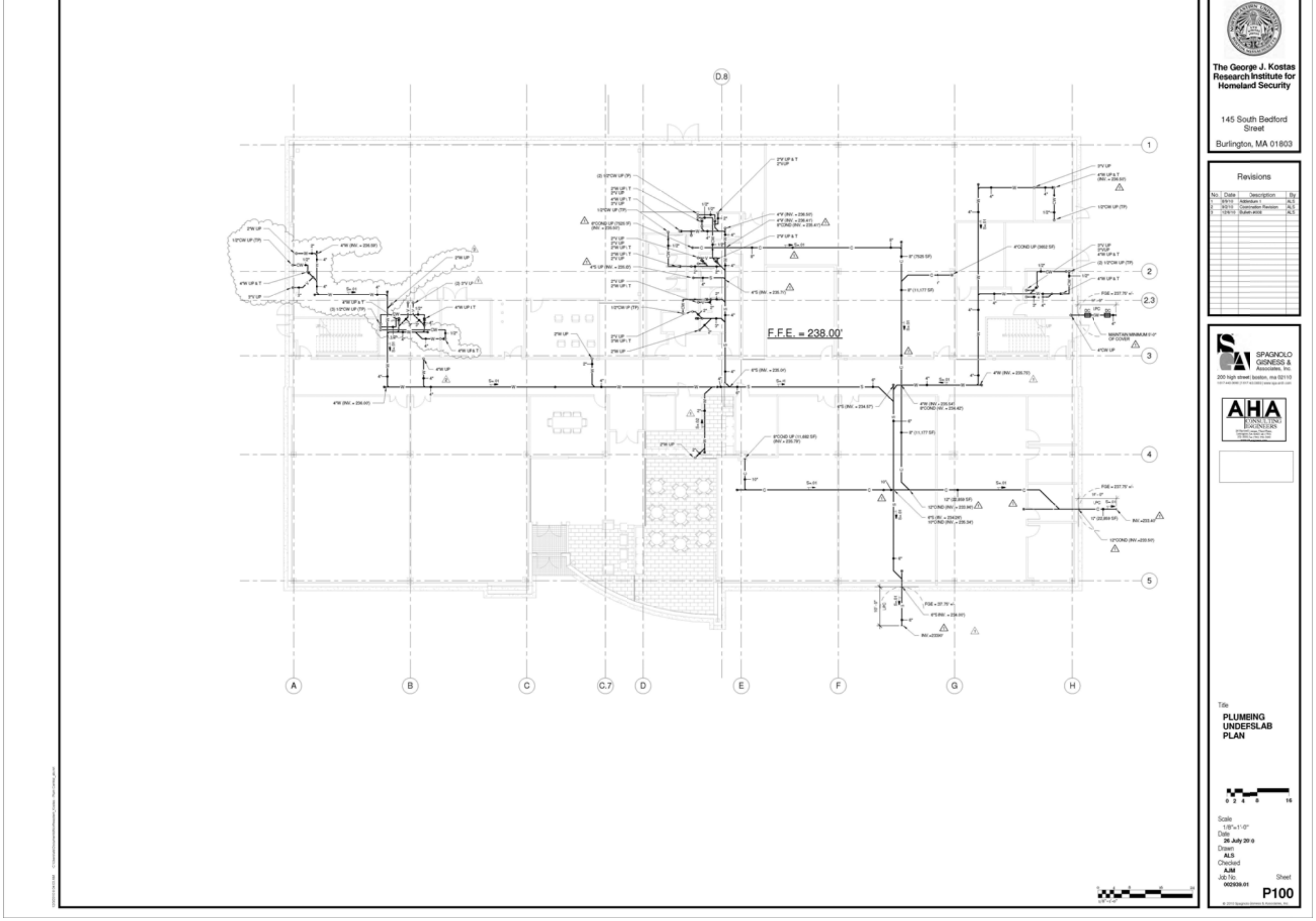
Revisions
SPAGNOLO GISNESS & Associates, Inc.
AHA
PLUMBING LEGEND & DIAGRAMS
NO SCALE
26 July 2010
ALS
AJM
P001



F.F.E. = 238.00'
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200 high street | boston, ma 02110
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Title
PLUMBING UNDERSLAB PLAN
Scale
1/8"=1'-0"
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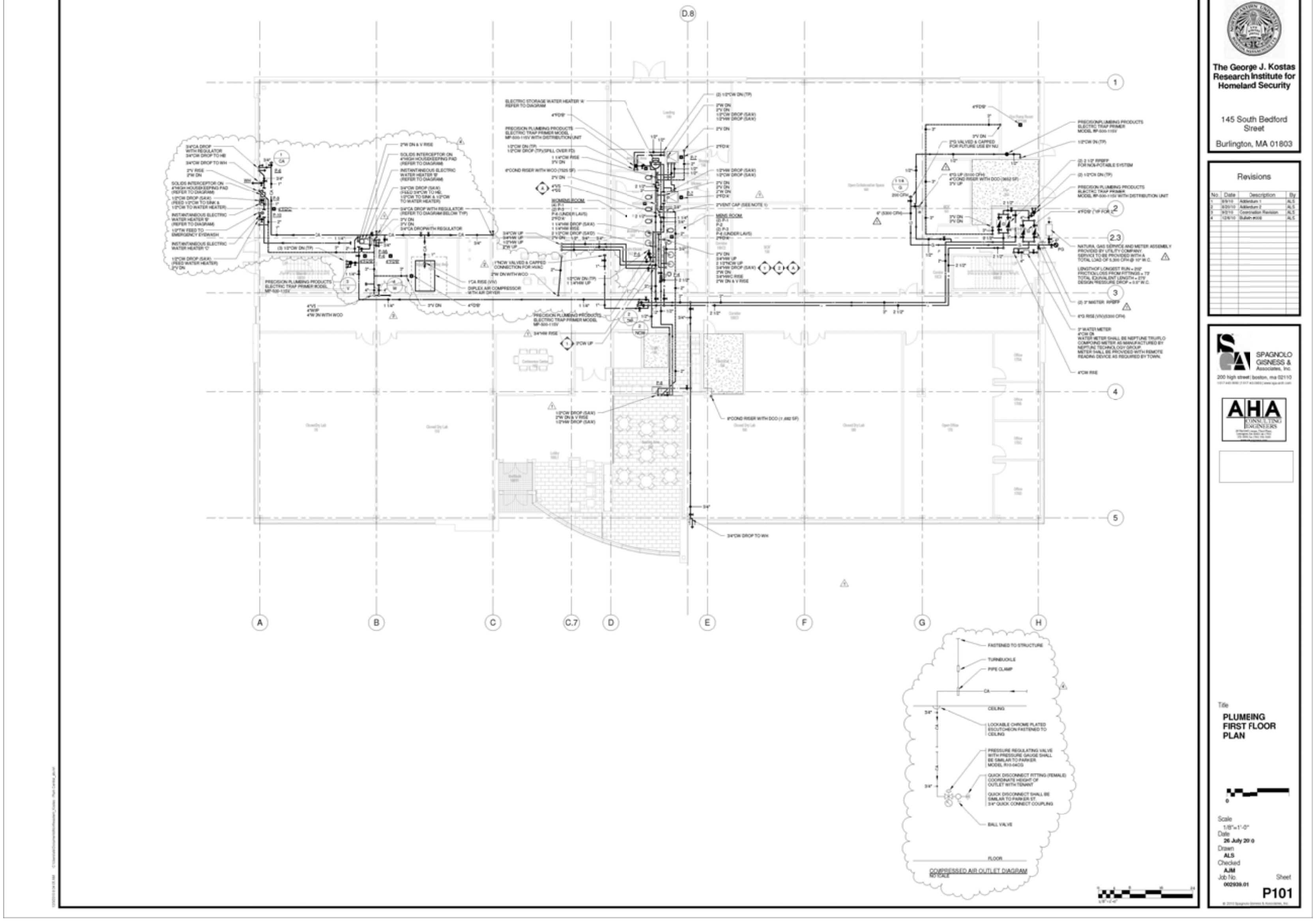
AJM
Job No.
002939.01
Sheet
P100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Title
PLUMEING FIRST FLOOR PLAN
Scale
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002939.01
Sheet
P101
COMPRESSED AIR OUTLET DIAGRAM
FASTENED TO STRUCTURE
TURNBUCKLE
PIPE CLAMP
CEILING
BALL VALVE
FLOOR

ROOF TOP AIR CONDITIONING UNIT (DIRECT EXPANSION, NATURAL GAS HEAT) — RTU

SYMBOL	MINIMUM NOMINAL TONNAGE	CFM TOTAL	CFM O.A.	SUPPLY FAN (W/VFD) CFM	T.S.P.	EXT. S.P.	FAN RPM	MAX BHP	MOTOR HP	RETURN FAN (W/VFD) CFM	T.S.P.	EXT. S.P.	FAN RPM	MAX BHP	MOTOR HP	DIRECT EXPANSION COIL TOT MBH	SENS MBH	MIN FACE AREA	EAT DB	EAT WB	LAT DB	LAT WB	MAX COIL VEL	GAS FURNACE TEMP RISE	MIN PRESS " W.C.	MAX PRESS " W.C.	MBH INPUT	MBH OUTPUT	FILTERS PRE TYPE	PRE AREA	FINAL TYPE	FINAL AREA	COMPRESSOR NO. OF COMPRESS	TYPE OF COMPRESS	CONDENSER NO. OF COND. FANS	HP (EA)	EER	LBS. OF REFRIGERATION	REFRIGERANT TYPE	ELECTRICAL V	PH	HZ	MCA	MOCP	MODEL	REMARKS
RTU-1	120	36,825	11,285	36,825	4.069	2.5	895	35.67	40	25,540	1.569	1.0	745	13.66	15	1455	1200	--	80.8	65.6	52.76	--	500	36.04	7	14	1800	1440	95%	71.25	95%	80	4	--	8	1.5	10	270	R-410A	460	3	60	284.3	300	SFHJ120	SERVES 1ST FLOOR
RTU-2	105	38,050	5,710	38,050	4.956	2.5	1165	49.04	60	32,340	2.456	1.0	997	18.67	25	1269	1176	--	78.10	62.80	51.79	--	500	21.32	7	14	1100	880	95%	71.25	95%	80	4	--	6	1.5	9.8	238	R-410A	460	3	60	298.30	350	SFHJ105	SERVES 2ND FLOOR
RTU-3	150	47,945	7,135	47,940	5.009	2.5	1069	61.91	75	40,805	2.509	1.0	924	24.36	30	1740	1556	--	78.30	63.20	50.96	--	500	27.68	7	14	1800	1440	95%	71.25	95%	80	4	--	8	1.5	9.7	318	R-410A	460	3	60	381.5	450	SFHJ150	SERVES 3RD FLOOR

SELECTION BASED ON TRANE. PROVIDE UNITS WITH VIBRATION ISOLATION AND SEISMIC ROOF CURBS (ROOF CURBS BY OTHERS).

EXHAUST FAN SCHEDULE — TEF, EF, REF

SYMBOL	MODEL	TYPE	SERVICE	CFM	S.P. (IN.)	FAN RPM	BHP	HP	VOLTS	PH	HZ	REMARKS
TEF-1	[illegible]	[illegible]	TOILETS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
EF-1	CSP-A410	[illegible]	ELEC. RM	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	1	60	
EF-2	CSP-A3600	[illegible]	ELEC. RM	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	1	60	
EF-3	CSP-A3600	[illegible]	ELEC. RM	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	1	60	
EF-4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
EF-5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
REF-1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

SELECTION BASED ON GREENHECK. PROVIDE WITH WEATHERHOOD, VIBRATION ISOLATION, AND MOUNTING RAILS.

ELEVATOR HOISTWAY VENT — EHV

SYMBOL	MODEL	PENTHOUSE SIZE	LOUVER (QTY) SIZE	LOUVER FREE AREA	SMOKE DAMPER SIZE	SMOKE DAMPER FREE AREA	REMARKS
EHV-1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

SELECTION BASED ON BUCKLEY ASSOCIATES, INC. PROVIDE WITH STANDARD 36" ROOF CURB, SMOKE DAMPER, AND DAMPER ACTUATOR.

IARL LAB COOLING WATER PUMPS — P

SYMBOL	SERVES	GPM	HEAD FT.	TYPE	IMP DIA.	NPSHR	BHP	MOTOR HP	MOTOR RPM	V	PH	HZ	EMERGENCY POWER	REMARKS
P-1	IARL LAB COOLING	[illegible]	[illegible]	(1)	--	--	--	[illegible]	--	460	3	60	NO	(1)(2)(3)
P-2	P-1 STAND-BY	[illegible]	[illegible]	(1)	--	--	--	[illegible]	--	460	3	60	NO	(1)(2)(3)

(1) PUMP SELECTIONS BASED ON PUMPS PROVIDED BY MPS SYSTEMS. REFER TO SPECIFICATIONS.
(2) PUMP AND CONTROL SKID PACKAGE TO BE A COMPLETE FACTORY ASSEMBLED PACKAGE UNIT.
(3) SYSTEM FLUID IS TO BE 40% PROPYLENE GLYCOL-WATER MIX.

EVAPORATIVE FLUID COOLER — EFC

SYMBOL	SERVES	COOLING WATER EWT	LWT	GPM	PD	OUTDOOR AIR DB	WB	FAN DATA FAN QTY	MOTOR HP	SPRAY PUMPS PUMP QTY	MOTOR HP	POWER V	PH	HZ	HEAT REJECTION BTUH	REMARKS
EFC-1	IARL LAB COOLING	[illegible]	[illegible]	[illegible]	--	--	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	460	3	60	[illegible]	

SELECTION BASED ON EVAPCO/BALTIMORE AIRCOOL CORPORATION. ALL MOTORS TO BE TEFC TYPE SUITABLE FOR OPERATION IN OUTDOOR/WET CONDITIONS. COOLING WATER AND INTERNAL SPRAY WATER CIRCUIT IS TO BE 40% PROPYLENE GLYCOL-WATER MIX.

FINNED TUBE RADIATION (ELECTRIC) — FTR

SYMBOL	COVER TYPE	OUTPUT (MBH) PER UNIT	WATTS PER UNIT	POWER V	PH	HZ	EMERGENCY POWER	MODEL	REMARKS
FTR-1	WALL MOUNT	[illegible]	[illegible]	277	1	60	N/A	[illegible]	[illegible]

SELECTION BASED ON DESIGN ARCHITECTURAL HEATING, INC. PROVIDE WITH TAMPER RESISTANT INTEGRAL THERMOSTAT.

SOUND ATTENUATORS — SA

FOR CONFIGURATION CHOOSE SUPPLY, RETURN OR EXHAUST

SYMBOL	CFM	DUCT SIZE	LENGTH	MAX P.D. IN WATER	DYNAMIC INSERTION LOSS (dB) 63	125	250	500	1K	2K	4K	8K	CONFIGURATION	MODEL	REMARKS
SA-1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	SUPPLY	[illegible]	RTU-1
SA-2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	SUPPLY	[illegible]	RTU-2
SA-3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	SUPPLY	[illegible]	[illegible]
SA-4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	SUPPLY	[illegible]	[illegible]
SA-5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	SUPPLY	[illegible]	[illegible]
SA-6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	RETURN	[illegible]	RTU-1
SA-7	38050	126.5"x40"	84"	0.08	7	14	21	31	29	20	14	11	RETURN	RMB-HV-F3	RTU-2
SA-8	47940	126.5"x40"	60"	0.13	5	7	15	27	33	24	18	11	RETURN	RMB-HV-F8	RTU-3

SELECTION BASED ON VIBRO-ACOUSTICS.

VARIABLE VOLUME TERMINAL (ELECTRIC HEAT) — VV

SYMBOL	PRIMARY AIR CFM RANGE	INLET SIZE	OUTLET SIZE	OPER. SP	MAX N.C.	ELECTRIC COIL DATA KW	STAGES	EAT	LAT	V	PH	HZ	MODEL	REMARKS
VV-1	0 - 350	6"ø	10X10	0.06	24	3	2	55	95	480	3	60	SDV SIZE 6	--
VV-2	351 - 700	8"ø	12X10	0.06	27	5	2	55	95	480	3	60	SDV SIZE 8	--
VV-3	701 - 1100	10"ø	14X12.5	0.05	28	7	3	55	95	480	3	60	SDV SIZE 10	--
VV-4	1101 - 1600	12"ø	16X15	0.05	27	10	3	55	95	480	3	60	SDV SIZE 12	--
VV-5	1601 - 2100	14"ø	20X17.5	0.06	29	13	3	55	95	480	3	60	SDV SIZE 14	--
VV-6	2101 - 2800	16"ø	24X17.5	0.06	30	18	3	55	95	480	3	60	SDV SIZE 16	--
VV-7	2801 - 3600	28X14	30X17.5	0.15	30	23	3	55	95	480	3	60	SDV SIZE 28X16	--

SELECTION BASED ON PRICE. PROVIDE WITH EXTENDED ACOUSTICAL LINING AND REQUIRED CONTROL VOLTAGE TRANSFORMER FOR 277/1/60 TO 24V.

(1) VV BOX MINIMUM CFM SHALL BE 5% OF MAXIMUM CFM UNLESS SHOWN OTHERWISE ON DRAWINGS.
(2) NC'S ARE DERIVED FROM SOUND POWER LEVELS, WHICH ARE OBTAINED IN ACCORDANCE WITH ARI STANDARD 880-98 AND ASHRAE STANDARD 130-1996.

CABINET UNIT HEATER (ELECTRIC) — CUH

SYMBOL	ARRANGEMENT	CFM	COIL DATA KW	STAGES	VOLTS	PH	HZ	AMPS	MBH	LAT (°F)	FAN DATA SPEED	CONTROL OPTIONS REMOTE THERMOSTAT/ INTEGRAL THERMOSTAT	MODEL	REMARKS
CUH-1	FIFO	500	10	2	480	3	60	13	34.1	123	MEDIUM	INTEGRAL	CUS45	--
CUH-2	FIFO	250	5	1	480	3	60	7	17.1	123	MEDIUM	INTEGRAL	CUS35	--

SELECTION BASED ON QMARK.

PROPELLER UNIT HEATER (ELECTRIC) — UH

SYMBOL	ARRANGEMENT	CFM	COIL DATA KW	STAGES	V	PH	HZ	AMPS	MBH	AR	CONTROL OPTIONS REMOTE THERMOSTAT/ INTEGRAL THERMOSTAT	EMERGENCY POWER	MODEL	REMARKS
UH-1	HORIZONTAL	650	10	2	480	3	60	12	34.1	49	INTEGRAL	N/A	MUH104	--
UH-2	HORIZONTAL	350	3	1	480	3	60	3.6	10.2	27	INTEGRAL	N/A	MUH0341	--
UH-3	HORIZONTAL	650	7.5	2	480	3	60	9	25.6	37	INTEGRAL	N/A	MUH074	--

SELECTION BASED ON QMARK.

