ADDENDUM NO. 02

August 9, 2024

Renovation of Fall Creek Intermediate School
12011 Olio Road
Fishers, IN 46038

TO: ALL BIDDERS OF RECORD

This Addendum forms a part of and modifies the Bidding Requirements, Contract Forms, Contract Conditions, the Specifications and the Drawings dated July 12, 2024, by krM Architecture. Acknowledge receipt of the Addendum in the space provided on the Bid Form. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of Pages ADD 2-1 through ADD 2-4 and attached krM Architecture Addendum No. 2 dated August 6, 2024, consisting of two pages of Civil and Architectural narrative and three pages of MEP narrative, a Geotechnical Report, new Specification Section 09 64 67 – Wood Gymnasium Floor Finishing, new Specification Section 23 37 23 – HVAC Gravity Ventilators, revised Specification Section 23 09 23 – Direct Digital Control (DDC) System for HVAC, and 7 Drawing Sheets.

A. SECTION 00 20 00 – INFORMATION AVAILABLE TO BIDDERS

1. Replace specification section with updated version included as part of this Addendum.

B. SECTION 00 31 00 – BID FORM SECTION

1. Replace specification section with updated version included as part of this Addendum.

C. SECTION 01 12 00 – MULTIPLE CONTRACT SUMMARY

3.03 BID CATEGORIES

A. BID CATEGORY NO. 1 – GENERAL TRADES

Add to following specification sections:
09 64 67 – Wood Gymnasium Floor Finishing

Add the following clarifications:
30. One fully finished classroom in Phase I is to be completed as a mockup for all future classrooms. Other Work in Phase I is not to be delayed while waiting for final mockup review. However, all Contractors shall be prepared for dedicated mobilization(s) or material shipment(s) to ensure the classroom mockup is prioritized.

B. BID CATEGORY NO. 2 – MASONRY

Add the following clarifications:
5. One fully finished classroom in Phase I is to be completed as a mockup for all future classrooms. Other Work is Phase I is not to be delayed while waiting for final mockup review, however all Contractors shall be prepared for dedicated mobilization(s) or material shipment(s) to ensure the classroom mockup is prioritized.

C. BID CATEGORY NO. 3 – METAL STUDS & DRYWALL

Delete the following clarifications previously added in Addendum 01:
28. Contractor is responsible for ¾" plywood protection at gymnasium prior to carpet installation for temporary classrooms.
29. Contractor is responsible for refinishing of the gymnasium wood flooring as noted in drawings. Specification forthcoming via future Addendum.

Add the following clarifications:
14. One fully finished classroom in Phase I is to be completed as a mockup for all future classrooms. Other Work is Phase I is not to be delayed while waiting for final mockup review, however all Contractors shall be prepared for dedicated mobilization(s) or material shipment(s) to ensure the classroom mockup is prioritized.

D. BID CATEGORY NO. 4 – ALUMINUM STOREFRONT & GLAZING

Add the following clarifications:
9. One fully finished classroom in Phase I is to be completed as a mockup for all future classrooms. Other Work is Phase I is not to be delayed while waiting for final mockup review, however all Contractors shall be prepared for dedicated mobilization(s) or material shipment(s) to ensure the classroom mockup is prioritized.

E. BID CATEGORY NO. 5 – FLOORING

Add the following clarifications:

4. One fully finished classroom in Phase I is to be completed as a mockup for all future classrooms. Other Work is Phase I is not to be delayed while waiting for final mockup review, however all Contractors shall be prepared for dedicated mobilization(s) or material shipment(s) to ensure the classroom mockup is prioritized.

F. BID CATEGORY NO. 6 – PAINTING

Add the following clarifications:

2. One fully finished classroom in Phase I is to be completed as a mockup for all future classrooms. Other Work is Phase I is not to be delayed while waiting for final mockup review, however all Contractors shall be prepared for dedicated mobilization(s) or material shipment(s) to ensure the classroom mockup is prioritized.

G. BID CATEGORY NO. 7 – CASEWORK

Add the following clarifications:

5. One fully finished classroom in Phase I is to be completed as a mockup for all future classrooms. Other Work is Phase I is not to be delayed while waiting for final mockup review, however all Contractors shall be prepared for dedicated mobilization(s) or material shipment(s) to ensure the classroom mockup is prioritized.

I. BID CATEGORY NO. 9 – FIRE PROTECTION

Add the following clarifications:

4. One fully finished classroom in Phase I is to be completed as a mockup for all future classrooms. Other Work is Phase I is not to be delayed while waiting for final mockup review, however all Contractors shall be prepared for dedicated mobilization(s) or material shipment(s) to ensure the classroom mockup is prioritized.

J. BID CATEGORY NO. 10 – PLUMBING & HVAC

Add the following specification sections:

23 37 23 – HVAC Gravity Ventilators

Replace the following specification sections:

23 09 23 – Direct Digital Control (DDC) System for HVAC

Delete the following clarifications previously added in Addendum 01:

28. Contractor is responsible for ¾" plywood protection at gymnasium prior to carpet installation for temporary classrooms.
29. Contractor is responsible for refinishing of the gymnasium wood flooring as noted in drawings. Specification forthcoming via future Addendum.

Add the following clarifications:

13. Contractor shall disregard Note E in the "Valve Replacement Scope of Work." Contractor shall also disregard Notes E and F in the "Pipe Fitting Replacement Scope of Work."
14. One fully finished classroom in Phase I is to be completed as a mockup for all future classrooms. Other Work is Phase I is not to be delayed while waiting for final mockup review, however all Contractors shall be prepared for dedicated mobilization(s) or material shipment(s) to ensure the classroom mockup is prioritized.

K. BID CATEGORY NO. 11 – ELECTRICAL

Add the following clarifications:

9. One fully finished classroom in Phase I is to be completed as a mockup for all future classrooms. Other Work in Phase I is not to be delayed while waiting for final mockup review. However, all Contractors shall be prepared for dedicated mobilization(s) or material shipment(s) to ensure the classroom mockup is prioritized.

D. SECTION 01 23 00 – ALTERNATES

1. Replace specification section with updated version included as part of this Addendum.

SECTION 00 20 00 - INFORMATION AVAILABLE TO BIDDERS

A. Existing Site Survey Information: A Site survey can be found within the construction drawings. It is not however, part of the Construction Contract Documents and is for informational use only. Information found is not a warrant or guarantee by the Owner or Project Consultant. The Contractor should visit the site and acquaint himself with all existing conditions. Any additional information, needed by the Contractor, shall be obtained by the Contractor at no cost to the Owner.

B. Asbestos Report: The Asbestos Report (if applicable), prepared for the Owner, is not part of the Construction Documents, and is on file at the Owner's Office and is available for review upon written request. The Architect and Construction Manager do not accept responsibility for the information contained in the report.

C. Lead Based Paint: Lead Based Paint Report (if applicable), prepared for the Owner, is not part of the Construction Documents, and is on file at the Owner's Office and is available for review upon written request. The Architect and Construction Manager do not accept responsibility for the information contained in the report.

D. Subsurface Investigation Information: The Soils Exploration Report and Soil Boring Logs were prepared for the Owner by **Atlas** dated January 17, 2024 for use in design. The following Subsurface Investigation Report is not a part of the construction Contract Documents and is enclosed within this document for informational use only. The Architect/Engineer and Construction Manager do not accept responsibility for the information contained in the report.

1. The enclosed report and Log of Borings, and any interpolations of conditions between test borings is not a warrant or guarantee by the Owner or Architect/Engineer of subsurface conditions.
2. The Contractor should visit the site and acquaint himself with all existing conditions. Prior to bidding, bidders may make their own subsurface investigations to satisfy themselves as to the site and subsurface conditions, but such subsurface investigations shall be performed only under the time schedules and arrangements approved in advance by the Owner. Any additional information, needed by the Contractor, shall be obtained by the Contractor at no cost to the Owner.
3. Structural design has been based on the report and assumes that existing soils are clean and can be compacted and will achieve the densities specified in the earthwork section. It shall be the Contractor's responsibility to determine for himself existing Site and or soil conditions.

E. A link to 3D scan of existing building conditions is included as part of Addendum 02. Copy and paste into internet browser window.

https://www.dropbox.com/scl/fi/a6lotv12c0hvaeupl40pz/Matterport-Links.txt?rlkey=w81aioruhi632h0mulxnttlay&e=2&st=tqvi9vw5&dl=0

END OF SECTION 00 20 00

CONTRACTOR'S BID FOR PUBLIC WORKS FORM NO. 96

Format (Revised 2013)
(Amended for HSE)

Renovation Fall Creek Intermediate School

(Hamilton Southeastern Schools)
(Hamilton County, Indiana)

PART I

(To be completed for all bids. Please type or print)

Date (month, day, year):_____

BIDDER (Firm) _____

Address _____ P.O. Box _____

City/State/Zip _____

Telephone Number: _____ Email Address: _____

Person to contact regarding this Bid_____

Pursuant to notices given, the undersigned offers to furnish labor and/or materials necessary to complete the public works project of:

_____
Insert Category No. (s) and Name(s)

Of public works project, **Renovation of Fall Creek Intermediate School**, in accordance with Plans and Specifications prepared by ***krM Architecture, 1020 Jackson Street, Anderson, IN 46016***, as follows:

BASE BID

For the sum of _____
(Sum in words)

_____DOLLARS ($_____)
(Sum in figures)

The undersigned acknowledges receipt of the following Addenda:
Receipt of Addenda No. (s) _____

PROPOSAL TIME

Bidder agrees that this Bid shall remain in force for a period of sixty (60) consecutive calendar days from the due date, and Bids may be accepted or rejected during this period. Bids not accepted within said sixty (60) consecutive calendar days shall be deemed rejected.

Attended pre-bid conference YES _____ NO_____

Has visited the jobsite YES _____ NO_____

The Bidder has reviewed the Guideline Schedule in Section 01 32 00 and the intent
Of the schedule can be met. YES _____ NO_____

Bidder has included their Written Drug Testing Plan that covers all employees of the bidder who will perform work on the public work project and meets or exceeds the requirements set in IC 4-13-18-5 or IC 4-13-18-6. YES _____ NO_____

The Skillman Corporation's diversity initiative is to create a program to encourage, assist and measure the active participation of Minority- Owned, Women-Owned, Veteran – Owned and Disabled Individual-Owned Businesses. The Program is to ensure that MWVDBEs are provided full and equal opportunity to participate in all Skillman Corporation's Projects.

Bidder has included:
DBE: YES _____% NO _____
MBE: YES _____% NO _____
WBE: YES _____% NO _____
VBE: YES _____% NO _____

The undersigned further agrees to furnish a bond or certified check with this Bid for an amount specified in the Notice to Bidders. If Alternate Bids apply, submit a proposal for each in accordance with the Plans and Specifications.

If additional units of material included in the contract are needed, the cost of units must be the same as that shown in the original contract if accepted by the governmental unit. If the bid is to be awarded on a unit bases, the itemization of the units shall be shown on a separate attachment.

The contractor and his subcontractors, if any, shall not discriminate against or intimidate any employee, or applicant for employment, to be employed in the performance of this contract, with respect to any matter directly or indirectly related to employment because of race, religion, color, sex, national origin or ancestry. Breach of this covenant may be regarded as a material breach of the contract.

CERTIFICATION OF USE OF UNITED STATES STEEL PRODUCTS
(if applicable)

I, the undersigned bidder or agent as a contractor on a public works project, understand my statutory obligation to use steel products made in the United States (I.C. 5-16-8-2). I hereby certify that I and all subcontractors employed by me for this project will use U.S. steel on this project if awarded. I understand that violations hereunder may result in forfeiture of contractual payments.

ALTERNATE BIDS

A blank entry or an entry of "No Bid", "N/A", or similar entry on any Alternate will cause the bid to be rejected as non-responsive only if that Alternate is selected. If no change in the bid amount is required, indicate "No Change".

****MARK "ADD" OR "DEDUCT" FOR EACH ALTERNATE****

Alternate Bid No. 1 – North Bus Lot Exterior Site Work

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT
(sum in figures)

Alternate Bid No. 2 – South Drop-Off Visitor Lot Exterior Site Work

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT
(sum in figures)

Alternate Bid No. 3 – Southwest Service Drive Exterior Site Work

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT
(sum in figures)

Alternate Bid No. 4 – South Drop-Off Visitor Partial Sidewalk Replacement

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT

(sum in figures)

Alternate Bid No. 5 – Kitchen Freezer and Cooler

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT

(sum in figures)

Alternate Bid No. 6 – Brick Staining

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT

(sum in figures)

Alternate Bid No. 7 – Exterior Columns

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT

(sum in figures)

Alternate Bid No. 8 – Gym Curtain

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT

(sum in figures)

Alternate Bid No. 9 – Metal Lockers in Academic Wings

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT
(sum in figures)

Alternate Bid No. 10 – Controls for Building Automation

10a. Alerton – Installed by Open Control Systems.

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT
(sum in figures)

10b. Johnson Controls – Installed by JCI.

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT
(sum in figures)

10c. Honeywell – Installed by Performance Services.

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT
(sum in figures)

10d. Alerton – Siemens – Installed by local Branch.

Change the Base Bid the sum of_____
(sum in words)

_____DOLLARS ($_____) ADD DEDUCT
(sum in figures)

PART II
(For projects of $150,000 or more – IC 36-1-12-4)

These statements to be submitted under oath by each bidder with and as a part of his bid. (Attach additional pages for each section as needed.)

SECTION I EXPERIENCE QUESTIONNAIRE

1. What public works projects has your organization completed for the period of one (1) year prior to the date of the current bid?

Contract Amount	Class of Work	Completion Date	Name and Address of Owner

2. What public works projects are now in process of construction by your organization?

Contract Amount	Class of Work	Completion Date	Name and Address of Owner

3. Have you ever failed to complete any work awarded to you?_____If so, where and why?

_____

_____

_____

4. List references from private firms for which you have performed work.

_____

_____

_____

SECTION II PLAN AND EQUIPMENT QUESTIONNAIRE

1. Explain your plan or layout for performing proposed Work. (Examples could include a narrative of when you could begin, complete the project, number of workers, etc. and any other information which you believe would enable the governmental unit to consider your bid.)

2. Please list the names and addresses of all subcontractors (i.e. persons or firms outside your own firm who have performed part of the work) that you have used on public works projects during the past five (5) years along with a brief description of the work done by each subcontractor.

3. If you intend to sublet any portion of the work, state the name and addresses of each subcontractor, equipment to be used by the subcontractor, and whether you will required a bond. However, if you are unable to currently provide a listing, please understand a listing must be provided prior to contract approval. Until the completion of the proposed project, you are under a continuing obligation to immediately notify the governmental unit in the event that you subsequently determine that you will use a subcontractor on the proposed project.

4. What equipment do you have available to use for the proposed Project? Any equipment used by subcontractors may also be required to be listed by the governmental unit.

_____

_____

_____

_____

5. Have you into contracts or received offers for all materials which substantiate the prices used in preparing your proposal? If not, please explain the rationale used which corroborate the process listed.

_____

_____

_____

_____

SECTION III CONTRACTOR'S FINANCIAL STATEMENT

Attachment of Bidder's financial statement is mandatory. Any Bid submitted without said financial statement as required by statute shall thereby be rendered invalid. The financial statement provided hereunder to the governing body awarding the Contract must be specific enough in detail so that said governing body can make a proper determination of the Bidder's capability for completing the Project if awarded.

SECTION IV CONTRACTOR NON-COLLUSION AFFIDAVIT

The undersigned Bidder or agent, being duly sworn on oath, says that he has not, nor has any other member, representative, or agent of the firm, company, corporation or partnership represented by him, entered into any combination, collusion or agreement with any person relative to the price to be bid by anyone at such letting nor to prevent any person from bidding nor to induce anyone to refrain from bidding, and that this Bid is made without reference to any other bid and without any agreement, understanding or combination with any other person in reference to such bidding.

He further says that no person or persons, firms, or corporations has, have, or will receive directly or indirectly, any rebate, fee, gift, commission, or thing of value on account of such contract.

SECTION V OATH AND AFFIRMATION

I HEREBY AFFIRM UNDER THE PENALTIES OF PERJURY THAT THE FACTS AND INFORMATION CONTAINED IN THE FOREGOING BID FOR PUBLIC WORKS ARE TRUE AND CORRECT

Dated at _____this _____ day of _____, 20

_____
(Name of Organization)

By

_____

_____
(Title of Person Signing)

ACKNOWLEDGEMENT

STATE OF _____)
) SS:
COUNTY OF _____)

Before me, a Notary Public, personally appeared the above-named

_____

Swore that the statements contained in the foregoing document are true and correct.

Subscribed and sworn to before me this _____ day of _____,

_____
(Title)

_____
Notary Public

My Commission Expires: _____

County of Residence: _____

END OF SECTION 00 31 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including amended General Conditions and other Division 1 Specification Sections, apply to work of this Section.

1.02 PURPOSE

A. The Bids for the Alternates described herein are required in order for the Owner to obtain information necessary for the proper consideration of the Project in its entirety.

1.03 ALTERNATES

A. Definitions: Alternates are defined as alternate products, materials, equipment, installations or systems for the Work, which may, at Owner's option and under terms established by Instructions to Bidders, be selected and recorded in the Owner-Contractor Agreement to either supplement or displace corresponding basic requirements of Contract Documents. Alternates may or may not substantially change scope and general character of the Work; and must not be confused with "allowances", "unit prices", "change orders", "substitutions", and other similar provisions.

1.04 SCHEDULE OF ALTERNATES

A. ALTERNATE NO. 1: North Bus Lot Exterior Site Work
Scope: Site improvements at North Bus Parking Lot
Drawings: C100, C101& C201
Specifications: Geotechnical Report, 31 20 00 – Earthwork, 32 12 16 – Asphalt Paving

B. ALTERNATE NO. 2: South Drop-Off Visitor Lot Exterior Site Work
Scope: Site improvements at South Drop-off Visitor Parking Lot
Drawings: C100, C102 & C202
Specifications: Geotechnical Report, 31 20 00 – Earthwork, 32 12 16 – Asphalt Paving, 32 13 13 – Concrete Paving

C. ALTERNATE NO. 3: Southwest Service Drive Exterior Site Work
Scope: Site improvements at Southwest Service Drive and Kitchen Sidewalk
Drawings: C100, C102 & C202
Specifications: Geotechnical Report, 31 20 00 – Earthwork, 32 12 16 – Asphalt Paving, 32 13 13 – Concrete Paving

D. ALTERNATE NO. 4: South Drop-Off Visitor Partial Sidewalk Replacement
Scope: Site improvements at Partial Sidewalk Replacements adjacent to the South Drop-off Visitor Parking Lot.
Drawings: C100, C102 & C202
Specifications: Geotechnical Report, 31 20 00 – Earthwork, 32 12 16 – Asphalt Paving, 32 13 13 – Concrete Paving

E. ALTERNATE NO. 5: Kitchen Freezer and Cooler
Scope: Add walk-in cooler and refurbishment to existing.
Drawings: D1-5, A1-1, A1-6, A8-1, A11-6, K-Series Drawings, Architectural Floor Plans – Note #13
Specifications: 11 40 00 Food Service Equipment

F. ALTERNATE NO. 6: Brick Staining
Scope: Stain existing masonry veneer and paint existing glazed masonry units.
Drawings: Exterior Elevations – Notes #12a - #12f, Detail 2/A4-5, Details 2, 3, 4 & 8 on A4-5.
Specifications: 04 01 05 – Masonry Staining

G. ALTERNATE NO. 7: Exterior Columns
Scope: Remove existing brick and install tile wall and granite base at all exterior columns.
Drawings: Exterior Elevations – Notes #12g & #12h, Detail 5/A4-5, Details 1, 5, 6 & 7 on A4-5.
Specifications: 04 43 13 – Stone Masonry Veneer, 09 30 00 – Tiling

H. ALTERNATE NO. 8: Gym Curtain
Scope: Replacement of gym divider curtain.
Drawings: D2-6, A1-1
Specifications: 11 66 23 – Gymnasium Equipment

I. ALTERNATE NO. 9: Metal Lockers in Academic Wings
Scope: Replace all metal lockers in academic wings.
Drawings: Architectural Floor Plans – Note #9,
Specifications: 10 51 13 – Metal Lockers

J. ALTERNATE NO. 10: Controls for Building Automation
Scope: Controls for building automation.
Specifications: 23 09 23 – Direct Digital Control (DDC) System for HVAC

10a. Alerton – Installed by Open Control Systems.
10b. Johnson Controls – Installed by JCI.
10c. Honeywell – Installed by Performance Services.
10d. Siemens – Installed by local Branch.