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1	8/9/10	ADDENDUM #1	
2	12/6/10	BULLETIN #008	

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AHA CONSULTING ENGINEERS

Title

HVAC SCHEDULES

0

Scale

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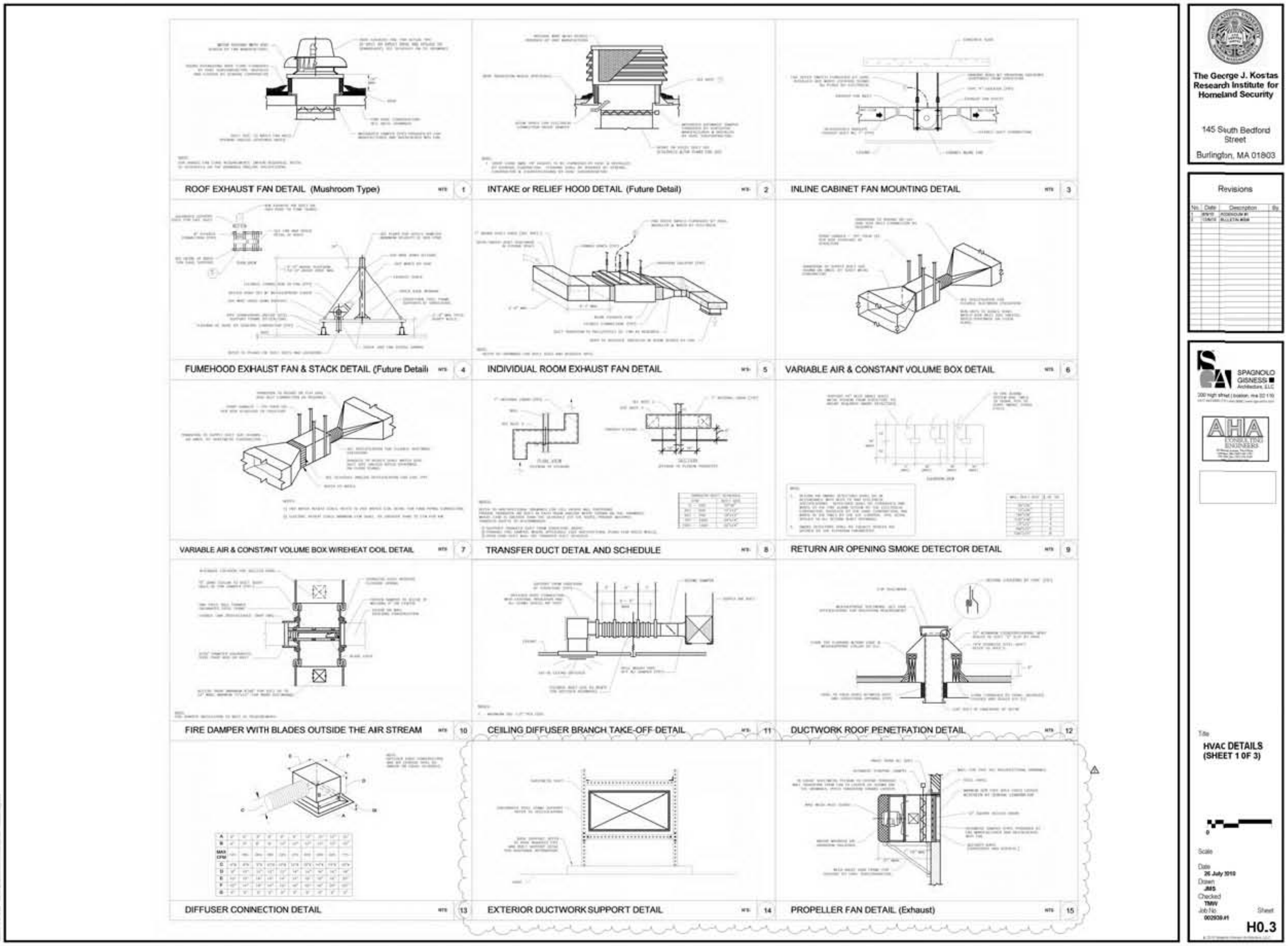
Job No. 002935.01

Sheet **H0.2**


ROOF EXHAUST FAN DETAIL (Mushroom Type)
INTAKE or RELIEF HOOD DETAIL (Future Detail)
INLINE CABINET FAN MOUNTING DETAIL
FUMEHOOD EXHAUST FAN & STACK DETAIL (Future Detail)
INDIVIDUAL ROOM EXHAUST FAN DETAIL
VARIABLE AIR & CONSTANT VOLUME BOX DETAIL
VARIABLE AIR & CONSTANT VOLUME BOX W/REHEAT COIL DETAIL
TRANSFER DUCT DETAIL AND SCHEDULE
RETURN AIR OPENING SMOKE DETECTOR DETAIL
FIRE DAMPER WITH BLADES OUTSIDE THE AIR STREAM
CEILING DIFFUSER BRANCH TAKE-OFF DETAIL
DUCTWORK ROOF PENETRATION DETAIL
DIFFUSER CONNECTION DETAIL
EXTERIOR DUCTWORK SUPPORT DETAIL
PROPELLER FAN DETAIL (Exhaust)
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SPAGNOLO GISNESS
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Title
HVAC DETAILS (SHEET 1 OF 3)
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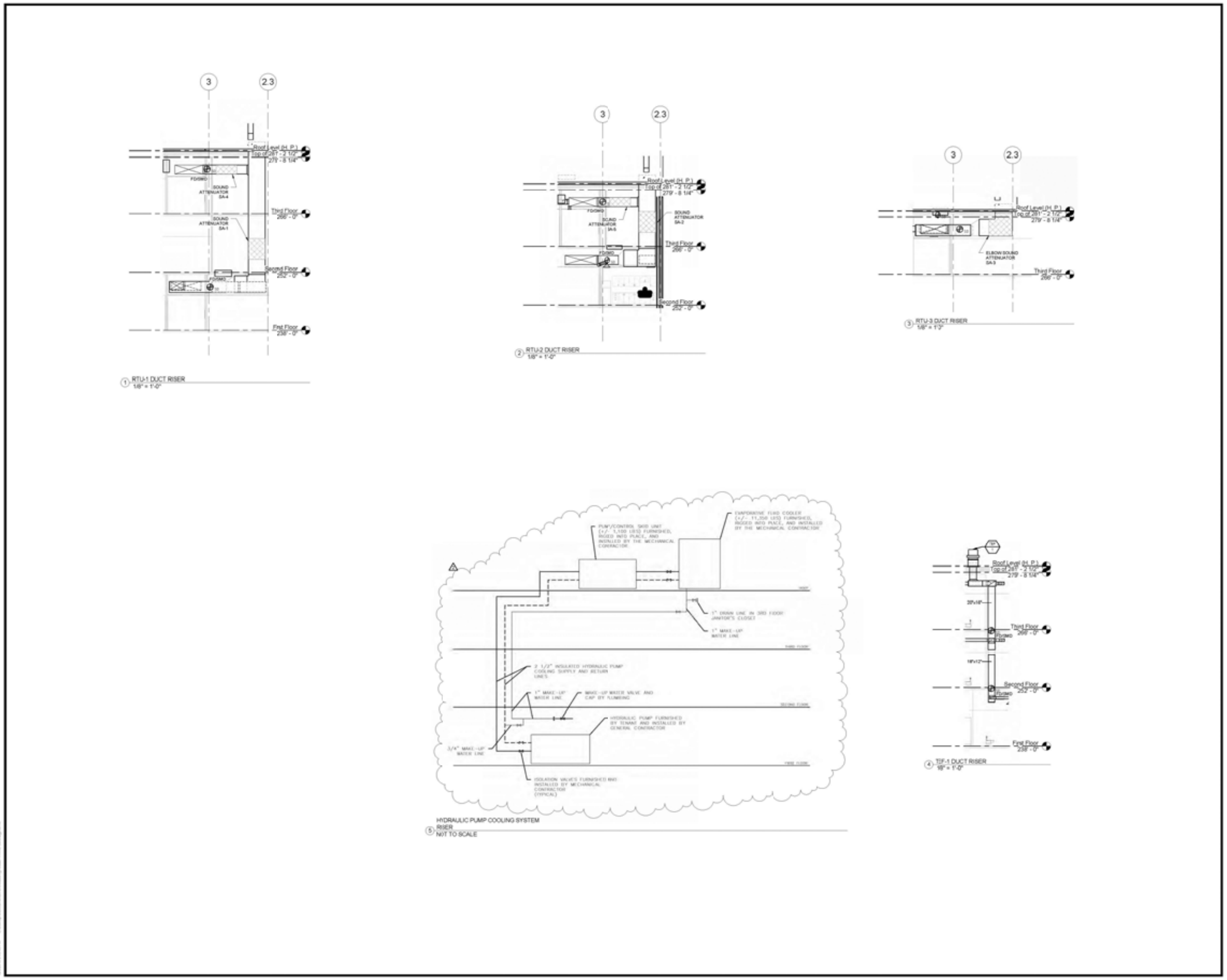

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Title

HVAC RISER DIAGRAMS

Scale

Date 26 July 2010

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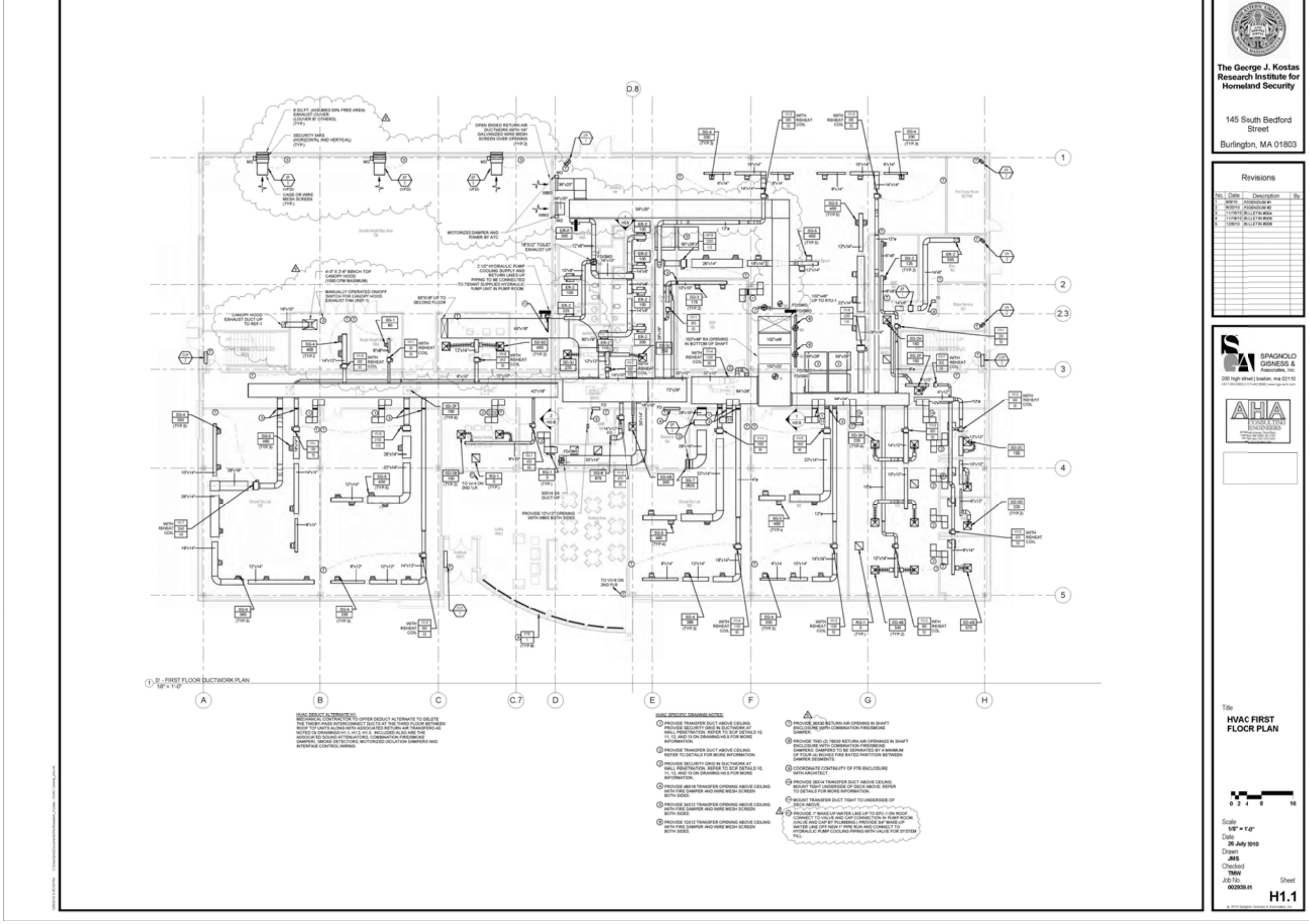

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HVAC FIRST FLOCR PLAN
Scale
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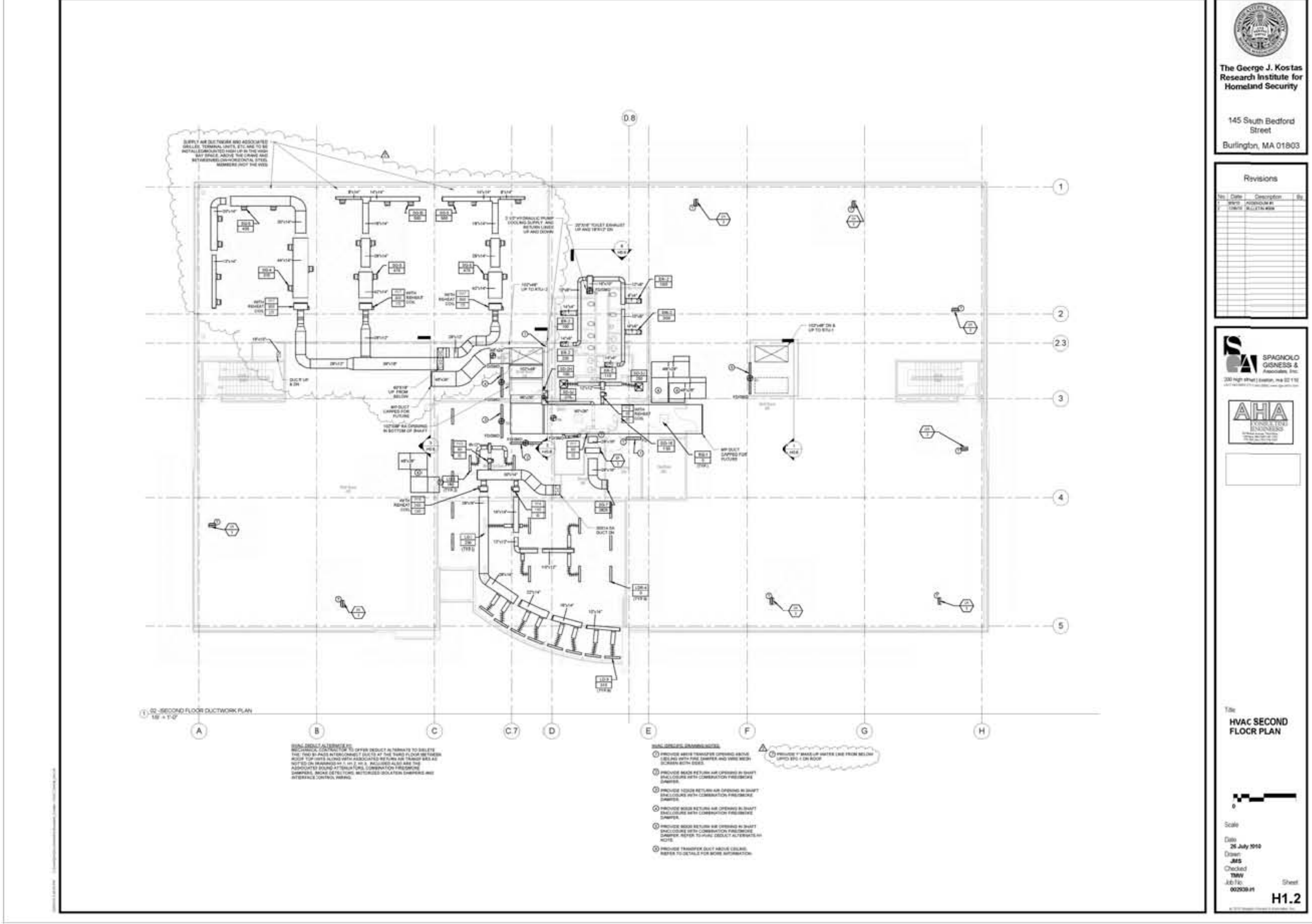

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HVAC SECOND FLOOR PLAN
26 July 2010
JMS
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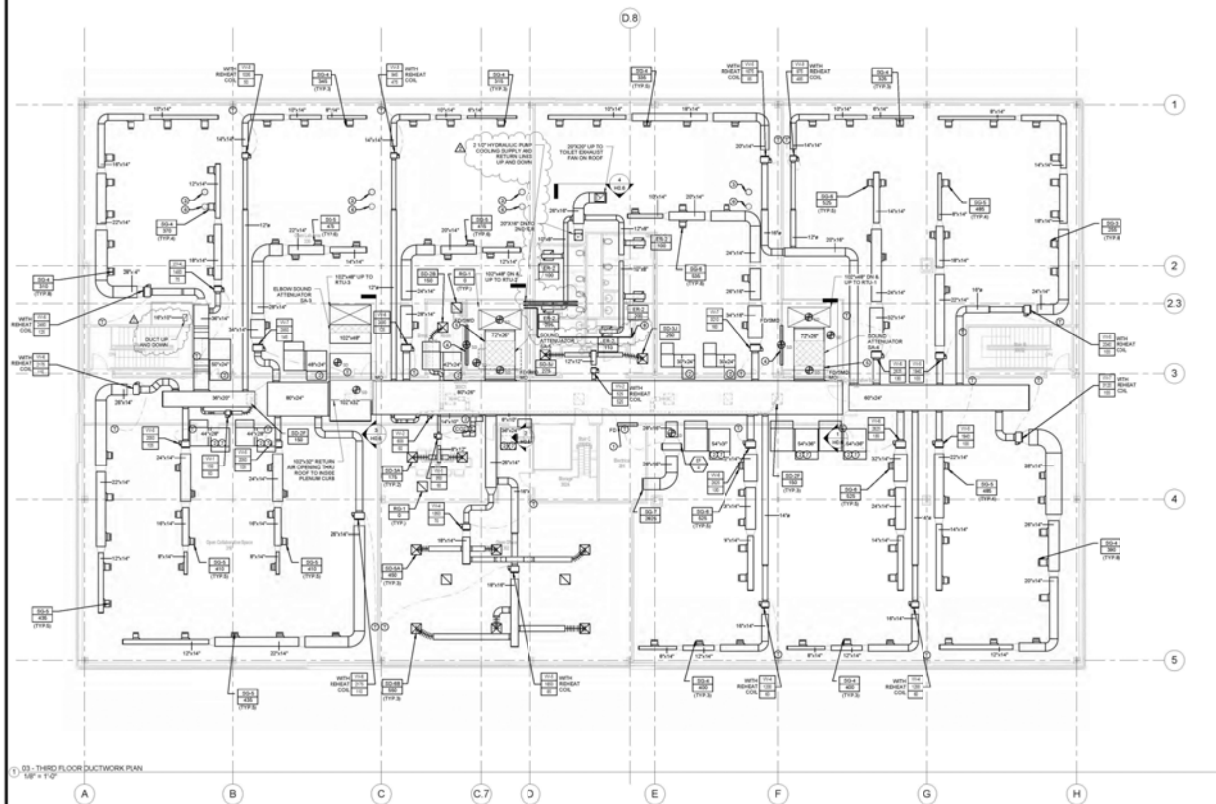
H1.2



HVAC DEDUCT ALTERNATE H1:
MECHANICAL CONTRACTOR TO OFFER DEDUCT ALTERNATE TO DELETE THE TWO BY-PASS INTERCONNECT DUCTS AT THE THIRD FLOOR BETWEEN ROOF TOP UNITS ALONG WITH ASSOCIATED RETURN AIR TRANSFERS AS NOTED ON DRAWINGS H1.1, H1.2, H1.3. INCLUDED ALSO ARE THE ASSOCIATED SOUND ATTENUATORS, COMBINATION FIRE/SMOKE DAMPERS, SMOKE DETECTORS, MOTORIZED ISOLATION DAMPERS AND INTERFACE CONTROL WIRING.

HVAC SPECIFIC DRAWING NOTES:

1. PROVIDE 48X18 TRANSFER OPENING ABOVE CEILING WITH FIRE DAMPER AND WIRE MESH SCREEN BOTH SIDES.
2. PROVIDE TRANSFER DUCT ABOVE CEILING. REFER TO DETAILS FOR MORE INFORMATION.
3. PROVIDE 14" DIA. STAINLESS STEEL DUCT THRU ROOF FOR FUTURE CONNECTION. CAP AND SEAL AIR TIGHT.
4. PROVIDE 96X30 RETURN AIR OPENING IN SHAFT ENCLOSURE WITH COMBINATION FIRE/SMOKE DAMPER. REFER TO HVAC DEDUCT ALTERNATE H1 NOTE.
5. RTU INTERCONNECT DUCT. REFER TO HVAC DEDUCT ALTERNATE H1 NOTE.
6. PROVIDE PIPE THRU ROOF FROM BELOW FOR FUTURE CONTROL WIRING, ETC. CAP BELOW BELOW ROOF AND SEAL AIR TIGHT.
7. MOUNT TRANSFER DUCT TIGHT TO UNDERSIDE OF DECK ABOVE.
8. PROVIDE 1" MAKE-UP WATER FROM BELOW UP TO ERC-1 ON ROOF. PROVIDE ISOLATION VALVE AND 1" DRAIN VALVE BETWEEN THE ISOLATION VALVE AND ERC-1.