PART 2 - PRODUCTS, PART 3 - EXECUTION (Not Used)

END OF SECTION 01 23 00

Addendum #2
Hamilton Southeastern Schools
Fall Creek Intermediate Renovations

Date: August 6, 2024
Project: Fall Creek Intermediate School
Project #: 23055
Pages: 1 of 2 pages
Bid Dates: **Thursday, August 22, 2024, at 10:00AM**

General Note:

The original Specifications and Drawings dated July 12, 2024, for the project referenced above are amended as noted in this Addendum No. 2. Receipt of this Addendum and any subsequent Addenda must be acknowledged on the Bid Form. Items changed or added by this addendum are to take precedence over the items or descriptions of the work in the project manual and the drawings. Items not mentioned in this addendum are to remain as described in the original plans and specifications.

Specifications Items:

Section 03 30 00 – Cast-in_Place Concrete

Add to section: 2.04G Moisture Vapor Reducing Admixture (MVRA)
b. ISELogik, MVRA 900: https://iselogik.com/

Section 08 11 13 – Hollow Metal Doors and Frames

Add to section: 2.01 Manufacturers
4. De La Fontaine Industries (DLF), https://www.delafontaine.com/
5. Metal Products, Inc. (MPI), https://metalproductsinc.com/

Section 08 14 16 – Flush Wood Doors

Add to section: 2.01 Manufacturers
4. Oshkosh Door Company, Architectural Flush Wood Doors, https://oshkoshdoor.com/

Section 09 63 00 – Metal Framed Skylights

Change 2.02/A/3 as follows:
3. Glazing: Multiwall Polycarbonate: 25MM multiwall polycarbonate panels.
    a. Clear/Crystal with Lumira Aerogel.

Section 09 30 00 – Tiling

Add to section: 1.08 Mock-ups
A. Construct mock-up, minimum 4 feet wide, illustrating variation, pattern, termination/ transition trim, and grouting.
B. Locate where directed by designer.
C. Mock-ups may remain as part of the work.

Section 09 64 67 – Wood Gymnasium Floor Refinishing

Add spec section in its entirety

Section 11 66 23 – Gymnasium Equipment

Add to section: 2.02A/6
d. Performance Sports Systems, Inc. 4020 Divider Curtain, https:// www.garedperfsports.com
Add to section: 2.03A/8
d. Performance Sports Systems, Inc. 4130 Class A Wall Pads with Z-Clips, https:// www.garedperfsports.com

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Attachments:

1. Section 09 64 67 – Wood Gymnasium Floor Refinishing
2. Geotechnical Report
3. Link to 3D Scan of Existing Conditions: https://www.dropbox.com/scl/fi/a6lotv12c0hvaeupl40pz/Matterport-Links.txt?rlkey=w81aioruhi632h0mulxnttlay&st=tqvi9vw5&dl=0

END

Addendum #2
Hamilton Southeastern Schools
Fall Creek Intermediate Renovations

Date: August 06, 2024
Project: FCI – Renovations
Project #: 23055
Pages: 1 of 3
Bid Dates: -

General Note:

The original Specifications and Drawings dated July 12th, 2024 for the project referenced above are amended as noted in this Addendum No. 2. Receipt of this Addendum and any subsequent Addenda must be acknowledged on the Bid Form. Items changed or added by this addendum are to take precedence over the items or descriptions of the work in the project manual and the drawings. Items not mentioned in this addendum are to remain as described in the original plans and specifications.

Specifications Items:

1. Specification Section 236416 – CENTRIFUGAL WATER CHILLERS
    a. Part 2 – Products - Section 2.02 MANUFACTURERS – Add "Quantech" as approved manufacturer.
2. Specification Section 233723 – HVAC GRAVITY VENTILATORS
    a. Add specification section in its entirety.
3. Specification Section 230923 – DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC
    a. Part 1 – General – Section 1.06 QUALITY ASSURANCE – 7. Acceptable Control Supplier.
        i. a. Alterton – Installed by Open Control Systems.
        ii. b. Johnson Controls – Installed by JCI.
        iii. c. Honeywell – Installed by Performance Services.
        iv. d. Siemens – Installed by local branch.
    b. Part 1 – General – Section 1.06 QUALITY ASSURANCE – 8 Acceptable Control Installation and Service Contractor.
        i. e. Siemens.

Drawing Set Items:

Sheet M0-1 MECHANICAL SEQUENCE & PHASING PLAN

1. Add drawing in its entirety.

Sheet T0-0 SYMBOLS AND ABBREVIATIONS

1. Added wireless microphone antenna symbol.
2. Revised Technology Responsibility Matrix

Sheet T1-5 FIRST FLOOR TECHNOLOGY PLAN - AREA F

1. Added wireless microphone antenna label.

Sheet T1-6 FIRST FLOOR TECHNOLOGY PLAN - AREA G

1. Added wireless microphone antenna label.
2. Revised keynote 5.
3. Added keynote 6.

Sheet P000 SYMBOLS AND ABBEVIATIONS

1. Changed the number of fittings of each size that the contractor should bid. See notes on the "PIPE FITTING REPLACEMENT SCOPE OF WORK" description. The note also applies to sheets P1-1, P1-2, P1-3, P1-4, P1-5 and P1-6.
2. Changed the number of valves of each size that the contractor should bid. See notes on the "VALVE REPLACEMENT SCOPE OF WORK" description. The note also applies to sheets P1-1, P1-2, P1-3, P1-4, P1-5 and P1-6.
3.

Sheet P1-5 FIRST FLOOR PLUMBING PLAN – AREA F

1. Moved note 2 to indicate the domestic hot water balancing valve in the laundry room.

Sheet P1-6 FIRST FLOOR PLUMBING PLAN – AREA G

1. Removed plumbing fixture designation L-2 for lavatory in Women's Rest Room 404B.

Attachments:

1. M0-1
2. T0-0
3. T1-5
4. T1-6
5. P000
6. P1-5
7. P1-6

8. Specification Section – 233723 – HVAC Gravity Ventilators
9. Specification Section – 230923 – Direct Digital Control (DDC) System for HVAC.
10.

END

GEOTECHNICAL ENGINEERING INVESTIGATION

PROPOSED PAVEMENT IMPROVEMENTS
FALL CREEK INTERMEDIATE SCHOOL
12011 OLIO ROAD
FISHERS, INDIANA

ATLAS PROJECT NO. 170GC01699

JANUARY 17, 2024

PREPARED FOR:

krM ARCHITECTURE
1515 NORTH PENNSYLVANIA STREET
INDIANAPOLIS, IN 46202

ATTENTION: MS. WINIFRID WILLIAMS, AIA, LEED AP+BC
ARCHITECT, PARTNER

January 17, 2024

Atlas Technical Consultants LLC

7988 Centerpoint Dr.
Suite 100
Indianapolis, IN 46256

Phone +1 317 849 4990

www.oneatlas.com

Ms. Winifrid Williams, AIA, LEED AP+BC
Architect, Partner
krM Architecture
1515 North Pennsylvania Street
Indianapolis, IN 46202

Re: **Geotechnical Engineering Investigation**
Proposed Pavement Improvements
Fall Creek Intermediate School
12011 Olio Road
Fishers, Indiana
Atlas Project No. 170GC01699

Dear Ms. Williams:

Submitted herewith is the report of the subsurface investigation performed by Atlas Technical Consultants LLC (Atlas) for the referenced project. This study was authorized in accordance with Atlas Proposal-Agreement No. 23-13638 dated December 6, 2023.

This report contains the results of the field and laboratory testing program, an engineering interpretation of this data with respect to the available project characteristics, and recommendations to aid design and construction of the earth-connected phases of this project. We wish to remind you that we will store the samples for 30 days, after which time they will be discarded unless you request otherwise.

We appreciate the opportunity to be of service to you on this project. If we can be of any further assistance, or if you have any questions regarding this report, please do not hesitate to contact either of the undersigned.

Sincerely,

David McIlwaine, P.E.
Senior Project Engineer

ROY D. MCILWAINE
No.
PE11200315
REGISTERED
STATE OF
INDIANA
PROFESSIONAL ENGINEER

Daniel Homm, P.E.
Senior Project Engineer

Table of Contents

1 PURPOSE AND SCOPE

The purpose of this study was to characterize the general subsurface conditions at the project site by drilling 13 soil test borings, to determine the condition of the existing pavements by obtaining pavement cores and aggregate base samples at the test boring locations, and to evaluate this data with respect to the proposed pavement improvements. Included in this report are a summary of the project characteristics, an overview of the subsurface investigation findings, and recommendations for the design of the earth-connected elements of the proposed project. Also included is an evaluation of the site with respect to potential construction problems and recommendations dealing with earthwork and quality control during construction.

2 PROJECT CHARACTERISTICS

krM Architecture is planning to assist Hamilton Southeastern Schools in the improvement or replacement of the existing parking lots and driveways at Fall Creek Intermediate School at 12011 Olio Road on the east side of Fishers, Indiana. The general location of the project site is shown on the Vicinity Map (Figure 1 in the Appendix), which is taken from a map made prior to the current level of development in the surrounding area. Improvements are planned for all of the existing parking and driveway areas surrounding the existing school building. The existing pavement areas on the site (i.e., proposed pavement improvement areas) and approximate as-drilled test boring locations are shown on the Boring Plan (Figure 2 in the Appendix). Proposed pavement improvements may utilize full-depth asphalt replacement, full-depth reclamation of the existing asphalt pavement, or mill and overlay and it is assumed that the finish pavement grade will not vary by more than a few inches from the existing grade.

3 GENERAL SUBSURFACE CONDITIONS

The general subsurface conditions were investigated by drilling 13 test borings to depths of 4.1 ft to 5.0 ft below the existing ground surface. The thickness and relative condition of the existing pavement sections were determined by obtaining pavement cores and aggregate base samples at these 13 locations. The borings were drilled and pavement cores collected at the approximate locations shown on the Boring Plan (Figure 2 in the Appendix). The subsurface conditions and existing pavement conditions disclosed by the field investigation are summarized in the following paragraphs. Detailed descriptions of the subsurface conditions encountered in each test boring are presented on the “Test Boring Logs” in the Appendix, and a photo report of the existing pavement conditions is also presented in the Appendix. It should be noted that the stratification lines shown on the test boring logs represent approximate transitions between material types. In-situ stratum changes could occur gradually or at different depths.

At the existing ground surface, the test borings and pavement cores revealed approximately 3 inches to 6 inches of asphalt pavement overlying approximately 4 inches of aggregate base, with total pavement section thicknesses ranging from about 7 inches to 10 inches. The aggregate base below the existing pavement generally consisted of irregular sizes of crushed limestone and gravel. It is important to recognize the variability in the pavement section thicknesses and that the pavement section characteristics will vary throughout the pavement areas. Grain size distribution tests were performed on selected samples of the aggregate base and the results of these tests are presented on the test report summary sheets in the Appendix of this report.

A summary of the pavement section thicknesses is presented in Table No. 1 below. Photographs of the test boring and pavement core locations, down-hole views, recovered pavement cores, and recovered aggregate base samples are provided in the "Pavement Core Photo Report" in the Appendix.

Table No. 1 – Summary of Measured Pavement Section Thicknesses

Boring/Core Location	Asphalt Thickness, inches	Aggregate Base Thickness, inches	Total Pavement Section Thickness, inches
B-1	4	4	8
B-2	6	4	10
B-3	5.5	4	9.5
B-4	5	4	9
B-5	4.5	4	8.5
B-6	4	4	8
B-7	5	4	9
B-8	5	4	9
B-9	5	4	9
B-10	6	4	10
B-11	4	4	8
B-12	3	4	7
B-13	4	4	8

Underlying the pavement sections as described above, the test borings revealed existing fill soils consisting of silty clay, clay and/or sandy silty clay containing varying amounts of sand and gravel to depths of about 1.8 ft to 2.0 ft below the existing ground surface. The fill soils in Borings B-9, B-10, B-11, B-12 and B-13 appeared to have been chemically stabilized during placement. Where no unnatural materials were observed within the soil samples that would positively identify these materials as fill, these soils were identified as fill materials due to the unusual color, texture, and/or stratification of the soil samples.

Below the existing fill materials, the test borings encountered medium stiff to very stiff, silty clay (CL), sandy silty clay (CL) and/or clay (CH) containing varying amounts of sand and gravel to the termination depths ranging from 4.1 ft to 5.0 ft below the existing ground surface. Boring B-8 revealed medium stiff clay (CH) with trace organics and marl between the depths of about 1.9 ft and 3.4 ft.

The qualitative strengths or consistencies of the cohesive soils as described above and on the test boring logs were estimated based on the results of the standard penetration test (ASTM D1586) and the definitions described on the "Field Classification System for Soil Exploration" contained in the Appendix of this report.

Ground water observations were made during the drilling operations by noting the depth of water (if any) on the drilling tools and in the open boreholes immediately after withdrawal of the drilling augers. No free ground water was encountered in any of the test borings at the time of this investigation. It must be noted that short-term ground water level observations made in cohesive soils are not necessarily a reliable indication of the current ground water level or future ground water levels, and shallow ground water in cohesive soils is typically contained (or "perched") within discontinuous sand seams or lenses within the cohesive soils. It is possible that "perched" ground water may be encountered at various depths and locations across the site above the hydrostatic ground water level due to water that is trapped within old fill materials, abandoned utilities, utility trenches, etc. or within saturated sand seams, if encountered. Although the amount of water trapped within old fill materials is usually not significant, it is important to recognize that such ground water may be encountered at various depths and locations. Furthermore, fluctuations in the level of the ground water should also be expected due to variations in rainfall and other factors not evident at the time of the field investigation.

4 DESIGN RECOMMENDATIONS

The following design recommendations have been developed on the basis of the previously described project characteristics (Section 2) and subsurface conditions (Section 3). If there are any changes in the project criteria, a review should be made by this office. The design recommendations presented herein are based on the assumption that all earth-related elements of the project will be carefully and continuously observed, tested, and evaluated by a geotechnical engineer, or qualified geotechnical technician working under the direction of a geotechnical engineer, to confirm that the earth-related elements of the project are compatible and consistent with the conditions upon which the design recommendations are based. The careful and thorough field testing and observation of the soil-related aspects of the project are critical and essential components of the design recommendations.

4.1 Pavement

Details regarding site grading in the pavement improvement or reconstruction areas are not available at this time; however, depending upon grading requirements and seasonal conditions, it is likely that most of the pavement subgrade areas will be wet, soft, or yielding at the time of construction. Our experience indicates that most subgrade soils beneath existing pavements will be soft or yielding once the existing pavement section is removed, regardless of the presence/condition of the existing pavement and any apparently firm soils in the test borings. Furthermore, near-surface subgrade soils may tend to yield and become unstable under construction traffic, particularly if the construction will be done during seasons when heavy precipitation and cooler temperatures typically occur (such as late fall, winter, and spring). The extent to which yielding subgrade may be a problem is difficult to predict beforehand since it is dependent upon several factors, including seasonal conditions, precipitation, cut depths, sequencing and scheduling of the earthwork, surface and subsurface drainage measures, the weight and traffic patterns of construction equipment, etc. However, it should

be expected that stabilization or modification of the subgrade soils will be needed in most, if not all, of the existing pavement areas due to the presence of the existing pavements and the clayey soils with a higher moisture content that were encountered in the test borings drilled for this project, in addition to other factors. In general, yielding subgrade problems are more prominent in at-grade areas (where saturated or nearly saturated silty and clayey soils are exposed by the excavation) or where little or no fill is placed.

The soils exposed at the new pavement subgrade level should be carefully observed, tested, and evaluated such as by proofrolling to determine where stabilization or removal and replacement of the existing soils is needed. In areas that are found to be excessively wet, soft, or yielding at the time of construction, it may be possible to stabilize the pavement subgrade soils by discing, aerating, and recompacting. However, if it is not possible to improve the subgrade soils in this manner (which is often the case) because of weather conditions, scheduling, or other site conditions or constraints, it is recommended that the subgrade soils be improved or modified using either chemical stabilization (i.e., lime-kiln-dust or cement), mechanical stabilization (i.e., a geogrid with additional crushed limestone placed over the subgrade), or removal of the unsuitable soils and replacement with crushed limestone and/or suitable fill soils determined to be appropriate by the geotechnical engineer. The best method for stabilizing the pavement subgrade should be determined in the field at the time of construction based upon the actual field conditions in conjunction with the specific soil type(s) encountered at the locations requiring stabilization, the sizes of the areas requiring stabilization, and the construction schedule. For soil conditions such as those at this site, chemical stabilization is often the most cost-effective subgrade stabilization method, particularly for large areas requiring stabilization. Chemical stabilization should be performed by a specialty contractor, who has the necessary equipment and experience in the determination of the appropriate chemical stabilizer and in the application of chemical stabilization methods. In areas where the soil conditions are not compatible with chemical stabilization or the sizes of the areas requiring stabilization do not justify the use of chemical stabilization, mechanical subgrade stabilization using a biaxial geogrid in conjunction with additional crushed limestone, or undercutting and replacement with crushed limestone and/or suitable fill soils determined to be appropriate by the geotechnical engineer, is considered appropriate for stabilization.

In order to cope with constructability problems and to avoid schedule delays associated with soft or yielding soils, it would be prudent to develop a plan for subgrade stabilization so that it can be implemented where deemed necessary by the geotechnical engineer at the time of construction based on the specific field conditions encountered. It is important that the geotechnical consultant provide continuous inspection during the earthwork operations to identify areas where special stabilization will be required while limiting the stabilization to only those areas where it is necessary.

Controlling subsurface water in pavement areas is important to enhancing the long-term performance of the pavements. The pavement subgrade surface should be uniformly sloped to facilitate drainage through the granular base and to avoid ponding of water beneath the pavement. Subsurface perforated drainage pipes should, at a minimum, be included beneath the lowest lines of the pavement and between catch basins. If catch basins are not included within the pavement areas, subsurface drains should be included near the lower or outside edges of the pavement to prevent water from being trapped or dammed up within the aggregate base. Subsurface perforated drainage pipes should also be included at transitions from concrete pavement sections to asphalt pavement sections and should be considered along the edges of the entrance roads where the greatest amount

of concentrated truck traffic occurs in order to enhance the long-term performance of the pavements in these areas. Furthermore, since the storm water catch basins in pavement areas are at the lowest points in pavement areas where water is often trapped beneath the pavements, they should be designed to allow water to drain from the aggregate base into the catch basins. At a minimum, subsurface perforated drainage pipes should be included that extend out beneath the pavement at least 25 ft from the catch basins in at least four directions in addition to the other subsurface perforated drainage pipes included for the project.

Based on the results of classification tests and our experience with similar soils, a resilient modulus value of 4,000 lbs/sq.in. has been estimated for use in pavement design for the clayey subgrade soils encountered at this site. The subgrade soils should be prepared and inspected as described in Sections 5.1 and 5.2 of this report.

The following report sections outline recommendations for asphalt and concrete pavements for automobile parking areas and bus/truck zones. It is important to note that the recommendations for the automobile parking areas are based on the assumption that these areas will not be subject to any heavy bus/truck traffic. Therefore, in areas where bus/truck traffic cannot be controlled (i.e., driveways), it is suggested that the thicker pavement section be utilized.

4.1.1 Full Reconstructed Asphalt Pavement

Based on a resilient modulus value of 4,000 lbs/sq.in., a design period of 15 years, and the conditions encountered at the site, the following asphalt pavement sections are recommended:

Automobile Parking Areas	3.5 in. of asphaltic concrete over 6 in. of aggregate base
Driveway Areas and Bus/Truck Zones	5 in. of asphaltic concrete over 9 in. of aggregate base

The base should be a well-graded crushed stone with a maximum of 10 percent (by weight) finer than the No. 200 sieve, such as coarse aggregate size No. 53 in accordance with INDOT Standard Specifications. Aggregates that are locally referred to as “commercial grade” No. 53 crushed stone should not be used as pavement base material. A combination of INDOT No. 2 coarse aggregate and INDOT No. 53 coarse aggregate can be used for aggregate bases that are at least 8 inches thick provided that a minimum of 3 in. of No. 53 crushed stone is used above the No. 2 stone for light duty pavement and a minimum of 4 in. of No. 53 crushed stone is used above the No. 2 stone for heavy duty pavement. The asphaltic concrete pavement should be designed and constructed in accordance with the INDOT Standard Specifications Section 400 – Asphalt Pavements and Section 402 – Hot Mix Asphalt, HMA, Pavement.

It should be expected that normal maintenance compatible with asphalt pavement and the design period selected will be required during the life of the pavement. Furthermore, overlaying the pavement surface may be desirable at an intermediate time period to extend the life of the pavement and improve serviceability.

4.1.2 Full Depth Reclamation

It is our understanding that "Full-Depth Reclamation" (FDR) of the existing pavement materials may be considered for rehabilitation of the pavements in some portions, or possibly all, of the existing pavement areas. In order to maintain existing surface grading and drainage patterns, it is assumed that the existing pavement section will need to be milled and removed to some depth. The depth of milling and removal required will be based upon several variables, including the required final pavement surface grading, the thickness of the existing asphalt, the existing and proposed pavement section thicknesses, etc. The pavement materials that remain in place after any required milling, along with the existing subgrade soils below the existing pavement aggregate base, will then be uniformly pulverized, blended with additional materials of appropriate gradation as determined to be necessary, and treated with a chemical modifier (cement) using the FDR technique.

It is recommended that a minimum FDR thickness of 9 inches and a maximum FDR thickness of 12 inches below the milled/removed pavement surface and new asphalt pavement be considered. It is recommended that the FDR treatment use cement as the chemical modifier and that the FDR treatment be designed to result in a minimum unconfined compressive strength of 350 lbs/sq.in. It is also recommended that a minimum cement content of 6 percent by dry weight of pulverized/blended material be used for preliminary planning purposes. The specific final FDR design, including determination of the chemical modifier content, shall be performed by the pavement contractor and/or the pavement contractor's consultant.

It is recommended that the pavement design section be based upon the 1993 AASHTO Design Guide methods and that a Structural Layer Coefficient value ("a") no greater than 0.26 be used for the FDR layer assuming that the FDR layer achieves a minimum unconfined compressive strength of 350 lbs/sq.in. It is suggested that the FDR mix design be performed by the contractor and/or the contractor's consultant and follow the guidelines provided by the ARRA document "Recommended Mix Design Guidelines for Full Depth Reclamation (FDR) Using Cement Stabilizing Agent" (FDR202, 12/22/2016) and the "Guide to Full-Depth Reclamation (FDR) with Cement", January 2019, published by the National Concrete Pavement Technology Center. The construction of the FDR should follow the general procedures outlined in the guidelines provided by the ARRA "Recommended Construction Guidelines for Full Depth Reclamation (FDR) Using Cementitious Stabilization" (FDR102, 09/12/2017) and the "Guide to Full-Depth Reclamation (FDR) with Cement", January 2019, published by the National Concrete Pavement Technology Center.

The aggregate base materials encountered below the existing pavements at the test boring locations was approximately 4 inches thick (as presented in Table No. 1 in Section 3). The aggregate base included various material types (including crushed limestone) that vary in gradation; however, the materials typically consisted of particles with a diameter of 3 inches, or less, in most cases (reports showing the results of grain size analysis tests that were performed on selected samples are presented in the Appendix, and photos of each of the recovered aggregate base samples are presented in the "Pavement Core Photo Report" in the Appendix). The subgrade soils, which generally consist of lower-plasticity to higher-plasticity silty clay, sandy silty clay, and/or clay appear to generally be compatible with the proposed full-depth reclamation as described herein.

Ground water was not encountered during drilling in any of the test borings drilled within the existing pavement areas. Based upon the thickness of the existing asphalt and aggregate base layers, it may be possible that the pavement contractor will need to blend in additional materials to achieve the desired gradation and composition for FDR.

4.1.3 Concrete Pavement

Concrete pavement thicknesses were determined from methods developed by the American Association of State Highway and Transportation Officials (AASHTO). These methods assume that the subgrade is firm, well-compacted, and non-pumping and that all joints are properly designed, located, and sealed to minimize moisture seepage into the subgrade. It is also important to ensure that proper concrete curing practices will be employed and that traffic will not be allowed on concrete that has had insufficient time to cure.

For design calculation purposes, the compressive strength of the concrete was assumed to be 4,000 lbs/sq.in. (or have a modulus of rupture of about 600 lbs/sq.in.). The modulus of subgrade reaction of the soil (k) was estimated to be 110 lbs/cu.in.

Based on the above information, the following concrete pavement sections are recommended:

Automobile Parking Areas	5 in. of concrete over 6 in. of aggregate base placed over a well-compacted, non-pumping subgrade
Driveway Areas and Bus/Truck Zones	8 in. of concrete over 6 in. of aggregate base placed over a well-compacted, non-pumping subgrade

The performance of the concrete paving section is highly dependent on controlling the pumping of the subgrade soils. Although no wet surface soils were noted at the time of this study, it is important that surface drainage be controlled to prevent water from ponding in pavement areas.

4.2 Site Grading and Drainage

Proper surface drainage should be provided at the site to minimize increase in moisture content of the subgrade soils and nearby foundation soils of existing structures/facilities. The proposed pavement grades should be sloped to prevent ponding of water, especially to prevent ponding of water around existing structures.

5 GENERAL CONSTRUCTION PROCEDURES AND RECOMMENDATIONS

Since this investigation identified actual subsurface conditions only at the test boring locations, it was necessary to extrapolate these conditions in order to characterize the entire project site. Even under the best of circumstances, the conditions encountered during construction can be expected to vary somewhat from the test boring results and may, in the extreme case, differ to the extent that modifications to the recommendations provided herein become necessary. Therefore, we recommend that Atlas be retained as geotechnical consultant through the earth-related phases of this project to correlate actual soil conditions with test boring data, identify variations, conduct additional tests that may be needed, and recommend solutions to earth-related problems that may develop.

5.1 Site Preparation

All areas that will support pavements should be properly prepared. Once rough grade has been established and prior to placement of fill in any fill areas, the exposed subgrade should be carefully tested, observed, and assessed by the geotechnical engineer, or a qualified soils technician working under the direction of the geotechnical engineer, by probing and testing as needed. The exposed subgrade should furthermore be tested by proofrolling with suitable equipment to check for pockets of soft material hidden beneath a thin crust of better soil. Any remnants from previous construction; unsuitable fill; utility pipes; organic material; frozen, wet, soft, or loose soil; and any other undesirable materials should be removed and replaced with engineered fill as outlined in Section 5.2. In cases or areas where determined to be appropriate by the geotechnical engineer, soft, loose, or yielding soils may be stabilized in-place using chemical or mechanical stabilization techniques as described in Section 4.1. Based on the results of the test borings and the nature of the project (since our experience indicates that most subgrade soils beneath existing pavements will be soft or yielding once the existing pavement section is removed, regardless of the presence of the existing pavement and any apparently firm soils in the test borings), it is anticipated that some, if not all, areas will need modification or stabilization due to unsuitable subgrade soils. It is suggested that the project include contingency plans for stabilization or modification (such as removal of unsuitable soils and replacement with compacted fill, chemical stabilization, mechanical stabilization, etc.) to be used as determined appropriate based upon careful observations of the specific conditions encountered in the field at the time of construction.

Care should be exercised during the grading operations at the site. Due to the nature of the near-surface soils, the traffic of construction equipment may create pumping and general deterioration of the shallower soils, especially if excess surface water is present. The grading, therefore, should be done during a dry season, if at all possible. Furthermore, it is important that positive surface drainage be established at the beginning of the earthwork operations and be maintained throughout the project. Surface water must not be allowed to pond. The site storm drainage elements (i.e., catch basins, pipes, manholes, etc.) should be installed as early as possible, which will aid in control of surface water and ground water. Additionally, compaction and sealing of the subgrade surface are important when precipitation is expected.

5.2 Fill Compaction

All engineered fill beneath pavements should be compacted to a dry density of at least 98 percent of the standard Proctor maximum dry density (ASTM D698). The compaction should be accomplished by placing the fill in about 8-inch-thick (or less), loose lifts and mechanically compacting each lift to at least the specified minimum dry density. The moisture content of the fill soil should be within a range of 2 percent below the optimum moisture content to the optimum moisture content. Field density tests should be performed on each lift as necessary to verify that adequate moisture conditioning and compaction are being achieved.

All soils encountered in the test borings made at this site are considered suitable as general fill material with the exception of any higher-plasticity, clayey soils and any soils that may contain debris from previous construction or particles larger than 3 inches in diameter. The need for some aeration and moisture conditioning of the soils should be expected before they can be placed and compacted to the specified density. Furthermore, it is emphasized that the high plasticity cohesive soils, which were found to be very prevalent at this site, may require chemical modification in order to be properly placed and compacted and to help prevent shrinking and swelling of the higher-plasticity soils, which could decrease the life and serviceability of the pavements if not treated. It is recommended that only well-graded granular material, such as pit-run sand and gravel or INDOT No. 53 crushed limestone, be used to fill excavations of limited lateral dimensions where proper compaction of cohesive materials is difficult and compaction can only be accomplished with small vibratory equipment.

5.3 Construction Dewatering

At the time of our investigation, the ground water level appeared to be below the anticipated excavation depths for the proposed pavement improvements. Depending on the seasonal conditions, some seepage into excavations may be experienced due to “perched” water that may be encountered within old fill materials, abandoned utilities, utility trenches, etc. or in isolated sand seams within the predominantly cohesive soils. It is anticipated that such seepage can likely be handled by conventional dewatering methods such as by pumping from sumps; however, if a saturated sand layer is encountered in the base of the excavation, it will not be possible to pump water directly from the base of the excavation without causing deterioration of the soil. In this case, it will be necessary to pump from a sump located adjacent to the excavation or to depress the ground water using wells or well points. The best dewatering system for each case must be determined at the time of construction based upon actual field conditions.

6 FIELD INVESTIGATION

Thirteen test borings were drilled and pavement cores collected at the approximate locations shown on the Boring Plan (Figure 2 in the Appendix). The borings were extended to depths of 4.1 ft to 5.0 ft below the existing grade, and continuous split-barrel samples were obtained by the Standard Penetration Test procedures (ASTM D1586). In addition, aggregate base samples were collected at all locations.

Logs of all test borings, which show visual descriptions of all soil strata encountered using the Unified Soil Classification System (ASTM D2488 “Standard Practice for Description and Identification of Soils by Visual-Manual Procedures”), have been included in numerical order in the Appendix. Ground water observations, sampling information, and other pertinent field data and observations are also included. In addition, a "Field Classification System for Soil Exploration" document defining the terms and symbols used on the test boring logs and explaining the Standard Penetration Test procedure is provided immediately following the test boring logs. Photographs of each of the test boring and pavement core locations, down-hole views, recovered pavement cores, and recovered aggregate base samples are provided in the “Pavement Core Photo Report” in the Appendix.

7 LABORATORY INVESTIGATION

The soil samples obtained from the test borings were inspected and classified in general accordance with the Unified Soil Classification System (ASTM D2488 “Standard Practice for Description and Identification of Soils by Visual-Manual Procedures”), and the boring logs were edited as deemed necessary based upon the visual inspection, field logs, and laboratory test results. To aid in classifying the soils and to determine general soil characteristics, laboratory tests were performed on selected samples. The laboratory tests performed on the selected soil samples are summarized in the following table, and the results of these tests are included on the “Test Boring Logs” and report summary sheets in the Appendix.

Table No. 2 – Laboratory Testing Program

Laboratory Test Description	Test Method Designation
"Standard Practice for Description and Identification of Soils by Visual-Manual Procedures"	ASTM D2488
Moisture Content Test of Soils	ASTM D2216
Atterberg Limits Tests	ASTM D4318
Organic Content (Loss-on-Ignition Test)	ASTM D2974
Marl Content ($CaCO_3$/$MgCO_3$ Content)	ITM 507
Particle-Size Distribution of Aggregate Using Sieve Analysis	ASTM C136
Calibrated Hand Penetrometer Test ("Pocket Penetrometer Test")	NA

NA – No standardized test method available.

8 LIMITATIONS OF STUDY

An inherent limitation of any geotechnical engineering study is that conclusions must be drawn on the basis of data collected at a limited number of discrete locations. The recommendations provided in this report were developed from the information obtained from the test borings that depict subsurface conditions only at these specific locations and at the particular times designated on the logs. Soil and ground water conditions at other locations may differ from conditions occurring at these boring locations, and ground water conditions will vary over time. The nature and extent of variations between the test borings may not become evident until the course of construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report after performing on-site observations during the excavation and construction period and noting the characteristics of any variations.

Any comments or recommendations made herein regarding construction-related issues or temporary conditions are solely for the purpose of evaluating feasibility and constructability and planning the design of the proposed facility improvements. The scope of this investigation is not sufficient to identify all potential construction-related issues, variations, anomalies, etc. or all factors that may affect construction means, methods, and costs.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with customary principles and practices in the field of geotechnical engineering at the time when the services were performed and at the location where the services were performed. This warranty is in lieu of all other warranties either express or implied. This company is not responsible for the independent conclusions, opinions, or recommendations made by others based on the field exploration and laboratory test data presented in this report. The scope of our services does not include any environmental assessment or investigation for the presence or

absence of hazardous or toxic materials in the soil, ground water, or surface water within or beyond the site studied.

Atlas Technical Consultants LLC (Atlas) assumes no responsibility for any construction procedures, temporary excavations (including utility trenches), temporary dewatering, or site safety during or after construction. Any recommendations, discussions, or comments provided herein regarding temporary conditions during construction are solely for use in the planning and design of the project. Under no circumstances shall the information provided herein be interpreted to mean that Atlas is responsible for construction site safety or contractor means and methods, and no responsibility is implied or inferred. The contractor shall be solely responsible for all construction procedures, construction means and methods, construction sequencing, and for all safety measures during construction, as well as the protection of all existing facilities. All applicable federal, state, and local laws and regulations regarding construction safety must be followed, including current Occupational Safety and Health Administration (OSHA) Regulations, including OSHA 29 CFR Part 1926 “Safety and Health Regulations for Construction”, Subpart P “Excavations”, and/or successor regulations. The contractor shall be solely responsible for designing and constructing stable, temporary excavations and should brace, shore, slope, or bench the sides of the excavations as necessary to maintain stability of the excavation sides and bottom and to protect the integrity of all existing facilities (i.e., existing foundations, floor slabs, structures, equipment, utilities, pavements, etc.) that are to remain in place.