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HVAC THIRD FLOOR PLAN

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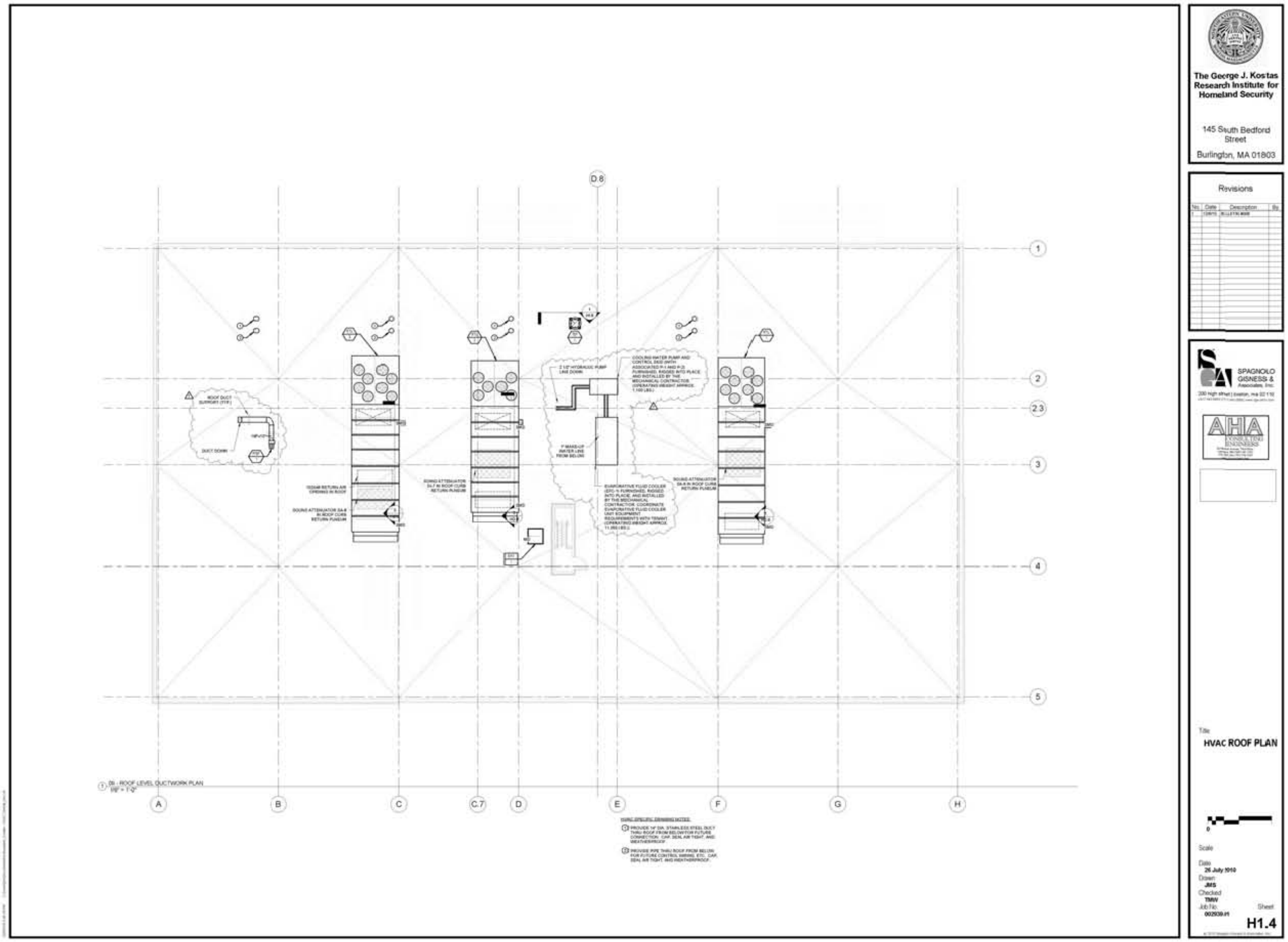
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HVAC ROOF PLAN
26 July 1910
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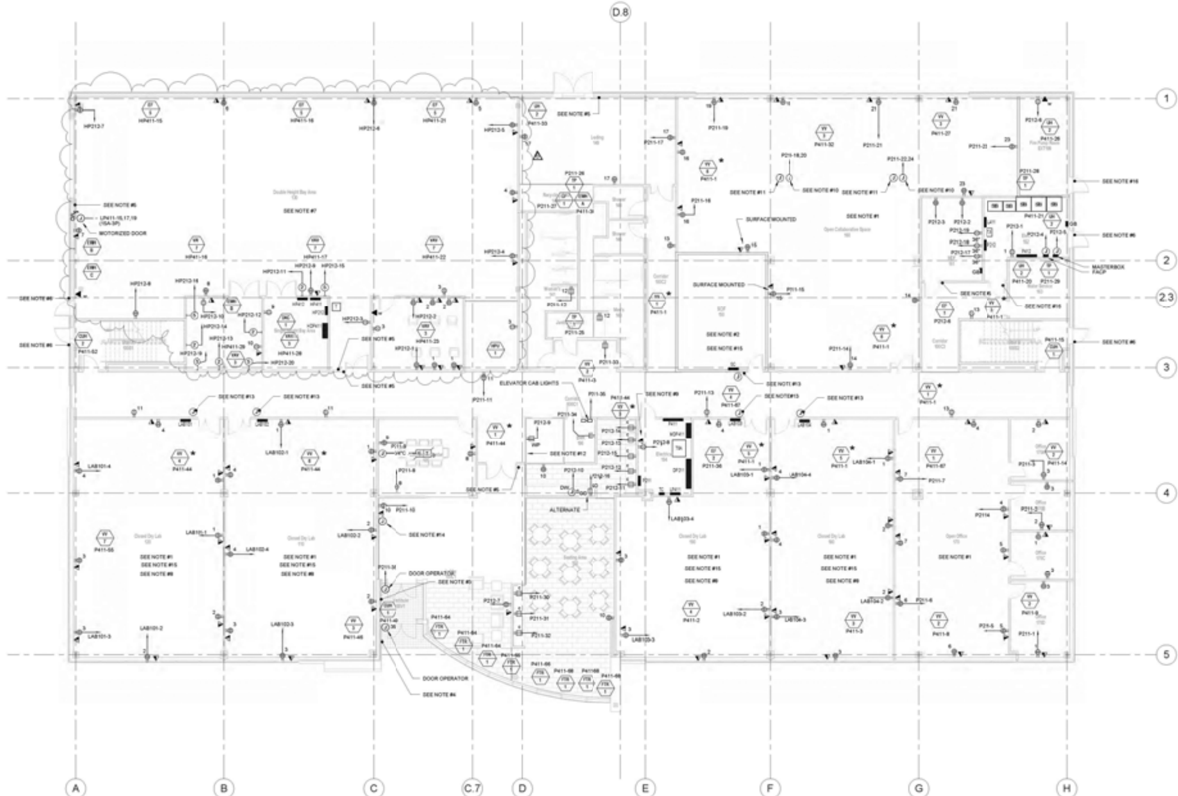
TMW
H1.4



01 - FIRST FLOOR POWER PLAN
1/8" = 1'-0"

NOTES:

1. LAB AND COLLABORATIVE SPACE POWER AND TELDATA RECEPTACLES HAVE BEEN PROVIDED PER THE LATEST OPR REQUIREMENTS, 1 POWER AND 1 TELDATA DEVICE PER 150 SQUARE FEET. EXACT OUTLET LOCATIONS TO BE COORDINATED WITH USER.
2. PROVIDE DI-ELECTRIC BREAK IN FEEDER TO SC PANEL. ALL DEVICES WITHIN SCIF ROOM SHALL BE SURFACE MOUNTED. PROVIDE 5500 SERIES WIREMOLD AROUND PERIMETER OF ROOM.
3. PROVIDE ADA DOOR OPERATOR FOR EACH DOOR AND CARD READER FOR ACCESS INTO LOBBY. PROVIDE 3/4"C. W/PULLSTRING FROM CARD READER TO MDF ROOM FOR SECURITY ACCESS SYSTEM. FOR ENTRY DOOR MAGLOCKS PROVIDE 3/4"C. FROM DOOR 101, TO A POWER SUPPLY UNIT, PROVIDED BY DOOR HARDWARE VENDOR, MOUNTED ABOVE FIRST FLOOR CONFERENCE ROOM CEILING. PROVIDE 3/4"C. AS NECESSARY FROM DOOR CONTROLS AND POWER CONNECTIONS TO ABOVE NEAREST CEILING.
4. PROVIDE ADA DOOR OPERATOR . PROVIDE 3/4"C. W/PULLSTRING AS NECESSARY FOR POWER AND CONTROL, STUB ABOVE NEAREST CEILING.
5. PROVIDE CARD READER WITH 3/4"C. W/PULLSTRING RUN TO MDF ROOM. .
6. PROVIDE 3/4"C. W/PULLSTRING FROM DOOR TO MDF ROOM FOR SECURITY DOOR CONTACT. FOR FURTHER DOOR ELECTRICAL REQUIREMENTS REFER TO DOOR SECURITY DETAIL "DK2" ON DWG. E303.
7. PROVIDE (10) 4"C. W/PULLSTRINGS FROM MDF ROOM TO 2ND FLOOR TELDATA ROOM.
8. PROVIDE 5500 SERIES WIREMOLD MOUNTED 18" AFF AROUND PERIMETER OF CLOSED LAB. PROVIDE 2"C. FROM EACH END OF WIREMOLD TO POWER PANEL IN ROOM. MOUNT RECEPTACLES IN WIRMOLD AT THE LOCATIONS INDICATED ON PLAN.
9. THESE TELDATA AND POWER RECEPTACLES ARE PROVIDED SOLELY FOR THE FMCS MODEM INTERFACE BETWEEN THE FACILITY AND THE MAIN CAMPUS AUTOMATIC TEMPERATURE CONTROL SYSTEM. FINAL LOCATION OF THIS OUTLET SHALL BE COORDINATED IN THE FIELD WITH THE BUILDING OWNER REPRESENTATIVE BEFORE FINAL INSTALLATION.
10. CEILING MOUNTED JUNCTION BOX WITH WIRE COILED INSIDE FOR FUTURE EXTENSION TO FLOOR MOUNTED DEVICES. CIRCUIT QUANTITIES AND NUMBERS AS INDICATED.
11. CEILING MOUNTED JUCTON BOX WITH (8) TELDATA CABLING COILED INSIDE FOR (2) FUTURE TELDATA RECEPTACLES.PROVIDE 25' OF COILED CABLE FOR EXTENSION TO FUTURE FLOOR MOUNTED DEVICES.
12. PROVIDE ELEVATOR PIT LIGHT AND ASSOCIATED WEATHER PROOF SWITCH.
13. PROVIDE EMPTY JUNCTION BOX WITH COVER PLATE FOR FUTURE TENANT CARD READER AND 3/4"C. W/PULLSTRINGRUN FROM JUNCTION BOX INTO TENANT SPACE FOR FUTURE CONNECTION TO TENANTSECURITY HEAD END EQUIPMENT. PROVIDE 3/4"C W/PULLSTRING FROM TENANT SPACE TO MDF ROOM FOR FUTURE CONNECTION OF TENANT HEAD END EQUIPMENT TO THE MDF ROOM. PROVIDE A 4"C. W/PULLSTRING FROM TENANT SPACE TO MDF ROOM FOR FUTURE SERVICE PROVIDERS.
14. PROVIDE JUNCTION BOX AND 3/4"C. W/PULLSTRING FROM FUTURE SECURITY DESK LOCATION TO DOOR 100, FOR INTERCOMM WIRING.
15. PROVIDE 2"C. WITH PULLSTRING TO 2ND FLOOR TELDATA ROOM 282, AND 2"C. FROM POWER PANEL IN LAB STUBBED INTO CORRIDOR.
16. PROVIDE 3/4"C. W/PULLSTRING FROM DOOR TO MDF ROOM FOR SECURITY DOOR CONTACT. FOR FURTHERDOOR ELECTRICAL REQUIREMENTS REFER TO DOOR SECURITY DETAIL "DK2" ON DWG. E303.
17. FUSED DISCONNECTS FOR TENANT EQUIPMENT TO BE LOCATED THROUGHOUT HIGH BAY SPACE. COORDINATE SIZE AND NUMBER OF DISCONNECTS WITH TENANT. COORDINATE LOCATIONS OF FEEDERS AND DISCONNECTS OF TENANT EQUIPMENT IN FIELD.

The George J. Kostas Research Institute for Homeland Security

145 South Bedford Street

Burlington, MA 01803

Revisions

No.	Date	Description	By
1	8/9/10	ADDENDUM #1	CJL
2	8/20/10	ADDENDUM #2	CJL
3	8/25/10	ADDENDUM #3	CJL
4	11/16/10	BULLETIN #004	CJL
6	12/06/10	BULLETIN #006	CJL

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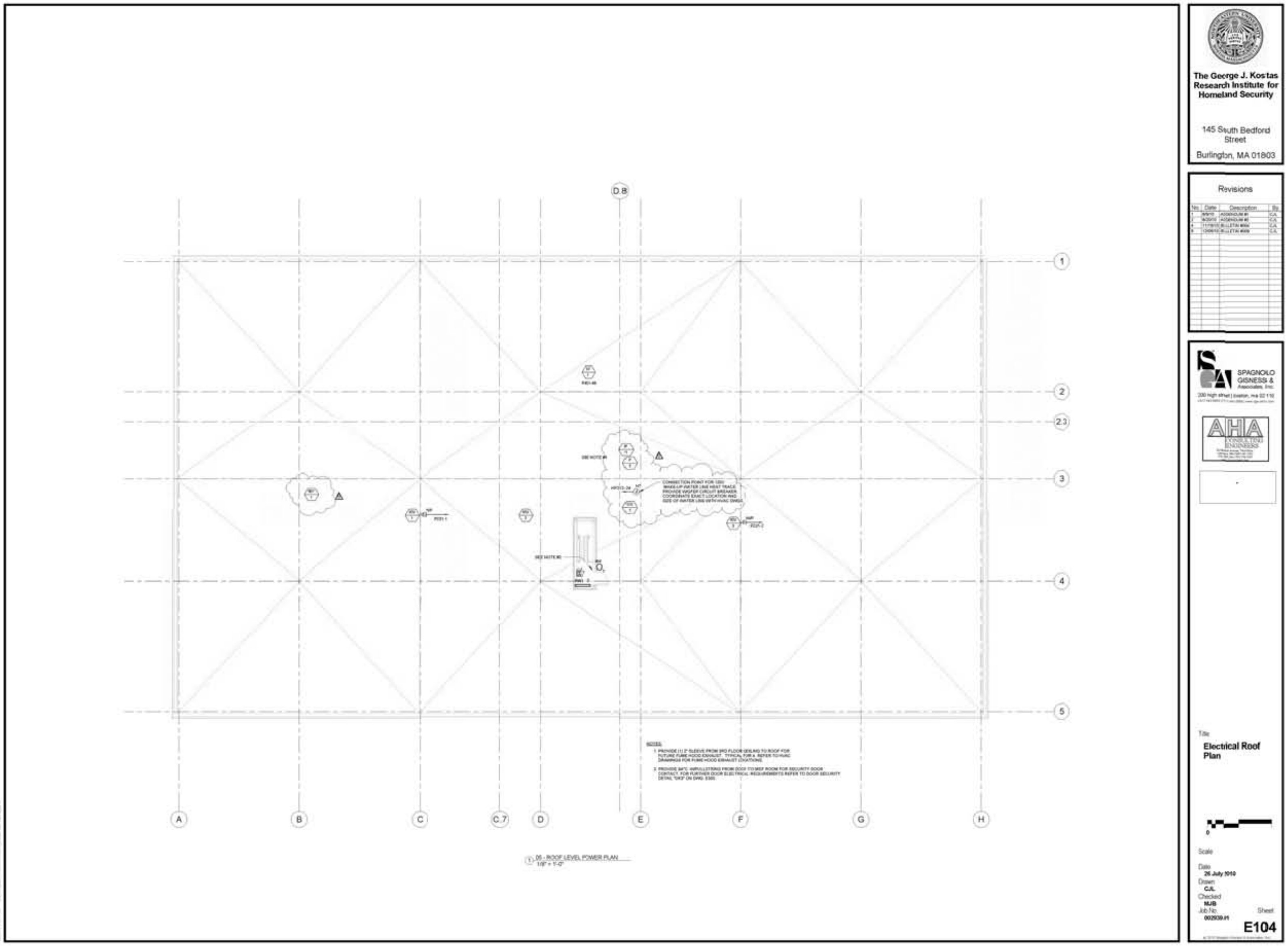
200 high street | boston, ma 02110

AHA CONSULTING ENGINEERS

Title
Electrical First Floor Power Plan

Scale

Date
26 July 2010
Drawn
CJL
Checked
MJB
Job No.
002939.01
Sheet
E101


The George J. Kostas Research Institute for Homeland Security
145 South Bedford Street
Burlington, MA 01803
Revisions
SPAGNOLO GISNESS & Associates, Inc.
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Title
Electrical Roof Plan
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Scale
Date
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Checked
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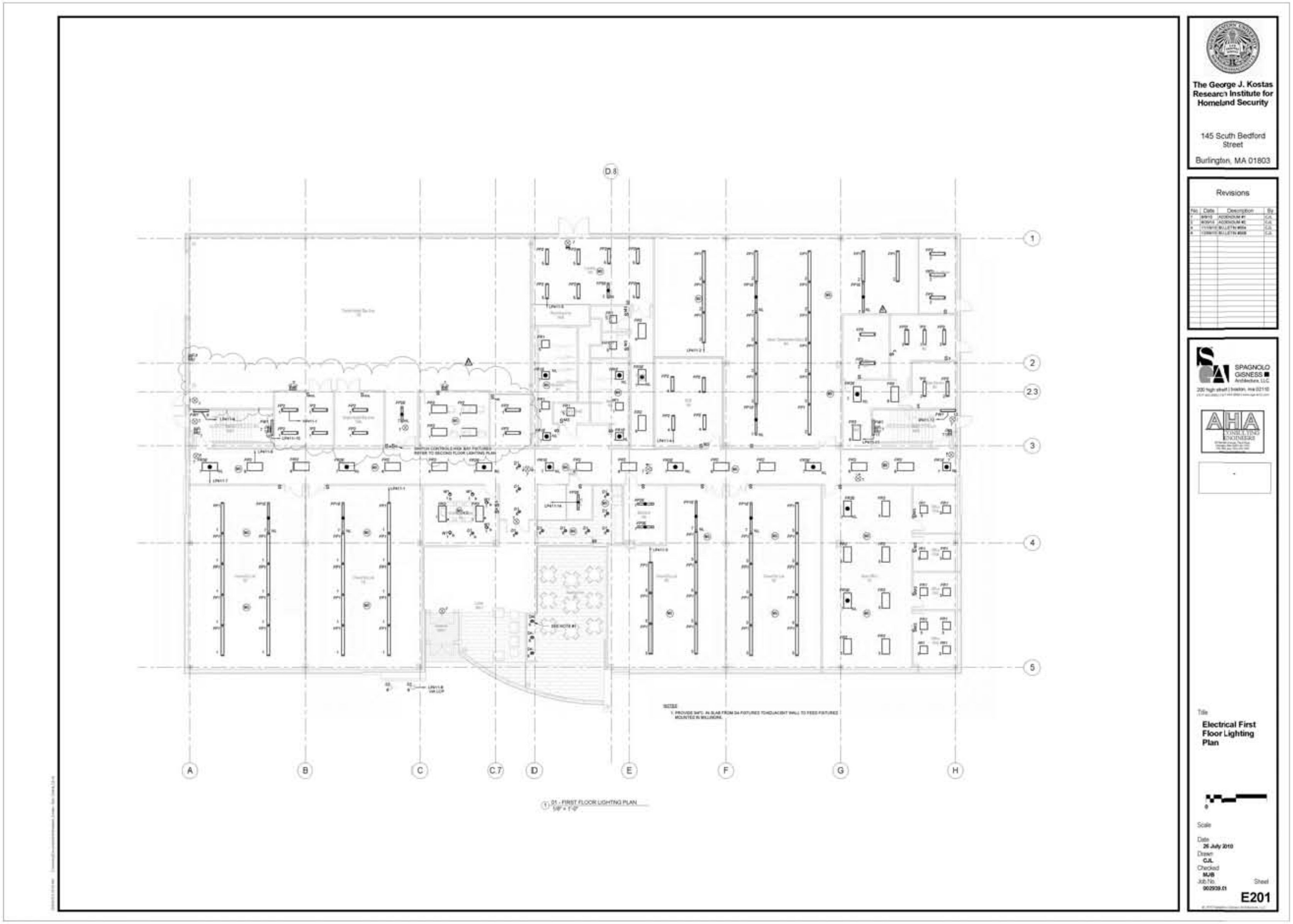
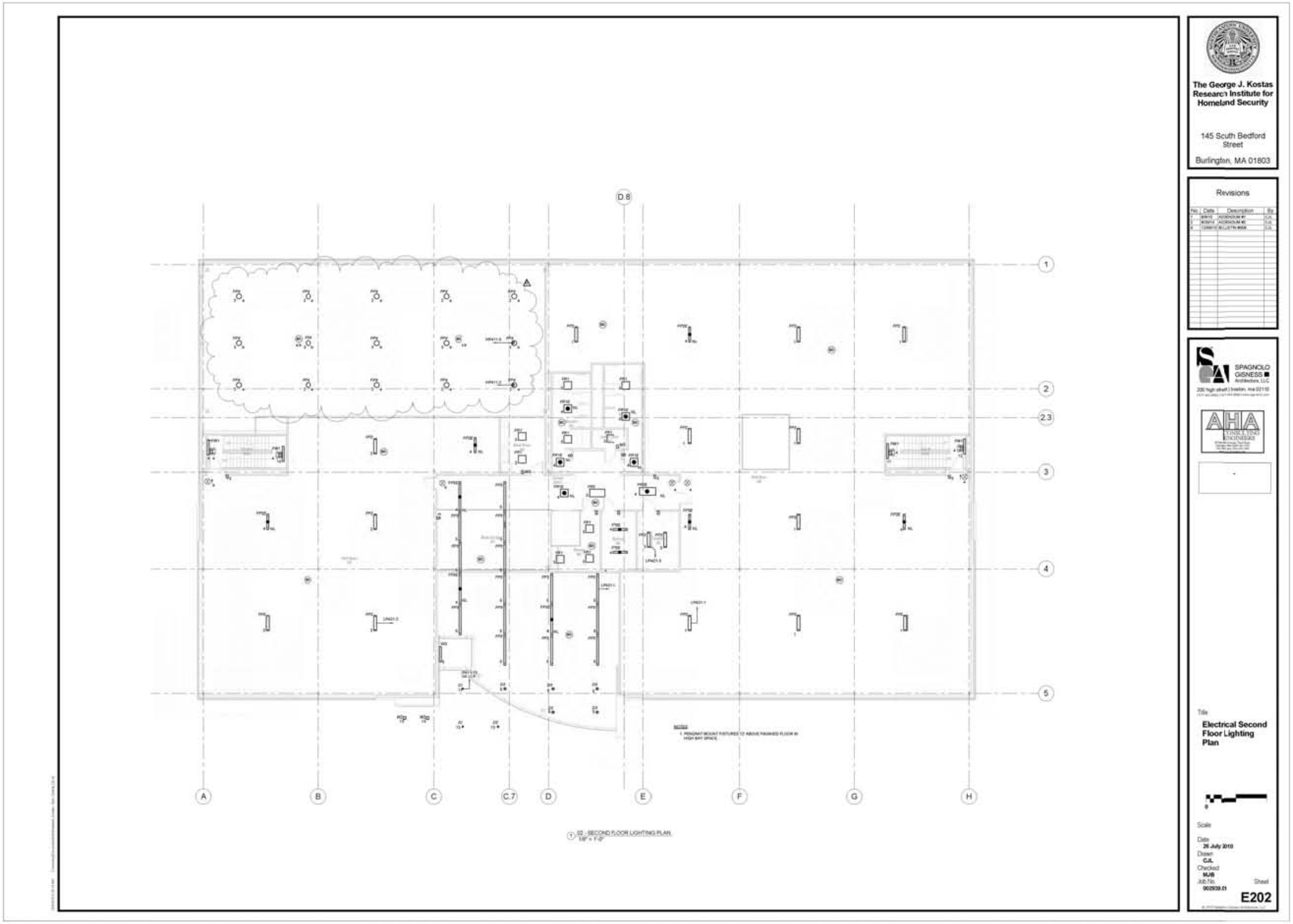
Job No.
Sheet
E104