Appendix

VICINITY MAP

PROPOSED PAVEMENT IMPROVEMENTS
FALL CREEK INTERMEDIATE SCHOOL
12011 OLIO ROAD
FISHERS, INDIANA

Project Number: 170GC01699		Drn. By: AK
Date: 12/18/2023	Scale: 1":2,000'	Ckd. By: DM
ATLAS		1

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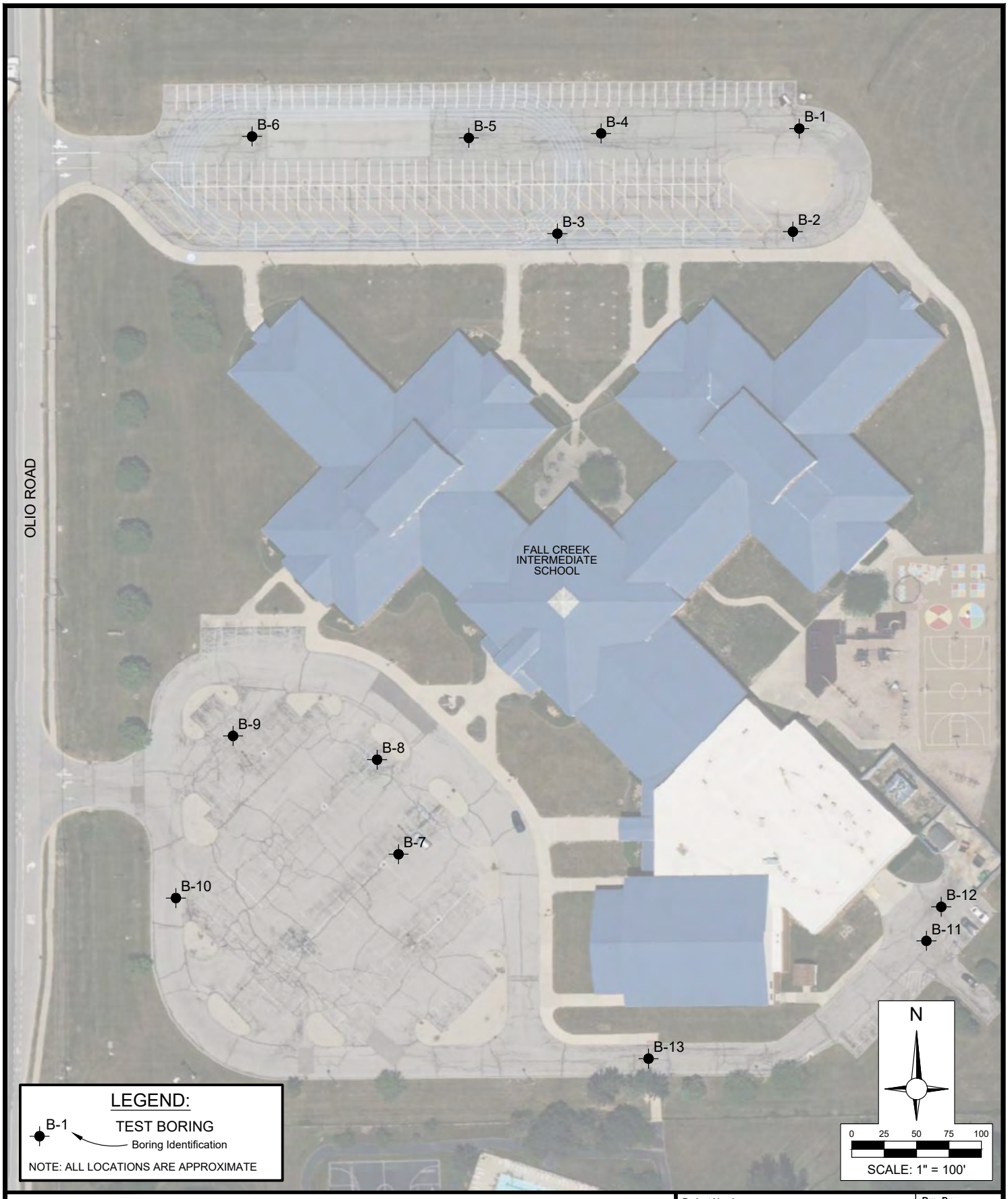

BORING PLAN

PROPOSED PAVEMENT IMPROVEMENTS
FALL CREEK INTERMEDIATE SCHOOL
12011 OLIO ROAD
FISHERS, INDIANA

Project Number: 170GC01699		Drn. By: AK
Date: 12/18/2023	Scale: AS SHOWN	Ckd. By: DM

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ATLAS
7988 Centerpoint Drive, Suite 100
Indianapolis, IN 46256
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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-1**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

SOIL CLASSIFICATION SURFACE ELEVATION 836	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4 in. Asphalt	835.7	0.3									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	835.3	0.7		1	SS			9-10-7	12.9		
Gray, moist, sandy silty clay with little gravel (FILL)	834.1	1.9		2	SS			6-6-6	13.5	2.0	
Brown, moist, stiff to very stiff, SILTY CLAY (CL) with little sand and trace gravel				3	SS			7-9-9	13.6	1.5	
Bottom of Test Boring at 4.9 ft.	831.1	4.9									

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After -- hours -- ft.
Cave Depth **4.5** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-2**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

SOIL CLASSIFICATION SURFACE ELEVATION 836	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
6 in. Asphalt	835.5	0.5									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	835.2	0.8		1	SS			4-5-7	31.3		
Dark gray, moist, clay with trace sand (FILL)	834.0	2.0									**Sample No. 1:** Atterberg Limits: LL=51 PL=28 PI=23
Gray, moist, stiff, CLAY (CH) with trace sand	832.5	3.5		2	SS			5-5-6	25.4	1.25	**Sample No. 2:** Atterberg Limits: LL=55 PL=18 PI=37
Dark brown and gray, moist, medium stiff, SILTY CLAY (CL) with little sand and trace gravel	831.0	5.0	5	3	SS		▨	3-3-4	23.5	1.5	
Bottom of Test Boring at 5.0 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **None** ft.
▽ At Completion **None** ft.
▼ After -- hours -- ft.
▨ Cave Depth **4.2** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-3**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

SOIL CLASSIFICATION SURFACE ELEVATION 836	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5.5 in. Asphalt	835.6	0.4									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	835.2	0.8		1	SS			6-4-4	31.5		
Dark gray and brown, moist, silty clay with trace sand (FILL)	834.1	1.9									
Gray and brown, moist, medium stiff, SILTY CLAY (CL) with little sand	832.6	3.4		2	SS			3-4-4	25.0	1.5	
Gray, moist, medium stiff, SILTY CLAY (CL) with trace sand and gravel	831.1	4.9		3	SS		▨	2-3-4	30.2		
Bottom of Test Boring at 4.9 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **None** ft.
▽ At Completion **None** ft.
▼ After -- hours -- ft.
▨ Cave Depth **4.6** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-4**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION 836	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5 in. Asphalt	835.6	0.4									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	835.2	0.8		1	SS			7-4-5			
Gray, moist, sandy silty clay with crushed limestone fragments and trace gravel (FILL)	834.1	1.9									
Brown, moist, stiff, SILTY CLAY (CL) with little sand and trace gravel				2	SS			5-7-6	12.2	2.0	
				3	SS			6-6-6	14.2	1.5	
	831.1	4.9					▨				
Bottom of Test Boring at 4.9 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **None** ft.
▽ At Completion **None** ft.
▼ After -- hours -- ft.
▨ Cave Depth **4.8** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-5**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 836	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4.5 in. Asphalt	835.6	0.4									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	835.3	0.7		1	SS			7-8-7	27.2		**Sample No. 1:** Atterberg Limits: LL=43 PL=21 PI=22
Dark gray and brown, moist, silty clay with trace sand (FILL)	834.1	1.9		2	SS			4-5-6	26.3	1.5	
Gray and brown, moist, stiff, SILTY CLAY (CL) with trace sand and gravel	832.6	3.4		3	SS			5-5-6	12.5	1.5	
Brown, moist, stiff, SILTY CLAY (CL) with little sand and trace gravel	831.1	4.9									
Bottom of Test Boring at 4.9 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After -- hours -- ft.
Cave Depth **4.2** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-6**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

SOIL CLASSIFICATION SURFACE ELEVATION 836	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4 in. Asphalt	835.7	0.3									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	835.3	0.7		1	SS			7-8-8	20.3		
Dark gray and brown, slightly moist, silty clay with little sand (FILL)	834.1	1.9									
Gray and brown, moist, very stiff, CLAY (CH) with trace sand	832.6	3.4		2	SS			8-8-10	27.7	2.0	**Sample No. 2:** Atterberg Limits: LL=56 PL=18 PI=38
Brown, moist, stiff, SILTY CLAY (CL) with trace sand	831.1	4.9		3	SS		▨	8-6-5	24.3	1.25	
Bottom of Test Boring at 4.9 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **None** ft.
▽ At Completion **None** ft.
▼ After -- hours -- ft.
▨ Cave Depth **4.0** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-7**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

SOIL CLASSIFICATION SURFACE ELEVATION 835	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5 in. Asphalt	834.6	0.4									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	834.2	0.8		1	SS			2-2-2	29.8		
Dark gray, gray, and brown, moist, sandy silty clay with trace gravel (FILL)	833.1	1.9									
Gray and brown, moist, medium stiff, SILTY CLAY (CL) with little sand and trace gravel	831.6	3.4		2	SS			3-3-3	25.1	1.75	
Gray, moist, stiff, SILTY CLAY (CL) with little sand and trace gravel	830.1	4.9		3	SS		▨	4-5-6			
Bottom of Test Boring at 4.9 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **None** ft.
▽ At Completion **None** ft.
▼ After -- hours -- ft.
▨ Cave Depth **4.3** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-8**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

SOIL CLASSIFICATION SURFACE ELEVATION 836	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5 in. Asphalt	835.6	0.4									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	835.2	0.8		1	SS			3-5-6	29.2		
Dark gray, moist, silty clay with little sand (FILL)	834.1	1.9									**Sample No. 1:** Atterberg Limits: LL=47 PL=26 PI=21
Dark gray, moist, medium stiff, CLAY (CH) with trace organics and marl	832.6	3.4		2	SS			4-4-4	27.2	1.75	**Sample No. 2:** Atterberg Limits: LL=51 PL=18 PI=33 Organic Content = 3.5% Marl Content = 11%
Gray, moist, medium stiff, SANDY SILTY CLAY (CL) with little gravel	831.1	4.9		3	SS		▨	3-4-4	27.1		
Bottom of Test Boring at 4.9 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **None** ft.
▽ At Completion **None** ft.
▼ After -- hours -- ft.
▨ Cave Depth **4.2** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-9**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 836	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5 in. Asphalt	835.6	0.4									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	835.2	0.8		1	SS			13-7-10	24.3		
Dark gray, slightly moist, silty clay with little sand (FILL) (possibly chemically stabilized)	834.1	1.9									**Sample No. 1:** pH = 9.5
Gray and brown, moist, stiff, SILTY CLAY (CL) with little sand and trace gravel	832.6	3.4		2	SS			5-6-8	25.4	1.5	
Brown and gray, moist, stiff, SILTY CLAY (CL) with trace sand	831.1	4.9		3	SS			4-5-6	23.9	1.0	
Bottom of Test Boring at 4.9 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After -- hours -- ft.
Cave Depth **4.5** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-10**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 837	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
6 in. Asphalt	836.5	0.5									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	836.2	0.8		1	SS			8-8-11	20.8		
Dark gray, slightly moist, sandy silty clay with trace gravel (FILL) (chemically stabilized)	835.0	2.0									**Sample No. 1:** pH = 9.2
Dark gray, moist, medium stiff to stiff, SILTY CLAY (CL) with trace sand and gravel				2	SS		▨	4-4-5	24.4		
				3	SS			7-50/0.1	23.5	2.0	
	832.9	4.1									
Bottom of Test Boring at 4.1 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **None** ft.
▽ At Completion **None** ft.
▼ After -- hours -- ft.
▨ Cave Depth **3.3** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-11**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

SOIL CLASSIFICATION SURFACE ELEVATION 838	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4 in. Asphalt	837.7	0.3									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	837.3	0.7		1	SS			5-5-8	27.5		
Dark gray, slightly moist, silty clay with little sand and trace gravel (FILL) (possibly chemically stabilized)	836.1	1.9									
Dark gray, moist, stiff, CLAY (CH) with trace sand	834.6	3.4		2	SS			5-5-6	24.0	1.75	**Sample No. 2:** Atterberg Limits: LL=50 PL=17 PI=33
Brown, moist, stiff, SILTY CLAY (CL) with little sand and trace gravel	833.1	4.9		3	SS		▨	5-6-7	14.2	2.25	
Bottom of Test Boring at 4.9 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **None** ft.
▽ At Completion **None** ft.
▼ After -- hours -- ft.
▨ Cave Depth **4.2** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-12**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 838	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
3 in. Asphalt	837.7	0.3									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	837.4	0.6		1	SS			13-16-13	27.8		
Dark gray, slightly moist, sandy silty clay with trace gravel (FILL) (chemically stabilized)	836.2	1.8									**Sample No. 1:** pH = 9.7
Dark brown and brown, moist, very stiff, CLAY (CH) with little sand	834.7	3.3		2	SS			8-10-13	24.6	1.5	**Sample No. 2:** Atterberg Limits: LL=57 PL=19 PI=38
Brown, moist, very stiff, SILTY CLAY (CL) with little sand	833.2	4.8		3	SS		▨	10-10-12	22.8	2.5	
Bottom of Test Boring at 4.8 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **None** ft.
▽ At Completion **None** ft.
▼ After -- hours -- ft.
▨ Cave Depth **4.2** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **krM Architecture** BORING # **B-13**

PROJECT NAME **Proposed Pavement Improvements** JOB # **170GC01699**

PROJECT LOCATION **Fall Creek Intermediate School**
12011 Olio Road, Fishers, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	1/2/24	Hammer Wt.	140 lbs.
Date Completed	1/2/24	Hammer Drop	30 in.
Drill Foreman	G. Lauber	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 837	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5 in. Asphalt	836.6	0.4									Ground surface elevation estimated from topography provided by the Hamilton County GIS website.
4 in. Aggregate Base	836.2	0.8		1	SS			4-7-8	29.2		
Gray, moist, silty clay with little sand (FILL) (chemically stabilized)	835.1	1.9									**Sample No. 1:** pH = 10.1
Brown, moist, stiff, SILTY CLAY (CL) with little sand and trace gravel				2	SS			6-6-7	26.2	2.0	
				3	SS			7-7-8	20.1	1.5	
	832.1	4.9									
Bottom of Test Boring at 4.9 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After -- hours -- ft.
Cave Depth **4.5** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON-COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

Density		SPT*
Very Loose	-	5 blows/ft or less
Loose	-	6 to 10 blows/ft
Medium Dense	-	11 to 30 blows/ft
Dense	-	31 to 50 blows/ft
Very Dense	-	51 blows/ft or more

Relative Proportions	
Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

Particle Size Identification			
Boulders	-	8 inch or greater	
Cobbles	-	3 to 8 inch	
Gravel	-	Coarse	- 1 to 3 inch
		Medium	- ½ to 1 inch
		Fine	- ¼ to ½ inch
Sand	-	Coarse	2.00mm to ¼ inch (dia. of pencil lead)
		Medium	0.42 to 2.00mm (dia. of broom straw)
		Fine	0.074 to 0.42mm (dia. of human hair)
Silt			0.074 to 0.002mm (cannot see particles)

COHESIVE SOILS
(Clay, Silt and Combinations)

Consistency		SPT*
Very Soft	-	3 blows/ft or less
Soft	-	4 to 5 blows/ft
Medium Stiff	-	6 to 10 blows/ft
Stiff	-	11 to 15 blows/ft
Very Stiff	-	16 to 30 blows/ft
Hard	-	31 blows/ft or more

Plasticity	
Degree of Plasticity	Plasticity Index
None to slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	over 22

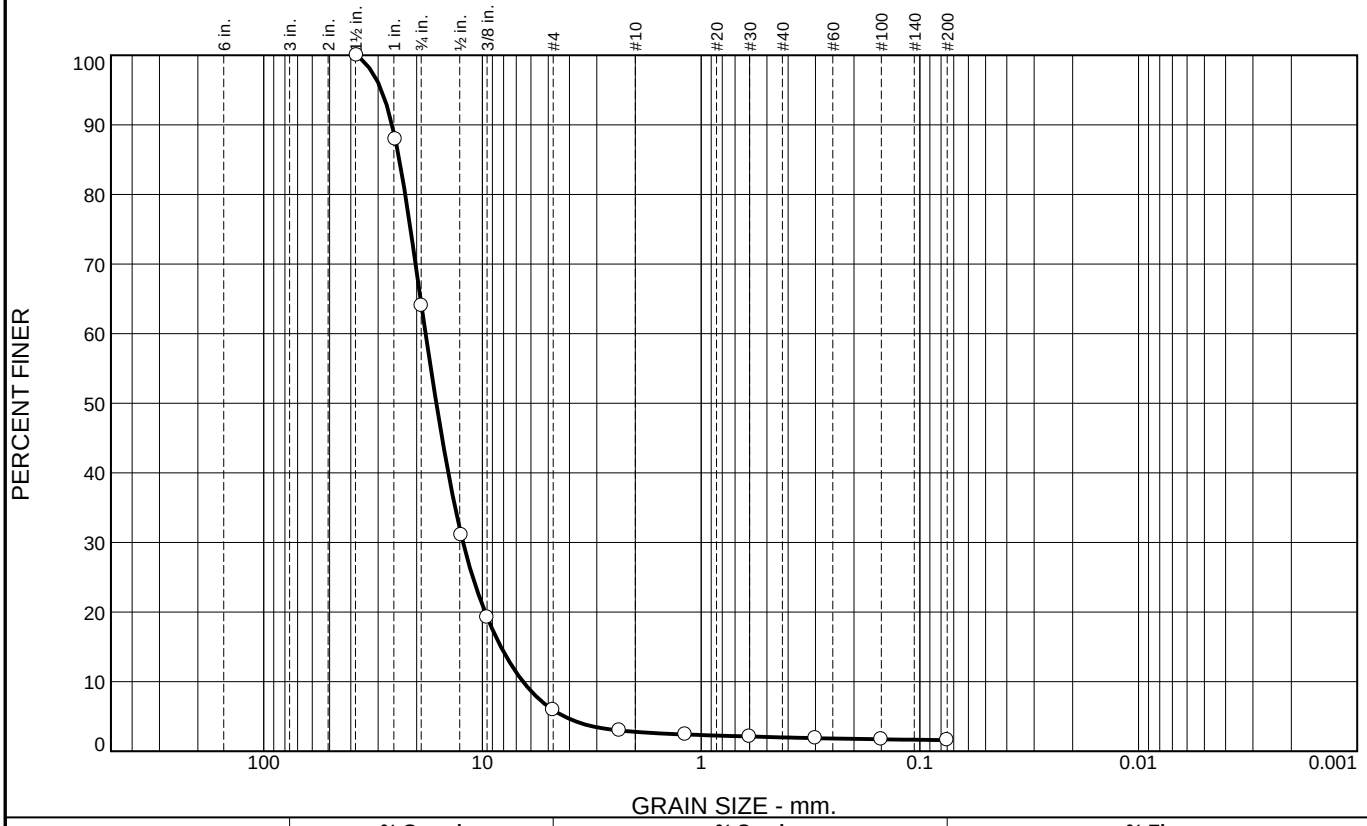
Classification on the logs are made by visual inspection of samples.
*Based upon results of Standard Penetration Test as described below.

Standard Penetration Test — Driving a 2.0" O.D. 1-3/8" I.D. sampler a distance of 12 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30 inches. It is customary for ATC to drive the split-barrel sampler 6 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the split-barrel sampler and making the test are recorded for each 6 inches of penetration of the sampler (Example – 6-8-9). The standard penetration test result can be obtained by adding the last two figures (i.e., 8 + 9 = 17 blows/ft). The Standard Penetration Test is performed according to ASTM D-1586-18.

Strata Changes — In the column "Soil Classifications" on the Test Boring Logs the horizontal lines represent strata changes. A solid line (_____) represents an actually observed change. A dashed line (_ _ _ _ _ _) represents an estimated change.

Ground Water observations were made at the times and conditions indicated on the Test Boring Logs. Porosity of soil strata, weather conditions, site topography, etc., may cause changes in the water levels indicated on the logs.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	35.7	58.4	3.1	0.8	0.4	1.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2	100.0		
1	87.9		
3/4	64.0		
1/2"	31.1		
3/8	19.2		
#4	5.9		
#8	3.0		
#16	2.4		
#30	2.1		
#50	1.9		
#100	1.7		
#200	1.6		

* (no specification provided)

Material Description

Aggregate Base

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 25.8668 D_{85}= 23.9826 D_{60}= 18.1956
D_{50}= 16.2540 D_{30}= 12.2601 D_{15}= 8.2261
D_{10}= 6.5225 C_u= 2.79 C_c= 1.27

Classification

USCS= AASHTO=

Remarks

Source of Sample: 15694 **Depth:** Aggregate
Sample Number: B-2, 3, & 4 **Date:**

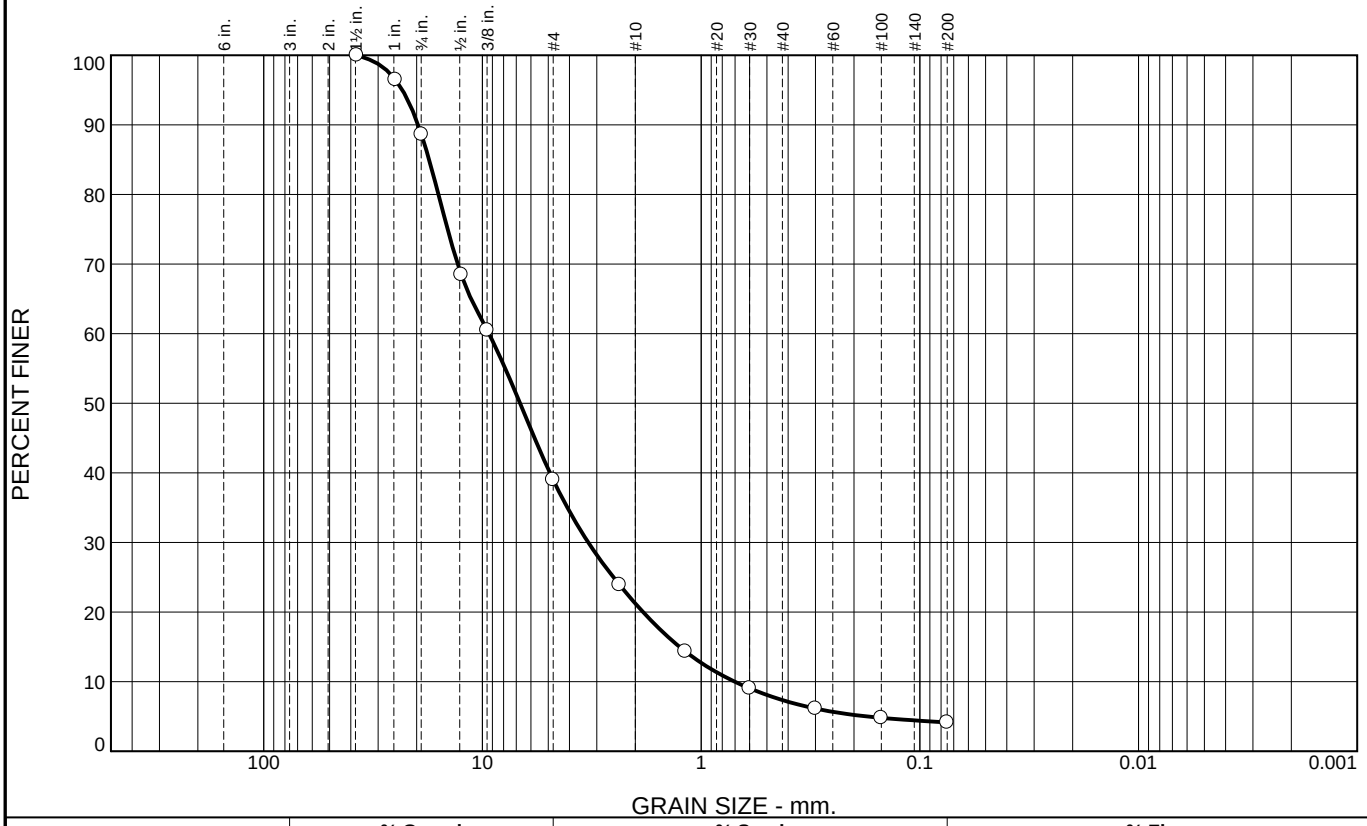
Atlas

Indianapolis, Indiana

Client: KRM
Project: FCI School Pavement

Project No: 170GC01699 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	11.3	49.7	17.8	13.8	3.2	4.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2	100.0		
1	96.5		
3/4	88.6		
1/2"	68.5		
3/8	60.5		
#4	39.0		
#8	23.9		
#16	14.3		
#30	9.1		
#50	6.1		
#100	4.8		
#200	4.2		

* (no specification provided)

Material Description

Aggregate Base

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 19.6757 D_{85}= 17.5431 D_{60}= 9.3300
D_{50}= 6.7310 D_{30}= 3.2806 D_{15}= 1.2542
D_{10}= 0.7017 C_u= 13.30 C_c= 1.64

Classification

USCS= AASHTO=

Remarks

Source of Sample: 15694 **Depth:** Aggregate
Sample Number: B-7 & 8 **Date:**

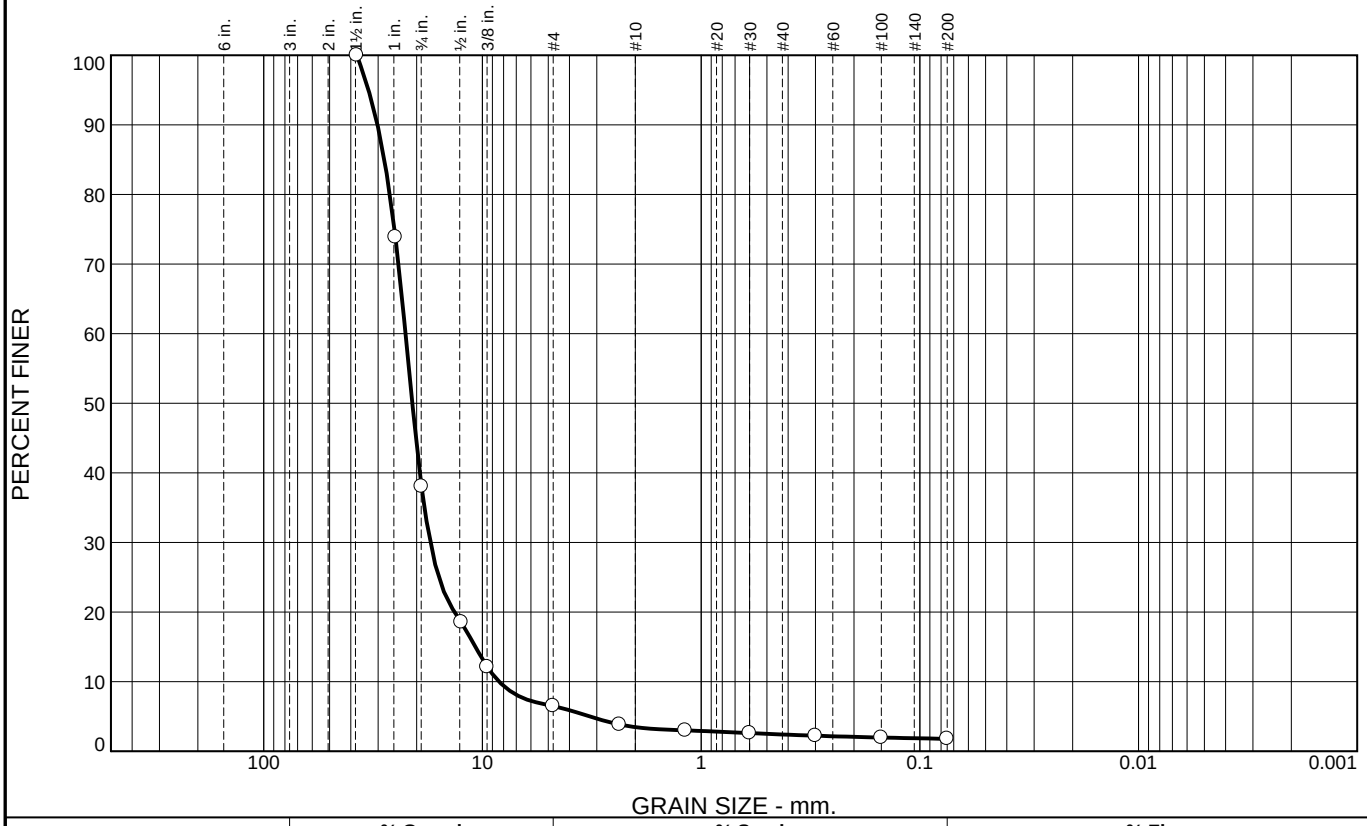
Atlas

Indianapolis, Indiana

Client: KRM
Project: FCI School Pavement

Project No: 170GC01699 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	61.7	31.8	3.0	1.1	0.6	1.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2	100.0		
1	73.9		
3/4	38.1		
1/2"	18.5		
3/8	12.1		
#4	6.5		
#8	3.9		
#16	3.0		
#30	2.6		
#50	2.2		
#100	2.0		
#200	1.8		

* (no specification provided)

Material Description

Aggregate Base

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 30.1729 D_{85}= 28.0674 D_{60}= 22.4836
D_{50}= 20.9249 D_{30}= 17.3242 D_{15}= 10.7683
D_{10}= 8.3883 C_u= 2.68 C_c= 1.59

Classification

USCS= AASHTO=

Remarks

Source of Sample: 15694 **Depth:** Aggregate
Sample Number: B-9 & 10 **Date:**

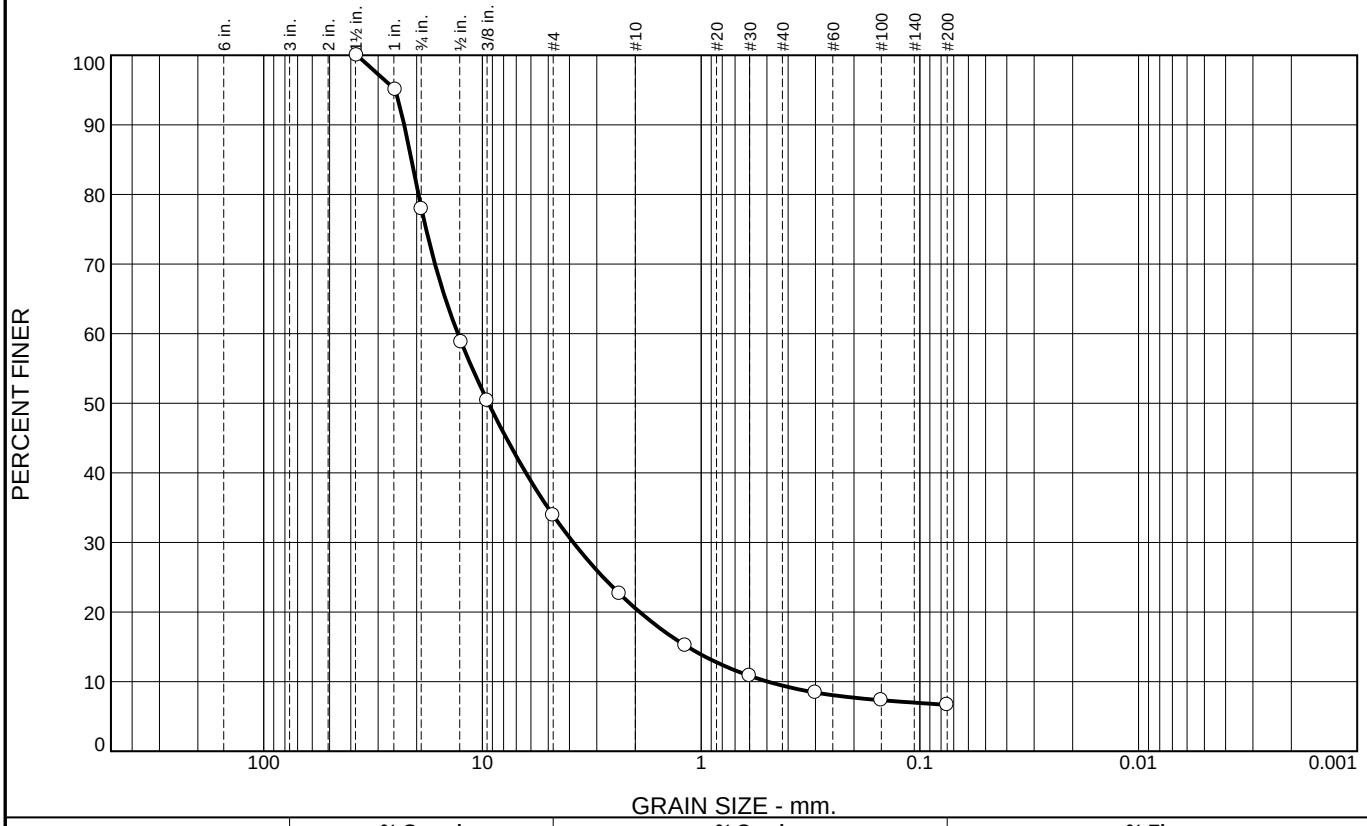
Atlas

Indianapolis, Indiana

Client: KRM
Project: FCI School Pavement

Project No: 170GC01699 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	21.9	44.2	13.3	11.2	2.7	6.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2	100.0		
1	95.0		
3/4	77.9		
1/2"	58.8		
3/8	50.4		
#4	33.9		
#8	22.6		
#16	15.2		
#30	10.8		
#50	8.4		
#100	7.3		
#200	6.7		

* (no specification provided)

Material Description

Aggregate Base

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 22.7903 D_{85}= 21.1177 D_{60}= 12.9445
D_{50}= 9.3740 D_{30}= 3.8414 D_{15}= 1.1518
D_{10}= 0.4939 C_u= 26.21 C_c= 2.31

Classification

USCS= AASHTO=

Remarks

Source of Sample: 15694 **Depth:** Aggregate
Sample Number: B-11 & 12 **Date:**

Atlas

Indianapolis, Indiana

Client: KRM
Project: FCI School Pavement

Project No: 170GC01699 **Figure**

ATLAS

Pavement Core Photo Report

BORING NO.: **B-1**

SHEET 1 OF 2

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-1.1
Site View

Figure B-1.2
Downhole View

Note: Coring process involves water.
Photos of pavement cores depict top of pavement core on the left.

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-1.3
Recovered Pavement Core

Figure B-1.4
Recovered Aggregate Base

Pavement Core Photo Report

BORING NO.: B-2

SHEET 1 OF 2

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-2.1
Site View

Figure B-2.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-2.3
Recovered Pavement Core

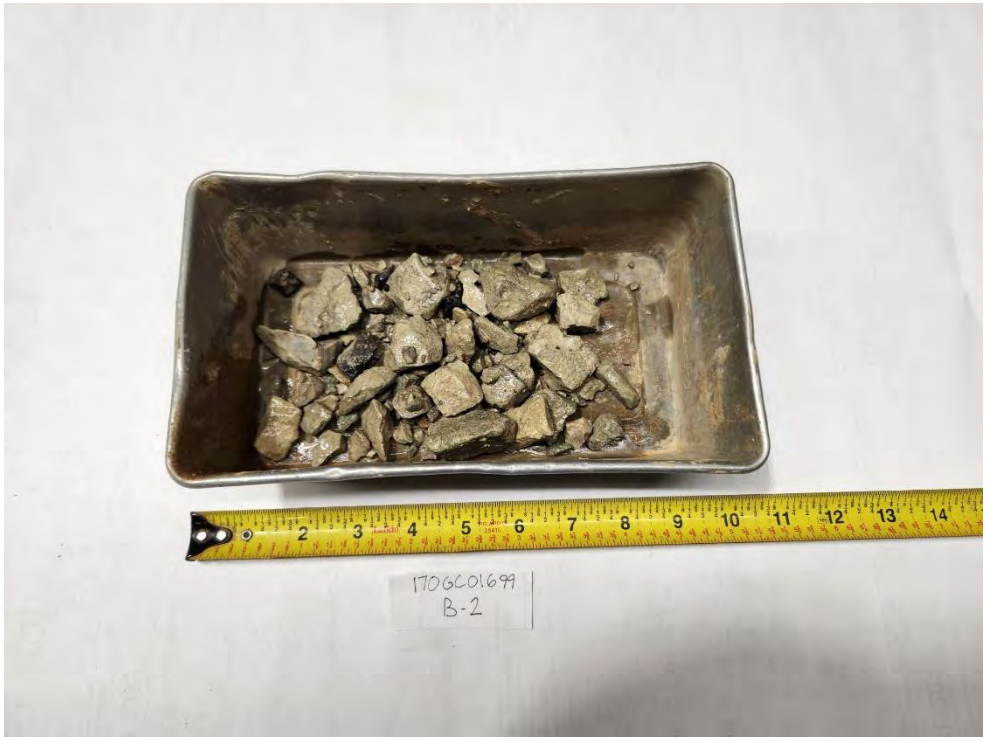


Figure B-2.4
Recovered Aggregate Base

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-3.1
Site View

Figure B-3.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-3.3
Recovered Pavement Core

Figure B-3.4
Recovered Aggregate Base

Pavement Core Photo Report

BORING NO.: **B-4**

SHEET 1 OF 2

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-4.1
Site View

Figure B-4.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-4.3
Recovered Pavement Core

Figure B-4.4
Recovered Aggregate Base

Pavement Core Photo Report

BORING NO.: **B-5**

SHEET 1 OF 2

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-5.1
Site View

Figure B-5.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-5.3
Recovered Pavement Core

Figure B-5.4
Recovered Aggregate Base

Pavement Core Photo Report

BORING NO.: B-6

SHEET 1 OF 2

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-6.1
Site View

Figure B-6.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-6.3
Recovered Pavement Core

Figure B-6.4
Recovered Aggregate Base

Pavement Core Photo Report

BORING NO.: B-7

SHEET 1 OF 2

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-7.1
Site View

Figure B-7.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-7.3
Recovered Pavement Core

Figure B-7.4
Recovered Aggregate Base

Pavement Core Photo Report

BORING NO.: B-8

SHEET 1 OF 2

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-8.1
Site View

Figure B-8.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-8.3
Recovered Pavement Core

Figure B-8.4
Recovered Aggregate Base

Pavement Core Photo Report

BORING NO.: B-9

SHEET 1 OF 2

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-9.1
Site View

Figure B-9.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-9.3
Recovered Pavement Core

Figure B-9.4
Recovered Aggregate Base

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-10.1
Site View

Figure B-10.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-10.3
Recovered Pavement Core

Figure B-10.4
Recovered Aggregate Base

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-11.1
Site View

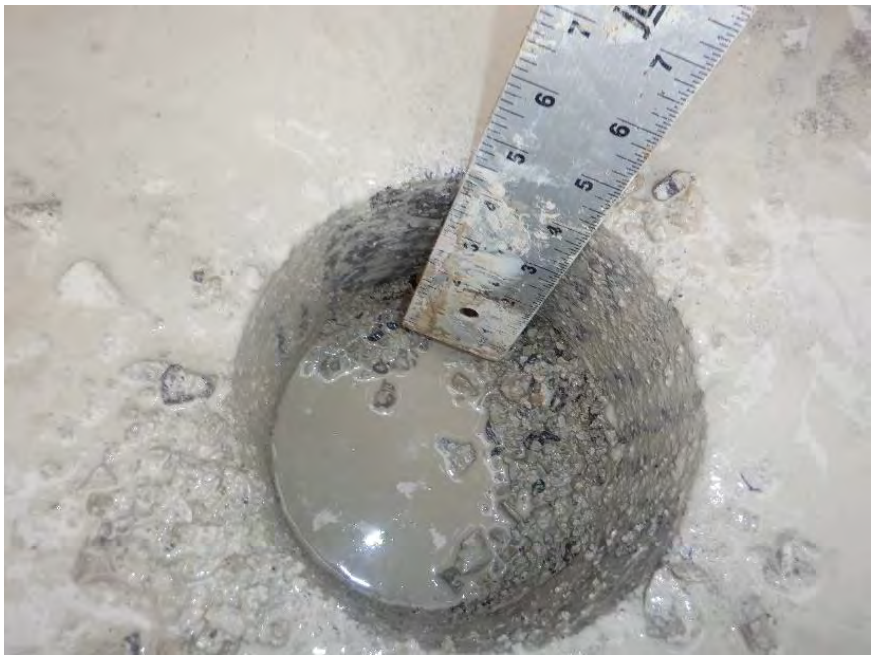


Figure B-11.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-11.3
Recovered Pavement Core