The George J. Kostas Research Institute for Homeland Security
145 South Bedford Street
Burlington, MA 01803
Revisions
SPAGNOLO GISNESS Architects, LLC
Title
Electrical First Floor Lighting Plan
Scale
Date
26 July 2010
Drawn
CJL
Checked
MJB
Job No.
002939.01
Sheet
E201
01 - FIRST FLOOR LIGHTING PLAN



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145 South Bedford Street
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Revisions
SPAGNOLO GISNESS
Title
Electrical Second Floor Lighting Plan
Scale
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E202
02 - SECOND FLOOR LIGHTING PLAN

FEEDER SIZE SCHEDULE ALUMINUM

FEEDER SYMBOL	CONDUCTORS (3 PHASE, 3 WIRE) WITH GROUND	CONDUIT SIZE	CONDUCTORS (3 PHASE, 4 WIRE) WITH GROUND	CONDUIT SIZE	NOMINAL AMPERE RATING
1	3#4 & 1#6G.	1"			60
2			4#4 & 1#6G.	1 1/4"	
3	3#3 & 1#6G.	1 1/4"			70
4			4#3 & 1#6G.	1 1/4"	
5	3#1 & 1#6G.	1 1/2"			100
6			4#1 & 1#6G.	1 1/2"	
7	3#2/0 & 1#6G.	1 1/2"			125
8			4#2/0 & 1#4G.	2"	
9	3#3/0 & 1#4G.	2"			150
10			4#3/0 & 1#4G.	2"	
11	3#4/0 & 1#4G.	2 1/2"			175
12			4#4/0 & 1#4G.	2 1/2"	
13	3-250 kcmil & 1#4G.	2 1/2"			200
14			4-250 kcmil & 1#4G.	3"	
15	3-300 kcmil & 1#2G.	2 1/2"			225
16			4-300 kcmil & 1#2G.	3"	
17	3-350 kcmil & 1#2G.	3"			250
18			4-350 kcmil & 1#2G.	3"	
19	3-500 kcmil & 1#2G.	3"			300
20			4-500 kcmil & 1#2G.	4"	
21	2 SETS OF 3-250 kcmil & 1#1G.	2-2 1/2"			400
22			2 SETS OF 4-250 kcmil & 1#1G.	2-3"	
23	2 SETS OF 3-500 kcmil & 1#2/0G.	2-3"			600
24			2 SETS OF 4-500 kcmil & 1#2/0G.	2-3"	
25	3 SETS OF 3-500 kcmil & 1#3/0G.	3-3"			800
26			3 SETS OF 4-500 kcmil & 1#3/0G.	3-3"	

"K" RATED TRANSFORMER SCHEDULE

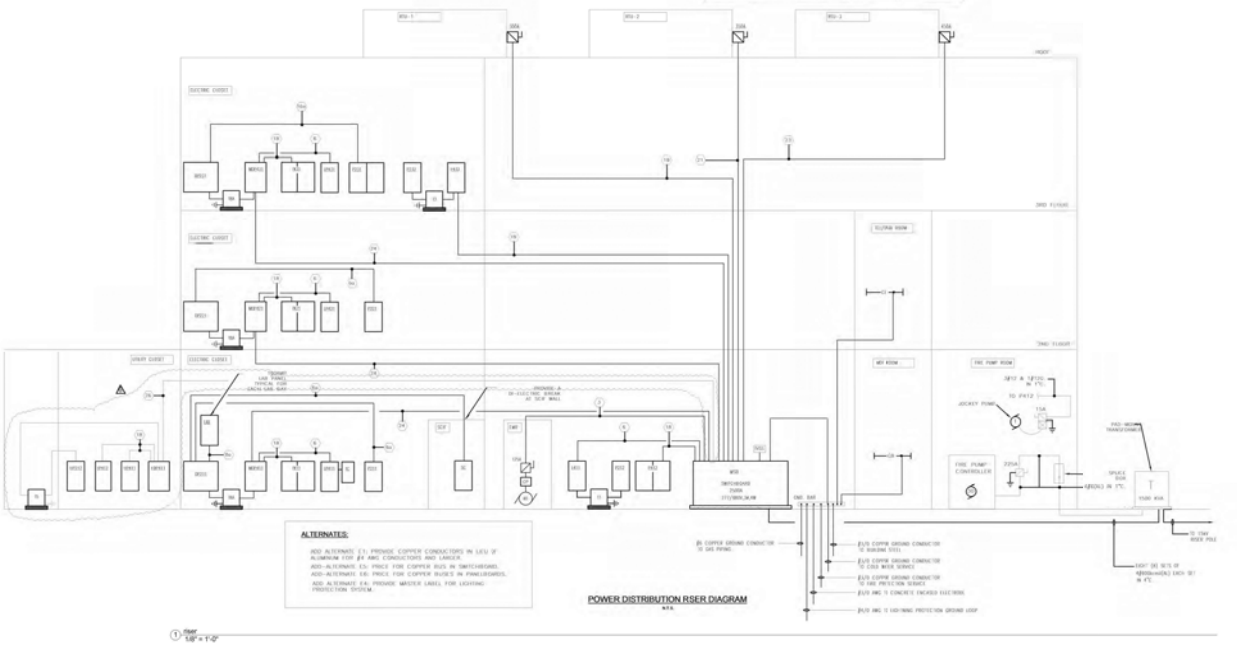
SIZE	KVA	480V PRIMARY			208/120V Y SECONDARY			GROUND & COND.
		PRI. AMPS	O.C. PROT.	FEEDER	SEC. AMPS	O.C. PROT.	FEEDER	
T8A	225 K-13	271	400A-3P	2 SETS OF 3-250kcmil(AL) & 1#1G.(AL) -3"C.	625	800A-3P	2 SETS OF 3-600kcmil(AL) & 2-600kcmil(AL) (NEUTRAL) 1#3/0G.(AL)-4"C.	1#250kcmil(AL) -1"C.

DRY TYPE TRANSFORMER SCHEDULE

SIZE	KVA	480V PRIMARY			208/120V Y SECONDARY			GROUND & COND.
		PRI. AMPS	O.C. PROT.	FEEDER	SEC. AMPS	O.C. PROT.	FEEDER	
T3	30	36	50A-3P	3#8(CU) & 1#10G.(CU) -3/4"C.	83	100A-3P	4#1(AL) & 1#8G.(CU) -1 1/2"C.	1#8(CU)-1/2"
T5	75	90	125A-3P	3#1&1#6G. -1 1/2"C.	208	250A-3P	4-250kcmil &1#4G. -3"C.	1#2-1/2"

200% FEEDER SIZE SCHEDULE (COPPER CONDUCTORS)

FEEDER SYMBOL	CONDUCTORS (3 PHASE, 4 WIRE) WITH GROUND	CONDUIT SIZE	NOMINAL AMPERE RATING
6a	3#1 & 1#4/0 (NEUTRAL) & 1#8G	2"	100
8a	3#2/0 & 2#2/0 (NEUTRAL) & 1#6G	2 1/2"	125
10a	3#3/0 & 2#3/0 (NEUTRAL) & 1#6G	2 1/2"	150
12a	3#4/0 & 2#4/0 (NEUTRAL) & 1#6G	2 1/2"	175
14a	3-250 kcmil & 2-250 kcmil (NEUTRAL) & 1#6G	3"	200
16a	3-300 kcmil & 2-300 kcmil (NEUTRAL) & 1#4G	3"	225



1 Riser
1/8" = 1'-0"

The George J. Kostas Research Institute for Homeland Security

145 South Bedford Street

Burlington, MA 01803

Revisions

No.	Date	Description	By
1	8/9/10	ADDENDUM #1	CJL
4	12/09/10	BULLETIN #008	CJL

SPAGNOLO GISNESS Architecture, LLC

200 high street | boston, ma 02110

AHA CONSULTING ENGINEERS

Title
Electrical Riser Diagram

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Scale

Date
26 July 2010
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002939.01
Sheet
E301

LIGHTING FIXTURE SCHEDULE

TYPE	MTG	DESCRIPTION	MANUFACTURER	CATALOG NO.	LAMPS NUM.	LAMPS TYPE	VOLT	REMARKS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

ALTERNATES: [illegible]

ALTERNATE LED LIGHTING FIXTURE SCHEDULE

TYPE	MTG	DESCRIPTION	MANUFACTURER	CATALOG NO.	LAMPS NUM.	LAMPS TYPE	VOLT	REMARKS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

MECHANICAL EQUIPMENT SCHEDULE

TAG	EQUIPMENT	CHARACTERISTICS	VOLTS	PH	PANEL	O.C.P.	FEEDER	CONNECTION TYPE	REMARKS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PANELBOARD SCHEDULE

PANEL	VOLTAGE	MAINS	MLO/ MCB	MTG	BRANCH CIRCUIT BREAKERS ACTIVE	BRANCH CIRCUIT BREAKERS SPARE	SPACES 1P.	A.I.C. (RMS)	REMARKS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SCHEDULES
1/8" = 1'-0"

MAIN SWITCHBOARD SCHEDULE

VOLTAGE: [illegible] MAINS: [illegible] MAIN CIRCUIT BREAKER: [illegible] INT. RATING: [illegible]

SECTION	CKT.	LOAD	FEEDER BREAKER FRAME	FEEDER BREAKER TRIP	FEEDER BREAKER POLES	FEEDER	REMARKS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SPECIAL PURPOSE RECEPTACLE SCHEDULE

SYMBOL	NEMA	DESCRIPTION	CIRCUIT BREAKER	BRANCH CIRCUIT
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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Revisions

No.	Date	Description	By
[illegible]	[illegible]	[illegible]	[illegible]

SPAGNOLO GISNESS
Architecture LLC

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Title
Electrical Schedules

Scale

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E302

PANELBOARD SCHEDULE

PANEL	VOLTAGE	MAINS	MLO/ MCB	MTG	BRANCH CIRCUIT BREAKERS		SPACES 1 P.	A.I.C. (RMS)	REMARKS
					ACTIVE	SPARE			
MDP411	277/480V 3Ø,4W	600A	MLO	SURF	(1) 250A-3P, (1) 400A-3P (1) 50A-3P, (1) 100A-3P	-	8	65K	
P411	277/480V 3Ø,4W	250A	MLO	SURF	(14) 15A-3P, (3) 20A-3P (5) 20A-1P, (1) 30A-3P (1) 40A-3P	-	19	65K	DOUBLE TUB WITH FEED-THRU LUGS
LP411	277/480V 3Ø,4W	100A	MLO	SURF	(15) 20A-1P	-	27	65K	
DP211	120/208V 3Ø,4W	800A	800A	SURF	(10) 100A-3P	-	12	22K	PROVIDE WITH 200% NEUTRALS
P211	120/208V 3Ø,4W	100A	MLO	SURF	(36) 20A-1P, (1) 20A-2P	-	4	10K	PROVIDE WITH 200% NEUTRALS
LAB (TYPICAL)	120/208V 3Ø,4W	100A	MLO	SURF	(20) 20A-1P	-	22	10K	PROVIDE WITH 200% NEUTRALS
P412	277/480V 3Ø,4W	250A	MLO	SURF	(1) 50A-3P, (2) 20A-3P (5) 20A-1P	-	70	65K	DOUBLE TUB WITH FEED-THRU LUGS
L411	277/480V 3Ø,4W	100A	MLO	SURF	(1) 50A-3P, (15) 20A-1P	-	24	65K	
P212	120/208V 3Ø,4W	100A	100A	SURF	(15) 20A-1P	(4) 20A-1P	23	10K	
MDP421	277/480V 3Ø,4W	600A	MLO	SURF	(1) 250A-3P, (1) 400A-3P (2) 50A-3P, (1) 100A-3P	-	27	65K	
P421	277/480V 3Ø,4W	250A	MLO	SURF	(8) 20A-3P, (2) 15A-3P (1) 20A-1P	-	53	65K	DOUBLE TUB WITH FEED-THRU LUGS
LP421	277/480V 3Ø,4W	100A	MLO	SURF	(15) 20A-1P	-	27	65K	

PANELBOARD SCHEDULE

DP221	120/208V 3Ø,4W	800A	800A	SURF	(9) 100A-3P	-	15	22K	PROVIDE WITH 200% NEUTRALS
P221	120/208V 3Ø,4W	100A	MLO	SURF	(6) 20A-1P, (1) 20A-2P	(4) 20A-1P	30	10K	PROVIDE WITH 200% NEUTRALS
MDP431	277/480V 3Ø,4W	600A	MLO	SURF	(1) 250A-3P, (1) 400A-3P (1) 50A-3P, (1) 100A-3P	-	30	65K	
P431	277/480V 3Ø,4W	250A	MLO	SURF	(6) 15A-3P, (3) 30A-3P (2) 20A-1P, (5) 20A-3P (1) 40A-3P	-	37	65K	DOUBLE TUB WITH FEED-THRU LUGS
LP431	277/480V 3Ø,4W	100A	MLO	SURF	(15) 20A-1P	-	27	65K	
DP231	120/208V 3Ø,4W	800A	800A	SURF	(8) 100A-3P, (1) 200A-3P	-	15	22K	PROVIDE WITH 200% NEUTRALS
P231	120/208V 3Ø,4W	200A	MLO	SURF	(48) 20A-1P, (1) 20A-2P	(6) 20A-1P	28	10K	DOUBLE TUB WITH FEED-THRU LUGS & 200% NEUTRALS
P432	277/480V 3Ø,4W	250A	MLO	SURF	(2) 20A-3P, (2) 15A-3P (9) 20A-1P, (1) 50A-3P	-	21	65K	
P232	120/208v 3Ø,4W	100A	100A	SURF	(10) 20A-1P	-	32	10K	
SC	120/208v 3Ø,4W	100A	MLO	SURF	(20) 20A-1P	-	22	10K	PROVIDE WITH 200% NEUTRALS
HDP411	277/480V 3Ø,4W	800A	MLO	SURF	(2) 250A-3P, (1) 125A-3P (1) 350A-3P, (2) 60A-3P (2) 15A-3P, (1) 70A-3P	-	3	65K	
HP411	277/480V 3Ø,4W	250A	MLO	SURF	(1) 175A-2P, (3) 40A-3P (4) 20A-1P, (6) 15A-3P (1) 30A-3P △8	-	6	65K	△6
HP412	277/480V 3Ø,4W	250A	MLO	SURF	(1) 100A-3P, (2) 50A-3P (3) 30A-3P, (2) 20A-3P	-	18	65K	
HP212	120/208V 3Ø,4W	250A	250A	SURF	(4) 30A-2P, (4) 30A-1P (11) 20A-1P	(4) 20A-1P	17	10K	

Appendix 2. Ancillary Tests of Concrete Strength

Concrete Cylinder Test Results are as follows:

Briggs Engineering & Testing
A Division of PK Associates, Inc.

Concrete Cylinder Test Results

Project:	Kostas Research Institute
Project#: 25352	Date Cast: 4/7/11
Date Tested: 4/14/11	Report Date: 4/15/11

Placement Location: Strong Slab

Compressive Strength Tests - Lab Cure

Specimen	PSI	Break Type	Age
39A	3070	4	7 Day
39B	3110	4	7 Day
40A	3070	4	7 Day
40B	3150	4	7 Day
41A	3080	5	7 Day
41B	3110	5	7 Day
42A	2870	4	7 Day
42B	2950	4	7 Day

Spliting Tensile Strength Tests - Lab Cure

Specimen	PSI	Age
39C	320	7 Day
39D	320	7 Day
40C	290	7 Day
40D	300	7 Day

Compressive Strength Tests - Field Cure

Specimen	PSI	Break Type	Age
39E (FC)	3350	4	7 Day
39F (FC)	3430	5	7 Day
40E (FC)	3390	4	7 Day
40F (FC)	3450	5	7 Day

Spliting Tensile Strength Tests - Field Cure

Specimen	PSI	Age
41E (FC)	345	7 Day
41F (FC)	350	7 Day

☒ 100 Weymouth St., Unit B-1, Rockland, Ma 02370
☐ 100 Pound Rd., Cumberland, RI 02864

Approved: ____________________

Director of Testing Servives: **Sean P. Skorohod**

cf-11,rev3,02

Briggs Engineering & Testing
A Division of PK Associates, Inc.

Concrete Cylinder Test Results

Project:	Kostas Research Institute		
Project#:	25352	**Date Cast:**	4/7/11
Date Tested:	5/5/11	**Report Date:**	5/10/11

Placement Location: Strong Slab

Compressive Strength Tests - Lab Cure

Specimen	PSI	Break Type	Age
47A	4610	4	28 Day
47B	4490	5	28 Day
48A	4350	4	28 Day
48B	4540	5	28 Day
49A	4760	4	28 Day
49B	4780	4	28 Day
50A	5080	4	28 Day
50B	4940	5	28 Day
51A	4840	4	28 Day
51B	4860	5	28 Day
52A	5030	5	28 Day
52B	4840	5	28 Day
53A	4740	4	28 Day
53B	4730	4	28 Day
54A	4400	4	28 Day
54B	4460	5	28 Day

Spliting Tensile Strength Tests - Lab Cure

Specimen	PSI	Age
43C	465	28 Day
43D	480	28 Day
44C	410	28 Day
44D	415	28 Day
45C	405	28 Day
45D	420	28 Day
46C	400	28 Day
46D	420	28 Day

Compressive Strength Tests - Field Cure

Specimen	PSI	Break Type	Age
45E	5730	4	28 Day
45F	5620	4	28 Day
46E	5490	4	28 Day
46F	5510	4	28 Day
47E	5650	5	28 Day
47F	5410	4	28 Day
48E	5550	4	28 Day
48F	5450	5	28 Day

Spliting Tensile Strength Tests - Field Cure

Specimen	PSI	Age
49E (FC)	545	28 Day
49F (FC)	555	28 Day
50E (FC)	475	28 Day
50F (FC)	500	28 Day

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☐ 100 Pound Rd., Cumberland, RI 02864

Approved: ____________________

Director of Testing Servives: **Sean P. Skorohod**

cf-11,rev3,02

Briggs Engineering & Testing
A Division of PK Associates, Inc.

Concrete Cylinder Test Results			
Project:	Kostas Research Institute		
Project#:	25352	Date Cast:	4/7/11
Date Tested:	6/2/11	Report Date:	6/9/11

Placement Location: Strong Slab

Compressive Strength Tests - Lab Cure

Specimen	PSI	Break Type	Age
55A	5250	5	56 Day
55B	5440	5	56 Day
56A	5100	4	56 Day
56B	5310	5	56 Day
57A	5750	5	56 Day
57B	5830	5	56 Day
58A	5310	4	56 Day
58B	5320	5	56 Day

Spliting Tensile Strength Tests - Lab Cure

Specimen	PSI	Age
47C	520	56 Day
47D	480	56 Day
48C	495	56 Day
48D	485	56 Day

Compressive Strength Tests - Field Cure

Specimen	PSI	Break Type	Age
51E	5690	4	56 Day
51F	5900	5	56 Day
52E	5800	4	56 Day
52F	6140	4	56 Day

Spliting Tensile Strength Tests - Field Cure

Specimen	PSI	Age
53E (FC)	540	56 Day
53F (FC)	510	56 Day

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☐ 100 Pound Rd., Cumberland, RI 02864

Approved: ______________________

Director of Testing Servives: Sean P. Skorohod

cf-11,rev3,02

Briggs Engineering & Testing
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Concrete Cylinder Test Results			
Project:	Kostas Research Institute		
Project#:	25352	Date Cast:	4/7/11
Date Tested:	7/6/11	Report Date:	7/15/11

Placement Location: Strong Slab

Compressive Strength Tests - Lab Cure

Specimen	PSI	Break Type	Age
59A	6500	5	90 Day
59B	6490	5	90 Day
60A	5250	5	90 Day
60B	5440	4	90 Day
61A	5100	5	90 Day
61B	5310	5	90 Day
62A	5750	4	90 Day
62B	5830	5	90 Day
63A	5310	5	90 Day
63B	5320	5	90 Day
64A	5310	5	90 Day
64B	5750	4	90 Day
65A	5830	5	90 Day
65B	5710	4	90 Day
66A	5320	5	90 Day
66B	5320	5	90 Day

Spliting Tensile Strength Tests - Lab Cure

Specimen	PSI	Age
49C	520	90 Day
49D	480	90 Day
50C	495	90 Day
50D	485	90 Day
51C	520	90 Day
51D	480	90 Day
52C	495	90 Day
52D	485	90 Day

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Approved: ____________________
Director of Testing Servives: Sean P. Skorohod

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Briggs Engineering & Testing
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Concrete Cylinder Test Results			
Project:	Kostas Research Institute		
Project#:	25352	Date Cast:	4/7/11
Date Tested:	7/6/11	Report Date:	7/15/11

Placement Location: Strong Slab

Compressive Strength Tests - Field Cure

Specimen	PSI	Break Type	Age
54E (FC)	5340	4	90 Day
54F (FC)	5160	5	90 Day
55E (FC)	5830	5	90 Day
55F (FC)	5650	5	90 Day
56E (FC)	5610	5	90 Day
56F (FC)	5860	4	90 Day
57E (FC)	6180	5	90 Day
57F (FC)	5960	5	90 Day

Spliting Tensile Strength Tests - Field Cure

Specimen	PSI	Age
58E (FC)	490	90 Day
58F (FC)	450	90 Day
59E (FC)	480	90 Day
59F (FC)	450	90 Day

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Concrete Cylinder Test Results

Project:	Kostas Research Institute		
Project#:	25352	**Date Cast:**	4/7/11
Date Tested:	10/4/11	**Report Date:**	10/19/11