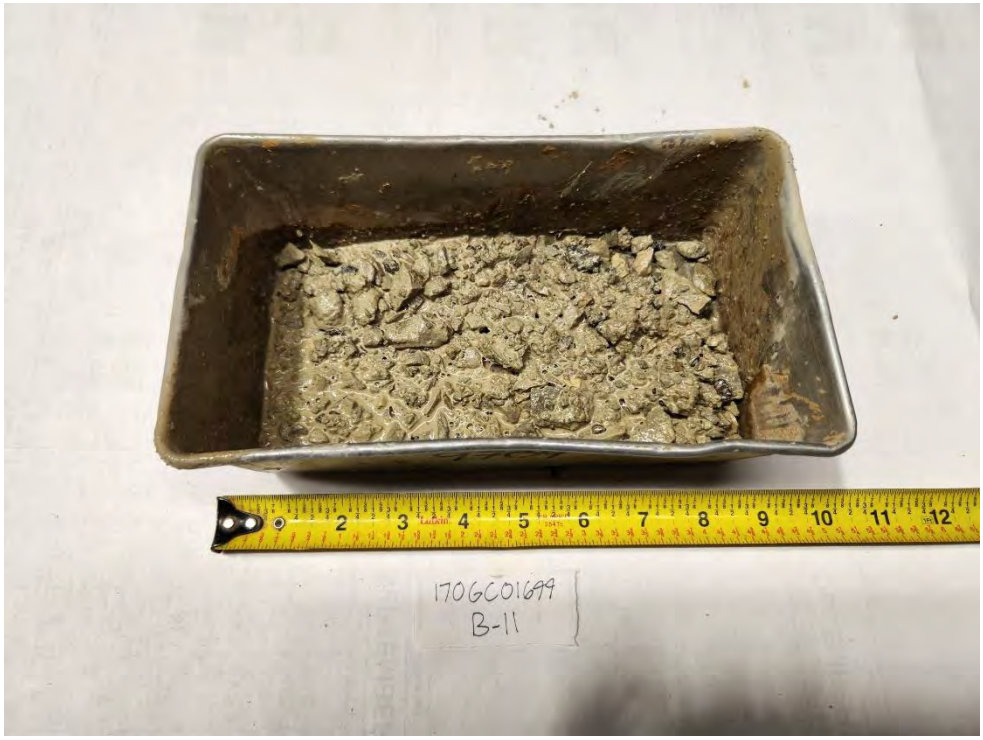


Figure B-11.4
Recovered Aggregate Base

Pavement Core Photo Report

BORING NO.: **B-12**

SHEET 1 OF 2

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-12.1
Site View

Figure B-12.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-12.3
Recovered Pavement Core

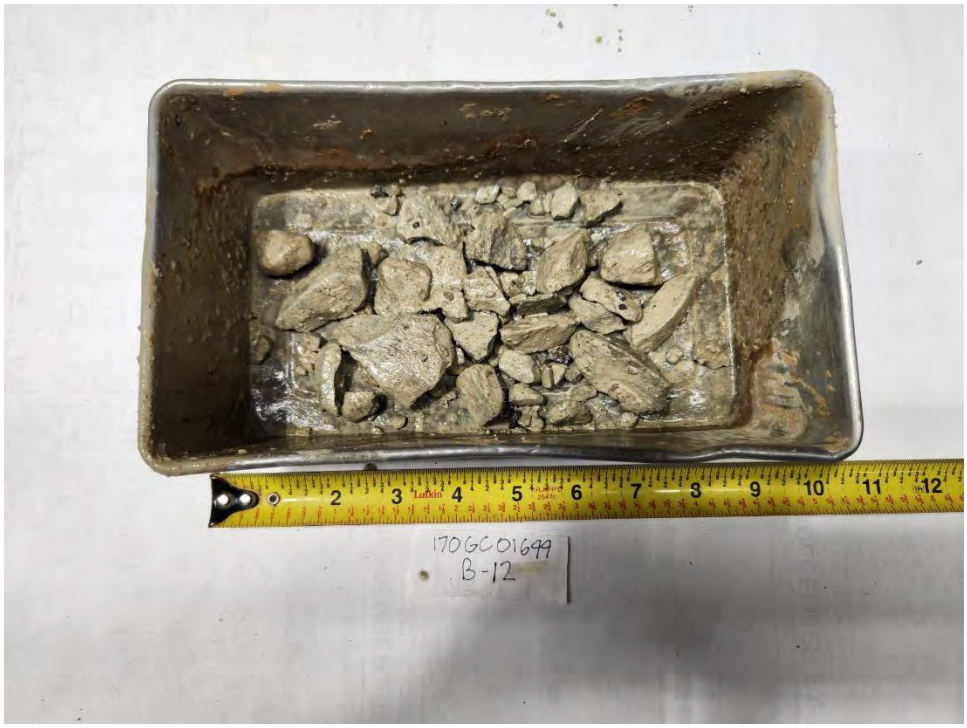


Figure B-12.4
Recovered Aggregate Base

Pavement Core Photo Report

BORING NO.: **B-13**

SHEET 1 OF 2

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-13.1
Site View

Figure B-13.2
Downhole View

Pavement Core Photo Report

CLIENT NAME: KRM Architecture

PROJECT TYPE: Proposed HSE Fall Creek Intermediate School Pavement Improvements, Fishers, IN

PHOTOS

Figure B-13.3
Recovered Pavement Core

Figure B-13.4
Recovered Aggregate Base

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

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SECTION 09 64 67

WOOD GYMNASIUM FLOOR REFINISHING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. RESURFACING OF THE EXISTING WOOD GYMNASIUM FLOOR, INCLUDING SANDING, REFINISHING, AND RESTRIPING.

B. Accessories.

1.02 REFERENCE STANDARDS

A. MFMA – GUIDE SPECIFICATION FOR MAPLE FLOORING SYSTEMS; CURRENT EDITION.

1.03 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

B. Preparation instructions and recommendations.

C. Storage and handline requirements and recommendations.

D. Installation methods.

E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors.

F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square, representing actual product, color, and pattern.

G. Maintenance Literature: Upon completion of floor installation, send to owner, attendants or individuals in charge and responsible for the upkeep of the building a CARE CARD. This card spells out care and maintenance instructions including temperature and humidity ranges for areas where flooring is installed.

1.04 PROJECT CONDITIONS

A. Resurfacing of existing floor system shall not commence until all masonry, finish and/or wet trades, such as, concrete, painting, etc., plastering/dry walling, tile and overhead mechanical trades are complete. The building must be enclosed and weather tight.

B. Permanent heat, light and ventilation shall be installed and operating before, during and after the resurfacing is complete; MFMA recommends a temperature range of 55 degrees to 75 degrees and a relative humidity range compatible with expected environmental conditions when the facility is occupied. (Maintaining a maximum 15 percent seasonal difference between high and low humidity levels). Expected minimum/maximum indoor relative humidity will depend upon building design, geographic location, HVAC systems and operating schedules.

C. Secure gymnasium area after floor is finished to allow proper curing time. If Contractor or Owner requires use of gym after proper curing time, he shall protect the floor by covering with non-marring Kraft paper or red rosin paper with taped joints until acceptance by owner of complete gymnasium floor.

PART 2 - PRODUCTS

2.01 MANUFACTURES

A. ACCEPTABLE MANUFACTURER: BONA US, 24 INVERNESS PLACE E. SUITE 100; ENGLEWOOD, CO 80112; TEL: 800-872-5515; Frank.Coppolino@bona.com; https://www.bona.com.

2.02 MATERIALS

A. STAIN: Bona; DriFast Stain.
   1. Multiple stain colors required, as indicated on Drawings.

B. SEALER: Bona; Sport Seal 350.

C. GAMELINES: Bona; SuperSport Paint
   1. Multiple colors required, as indicated on Drawings.

2. Custom match colors may be required.
3. FINISH: Bona; Sport Poly 350.

D. ACCESSORIES
1. Ventilating Base: Molded rubber, 4” high with a 4” toe, pre-molded outside corners; black color.
2. Edge Strip: Angle; mill finish aluminum.
3. Transition Strip: Same species and finish as flooring; profiles as required and approved by Architect.
4. Game Socket Devices: Cast aluminum type, with anchors; compatible with existing sports equipment.
5. Adhesives: Types recommended by flooring manufacturer.

PART 3 - EXECUTION

3.01 MANUFACTURERS INSTRUCTIONS

A. Comply with the instructions and recommendations of the floor finish system manufacturer.

3.02 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
1. All, if any, repair work on the athletic system shall be completed prior to the start of the sanding process.

3.03 PREPARATION

A. Protect adjacent finish surface to prevent damage during sanding and sport floor system application.

3.04 FINISHING PROCEDURES (NOTE: FOLLOW SELECTED FINISH MANUFACTURERS RECOMMENDATIONS)

A. Machine sand with coarse, medium, and fine grit sandpaper to a smooth, even, and uniform surface.

B. Additional sanding as recommended by finish manufacture to ensure proper adhesion of the finish.

C. Remove sanding dust from entire surface by tack or vacuum between each sanding operation or cut.

D. Inspect entire area of floor insuring surface is acceptable for finishing, clean and completely free from sanding dust.

E. Apply coatings per finish manufacturer’s recommendations. Provide a minimum of two (2) coats of approved sealer and two (2) coats of approved finish.

F. Court markings, game lines, and logos are to be added after the first coat of finish. More than one coat may be needed for uniform coverage.

G. Abrade surface in accordance with manufacturer’s instructions between each coating operation. Vacuum and tack thoroughly after abrading.

3.05 CLEANING

A. Remove excess and waste materials from area of Work.

3.06 PROTECTION

A. After application, protect floor finish from damage during subsequent work.

B. Do not allow foot traffic until floor is sufficiently dried and cured.

END OF SECTION

SECTION 23 37 23
HVAC GRAVITY VENTILATORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Louvered-penthouse ventilators.
   2. Roof hoods.
   3. Goosenecks.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For gravity ventilators.
   1. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
   2. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of louvered-penthouse ventilator indicated, in manufacturer's standard size.

F. Delegated-Design Submittal: For shop-fabricated ventilators indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of shop-fabricated ventilators.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For ventilators, accessories, and components, from manufacturer.

1.5 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
   1. Use types and sizes to suit unit installation conditions.
   2. Use hex-head screws for exposed fasteners unless otherwise indicated.

E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times

the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Factory fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

2.3 LOUVERED-PENTHOUSE VENTILATORS

A. Description: Multitier rectangular louvered penthouse for intake or relief air.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acme Manufacturing Corp.
   2. Carnes.
   3. Greenheck.
   4. Loren Cook Company.
   5. Ruskin.
   6. Twin City.

C. Source Limitations: Obtain louvered-penthouse ventilators from single manufacturer.

D. Construction: All-welded assembly with 4-inch deep louvers, mitered corners, and aluminum sheet roof.

E. Frame and Blade Material and Nominal Thickness: Extruded aluminum, of thickness required to comply with structural performance requirements, but not less than 0.080 inch for frames and 0.080 inch for blades with condensate deflectors.
   1. AMCA Seal: Mark units with the AMCA Certified Ratings Seal.
   2. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.

F. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, of thickness required to comply with structural performance requirements, but not less than 0.052 inch for frames and 0.052 inch for blades with condensate deflectors.
   1. AMCA Seal: Mark units with the AMCA Certified Ratings Seal.
   2. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.

G. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
   1. Overall Height: 16 inches minimum unless otherwise indicated.

H. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

I. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

J. Galvanized-Steel Sheet Finish:
   1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.

2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
    a. Color and Gloss: As indicated by manufacturer's designations.

2.4 ROOF HOODS (gravity ventilator)

A. Description: Hooded rectangular or round penthouse for intake or relief air.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Manufacturing Corp.
2. Carnes.
3. Greenheck.
4. Loren Cook Company.
5. Pennbarry.
6. Twin City.

C. Source Limitations: Obtain hooded ventilators from single manufacturer.

D. Factory fabricated according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.

E. Materials: Aluminum sheet, minimum 0.063-inch-thick base and 0.050-inch-thick hood; suitably reinforced.

F. Include factory mounted backdraft damper.

G. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Overall Height: 16 inches minimum unless otherwise indicated.

H. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

I. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

J. Galvanized-Steel Sheet Finish:
1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
    a. Color and Gloss: As indicated by manufacturer's designations.

2.5 GOOSENECKS

A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 6-5; with a minimum of 0.052-inch- (1.3-mm-) thick, galvanized-steel sheet.

A. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

B. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

C. Galvanized-Steel Sheet Finish:
1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas, and repair galvanizing according to ASTM A780/A780M. Apply a conversion coating suited to the organic coating to be applied over it.

2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat and an overall minimum dry film thickness of 2 mils (0.05 mm).
    a. Color and Gloss: As indicated by manufacturer's designations.

D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to fit roof opening and ventilator base.
    1. Overall Height: 16 inches minimum unless otherwise indicated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Secure gravity ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible.

C. Install goosenecks on curb base where throat size exceeds 9 by 9 inches.

D. Install gravity ventilators with clearances for service and maintenance.

E. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

F. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.

G. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

H. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

I. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

J. Relief/Intake hoods and ventilators to be a minimum of 24” from roof to air inlet.

END OF SECTION

SECTION 23 09 23
DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Scope:
   1. The Temperature Control Contractor (TCC) shall install, furnish, program, and turn over to client a complete operating DDC system for monitoring and controlling of MEP systems as shown in the Contract Documents.

B. Section Includes:
   1. DDC system for monitoring and controlling of MEP systems.
   2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.

C. Scope not included in 230923:
   1. Electrical Contractor (EC) to provide all wiring to all motor starters, variable frequency drives, and motor control centers.
   2. EC to provide 120 V/60 Hz power to all direct digital controllers (DDC) that require 120 V power.
   3. Sheet Metal Contractor shall install all motorized dampers, duct mounted airflow measuring stations, thermowells (for temperature & pressure sensors), flow meters, control valves, and other accessories that are furnaced by the TCC.
   4. Mechanical Contractor shall install all temperature and pressure sensing wells and control valves furnished by the Temperature Control Contactor.

1.02 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. BACnet Specific Definitions:
   1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
   2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
   3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
   4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
   5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.

D. Binary: Two-state signal where a high signal level represents ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.

E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.

F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

G. COV: Changes of value.

H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.

I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.

J. DOCSIS: Data-Over Cable Service Interface Specifications.

K. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.
L. HLC: Heavy load conditions.
M. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.
N. LAN: Local area network.
O. LNS: LonWorks Network Services.
P. LON Specific Definitions:
    1. FTT-10: Echelon Transmitter-Free Topology Transceiver.
    2. LonMark: Association comprising suppliers and installers of LonTalk products. Association provides guidelines for implementing LonTalk protocol to ensure interoperability through a standard or consistent implementation.
    3. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a "Neuron Chip" for communication. LonTalk is a register trademark of Echelon.
    4. LonWorks: Network technology developed by Echelon.
    5. Node: Device that communicates using CEA-709.1-C protocol and that is connected to a CEA-709.1-C network.
    6. Node Address: The logical address of a node on the network, consisting of a Domain number, Subnet number, and Node number. "Node number" portion of an address is a number assigned to device during installation, is unique within a subnet, and is not a factory-set unique Node ID.
    7. Node ID: A unique 48-bit identifier assigned at factory to each CEA-709.1-C device. Sometimes called a "Neuron ID."
    8. Program ID: An identifier (number) stored in a device (usually EEPROM) that identifies node manufacturer, functionality of device (application and sequence), transceiver used, and intended device usage.
    9. Standard Configuration Property Type (SCPT): Pronounced "skip-it." A standard format type maintained by LonMark International for configuration properties.
    10. Standard Network Variable Type (SNVT): Pronounced "snivet." A standard format type maintained by LonMark used to define data information transmitted and received by individual nodes. "SNVT" is used in two ways. It is an acronym for "Standard Network Variable Type" and is often used to indicate a network variable itself (i.e., it can mean "a network variable of a standard network variable type").
    11. Subnet: Consists of a logical grouping of up to 127 nodes, where logical grouping is defined by node addressing. Each subnet is assigned a number, which is unique within a Domain. See "Node Address."
    12. TP/FT-10: Free Topology Twisted Pair network defined by CEA-709.3 and is most common media type for a CEA-709.1-C control network.
    13. TP/XF-1250: High-speed, 1.25-Mbps, twisted-pair, doubly terminated bus network defined by "LonMark Interoperability Guidelines" typically used only to connect multiple TP/FT-10 networks.
    14. User-Defined Configuration Property Type (UCPT): Pronounced "U-Keep-It." A Configuration Property format type that is defined by device manufacturer.
    15. User-Defined Network Variable Type (UNVT): Network variable format defined by device manufacturer. UNVTs create non-standard communications that other vendors' devices may not correctly interpret and may negatively impact system operation. UNVTs are not allowed.
Q. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
R. Modbus TCP/IP: An open protocol for exchange of process data.

S. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
T. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.
U. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.
V. PDA: Personal digital assistant.
W. Peer to Peer: Networking architecture that treats all network stations as equal partners.
X. RAM: Random access memory.
Y. RF: Radio frequency.
Z. Router: Device connecting two or more networks at network layer.
AA. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
BB. UPS: Uninterruptible power supply.
CC. USB: Universal Serial Bus.
DD. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.
EE. VAV: Variable air volume.
FF. WLED: White light emitting diode.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product include the following:
1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

B. Shop Drawings:
1. Include plans, elevations, sections, and mounting details where applicable.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail means of vibration isolation and show attachments to rotating equipment.
4. Plan Drawings indicating the following:
a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
c. Each desktop operator workstation, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.
d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.

e. Network communication cable and raceway routing.
f. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.

5. Schematic drawings for each controlled HVAC system indicating the following:
   a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
   b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
   c. A graphic showing location of control I/O in proper relationship to HVAC system.
   d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
   e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
   f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
   g. Narrative sequence of operation.
   h. Graphic sequence of operation, showing all inputs and output logical blocks.
6. Control panel drawings indicating the following:
   a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
   b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
   c. Front, rear, and side elevations and nameplate legend.
   d. Unique drawing for each panel.
7. DDC system network riser diagram indicating the following:
   a. Each device connected to network with unique identification for each.
   b. Interconnection of each different network in DDC system.
   c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or fiber-optic cable type. Indicate raceway type and size for each.
   d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.
8. DDC system electrical power riser diagram indicating the following:
   a. Each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
   b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
   c. Each product requiring power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
   d. Power wiring type and size, race type, and size for each.
9. Monitoring and control signal diagrams indicating the following:
   a. Control signal cable and wiring between controllers and I/O.
   b. Point-to-point schematic wiring diagrams for each product.
   c. Control signal tubing to sensors, switches and transmitters.
   d. Process signal tubing to sensors, switches and transmitters.

C. System Description:
1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.

3. System and product operation under each potential failure condition including, but not limited to, the following:
    a. Loss of power.
    b. Loss of network communication signal.
    c. Loss of controller signals to inputs and outpoints.
    d. Operator workstation failure.
    e. Gateway failure.
    f. Network failure
    g. Controller failure.
    h. Instrument failure.
    i. Control damper and valve actuator failure.
4. Complete bibliography of documentation and media to be delivered to Owner.
5. Description of testing plans and procedures.
6. Description of Owner training.

D. Samples:
1. For each exposed product, installed in finished space for approval of selection of aesthetic characteristics.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings, reflected ceiling plan(s), and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Qualification Data:
1. Systems Provider Qualification Data:
    a. Resume of project manager assigned to Project.
    b. Resumes of application engineering staff assigned to Project.
    c. Resumes of installation and programming technicians assigned to Project.
    d. Resumes of service technicians assigned to Project.
    e. Brief description of past project including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function.
    f. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
    g. Names of staff assigned to past project that will also be assigned to execute work of this Project.
    h. Owner contact information for past project including name, phone number, and e-mail address.
    i. Contractor contact information for past project including name, phone number, and e-mail address.
    j. Architect and Engineer contact information for past project including name, phone number, and e-mail address.
2. Manufacturer's qualification data.
3. Testing agency's qualifications data.

C. Welding certificates.

D. Product Certificates:
1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

E. Product Test Reports: For each product that requires testing to be performed by manufacturer.

F. Preconstruction Test Reports: For each separate test performed.

G. Source quality-control reports.

H. Field quality-control reports.

I. Sample Warranty: For manufacturer's warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
c. As-built versions of submittal Product Data.
d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
g. Engineering, installation, and maintenance manuals that explain how to:
    1) Design and install new points, panels, and other hardware.
    2) Perform preventive maintenance and calibration.
    3) Debug hardware problems.
    4) Repair or replace hardware.
h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
j. List of recommended spare parts with part numbers and suppliers.
k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
m. Licenses, guarantees, and warranty documents.
n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
o. Owner training materials.

1.06 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:
1. Nationally recognized manufacturer of DDC systems and products.
2. DDC systems with similar requirements to those indicated for a continuous period of 5 years within time of bid.
3. DDC systems and products that have been successfully tested and in use on at least 3 past projects.
4. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
5. Having full-time in-house employees for the following:
    a. Product research and development.
    b. Product and application engineering.
    c. Product manufacturing, testing and quality control.
    d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
    e. Owner operator training.
6. TCC to provide Niagara Framework (Tridium) automation system.
7. Acceptable Control Supplier:
    a. Alerton – Installed by Open Control Systems.
    b. Johnson Controls – Installed by JCI.
    c. Honeywell – Installed by Performance Services.
    d. Siemens – Installed by local Branch.

8. Acceptable Control Installation and Service Contractor:
    a. Open Control System.
    b. Performance Services.
    c. Johnson Controls.
    d. Grantham.
    e. Siemens.

B. DDC System Provider Qualifications:
    1. Authorized representative of, and trained by, DDC system manufacturer.
    2. In-place facility located within 150 miles of Project and be capable of to respond on-site within 4 hours of notice.
    3. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
    4. Service and maintenance staff assigned to support Project during warranty period.
    5. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.
    6. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

C. Testing Agency Qualifications: Member company of NETA or an NRTL.
    1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

D. Welding Qualifications: Qualify procedures and personnel according to the following:
    1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
    2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
    3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
    4. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.07 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period at no cost to client.
    1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
    2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.
        a. Install updates only after receiving Owner's written authorization.
    3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.
    4. Warranty Period: 3 years from date of Substantial Completion. Warranty shall cover labor, material, replacement, and repairs for work performed during warranty period.

PART 2 PRODUCTS

2.01 DDC SYSTEM DESCRIPTION

A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.
    1. DDC system shall consist of a high-speed, peer-to-peer network of distributed DDC controllers, other network devices, operator interfaces, and software.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated.
    1. System Performance Objectives:
        a. DDC system shall manage HVAC systems.

b. DDC system control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.
c. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
d. DDC system shall operate while unattended by an operator and through operator interaction.
e. DDC system shall record & store trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.

B. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. DDC System Data Storage:
1. Include server(s) with disk drive data storage to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
2. When logged onto a server, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.
3. Server(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.
4. Server(s) shall use IT industry-standard database platforms such as Microsoft SQL Server and Microsoft Data Engine (MSDE).

D. Future Expandability:
1. DDC system size shall be expandable to an ultimate capacity of at least 125% times total I/O points indicated.
2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.
3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.

E. Environmental Conditions for Controllers, Gateways, and Routers:
1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.
a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.
2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
a. Outdoors, Protected: Type 4.
b. Outdoors, Unprotected: Type 4.
c. Indoors, Heated with Filtered Ventilation: Type 2.
d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
e. Indoors, Heated and Air Conditioned: Type 2.
f. Mechanical Equipment Rooms:
1) Chiller and Boiler Rooms: Type 4.
2) Air-Moving Equipment Rooms: Type 4.
g. Localized Areas Exposed to Washdown: Type 4.

h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 3.
i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.
j. Hazardous Locations: Explosion-proof rating for condition.

F. Environmental Conditions for Instruments and Actuators:
1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and ventilated as required by instrument and application.
2. Instruments, actuators and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments and actuators not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
a. Outdoors, Protected: Type 4.
b. Outdoors, Unprotected: Type 4.
c. Indoors, Heated with Filtered Ventilation: Type 2.
d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
e. Indoors, Heated and Air Conditioned: Type 2.
f. Mechanical Equipment Rooms:
1) Chiller and Boiler Rooms: Type 4.
2) Air-Moving Equipment Rooms: Type 4.
g. Localized Areas Exposed to Washdown: Type 4.
h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 3.
i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.
j. Hazardous Locations: Explosion-proof rating for condition.

G. Electric Power Quality:
1. Power-Line Surges:
a. Protect DDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41.
b. Do not use fuses for surge protection.
c. Test protection in the normal mode and in the common mode, using the following two waveforms:
1) 10-by-1000-mic.sec. waveform with a peak voltage of 1500 V and a peak current of 60 A.
2) 8-by-20-mic.sec. waveform with a peak voltage of 1000 V and a peak current of 500 A.
2. Power Conditioning:
a. Protect DDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:
1) At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
2) During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
3) Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.
4) Total harmonic distortion shall not exceed 3-1/2 percent at full load.

3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

H. Backup Power Source:
   1. HVAC systems and equipment served by a backup power source shall have associated DDC system products that control such systems and equipment also served from a backup power source.

I. UPS:
   1. DDC system products powered by UPS units shall include the following:
      a. Desktop operator workstations.
      b. Printers.
      c. Servers.
      d. Gateways.
      e. DDC controllers.
   2. DDC system instruments and actuators powered by UPS units shall be defined in the documents.

J. Continuity of Operation after Electric Power Interruption:
   1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.03 SYSTEM ARCHITECTURE

A. System architecture shall consist of no more than 3 levels of LANs.
   1. Level one LAN shall connect network controllers and operator workstations.
   2. Level two LAN shall connect programmable application controllers to other programmable application controllers, and to network controllers.
   3. Level three LAN shall connect application-specific controllers to programmable application controllers and network controllers.
   4. Level three LAN shall connect application-specific controllers to application-specific controllers.

B. DDC system shall consist of dedicated and/or separated LANs that are not shared with other building systems and tenant data and communication networks.

C. System architecture shall be modular and have inherent ability to expand to not less than 3 times system size indicated with no impact to performance indicated.

D. System architecture shall perform modifications without having to remove and replace existing network equipment.

E. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.

F. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.

G. Special Network Architecture Requirements:
   1. Air-Handling Systems: For control applications of an air-handling system that consists of air-handling unit(s) and VAV terminal units, include a dedicated LAN of application-specific controllers serving VAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s). Basically, create a DDC system LAN that aligns with air-handling system being controlled.

2.04 DDC SYSTEM OPERATOR INTERFACES

A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:
   1. Desktop and portable operator workstation with hardwired connection through LAN port.
   2. Portable operator terminal with hardwired connection through LAN port.
   3. Portable operator workstation with wireless connection through LAN router.
   4. Remote connection using outside of system personal computer or through Web access.

5. Remote connection using portable operator workstation and internet connection.
6. Mobile device.

B. Access to system, regardless of operator means used, shall be transparent to operator.

C. Desktop Workstations:
1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.
3. Able to communicate, with modems, remotely with any device connected to any DDC system LAN.
4. Communication via a modem shall not interfere with LAN activity and LAN activity shall not prevent workstation from handling incoming calls.

D. Critical Alarm Reporting:
1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention.
2. DDC system shall send alarm notification to multiple recipients that are assigned for each alarm.
3. DDC system shall notify recipients by any or all means, including e-mail, text message, and prerecorded phone message to mobile and landline phone numbers.

E. Simultaneous Operator Use: Capable of accommodating up to 10 simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

2.05 NETWORK COMMUNICATION PROTOCOL

A. Network communication protocol(s) used throughout entire DDC system shall be open to public and available to other companies for use in making future modifications to DDC system.

B. ASHRAE 135 Protocol:
1. ASHRAE 135 communication protocol shall be sole and native protocol used throughout entire DDC system.
2. DDC system shall not require use of gateways except to integrate HVAC equipment and other building systems and equipment, not required to use ASHRAE 135 communication protocol.
3. If used, gateways shall connect to DDC system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
4. Operator workstations, controllers and other network devices shall be tested and listed by BACnet Testing Laboratories.

2.06 DESKTOP OPERATOR WORKSTATIONS

A. Performance Requirements:
1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
2. Energy Star compliant.

B. Computer Workstation:
1. Shall include computer, monitor(s), mouse, and keyboard.
a. Computer shall support all building automation operations, email, include all Microsoft Office suit programs, and pdf viewer and edit program.
1) Shall be a minimum i5 processor with 16 GB RAM and 3.6 GHz processor.
2) 64-bit.
3) Capable of expanding ram to 32 GB.
4) 1 TB hard drive.
5) 4 USB ports, no optical drive required.
6) Graphics card suitable for BAS requirements.
7) Sound card.
8) Network card and built in wireless.
9) Windows 10 or newer.

2.07 ASHRAE 135 GATEWAYS

A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, boilers, chillers, and variable-speed drives.

B. Include gateways to connect BACnet to legacy systems, existing non-BACnet devices, and existing non-BACnet DDC-controlled equipment, only when specifically requested and approved by Owner.

C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.

D. Gateway Minimum Requirements:
   1. Read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
   2. Write to all writeable object properties on non-BACnet network from BACnet network and vice versa where applicable.
   3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
   4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Binding-B, and Device Management Communication Control BIBBs according to ASHRAE 135.
   5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
   6. Backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.

2.08 DDC CONTROLLERS

A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.

E. Environment Requirements:
   1. Controller hardware shall be suitable for the anticipated ambient conditions.
   2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.
   3. Controllers located outdoors shall be rated for operation at 40 to 150 deg F.

F. Power and Noise Immunity:
   1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
   2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.

G. DDC Controller Spare Processing Capacity:
   1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:
      a. Network Controllers: 50 percent.
      b. Programmable Application Controllers: Not less than 60 percent.
      c. Application-Specific Controllers: Not less than 70 percent.
   2. Memory shall support DDC controller's operating system and database and shall include the following:
      a. Monitoring and control.
      b. Energy management, operation and optimization applications.
      c. Alarm management.
      d. Historical trend data of all connected I/O points.

e. Maintenance applications.
f. Operator interfaces.
g. Monitoring of manual overrides.

H. Maintenance and Support: Include the following features to facilitate maintenance and support:
1. Mount microprocessor components on circuit cards for ease of removal and replacement.
2. Means to quickly and easily disconnect controller from network.
3. Means to quickly and easily access connect to field test equipment.
4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.

I. Input and Output Point Interface:
1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers.
2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.
3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.
4. AIs:
a. AIs shall include monitoring of low-voltage (zero- to 10-V dc), current (4 to 20 mA) and resistance signals from thermistor and RTD sensors.
b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
c. Controller AIs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.
d. Signal conditioning including transient rejection shall be provided for each AI.
e. Capable of being individually calibrated for zero and span.
f. Incorporate common-mode noise rejection of at least 50 dB from zero to 100 Hz for differential inputs, and normal-mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10000 ohms.
5. AOs:
a. Controller AOs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.
b. Output signals shall have a range of 4 to 20 mA dc or zero- to 10-V dc as required to include proper control of output device.
c. Capable of being individually calibrated for zero and span.
d. AOs shall not exhibit a drift of greater than 0.4 percent of range per year.
6. BIs:
a. Controller BIs shall accept contact closures and shall ignore transients of less than 5-ms duration.
b. Isolation and protection against an applied steady-state voltage of up to 180-V ac peak.
c. BIs shall include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
d. BIs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
e. Pulse accumulation input points shall comply with all requirements of BIs and accept up to 10 pulses per second for pulse accumulation. Buffer shall be provided to totalize pulses. Pulse accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero on operator's command.
7. BOs:
a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.
1) Relay contact closures shall have a minimum duration of 0.1 second. Relays shall include at least 180 V of isolation. Electromagnetic interference suppression

shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be 1 A at 24-V ac.

2) Triac outputs shall include at least 180 V of isolation. Minimum contact rating shall be 1 A at 24-V ac.

b. BOs shall include for two-state operation or a pulsed low-voltage signal for pulse-width modulation control.

c. BOs shall be selectable for either normally open or normally closed operation.

d. Include tristate outputs (two coordinated BOs) for control of three-point floating-type electronic actuators without feedback.

e. Limit use of three-point floating devices to VAV terminal unit control applications, and other applications indicated on Drawings, Control algorithms shall operate actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.09 NETWORK CONTROLLERS

A. General Network Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers that perform scheduling shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.

B. Communication:

1. Network controllers shall communicate with other devices on DDC system network.
2. Network controller also shall perform routing if connected to a network of programmable application and application-specific controllers.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.
2. Local Keypad and Display:
   a. Equip controller with local keypad and digital display for interrogating and editing data.
   b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.10 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Controller shall have enough memory to support its operating system, database, and programming requirements.
3. Data shall be shared between networked controllers and other network devices.
4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.

5. Controllers that perform scheduling shall have a real-time clock.
6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
7. Controllers shall be fully programmable.

B. Communication:
1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:
1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.
2. Local Keypad and Display:
a. Equip controller with local keypad and digital display for interrogating and editing data.
b. Use of keypad and display shall require security password.

D. Serviceability:
1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.11 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.
1. Capable of standalone operation and shall continue to include control functions without being connected to network.
2. Data shall be shared between networked controllers and other network devices.

B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation. Connection shall extend to port on space temperature sensor that is connected to controller.

D. Serviceability:
1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

2.12 CONTROLLER SOFTWARE

A. General Controller Software Requirements:
1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
2. I/O points shall be identified by a character point name. Same names shall be used at operator workstations.
3. Control functions shall be executed within controllers using DDC algorithms.
4. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.

B. Security:
1. Operator access shall be secured using individual security passwords and user names.
2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.

3. Operator log-on and log-off attempts shall be recorded.
4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.

C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:
1. Weekly Schedule:
a. Include separate schedules for each day of week.
b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
c. Each schedule may consist of up to 10 events.
d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.
2. Exception Schedules:
a. Include ability for operator to designate any day of the year as an exception schedule.
b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.
3. Holiday Schedules:
a. Include capability for operator to define up to 99 special or holiday schedules.
b. Schedules may be placed on scheduling calendar and will be repeated each year.
c. Operator shall be able to define length of each holiday period.

D. System Coordination:
1. Include standard application for proper coordination of equipment.
2. Application shall include operator with a method of grouping together equipment based on function and location.
3. Group may then be used for scheduling and other applications.

E. Binary Alarms:
1. Each binary point shall be set to alarm based on operator-specified state.
2. Include capability to automatically and manually disable alarming.

F. Analog Alarms:
1. Each analog object shall have both high and low alarm limits.
2. Alarming shall be able to be automatically and manually disabled.

G. Alarm Reporting:
1. Operator shall be able to determine action to be taken in event of an alarm.
2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.

H. Remote Communication:
1. System shall have ability to dial out in the event of an alarm.

I. Control Loops:
1. Support any of the following control loops, as applicable to control required:
a. Two-position (on/off, open/close, slow/fast) control.
b. Proportional control.
c. Proportional plus integral (PI) control.
d. Proportional plus integral plus derivative (PID) control.
1) Include PID algorithms with direct or reverse action and anti-windup.
2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.
3) Controlled variable, set point, and PID gains shall be operator-selectable.
e. Adaptive (automatic tuning).

J. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator-selectable.

K. Anti-Short Cycling:
   1. BO points shall be protected from short cycling.
   2. Feature shall allow minimum on-time and off-time to be selected.

L. On and Off Control with Differential:
   1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
   2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.

M. Run-Time Totalization:
   1. Include software to totalize run-times for all BI and BO points.
   2. A high run-time alarm shall be assigned, if required, by operator.

2.13 ENCLOSURES

A. General Enclosure Requirements:
   1. House each controller and associated control accessories in a enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
   2. Do not house more than one controller in a single enclosure.
   3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
   4. Equip doors of enclosures housing controllers and components with analog or digital displays with windows to allow visual observation of displays without opening enclosure door.
   5. Individual wall-mounted single-door enclosures shall not exceed 36 inches wide and 48 inches high.
   6. Individual wall-mounted double-door enclosures shall not exceed 60 inches wide and 36 inches high.
   7. Include wall-mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as indicated.
   8. Supply each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature located in a pocket on inside of door.

B. Internal Arrangement:
   1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.
   2. Arrange layout to group similar products together.
   3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
   4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
   5. Terminate field cable and wire using heavy-duty terminal blocks.
   6. Include spare terminals, equal to not less than 25 percent of used terminals.
   7. Include spade lugs for stranded cable and wire.
   8. Install a maximum of two wires on each side of a terminal.
   9. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
   10. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.
   11. Mount products within enclosure on removable internal panel(s).
   12. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch-high lettering.
   13. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.
   14. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.

15. Size enclosure internal panel to include at least 25 percent spare area on face of panel.

C. Environmental Requirements:
   1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
   2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
   3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
   4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.