Placement Location: Strong Slab

Compressive Strength Tests - Lab Cure

Specimen	PSI	Break Type	Age
67A	7240	4	180 Day
67B	7170	5	180 Day
68A	7220	4	180 Day
68B	7230	5	180 Day
53C	6350	5	180 Day
53D	6750	5	180 Day
54C	6390	5	180 Day
54D	6090	5	180 Day

Spliting Tensile Strength Tests - Lab Cure

Specimen	PSI	Age
55C	600	180 Day
55D	565	180 Day
56C	665	180 Day
56D	660	180 Day

Compressive Strength Tests - Field Cure

Specimen	PSI	Break Type	Age
60E (FC)	6220	5	180 Day
60F (FC)	6230	5	180 Day
61E (FC)	5540	4	180 Day
61F (FC)	5420	5	180 Day

Spliting Tensile Strength Tests - Field Cure

Specimen	PSI	Age
62E (FC)	560	180 Day
62F (FC)	580	180 Day

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Briggs Engineering & Testing

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Concrete Cylinder Test Results

Project:	Kostas Research Institute		
Project#:	25352	**Date Cast:**	3/18/11
Date Tested:	3/25/11	**Report Date:**	3/30/11

Placement Location: Staging Floor

Compressive Strength Tests

Specimen	PSI	Break Type	Age
38A	3500	4	7 Day
38B	3370	4	7 Day
38C	3470	5	7 Day

Spliting Tensile Strength Tests

Specimen	PSI	Age
38D	285	7 Day
38E	260	7 Day
38F	290	7 Day

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Concrete Cylinder Test Results			
Project:	Kostas Research Institute		
Project#:	25352	Date Cast:	3/18/11
Date Tested:	4/15/11	Report Date:	4/20/11

Placement Location: Staging Floor

Compressive Strength Tests

Specimen	PSI	Break Type	Age
38G	4530	4	28 Day
38H	4620	4	28 Day
38I	4310	5	28 Day

Spliting Tensile Strength Tests

Specimen	PSI	Age
38J	400	28 Day
38K	430	28 Day
38L	415	28 Day

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Concrete Cylinder Test Results			
Project:	Kostas Research Institute		
Project#:	25352	Date Cast:	3/18/11
Date Tested:	5/12/11	Report Date:	5/19/11

Placement Location: Staging Floor

Compressive Strength Tests

Specimen	PSI	Break Type	Age
38M	5200	4	56 Day
38N	5285	4	56 Day
38O	5475	4	56 Day

Spliting Tensile Strength Tests

Specimen	PSI	Age
38P	500	56 Day
38Q	505	56 Day
38R	525	56 Day

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Concrete Cylinder Test Results			
Project:	Kostas Research Institute		
Project#:	25352	Date Cast:	3/18/11
Date Tested:	6/14/11	Report Date:	6/20/11

Placement Location: Staging Floor

Compressive Strength Tests

Specimen	PSI	Break Type	Age
38S	6350	5	90 Day
38T	6040	3	90 Day
38U	6050	3	90 Day

Spliting Tensile Strength Tests

Specimen	PSI	Age
38V	530	90 Day
38W	610	90 Day
38X	610	90 Day

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Appendix 3. Concrete Strengths

Level 1 - Truck Numbers Showing Locations on the Strong Floor of Concrete from that Truck

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
1	402	402	402	402	402	402	402	402	402	402	507	507	507	507	507	507	507	507	507	504	504	504	504	504	504	504	504
2	402	402	402	402	402	402	402	402	402	402	507	507	507	507	507	507	507	507	507	504	504	504	504	504	504	504	504
3	402	402	402	402	402	402	402	402	402	402	507	507	507	507	507	507	507	507	507	504	504	504	504	504	504	504	504
4	402	402	402	402	402	400	400	400	400	400	507	507	507	507	507	510	510	510	510	504	504	503	503	503	503	503	503
5	402	402	402	402	402	400	400	400	400	400	507	507	507	507	507	510	510	510	510	504	504	503	503	503	503	503	503
6	402	402	402	402	402	400	400	400	400	400	507	507	507	507	507	510	510	510	510	504	504	503	503	503	503	503	503
7	401	401	401	401	401	400	400	400	400	400	507	507	507	507	507	510	510	510	510	504	504	503	503	503	503	503	503
8	401	401	401	401	401	400	400	400	400	400	507	507	507	507	507	510	510	510	510	306	306	503	503	503	503	503	503
9	401	401	401	401	401	400	400	400	400	400	500	500	500	500	500	510	510	510	510	306	306	503	503	503	503	503	503
10	401	401	401	401	401	400	400	400	400	400	500	500	500	500	500	510	510	510	510	306	306	503	503	503	503	503	503
11	401	401	401	401	401	405	405	405	405	405	500	500	500	500	500	510	510	510	510	306	306	502	502	502	502	502	502
12	401	401	401	401	401	405	405	405	405	405	500	500	500	500	500	510	510	510	510	306	306	502	502	502	502	502	502
13	401	401	401	401	401	405	405	405	405	405	405	405	405	405	405	510	510	510	510	306	306	502	502	502	502	502	502
14	401	401	401	401	401	405	405	405	405	405	405	405	405	405	405	510	510	510	510	306	306	502	502	502	502	502	502
15	401	401	401	401	401	405	405	405	405	405	405	405	405	405	405	510	510	510	510	306	306	502	502	502	502	502	502
16	401	401	401	401	401	405	405	405	405	405	405	405	405	405	405	510	510	510	510	306	306	502	502	502	502	502	502
	401	401	401	401	401	405	405	405	405	405	405	405	405	405	405	306	306	306	306	306	306	502	502	502	502	502	502

Level 2 - Truck Numbers Showing Locations on the Strong Floor of Concrete from that Truck

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
1	302	402	402	402	402	401	401	401	405	405	405	405	405	405	405	405	306	306	306	306	306	306	306	306	306	306	306
2	302	402	402	402	402	401	401	401	405	405	405	405	405	405	405	405	510	510	510	510	306	306	306	306	306	306	306
3	302	402	402	402	402	401	401	401	405	405	405	405	405	405	405	405	510	510	510	510	306	306	306	306	306	306	306
4	302	402	402	402	402	401	401	401	405	405	405	500	500	500	500	500	510	510	510	510	504	504	504	504	504	504	504
5	302	402	402	402	402	401	401	401	405	405	405	500	500	500	500	500	510	510	510	510	504	504	504	504	504	504	504
6	302	402	402	402	402	401	401	401	405	405	405	500	500	500	500	500	510	510	510	510	504	504	504	504	504	504	504
7	302	402	402	402	402	401	401	401	405	405	405	500	500	500	500	500	510	510	510	510	504	504	504	504	504	504	504
8	302	402	402	402	402	401	401	401	405	405	405	500	500	500	500	500	510	510	510	510	504	504	504	504	504	504	504
9	302	402	402	402	402	401	401	401	405	405	405	500	500	500	500	500	510	510	510	510	504	504	504	504	504	504	504
10	302	402	402	402	402	401	401	401	405	405	405	500	500	500	500	500	510	510	510	510	503	503	503	503	503	503	503
11	302	402	402	402	402	401	401	401	405	405	405	500	500	500	500	500	510	510	510	510	503	503	503	503	503	503	503
12	302	402	402	402	402	400	400	400	405	405	405	500	500	500	500	500	510	510	510	510	503	503	503	503	503	503	503
13	302	402	402	402	402	400	400	400	405	405	405	500	500	500	500	500	510	510	510	510	503	503	503	503	503	503	503
14	302	302	302	302	302	400	400	400	405	405	405	500	500	500	500	500	510	510	510	510	503	503	503	503	503	503	503
15	302	302	302	302	302	400	400	400	400	400	400	507	507	507	507	507	507	507	507	507	502	502	502	502	502	502	502
16	302	302	302	302	302	400	400	400	400	400	400	507	507	507	507	507	507	507	507	507	502	502	502	502	502	502	502
	302	302	302	302	302	400	400	400	400	400	400	507	507	507	507	507	507	507	507	507	502	502	502	502	502	502	502

Level 3 - Truck Numbers Showing Locations on the Strong Floor of Concrete from that Truck

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
1	402	402	402	402	400	400	500	500	500	500	500	500	507	507	507	306	306	306	306	306	306	306	306	306	306	306	306
2	402	402	402	402	400	400	500	500	500	500	500	500	507	507	507	306	306	306	306	306	306	306	306	306	306	306	306
3	402	402	402	402	400	400	500	500	500	500	500	500	507	507	507	306	306	306	306	306	306	306	306	306	306	306	306
4	402	402	402	402	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	306	306	306	306	306	306	306
5	402	402	402	402	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	306	306	306	306	306	306	306
6	402	402	402	402	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	306	306	306	306	306	306	306
7	402	402	402	402	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	306	306	306	306	306	306	306
8	402	402	402	402	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	306	306	306	306	306	306	306
9	400	400	400	400	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	306	306	306	306	306	306	306
10	400	400	400	400	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	306	306	306	306	306	306	306
11	400	400	400	400	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	504	504	504	504	504	504	504
12	400	400	400	400	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	504	504	504	504	504	504	504
13	400	400	400	400	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	504	504	504	504	504	504	504
14	400	400	400	400	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	504	504	504	504	504	504	504
15	400	400	400	400	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	504	504	504	504	302	302	302
16	400	400	400	400	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	504	504	504	504	302	302	302
	400	400	400	400	400	400	500	500	500	500	507	507	507	507	507	306	306	306	306	306	504	504	504	504	302	302	302

Average Concrete Strengths on the Strong Floor

				7 Days				14 Days			
				Compressive Strength (psi)		Split Tensile Strength (psi)		Compressive Strength (psi)		Split Tensile Strength (psi)	
	Truck #	Time	Cylinder Labels (A-F)	Lab Cure	Field Cure	Lab Cure	Field Cure	Lab Cure	Field Cure	Lab Cure	Field Cure
Layer 1	502	7.05	39	3090	3390	320					
	503	7.17	40	3110	3420	295					
	504	7.26	41	3095			347.5				
	306	7.34	42	2910							
	510	7.41	43								
	507	7.49	44								
	500	7.59	45								
	405	8.32	46								
	400	9.04	47								
	402	9.10	48								
	401	9.20	49								
Layer 2	502	9.28	50								
	503	9.36	51								
			52								
	504	9.46	53								
	306	9.55	54								
	510	10.03	55								
	507	10.12	56								
	500	10.19	57								
	405	10.28	58								
	400	10.41	59								
	401	10.59	60								
	402	11.12	61								
	302	11.24	62								
Layer 3	504	12.14	63								
	306	12.21	64								
	507	12.40	65								
	500	12.52	66								
	400	1.07	67								
	402	1.19	68								

				28 Days				56 Days			
				Compressive Strength (psi)		Split Tensile Strength (psi)		Compressive Strength (psi)		Split Tensile Strength (psi)	
	Truck #	Time	Cylinder Labels (A-F)	Lab Cure	Field Cure	Lab Cure	Field Cure	Lab Cure	Field Cure	Lab Cure	Field Cure
Layer 1	502	7.05	39								
	503	7.17	40								
	504	7.26	41								
	306	7.34	42								
	510	7.41	43			472.5					
	507	7.49	44			412.5					
	500	7.59	45		5675	412.5					
	405	8.32	46		5500	410					
	400	9.04	47	4550	5530					500	
	402	9.10	48	4445	5500					490	
	401	9.20	49	4770			550				
Layer 2	502	9.28	50	5010			487.5				
	503	9.36	51	4850					5795		
			52	4935					5970		
	504	9.46	53	4735							525
	306	9.55	54	4430							
	510	10.03	55					5345			
	507	10.12	56					5205			
	500	10.19	57					5790			
	405	10.28	58					5315			
	400	10.41	59								
	401	10.59	60								
	402	11.12	61								
	302	11.24	62								
Layer 3	504	12.14	63								
	306	12.21	64								
	507	12.40	65								
	500	12.52	66								
	400	1.07	67								
	402	1.19	68								

				90 Days				180 Days			
				Compressive Strength (psi)		Split Tensile Strength (psi)		Compressive Strength (psi)		Split Tensile Strength (psi)	
	Truck #	Time	Cylinder Labels (A-F)	Lab Cure	Field Cure	Lab Cure	Field Cure	Lab Cure	Field Cure	Lab Cure	Field Cure
Layer 1	502	7.05	39								
	503	7.17	40								
	504	7.26	41								
	306	7.34	42								
	510	7.41	43								
	507	7.49	44								
	500	7.59	45								
	405	8.32	46								
	400	9.04	47								
	402	9.10	48								
	401	9.20	49			500					
Layer 2	502	9.28	50			490					
	503	9.36	51			500					
			52			490					
	504	9.46	53					6550			
	306	9.55	54		5250			6240			
	510	10.03	55		5740					582.5	
	507	10.12	56		5735					662.5	
	500	10.19	57		6070						
	405	10.28	58				470				
	400	10.41	59	6495			465				
	401	10.59	60	5345					6225		
	402	11.12	61	5205					5480		
	302	11.24	62	5790							570
Layer 3	504	12.14	63	5315							
	306	12.21	64	5530							
	507	12.40	65	5770							
	500	12.52	66	5320							
	400	1.07	67					7205			
	402	1.19	68					7225			

				360 Days				
				Compressive Strength (psi)		Split Tensile Strength (psi)		
	Truck #	Time	Cylinder Labels (A-F)	Lab Cure	Field Cure	Lab Cure	Field Cure	Slump Test (in.)
Layer 1	502	7.05	39					6
	503	7.17	40					
	504	7.26	41					
	306	7.34	42					
	510	7.41	43					
	507	7.49	44					7
	500	7.59	45					
	405	8.32	46					
	400	9.04	47					
	402	9.10	48					
	401	9.20	49					
Layer 2	502	9.28	50					
	503	9.36	51					
			52					
	504	9.46	53					
	306	9.55	54					
	510	10.03	55					
	507	10.12	56					
	500	10.19	57					
	405	10.28	58					7 1/2
	400	10.41	59					
	401	10.59	60					
	402	11.12	61					
	302	11.24	62					7 1/2
Layer 3	504	12.14	63					
	306	12.21	64					
	507	12.40	65					
	500	12.52	66					
	400	1.07	67					
	402	1.19	68					

Detailed Concrete Strengths on the Strong Floor

				7 Days							
				Compressive Strength (psi)				Split Tensile Strength (psi)			
	Truck #	Time	Cylinder Labels (A-F)	Lab Cure		Field Cure		Lab Cure		Field Cure	
				A	B	E	F	C	D	E	F
Layer 1	502	7.05	39	3070	3110	3350	3430	320	320		
	503	7.17	40	3070	3150	3390	3450	290	300		
	504	7.26	41	3080	3110					345	350
	306	7.34	42	2870	2950						
	510	7.41	43								
	507	7.49	44								
	500	7.59	45								
	405	8.32	46								
	400	9.04	47								
	402	9.10	48								
	401	9.20	49								
Layer 2	502	9.28	50								
	503	9.36	51								
			52								
	504	9.46	53								
	306	9.55	54								
	510	10.03	55								
	507	10.12	56								
	500	10.19	57								
	405	10.28	58								
	400	10.41	59								
	401	10.59	60								
	402	11.12	61								
	302	11.24	62								
Layer 3	504	12.14	63								
	306	12.21	64								
	507	12.40	65								
	500	12.52	66								
	400	1.07	67								
	402	1.19	68								

				14 Days							
				Compressive Strength (psi)				Split Tensile Strength (psi)			
	Truck #	Time	Cylinder Labels (A-F)	Lab Cure		Field Cure		Lab Cure		Field Cure	
				A	B	E	F	C	D	E	F
Layer 1	502	7.05	39								
	503	7.17	40								
	504	7.26	41								
	306	7.34	42								
	510	7.41	43								
	507	7.49	44								
	500	7.59	45								
	405	8.32	46								
	400	9.04	47								
	402	9.10	48								
	401	9.20	49								
Layer 2	502	9.28	50								
	503	9.36	51								
			52								
	504	9.46	53								
	306	9.55	54								
	510	10.03	55								
	507	10.12	56								
	500	10.19	57								
	405	10.28	58								
	400	10.41	59								
	401	10.59	60								
	402	11.12	61								
	302	11.24	62								
Layer 3	504	12.14	63								
	306	12.21	64								
	507	12.40	65								
	500	12.52	66								
	400	1.07	67								
	402	1.19	68								

	Truck #	Time	Cylinder Labels (A-F)	28 Days							
				Compressive Strength (psi)				Split Tensile Strength (psi)			
				Lab Cure		Field Cure		Lab Cure		Field Cure	
				A	B	E	F	C	D	E	F
Layer 1	502	7.05	39								
	503	7.17	40								
	504	7.26	41								
	306	7.34	42								
	510	7.41	43					465	480		
	507	7.49	44					410	415		
	500	7.59	45			5730	5620	405	420		
	405	8.32	46			5490	5510	400	420		
	400	9.04	47	4610	4490	5650	5410				
	402	9.10	48	4350	4540	5550	5450				
	401	9.20	49	4760	4780					545	555
Layer 2	502	9.28	50	5080	4940					475	500
	503	9.36	51	4840	4860						
			52	5030	4840						
	504	9.46	53	4740	4730						
	306	9.55	54	4400	4460						
	510	10.03	55								
	507	10.12	56								
	500	10.19	57								
	405	10.28	58								
	400	10.41	59								
	401	10.59	60								
	402	11.12	61								
	302	11.24	62								
Layer 3	504	12.14	63								
	306	12.21	64								
	507	12.40	65								
	500	12.52	66								
	400	1.07	67								
	402	1.19	68								

				56 Days							
				Compressive Strength (psi)				Split Tensile Strength (psi)			
	Truck #	Time	Cylinder Labels (A-F)	Lab Cure		Field Cure		Lab Cure		Field Cure	
				A	B	E	F	C	D	E	F
Layer 1	502	7.05	39								
	503	7.17	40								
	504	7.26	41								
	306	7.34	42								
	510	7.41	43								
	507	7.49	44								
	500	7.59	45								
	405	8.32	46								
	400	9.04	47					520	480		
	402	9.10	48					495	485		
	401	9.20	49								
Layer 2	502	9.28	50								
	503	9.36	51			5690	5900				
			52			5800	6140				
	504	9.46	53							540	510
	306	9.55	54								
	510	10.03	55	5250	5440						
	507	10.12	56	5100	5310						
	500	10.19	57	5750	5830						
	405	10.28	58	5310	5320						
	400	10.41	59								
	401	10.59	60								
	402	11.12	61								
	302	11.24	62								
Layer 3	504	12.14	63								
	306	12.21	64								
	507	12.40	65								
	500	12.52	66								
	400	1.07	67								
	402	1.19	68								

	Truck #	Time	Cylinder Labels (A-F)	90 Days							
				Compressive Strength (psi)				Split Tensile Strength (psi)			
				Lab Cure		Field Cure		Lab Cure		Field Cure	
				A	B	E	F	C	D	E	F
Layer 1	502	7.05	39								
	503	7.17	40								
	504	7.26	41								
	306	7.34	42								
	510	7.41	43								
	507	7.49	44								
	500	7.59	45								
	405	8.32	46								
	400	9.04	47								
	402	9.10	48								
	401	9.20	49					520	480		
Layer 2	502	9.28	50					495	485		
	503	9.36	51					520	480		
			52					495	485		
	504	9.46	53								
	306	9.55	54			5340	5160				
	510	10.03	55			5830	5650				
	507	10.12	56			5610	5860				
	500	10.19	57			6180	5960				
	405	10.28	58							490	450
	400	10.41	59	6500	6490					480	450
	401	10.59	60	5250	5440						
	402	11.12	61	5100	5310						
	302	11.24	62	5750	5830						
Layer 3	504	12.14	63	5310	5320						
	306	12.21	64	5310	5750						
	507	12.40	65	5830	5710						
	500	12.52	66	5320	5320						
	400	1.07	67								
	402	1.19	68								

				180 Days											
				Compressive Strength (psi)						Split Tensile Strength (psi)					
	Truck #	Time	Cylinder Labels (A-F)	Lab Cure				Field Cure		Lab Cure		Field Cure			Slump Test (in.)
				A	B	C	D	E	F	C	D	E	F		
Layer 1	502	7.05	39												6
	503	7.17	40												
	504	7.26	41												
	306	7.34	42												
	510	7.41	43												
	507	7.49	44												7
	500	7.59	45												
	405	8.32	46												
	400	9.04	47												
	402	9.10	48												
	401	9.20	49												
Layer 2	502	9.28	50												
	503	9.36	51												
			52												
	504	9.46	53			6350	6750								
	306	9.55	54			6390	6090								
	510	10.03	55							600	565				
	507	10.12	56							665	660				
	500	10.19	57												
	405	10.28	58												7 1/2
	400	10.41	59												
	401	10.59	60					6220	6230						
	402	11.12	61					5540	5420						
	302	11.24	62									560	580		7 1/2
Layer 3	504	12.14	63												
	306	12.21	64												
	507	12.40	65												
	500	12.52	66												
	400	1.07	67	7240	7170										
	402	1.19	68	7220	7230										

Average Concrete Strengths on the Staging Area Floor

Days	Test Type	Cylinder Set 38
		Strength (psi), average
7 days	Compressive Strength	3447
	Split Tensile Strength	278
14 days	Compressive Strength	
	Split Tensile Strength	
28 days	Compressive Strength	4487
	Split Tensile Strength	415
56 days	Compressive Strength	5320
	Split Tensile Strength	510
90 days	Compressive Strength	6147
	Split Tensile Strength	583

Detailed Concrete Strengths on the Staging Area Floor

		Cylinder Set 38	
		Label	Strength (psi)
7 days	Compressive Strength	A	3500
		B	3370
		C	3470
	Split Tensile Strength	D	285
		E	260
		F	290
14 days	Compressive Strength		
	Split Tensile Strength		
28 days	Compressive Strength	G	4530
		H	4620
		I	4310
	Split Tensile Strength	J	400
		K	430
		L	415
56 days	Compressive Strength		5200
			5285
			5475
	Split Tensile Strength		500
			505
			525

		Cylinder Set 38	
		Label	Strength (psi)
90 days	Compressive Strength	S	6350
		T	6040
		U	6050
	Split Tensile Strength	V	530
		W	610
		X	610
180 days	Compressive Strength		
	Split Tensile Strength		
360 days	Compressive Strength		
	Split Tensile Strength		

Concrete Cylinder Testing Schedule for Strong Floor

Compression						
Age	Lab Cured			Field Cured		
7 days	39	A	B	39	E	F
	40	A	B	40	E	F
	41	A	B			
	42	A	B			
14 days	43	A	B	41	E	F
	44	A	B	42	E	F
	45	A	B			
	46	A	B			
28 days	47	A	B	45	E	F
	48	A	B	46	E	F
	49	A	B	47	E	F
	50	A	B	48	E	F
	51	A	B			
	52	A	B			
	53	A	B			
	54	A	B			
56 days	55	A	B	51	E	F
	56	A	B	52	E	F
	57	A	B			
	58	A	B			
90 days	59	A	B	54	E	F
	60	A	B	55	E	F
	61	A	B	56	E	F
	62	A	B	57	E	F
	63	A	B			
	64	A	B			
	65	A	B			
	66	A	B			
180 days	67	A	B	60	E	F
	68	A	B	61	E	F
	53	C	D			
	54	C	D			
360 days	57	A	B	63	E	F
	58	A	B	64	E	F
	59	A	B	65	E	F
	60	A	B	66	E	F
	61	A	B			
	62	A	B			
	63	A	B			
	64	A	B			

Tensile						
Age	Lab Cured			Field Cured		
7 days	39	C	D	41	E	F
	40	C	D			
14 days	41	C	D	43	E	F
	42	C	D			
28 days	43	C	D	49	E	F
	44	C	D	50	E	F
	45	C	D			
	46	C	D			
56 days	47	C	D	53	E	F
	48	C	D			
90 days	49	C	D	58	E	F
	50	C	D	59	E	F
	51	C	D			
	52	C	D			
180 days	55	C	D	62	E	F
	56	C	D			
360 days	65	C	D	67	E	F
	66	C	D	68	E	F
	67	C	D			
	68	C	D			

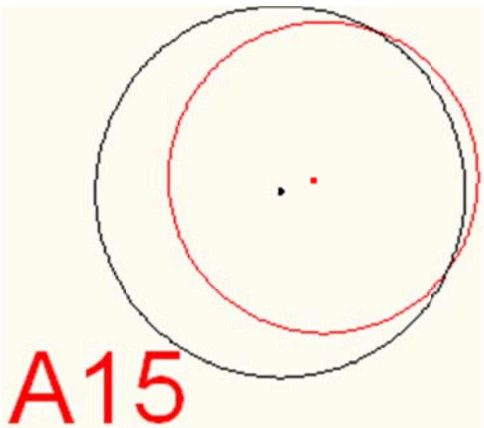
Appendix 4. Out-of-Tolerance Anchor Locations from the Surveys of Strong Floor

1st Survey (Points are ordered as follows: most out-of-tolerance hole, increasing east-to-west; then increasing south-to-north)

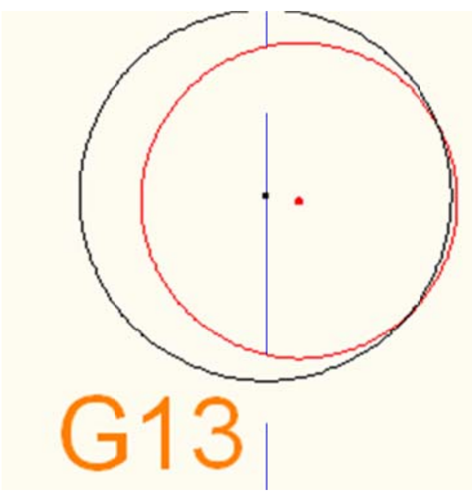
Hole Diameter: 1.75'' + 5/16''

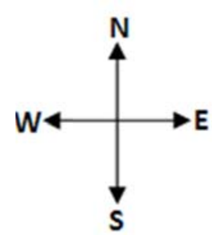
Nomenclature for letter and number of the anchor: number of 32nd inch of error in N-S direction, number of 32nd inch of error in E-W direction

A15 (2N, 6E):

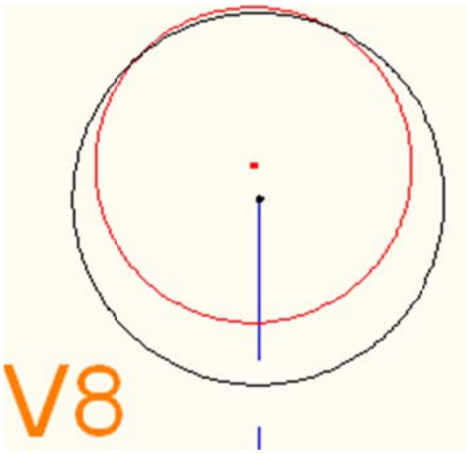


G13 (1S, 6E):

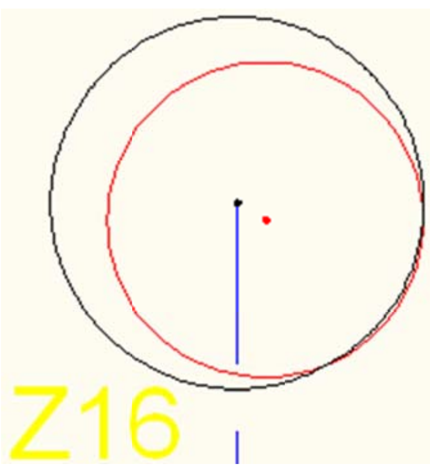




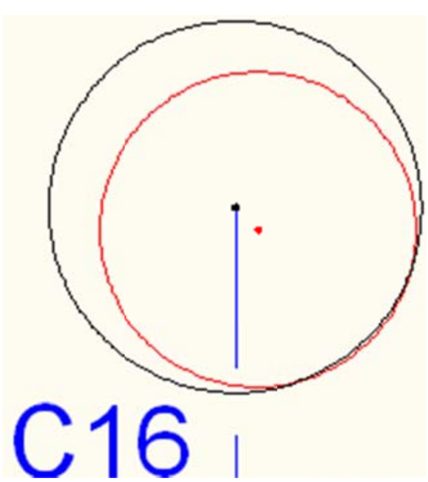
V8 (6N, 1W):

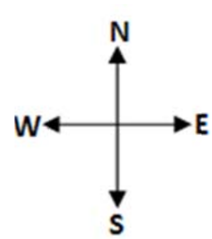


Z16 (3S, 5E):

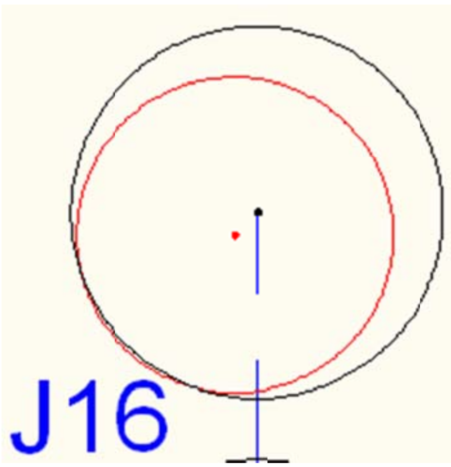


C16 (4S, 4E):

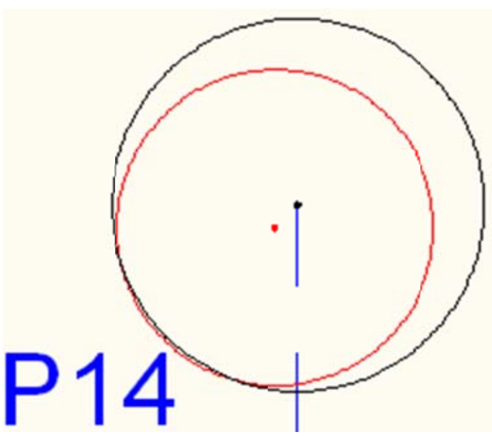




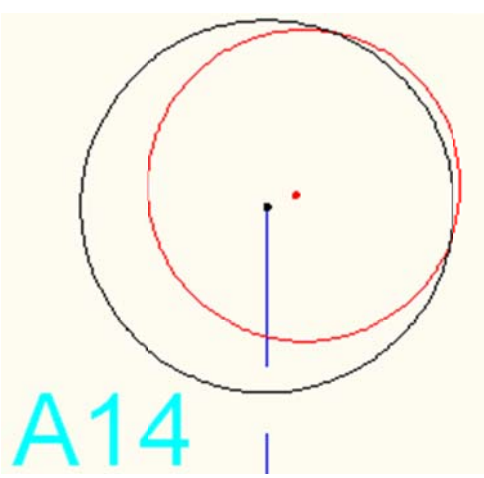
J16 (4S, 4W):

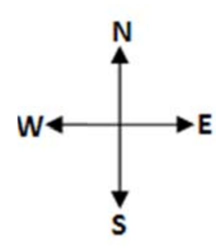


P14 (4S, 4W):

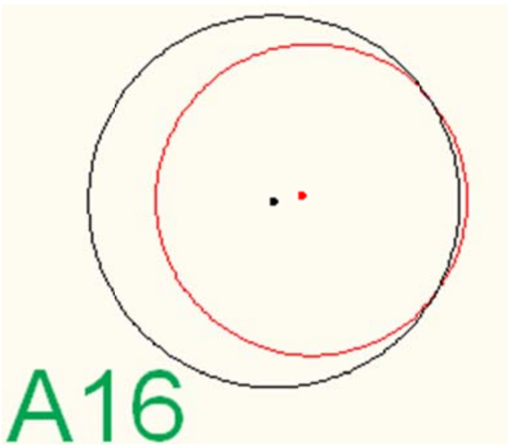


A14 (1N, 5E):

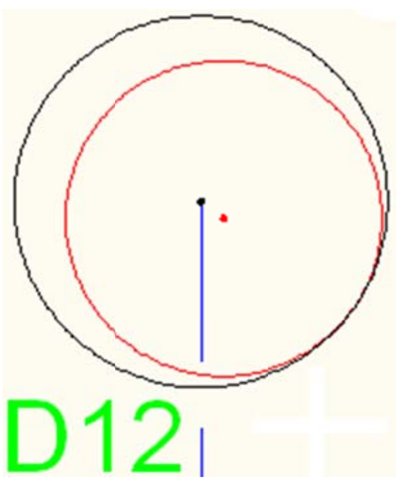




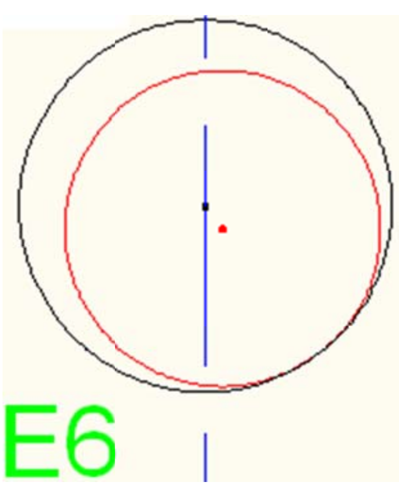
A16 (1N, 5E):

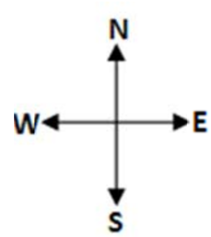


D12 (3S, 4E):

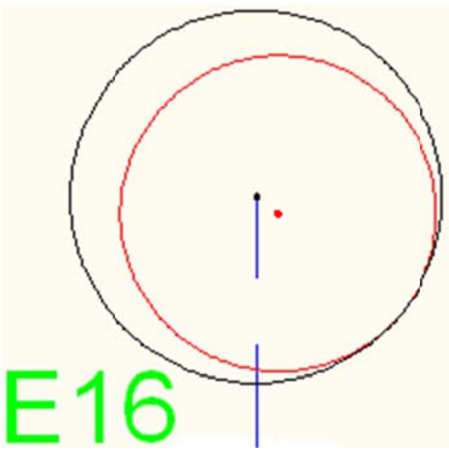


E6 (4S, 3E):

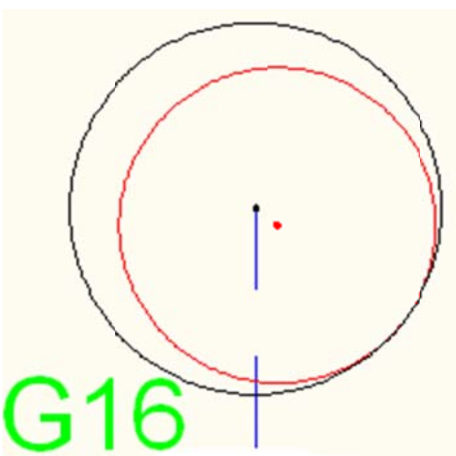




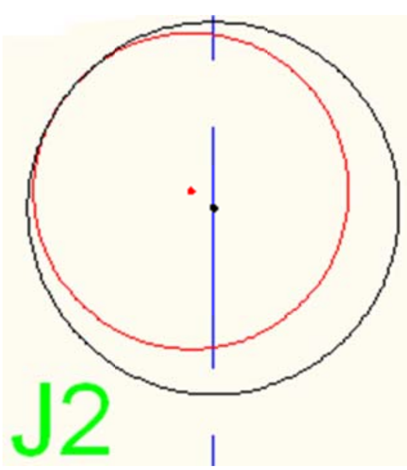
E16 (3S, 4E):

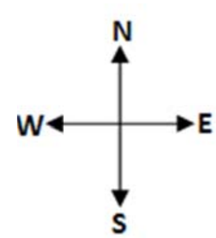


G16 (3S, 4E):

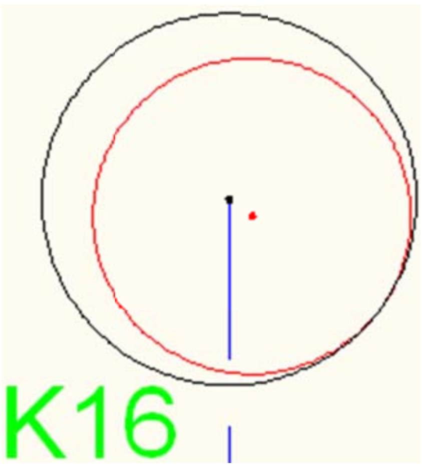


J2 (3N, 4W):

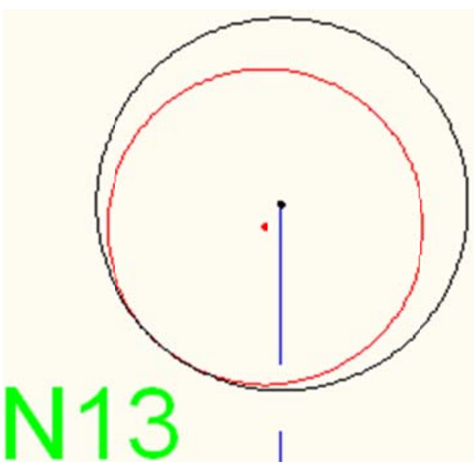




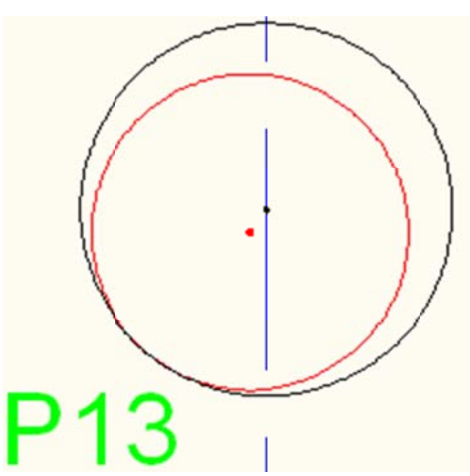
K16 (3S, 4E):

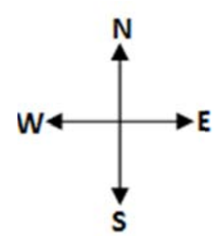


N13 (4S, 3W):

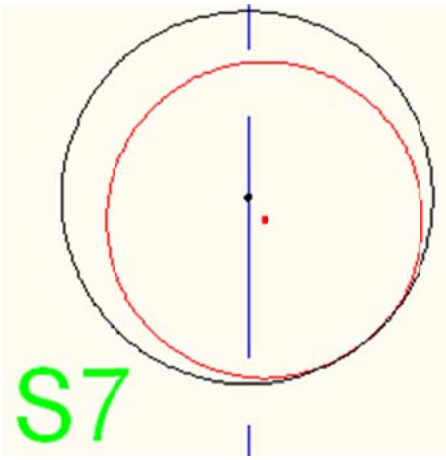


P13 (4S, 3W):

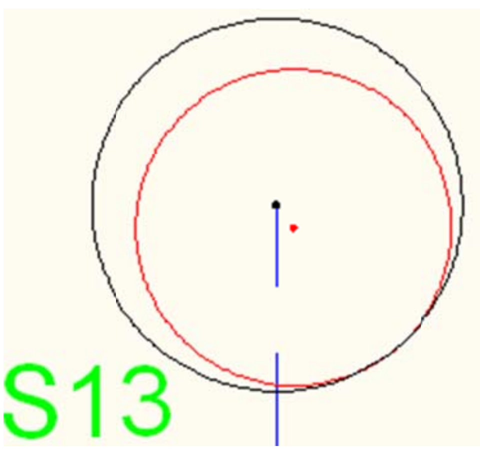




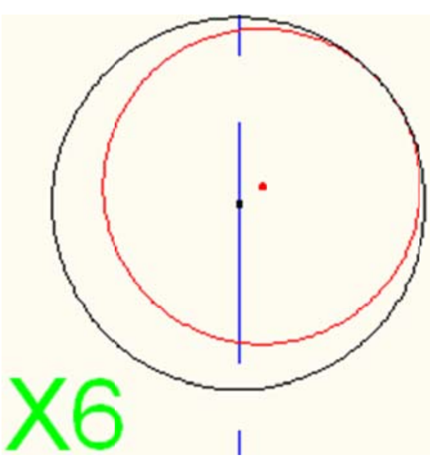
S7 (4S, 3E):

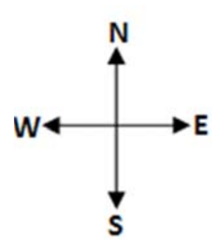


S13 (4S, 3E):

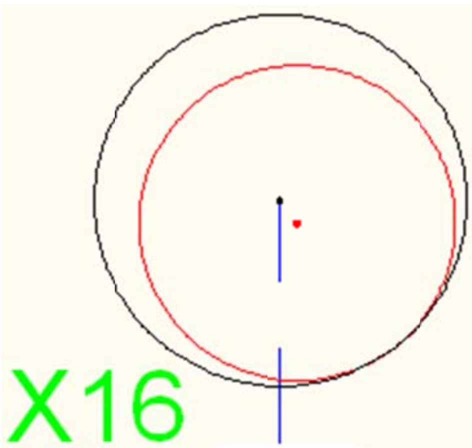


X6 (3N, 4E):

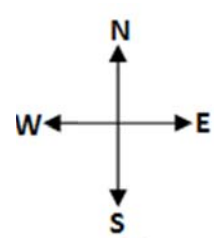




X16 (4S, 3E):



Y16 (4S, 3W):

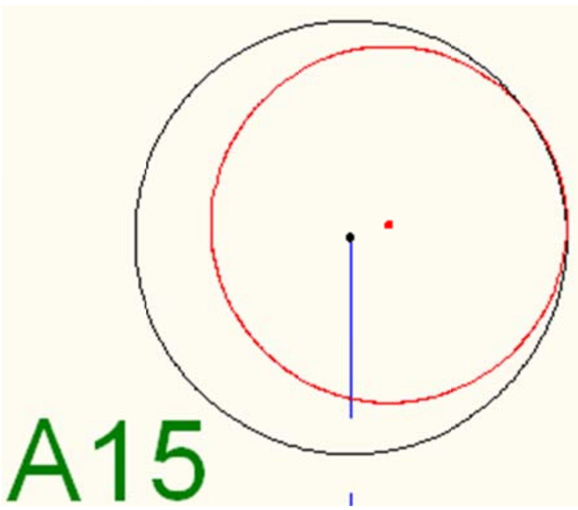


1st Survey (Points are ordered as follows: most out-of-tolerance hole, increasing east-to-west; then increasing south-to-north)

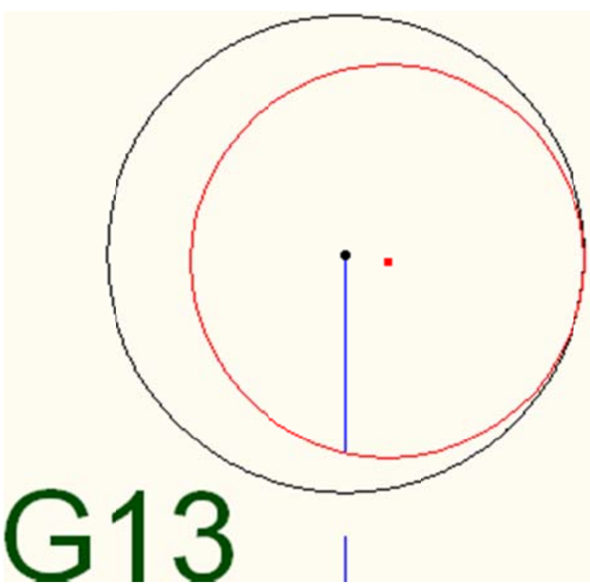
Hole Diameter: 1.75’’ + 6/16’’

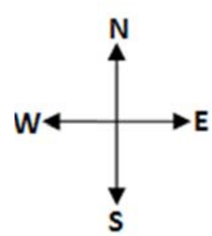
Nomenclature for letter and number of the anchor: number of 32^{nd} inch of error in N-S direction, number of 32^{nd} inch of error in E-W direction

A15 (2N, 6E):

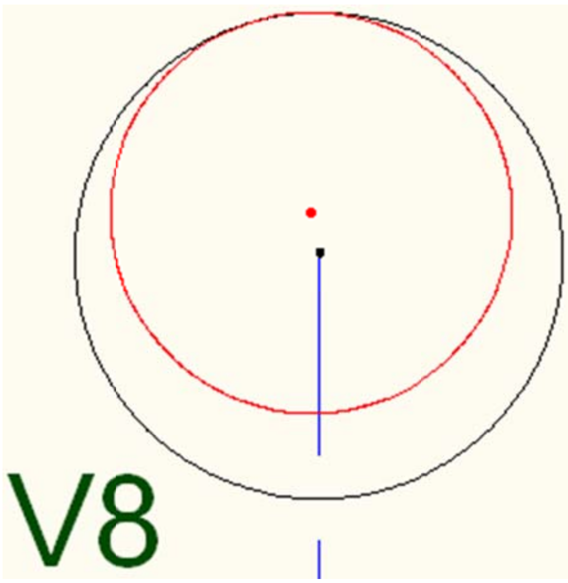


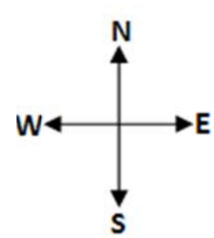
G13 (1S, 6E):





V8 (6N, 1W):



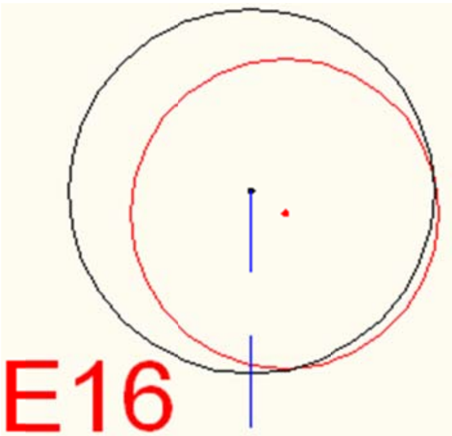


2st Survey (Points are ordered as follows: most out-of-tolerance hole, increasing east-to-west; then increasing south-to-north)

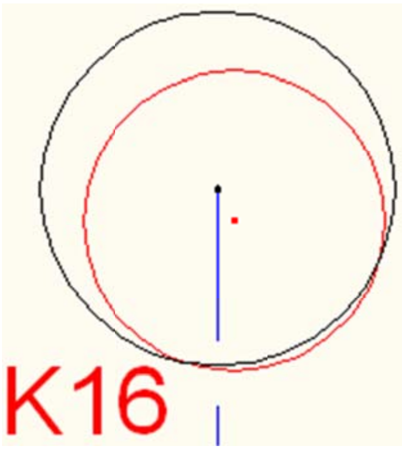
Hole Diameter: 1.75'' + 5/16''

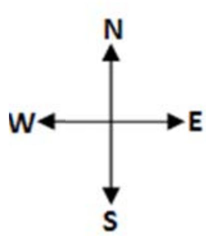
Nomenclature for letter and number of the anchor: number of 32nd inch of error in N-S direction, number of 32nd inch of error in E-W direction

E16 (4S, 6E):

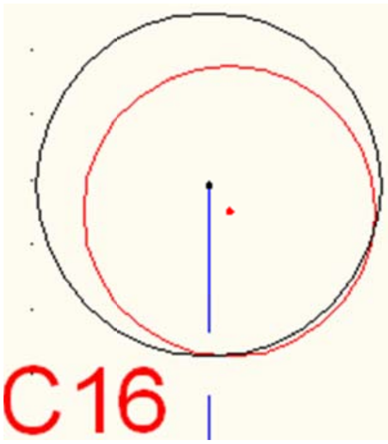


K16 (6N, 3E):

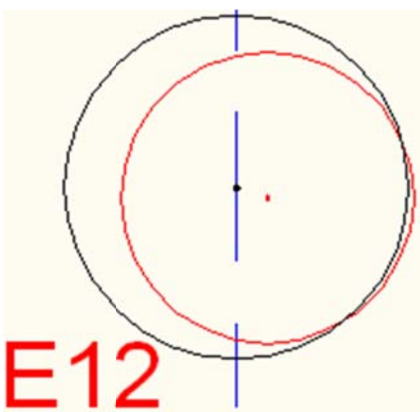




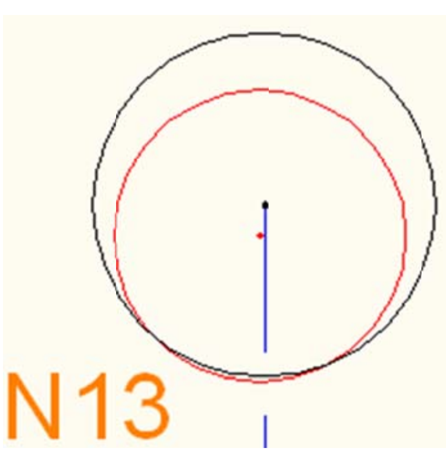
C16 (5S, 4E):

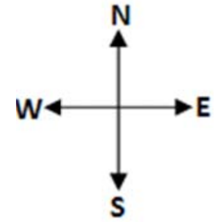


E12 (2S, 6E):



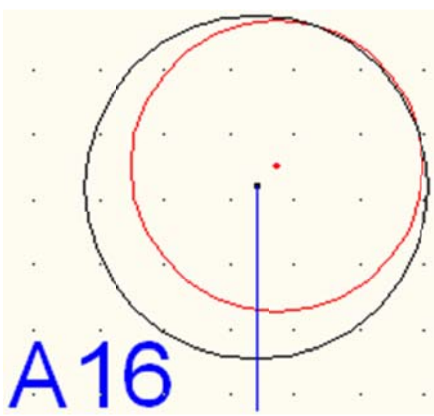
N13 (6S, 1W):



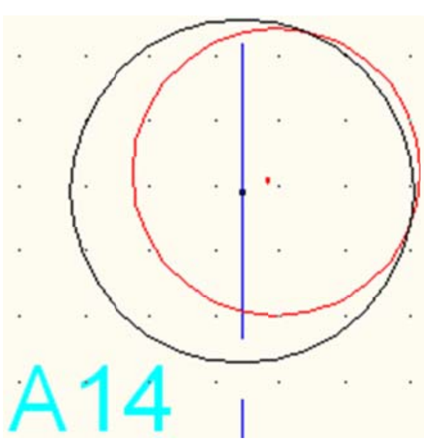


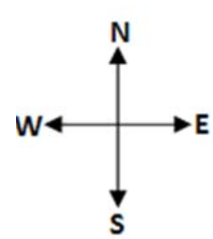
G13 (0, 6E):

A16 (4N, 4E):

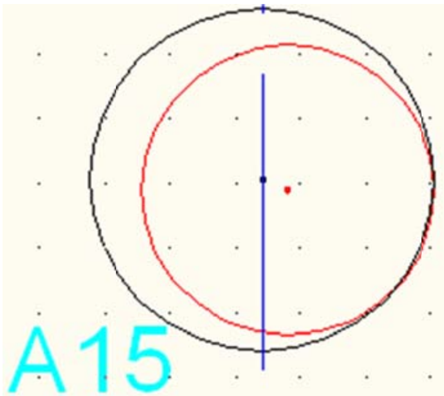


A14 (2N, 5E):

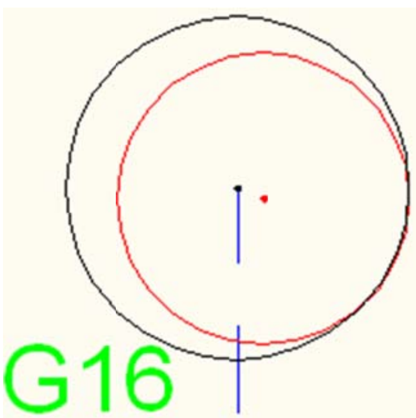




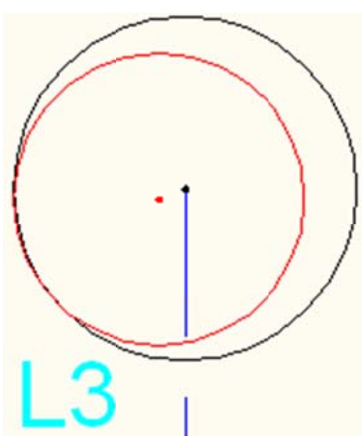
A15 (2S, 5E):

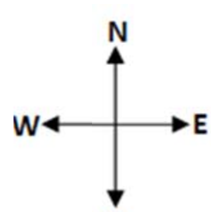


G16 (2S, 5E):

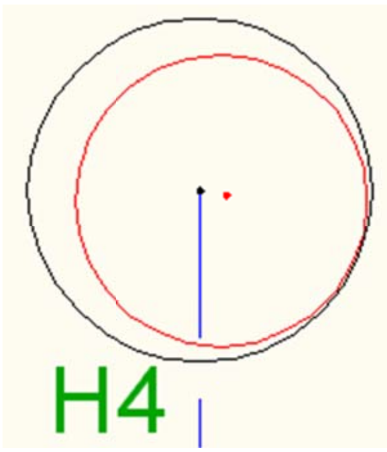


L3 (2S, 5W):

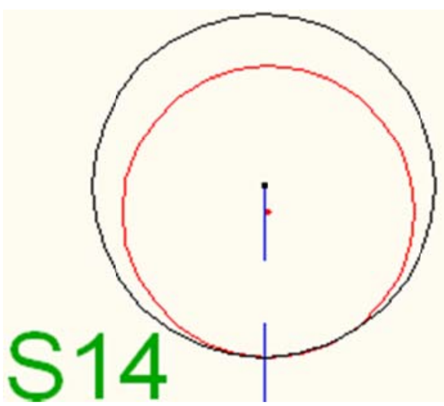




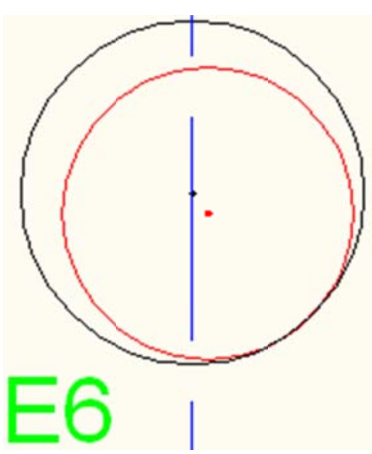
H4 (1S, 5E):

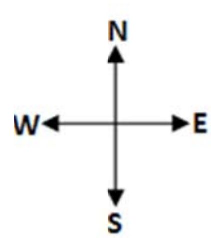


S14 (5S, 1E):

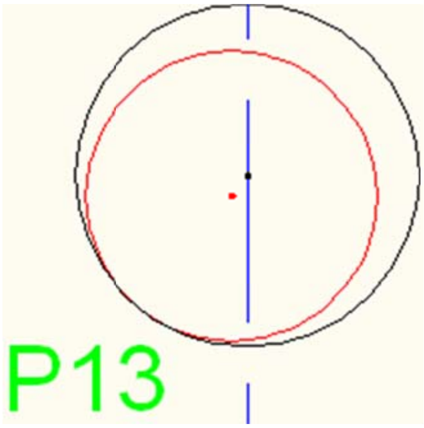


E6 (4S, 3E):

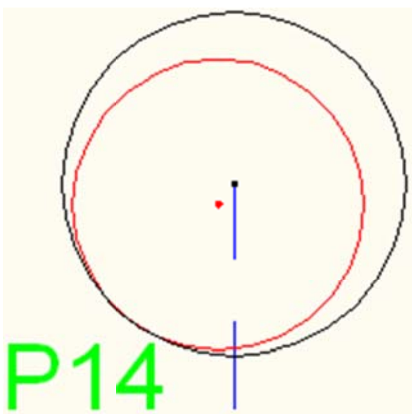




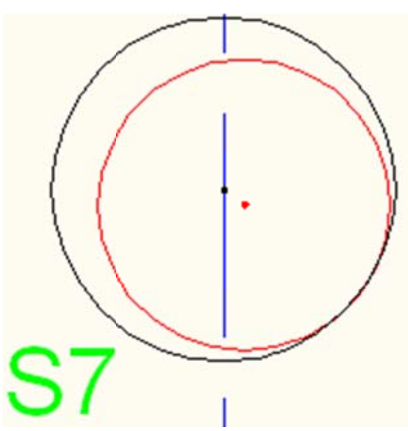
P13 (4S, 3W):

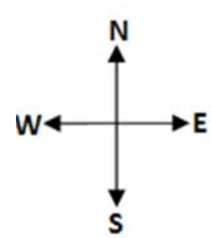


P14 (4S, 3W):



S7 (3S, 4E):



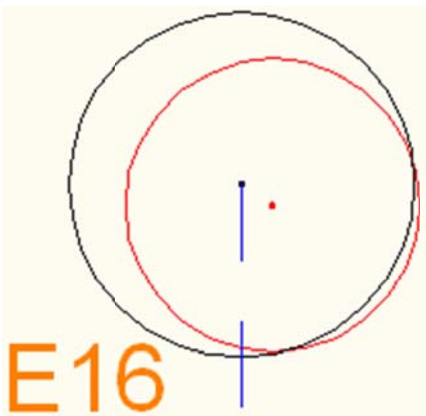


2^{st} Survey (Points are ordered as follows: most out-of-tolerance hole, increasing east-to-west; then increasing south-to-north)

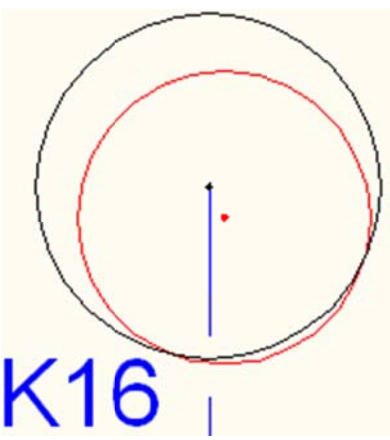
Hole Diameter: 1.75'' + 6/16''

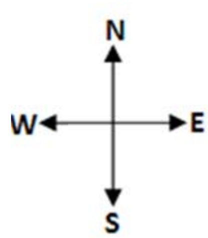
Nomenclature for letter and number of the anchor: number of 32^{nd} inch of error in N-S direction, number of 32^{nd} inch of error in E-W direction

E16 (4S, 6E):

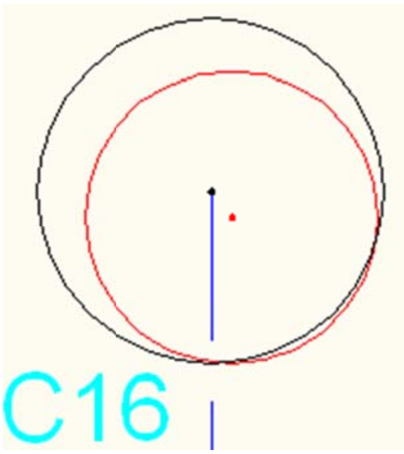


K16 (6N, 3E):

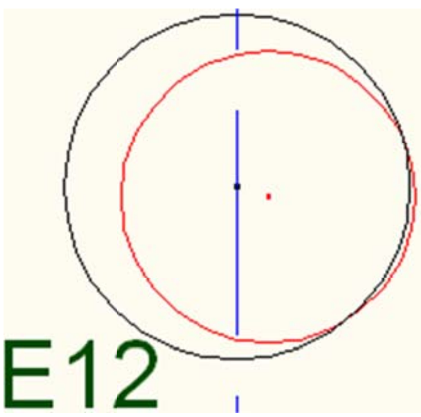




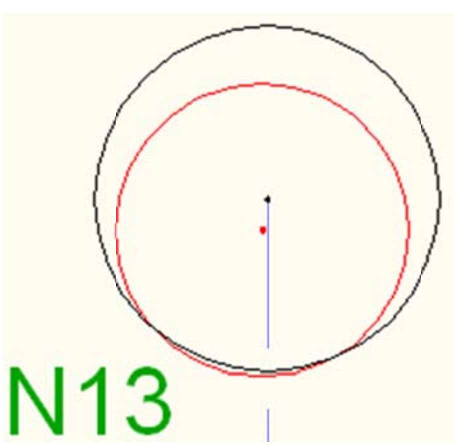
C16 (5S, 4E):

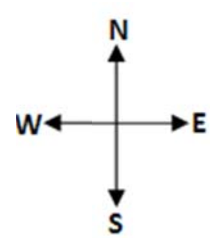


E12 (2S, 6E):

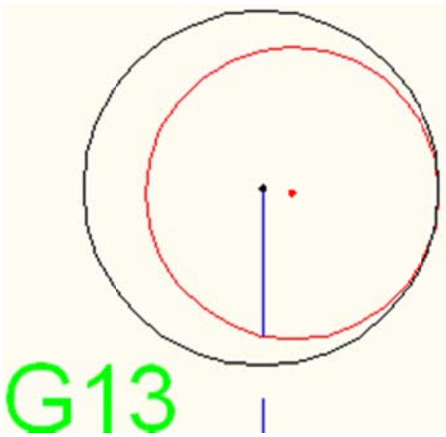


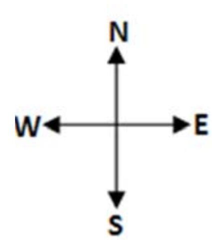
N13 (6S, 1W):





G13 (0, 6E):



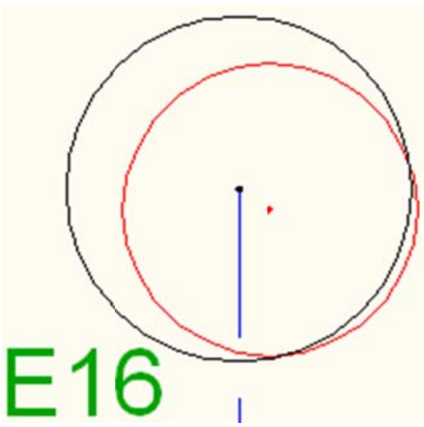


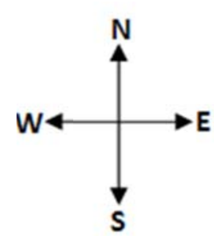
2st Survey (Points are ordered as follows: most out-of-tolerance hole, increasing east-to-west; then increasing south-to-north)

Hole Diameter: 1.75'' + 7/16''

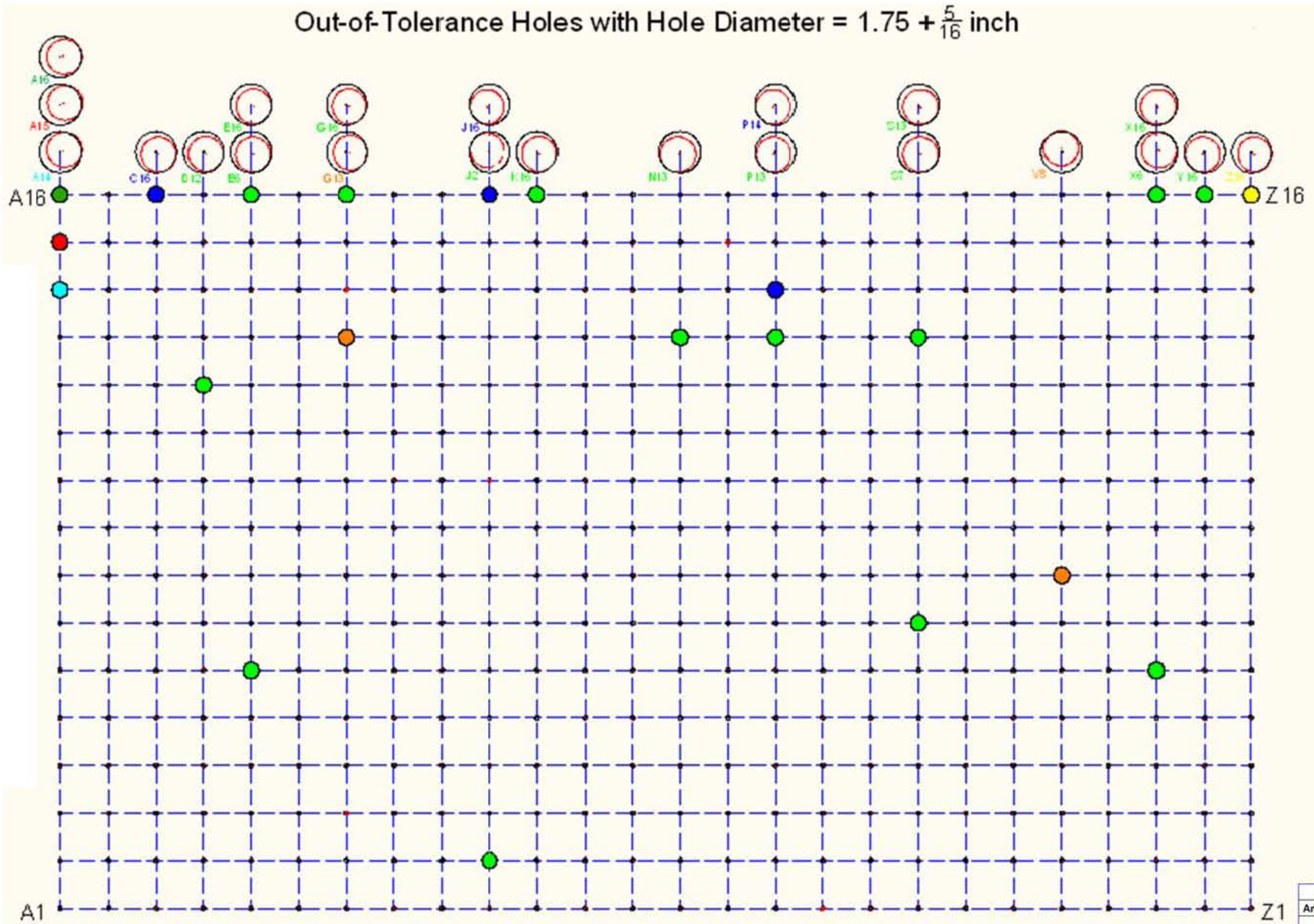
Nomenclature for letter and number of the anchor: number of 32nd inch of error in N-S direction, number of 32nd inch of error in E-W direction

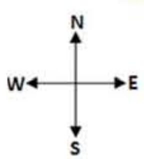
E16 (4S, 6E):





Out-of-Tolerance and Out-of-Tilt Anchor Location from the 1st Survey of Strong Floor

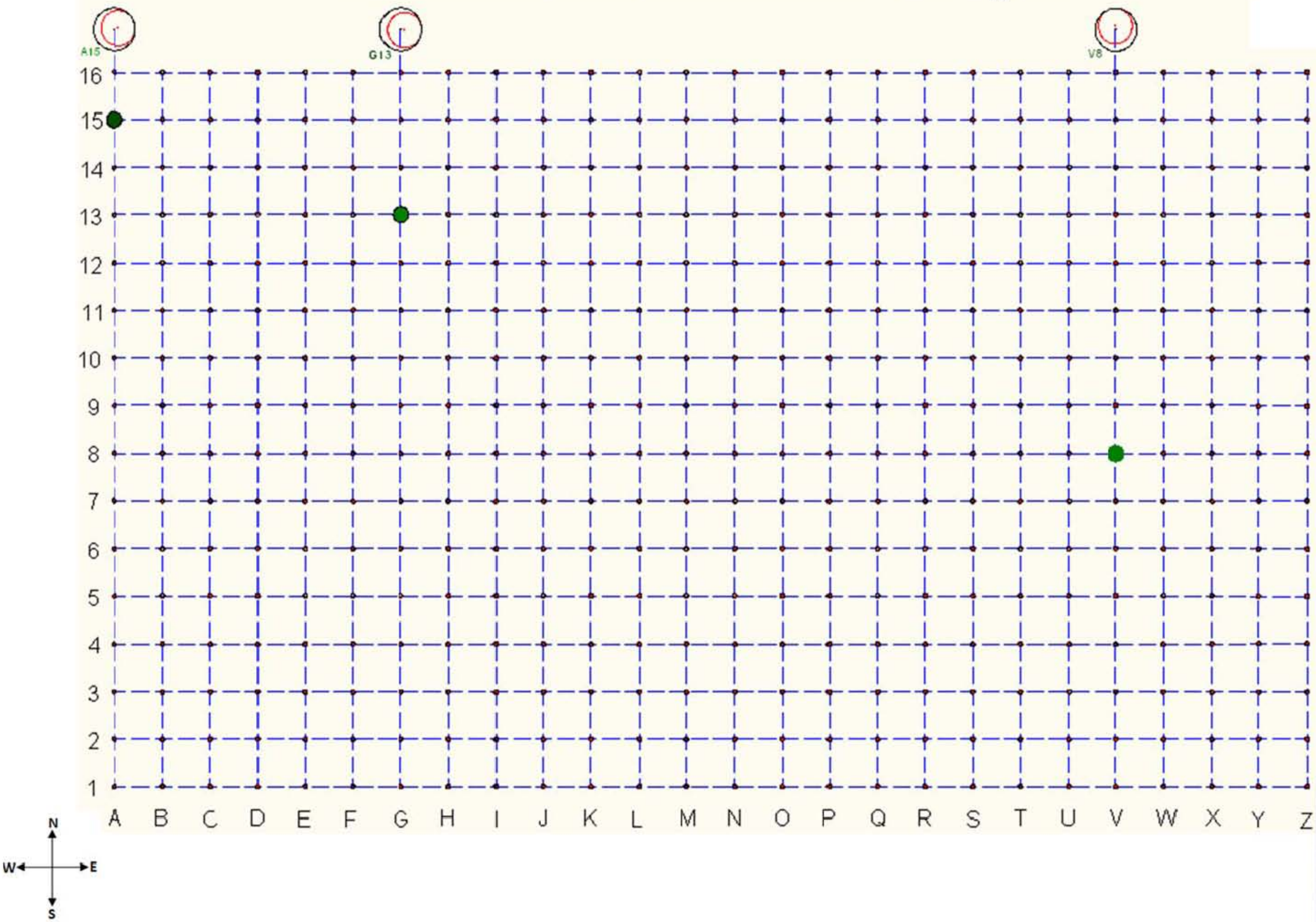




Legend

Amount of Overlap (in)	Colors
0.00000	
0.00259	
0.00309	
0.01014	
0.01204	
0.02053	
0.02597	
0.03384	
0.04139	

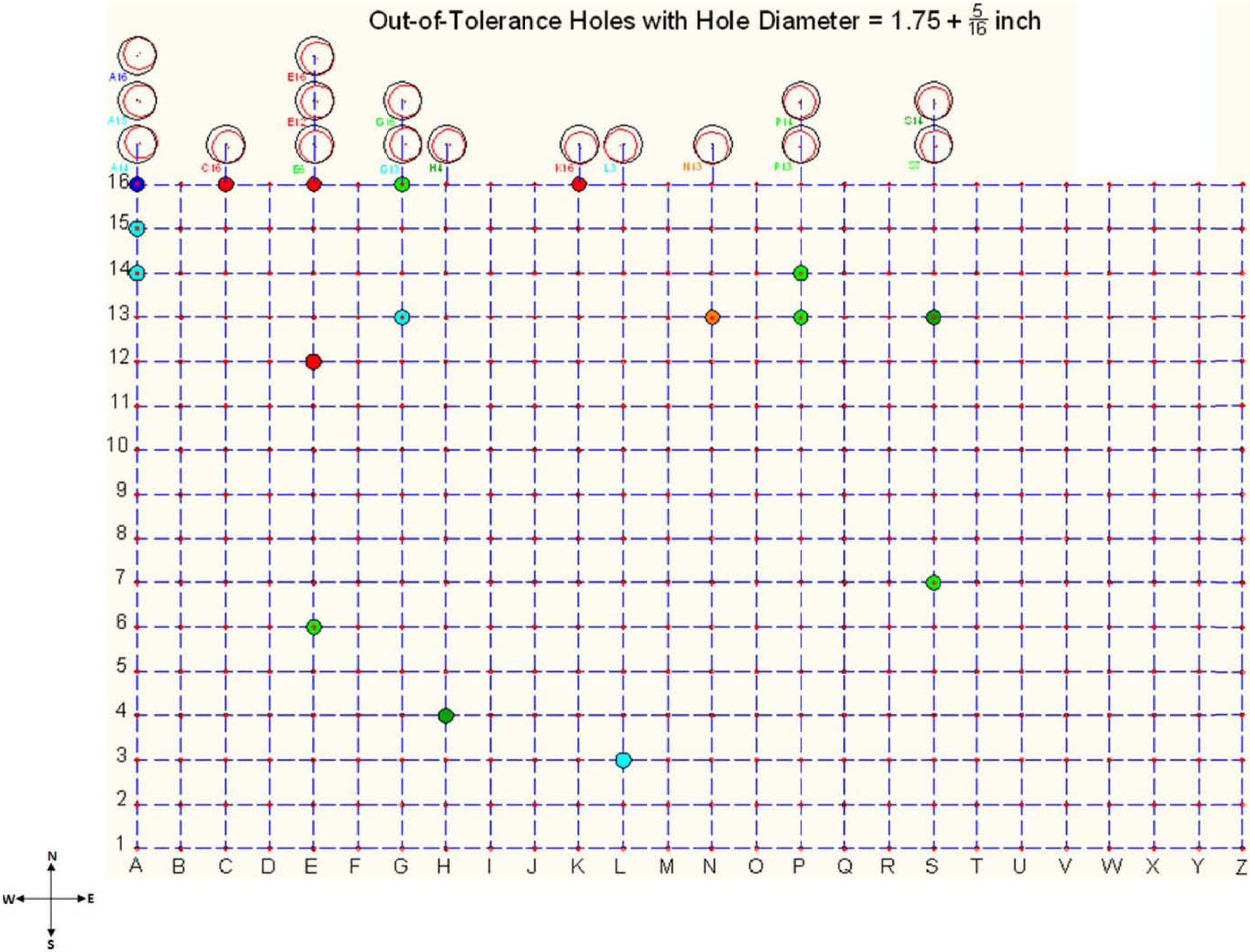
Out-of-Tolerance Holes with Hole Diameter = 1.75 + $\frac{6}{16}$ inch



Legend

Amount of Overlap (in)	Colors
0.00000	
0.00259	
0.00309	
0.01014	
0.01204	
0.02053	
0.02597	
0.03384	
0.04139	

Out-of-Tolerance and Out-of-Tilt Anchor Location from the 2nd Survey of Strong Floor



Legend

Amount of Overlap (in)	Colors
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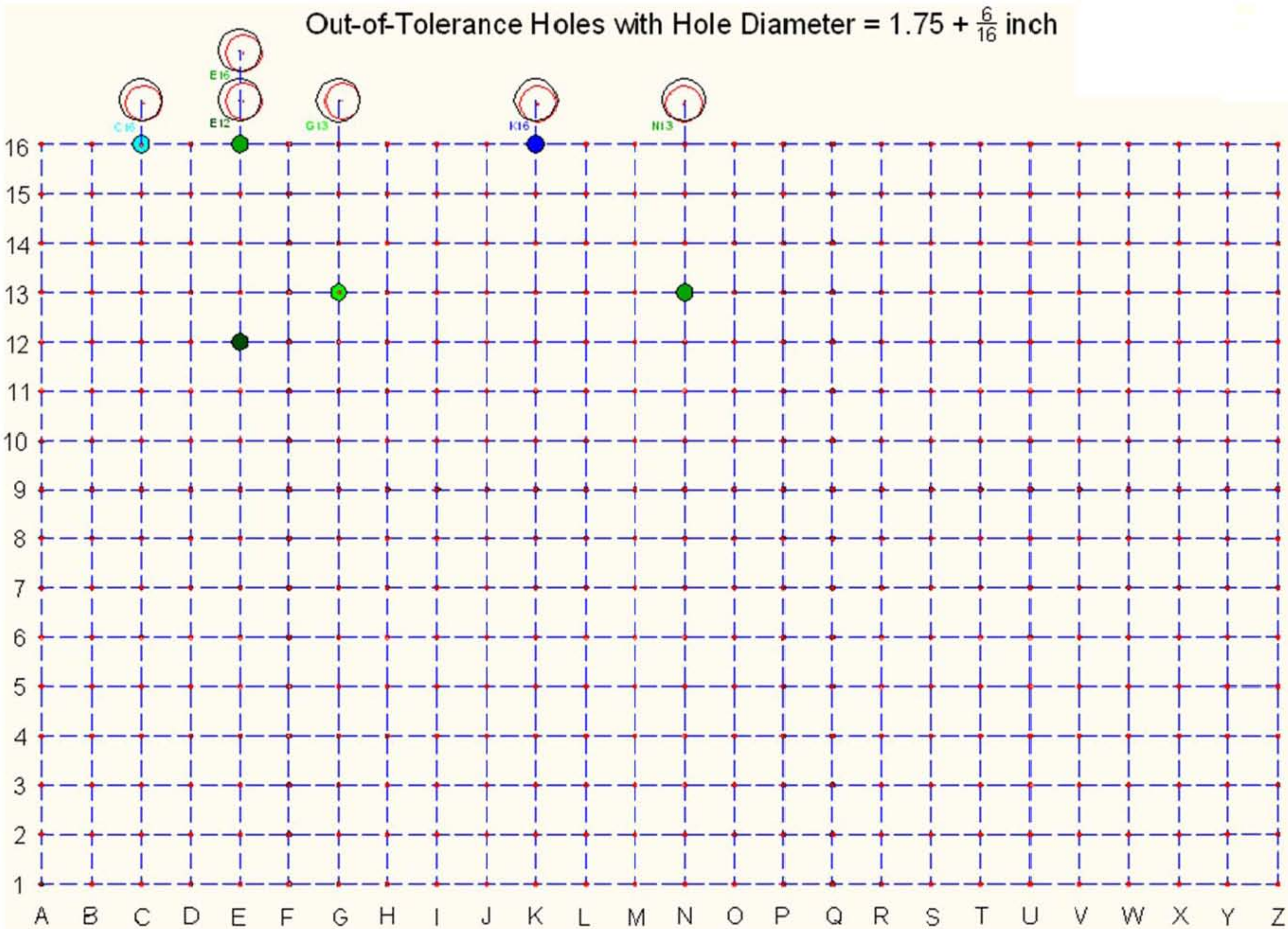
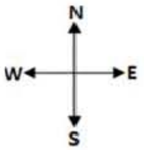
0.00309	
0.00660	
0.01014	
0.01204	
0.02053	
0.02213	
0.03125	
0.03384	
0.03785	
0.04139	
0.04385	
0.05338	
0.06910	





Legend	
Amount of Overlap (in)	Colors
0.00000	
0.00259	
0.00309	
0.00660	
0.01014	
0.01204	
0.02053	
0.02213	
0.03125	
0.03384	
0.03785	
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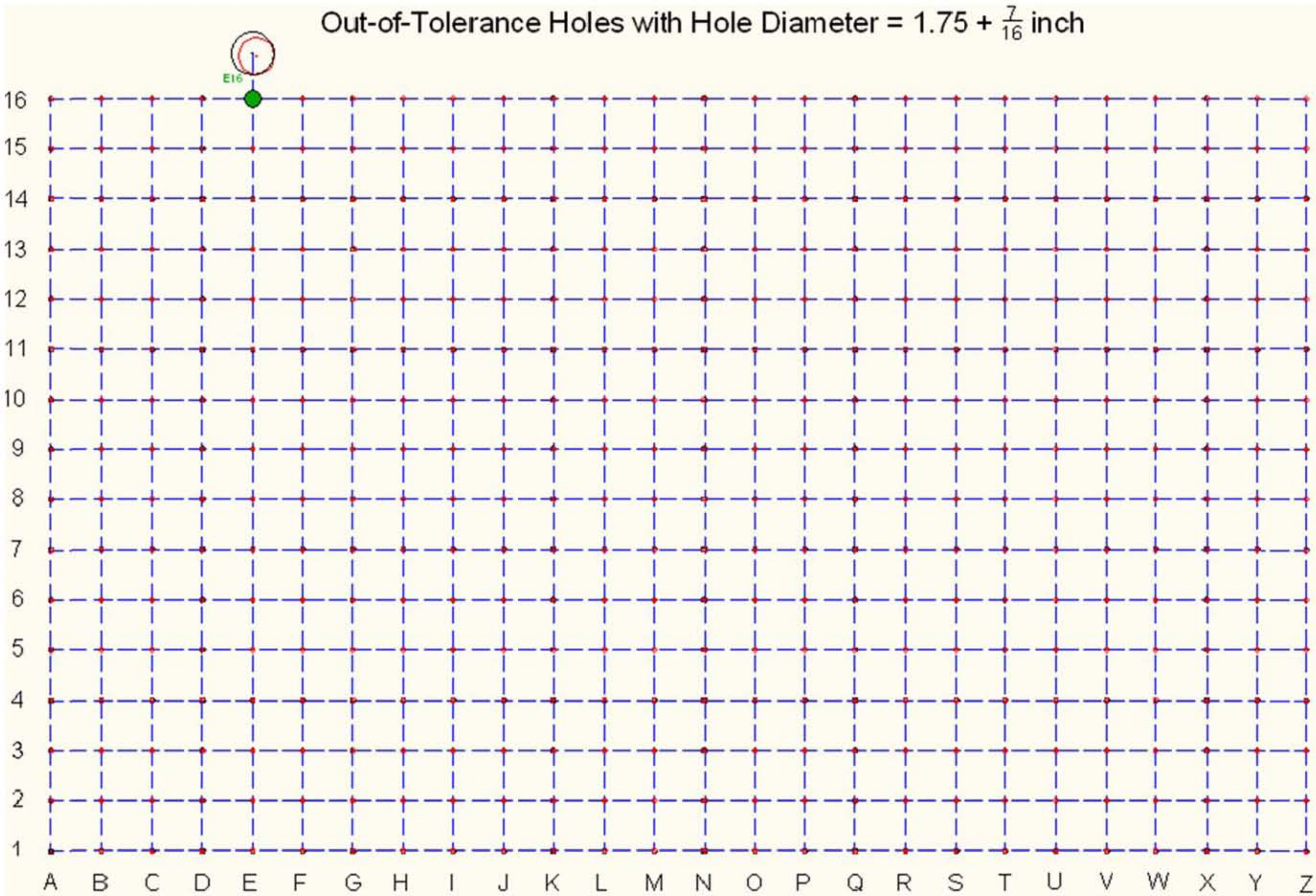

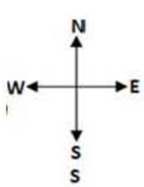

Legend	
Amount of Overlap (in)	Colors
0.00000	
0.00259	
0.00309	
0.00660	
0.01014	
0.01204	
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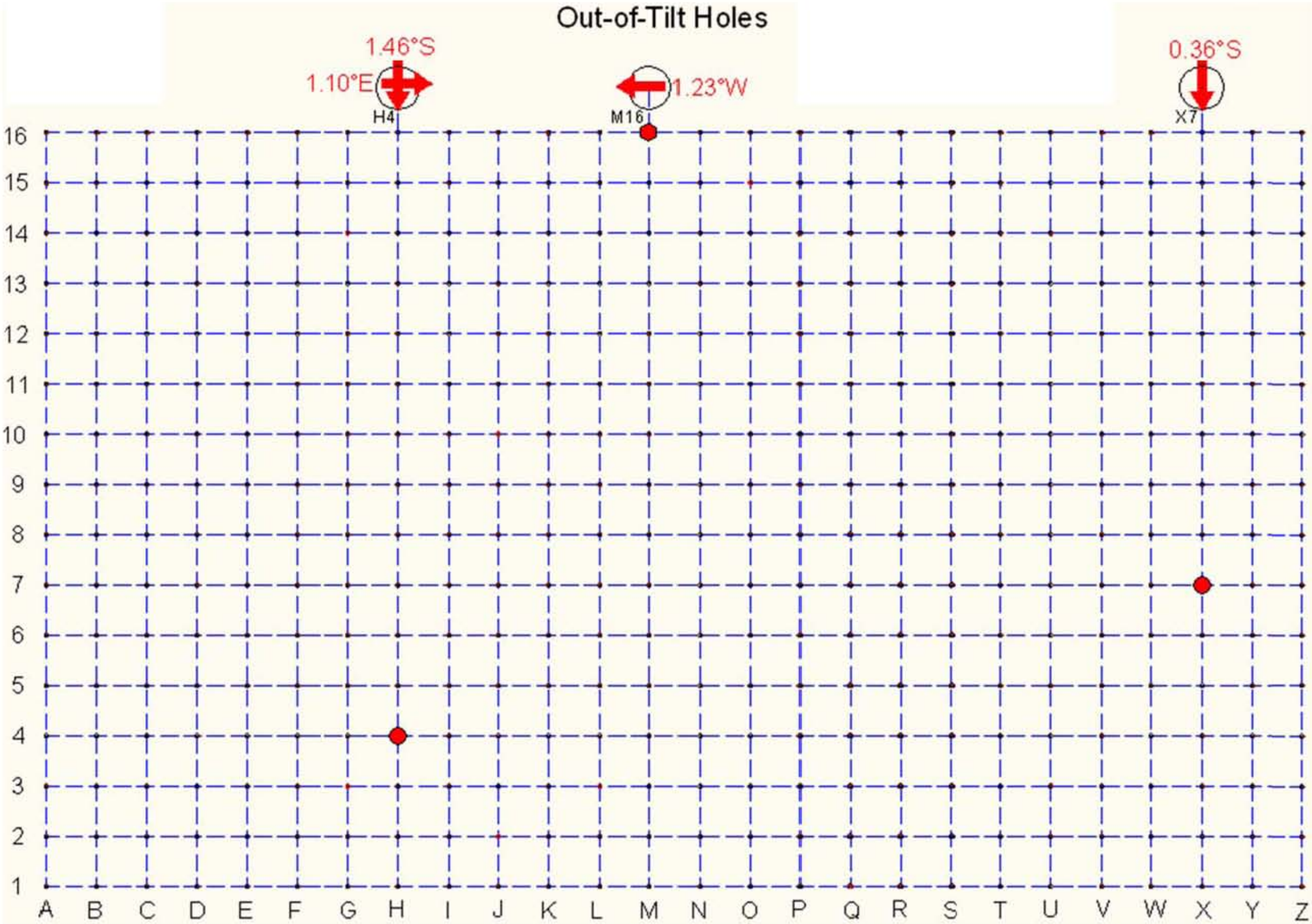
Out-of-Tilt Holes
1.46°S
1.10°E
H4
M16
1.23°W
0.36°S
X7
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Department of Civil and Environmental Engineering Reports

Northeastern University

REPORT NO.	AUTHORS	TITLE	DATE
NEU-CEE-2011-01	Hajjar, J. F., Guldur, B., and Sesen, A. H.	Northeastern Laboratory for Structural Testing of Resilient and Sustainable Systems (STReSS Laboratory): Features and Specifications	September 2011