D. Wall-Mounted, NEMA 250, Type 1:
   1. Enclosure shall be NRTL listed according to UL 50 or UL 50E.
   2. Construct enclosure of steel.
   3. Finish enclosure inside and out with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
      a. Exterior color shall be NSF/ANSI 61 gray or manufacturer's standard.
      b. Interior color shall be NSF/ANSI 61 gray or manufacturer's standard.
   4. Hinged door full size of front face of enclosure and supported using:
      a. Enclosures sizes less than 36 in. tall: Multiple butt hinges.
      b. Enclosures sizes 36 in. tall and larger: Continuous piano hinges.
   5. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
   6. Internal panel mounting hardware, grounding hardware and sealing washers.
   7. Grounding stud on enclosure body.
   8. Thermoplastic pocket on inside of door for record Drawings and Product Data.

E. Wall Mounted NEMA 250, Types 4 and 12:
   1. Enclosure shall be NRTL listed according to UL 508A.
   2. Seam and joints are continuously welded and ground smooth.
   3. Where recessed enclosures are indicated, include enclosures with face flange for flush mounting.
   4. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
   5. Single-door enclosure sizes up to 60 inches tall by 36 inches wide.
   6. Double-door enclosure sizes up to 36 inches tall by 60 inches wide.
   7. Construct enclosure of steel.
   8. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
      a. Exterior color shall be NSF/ANSI 61 gray or manufacturer's standard.
      b. Interior color shall be NSF/ANSI 61 gray or manufacturer's standard.
   9. Corner-formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.
      a. Sizes through 24 Inches Tall: Two hinges.
      b. Sizes between 24 Inches through 48 Inches Tall: Three hinges.
      c. Sizes Larger 48 Inches Tall: Four hinges.
   10. Double-door enclosures with overlapping door design to include unobstructed full-width access.
      a. Single-door enclosures 48 inches and taller, and all double-door enclosures, with three-point (top, middle and bottom) latch system.
   11. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
   12. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.

13. Grounding stud on enclosure body.
14. Thermoplastic pocket on inside of door for record Drawings and Product Data.

F. Accessories:
1. Electric Heater:
a. Aluminum housing with brushed finish.
b. Thermostatic control with adjustable set point from zero to 100 deg F.
c. Capacity: 100, 200, 400, and 800 W as required by application.
d. Fan draws cool air from bottom of enclosure and passes air across thermostat and heating elements before being released into enclosure cavity. Heated air is discharged through the top of heater.
2. Ventilation Fans, Filtered Intake and Exhaust Grilles:
a. Number and size of fans, filters and grilles as required by application.
b. Compact cooling fans engineered for 50,000 hours of continuous operation without lubrication or service.
c. Fans capable of being installed on any surface and in any position within enclosure for spot cooling or air circulation.
d. Thermostatic control with adjustable set point from 32 to 140 deg F.
e. Airflow Capacity at Zero Pressure:
1) 4-Inch Fan: 100 cfm.
2) 6-Inch Fan: 240 cfm.
3) 10-Inch Fan: 560 cfm.
f. Maximum operating temperature of 158 deg F.
g. 4-inch fan thermally protected and provided with permanently lubricated ball-bearings.
h. 6- and 10-inch fans with ball-bearing construction and split capacitor motors thermally protected to avoid premature failure.
i. Dynamically balanced impellers molded from polycarbonate material.
j. Fan furnished with power cord and polarized plug for power connection.
k. Fan brackets, finger guards and mounting hardware provided with fans to complete installation.
l. Removable Intake and Exhaust Grilles: Stainless steel of size to match fan size and suitable for NEMA 250, Types 1 and 12 enclosures.
m. Filters for NEMA 250, Type 1 Enclosures: Washable aluminum, of a size to match intake grille.
n. Filters for NEMA 250, Type 12 Enclosures: Disposable, of a size to match intake grille.
3. Bar handle with keyed cylinder lock set.

2.14 RELAYS

A. General-Purpose Relays:
1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Relays shall have LED indication and a manual reset and push-to-test button.
7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

B. Multifunction Time-Delay Relays:
1. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.

2. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
3. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a dust-tight cover.
6. Include knob and dial scale for setting delay time.
7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

C. Latching Relays:
1. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either DPDT or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with a multibladed plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Equip relays with coil transient suppression to limit transients to non-damaging levels.
7. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
8. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

D. Current Sensing Relay:
1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current is adjustable from 50 to 95 percent of pickup current.
6. Include a current transformer, if required for application.
7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

E. Combination On-Off Status Sensor and On-Off Relay:
1. Description:
   a. On-off control and status indication in a single device.
   b. LED status indication of activated relay and current trigger.
   c. Closed-Open-Auto override switch located on the load side of the relay.
2. Performance:
   a. Ambient Temperature: Minus 30 to 140 deg F.
   b. Voltage Rating: Single-phase loads rated for 300-V ac. Three-phase loads rated for 600-V ac.
3. Status Indication:
   a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
   b. Current Sensor Range: As required by application.
   c. Current Set Point: Fixed or adjustable as required by application.
   d. Current Sensor Output:
      1) Solid-state, single-pole double-throw contact rated for 30-V ac and dc and for 0.4 A.
      2) Solid-state, single-pole double-throw contact rated for 120-V ac and 1.0 A.
      3) Analog, zero- to 5- or 10-V dc.
      4) Analog, 4 to 20 mA, loop powered.
4. Relay: Single-pole double-throw, continuous-duty coil; rated for 10-million mechanical cycles.

5. Enclosure: NEMA 250, Type 1 enclosure.

2.15 ELECTRICAL POWER DEVICES

A. Transformers:
   1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
   2. Transformer shall be at least 100 VA.
   3. Transformer shall have both primary and secondary fuses.

B. DC Power Supply:
   1. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
   2. Enclose circuitry in a housing.
   3. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
   4. Performance:
      a. Output voltage nominally 25-V dc within 5 percent.
      b. Output current up to 100 mA.
      c. Input voltage nominally 120-V ac, 60 Hz.
      d. Load regulation within 0.5 percent from zero- to 100-mA load.
      e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
      f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

2.16 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS

A. 250 through 1000 VA:
   1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
   2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
      a. Larger-capacity units shall be provided for systems with larger connected loads.
      b. UPS shall provide 5 minutes of battery power.
   3. Performance:
      a. Input Voltage: Single phase, 120- or 230-V ac, compatible with field power source.
      b. Load Power Factor Range (Crest Factor): 0.65 to 1.0.
      c. Output Voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
      d. On Battery Output Voltage: Sine wave.
      e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
      f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cutoff.
      g. Transfer Time: 6 ms.
      h. Surge Voltage Withstand Capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.
   4. UPS shall be automatic during fault or overload conditions.
   5. Unit with integral line-interactive, power condition topology to eliminate all power contaminants.
   6. Include front panel with power switch and visual indication of power, battery, fault and temperature.
   7. Unit shall include an audible alarm of faults and front panel silence feature.
   8. Unit with four NEMA WD 1, NEMA WD 6 Configuration 5-15R receptacles.
   9. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure) and connect the points to the DDC system.
   10. Batteries shall be sealed lead-acid type and be maintenance free. Battery replacement shall be front accessible by user without dropping load.
   11. Include tower models installed in ventilated cabinets to the particular installation location.

B. 1000 through 3000 VA:

1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
    a. Larger-capacity units, or multiple units, shall be provided for systems with larger connected loads.
    b. UPS shall provide 5 minutes of battery power.
3. Performance:
    a. Input Voltage: Single phase, 120-V ac, plus 20 to minus 30 percent.
    b. Power Factor: Minimum 0.97 at full load.
    c. Output Voltage: Single phase, 120-V ac, within 3 percent, steady state with rated output current of 10.0 A, 30.0-A peak.
    d. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
    e. Recharge time shall be a maximum of eight hours to 90 percent capacity.
4. UPS bypass shall be automatic during fault or overload conditions.
5. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure) and connect the points to the DDC system.
6. Batteries shall be sealed lead-acid type and be maintenance free.
7. Include tower models installed in ventilated cabinets or rack models installed on matching racks, as applicable to the particular installation location and space availability/configuration.

2.17 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.
    1. Wire size shall be at least No. 14 AWG or sized per length of run.
    2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5-inch lay.
    3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
    4. Conductor colors shall be black (hot), white (neutral), and green (ground).
    5. Furnish wire on spools.
B. Single Twisted Shielded Instrumentation Cable above 24 V:
    1. Wire size shall be a minimum No. 18 AWG or sized per length of run.
    2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch lay.
    3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
    4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
    5. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
    6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
    7. Furnish wire on spools.
C. Single Twisted Shielded Instrumentation Cable 24 V and Less:
    1. Wire size shall be a minimum No. 18 AWG or sized per length of run.
    2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch lay.
    3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
    4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
    5. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable.
    6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
    7. Furnish wire on spools.
D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.

1. Cable shall be plenum rated.
2. Cable shall comply with NFPA 70.
3. Cable shall have a unique color that is different from other cables used on Project.
4. Copper Cable for Ethernet Network:
    a. 100BASE-TX, 1000BASE-T, or 1000BASE-TX.
    b. TIA/EIA 586, Category 6.
    c. Minimum No. 22 AWG solid or sized per length of run.
    d. Shielded Twisted Pair (STP).
    e. Thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, Class CMP as plenum rated.

2.18 RACEWAYS FOR CONTROL WIRING, CABLING, AND TUBING

A. Metal Conduits, Tubing, and Fittings:
1. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. EMT: Comply with NEMA ANSI C80.3 and UL 797.
3. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.19 CONTROL POWER WIRING AND RACEWAYS

A. Installation minimum requirements:
1. Mechanical spaces, services spaces, and areas without ceiling: All wiring including cables in EMT.
2. Space sensors and alarms: All wiring cables in EMT within wall construction.
3. Ducted ceiling return: Approved non-plenum cable.
4. Non-ducted return ceiling plenum: Approved plenum rated cable.
5. Non-accessible ceilings: EMT or code compliant equal solid conduit.
6. Inside air handling units: All wiring including cables in EMT or code compliant solid conduit.
7. Note the use of cable is limited to low voltage service with less than 24 volt only.
8. Do not lay cables on ceiling grids.
9. Conduit junctions and terminations shall utilize compression fittings.

B. All control wiring that is stated to be routed in EMT shall be separate from any power wiring.

2.20 FIELD EQUIPMENT

A. Space Sensors:
1. See space sensor schedule on drawings.
2. Set-point adjustment to be a maximum plus and minus 5 degrees from the null setpoint programmed through the DDC system.
3. Space sensors may be (RTD) 1,000 Ohm platinum with an accuracy of ±0.5 deg F or 10,000 OHM thermistor with accuracy of ±0.5 deg. F for all spaces.
4. Space sensor shall be manufacture's standard color.
5. Provide insulating bases for all sensors located on exterior walls and on exterior column wraps. Foam seal cavity and junction box prior to installing insulating base.
6. Space sensors with occupant set-point adjustment shall be adjustable from the operator's workstation as to the deadband of adjustability allowed to the occupants.

B. Temperature Sensors:
1. Duct sensors for critical spaces shall utilize averaging elements, 1000 OHM platinum Resistance Temperature Detectors (RTD) having an accuracy of ±0.5 deg F.
2. Duct sensors for non-critical spaces may utilize 10,000 OHM or 20,000 OHM thermistor having an accuracy of ±1.0 deg F. 1000 OHM RTDs are also acceptable for non-critical applications.
3. Immersion sensors to be furnished with companion wells separable stainless steel. Well pressure rating shall be consistent with and extend the system pressure it will be immersed in. Wells shall withstand pipe design flow velocities.

C. Low limit thermostats:

1. Low limit safety thermostats shall be manually reset, line voltage with maximum 23'-0" flexible sensing elements responsible to lowest temperature along entire length. Furnish minimum two (2) wired in series on the discharge side of the first hydronic coils (i.e., a 4-section coil requires eight low limit thermostats wired in series). Contractor to note that the operating head of such instruments shall be shielded from conditions whereby it could be activated by low temperature.
2. All flexible averaging sensors shall be attached by wire ties to a suspended wire or insulated cable to prevent sensor contact with metal or other unit components.
3. Install flexible sensors across all coils at a maximum of 6” from the bottom of the bottom coil and a minimum of 7” diameter to turn the sensor. Install the detector with a maximum free distance of 12” between each pass.
4. Staggered coils (if applicable) shall utilize multiple sensors. Each sensor shall cover one section of the staggered coil. Sensing elements shall be a minimum of 17’ long.
5. All flexible sensors shall be protected at point of penetration of unit via a section of poly tubing to prevent contact of the sensor and the unit.
6. Mount detector within 6” of the face of the coil unless noted otherwise. For staggered coil banks, this requirement applies for each half of the bank
7. TCC to note that when any low limit controls are above an elevation 7'-0" above floor level or otherwise inaccessible, they shall employ automatic reset and shall be wired to an auxiliary control panel of a 5'-0" elevation. The control panel with piano hinged door shall utilize a latching reset relay for each individual low limit control which ensures that the fan is de-energized even as the low limit resets automatically. The panel face shall utilize a red alarm pilot light that remains lit until the 10 second time delay reset relay momentary contact switch is activated. An LED inside the panel shall indicate which of low limits has signaled the alarm.

D. Electronic Actuators:
1. Manufactured, brand labeled or distributed by Belimo or Johnson Controls, Inc. or Siemens.
2. Size for torque required for damper seal at load conditions.
3. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
4. Mounting: Actuators shall be direct shaft mount type. Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
5. Overload protected electronically throughout rotation.
6. Fail safe operation: Mechanical, spring return mechanism.
7. Power requirements (spring return): 24 VAC.
8. Proportional actuators shall be fully programmable through an EEPROM without the use of actuator mounted switches.
9. Temperature rating: -22 deg. F to +122 deg. F.
10. Housing: Minimum requirement NEMA Type 2/IP54 mounted in any orientation. NEMA 4/4X (IP67) required for outdoor applications.
11. Agency listings: ISO 9001 or UL.
12. The manufacturer shall warrant all components for a period of 5 years from the date of production with the first two years unconditional.
13. All damper actuators used on equipment introducing outdoor air shall be furnished with mechanical spring return mechanism as indicated in “fail safe operation” above.
14. All actuators shall have external adjustable stops to limit the travel in either direction and a gear release to allow manual positioning.
15. Actuators shall be provided with position feedback signal (2-10 VDC or 4-20 mA) where indicated on control drawings. Feedback signal shall be independent of the input signal and shall provide true position indication.

E. Dampers:
1. All automatic dampers furnished by this Contractor for modulating control shall be of the proportioning type with opposed or parallel blades depending on the application or as shown on the drawings. Dampers for two position action shall be of the opposed blade type for all applications except those located immediately at the inlet of fans and as noted

otherwise on the drawings. Dampers for generator radiator fan exhaust shall be opposed blade type.

2. All dampers for outdoor air service and exhaust air service to be equivalent to TAMCO Series 9000 aluminum and have the following features:
   a. Frames shall be 4” deep X 1” and no less than .080” in thickness, mill finish extruded aluminum 6063-T5 with mounting flanges on both sides of the frame. Frame to be assembled using plated steel mounting fasteners.
   b. Entire frame shall be thermally broken by means of two polyurethane resin pockets complete with thermal cuts.
   c. Blades shall be extruded aluminum 6063-T5, mill finish air foil profiles, internally insulated with expanded polyurethane foam and shall be thermally broken.
   d. Blade and frame seals shall be of extruded silicone and shall be secured in an integral slot within the aluminum extrusions. Blade and frame seals are to be mechanically fastened to eliminate shrinkage and movement over the life of the damper. Adhesive or clip on type blade seals shall not be approved. Jamb seals shall be silicone.
   e. Maintenance free bearings are to be composed of an inner bearing fixed to a 7/16” aluminum hexagon blade pivot pin, rotating within a polycarbonate outer bearing inserted into the frame. There shall be no metal-to-metal or metal-to-plastic contact.
   f. Adjustable 7/16” hexagonal drive rod, U-bolt fastener and hexagonal retaining nuts shall be corrosion resistant, zinc plated steel to provide positive connection to blades and linkage.
   g. Linkage hardware shall be installed in the frame side. All linkage crank arm and rod hardware parts shall be constructed of mill finished aluminum, complete with corrosion resistant, zinc plated trunnions and cup point trunnion screws for a slip-proof grip.
   h. Dampers are to be designed for operation in temperatures ranging between -40 deg. F (-40 deg. C) and 212 deg. F (100 deg. C).
   i. Dampers shall be rated Leakage Class 1A at 1 in. w.g. (0.25 kPa) static pressure differential. Standard air leakage data shall be certified under the AMCA Certified Ratings Program.
   j. Dampers shall be made to size required without blanking off free area.
   k. Dampers shall be available as “flanged to duct” mounting type.
   l. Installation of dampers must be in accordance with manufacturer’s installation guidelines provided with each damper shipment.
   m. Intermediate or tubular steel structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width. (See manufacturer’s installation guidelines).
3. Dampers for all other applications to be equal to TAMCO Series 1500 Ultra Low Leakage Air Foil Aluminum and have the following features:
   a. Frames shall be 4” deep X 1” and no less than .080” in thickness, mill finish extruded aluminum 6063-T5 with mounting flanges on both sides of the frame. Frame to be assembled using plated steel mounting fasteners.
   b. Entire frame shall be thermally broken by means of two polyurethane resin pockets complete with thermal cuts.
   c. Blades shall be extruded aluminum 6063-T5, mill finish air foil profiles, internally insulated with expanded polyurethane foam and shall be thermally broken.
   d. Blade and frame seals shall be of extruded silicone and shall be secured in an integral slot within the aluminum extrusions. Blade and frame seals are to be mechanically fastened to eliminate shrinkage and movement over the life of the damper. Adhesive or clip on type blade seals shall not be approved.
   e. Maintenance free bearings are to be composed of an inner bearing fixed to a 7/16” aluminum hexagon blade pivot pin, rotating within a polycarbonate outer bearing inserted into the frame. There shall be no metal-to-metal or metal-to-plastic contact.
   f. Adjustable 7/16” hexagonal drive rod, U-bolt fastener and hexagonal retaining nuts shall be corrosion resistant, zinc plated steel to provide positive connection to blades and linkage.

g. Linkage hardware shall be installed in the frame side. All linkage crank arm and rod hardware parts shall be constructed of mill finished aluminum, complete with corrosion resistant, zinc plated trunnions and cup point trunnion screws for a slip-proof grip.
h. Dampers are to be designed for operation in temperatures ranging between -40 deg. F (-40 deg. C) and 212 deg. F (100 deg. C).
i. Dampers shall be rated Leakage Class 1A at 1 in. w.g. (0.25 kPa) static pressure differential. Standard air leakage data shall be certified under the AMCA Certified Ratings Program.
j. Dampers shall be made to size required without blanking off free area.
k. Dampers shall be available with either opposed blade action or parallel blade action.
l. Dampers shall be available as “flanged to duct” mounting type.
m. Installation of dampers must be in accordance with manufacturer’s installation guidelines provided with each damper shipment.
n. Intermediate or tubular steel structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width. (See manufacturer’s installation guidelines).

4. Automatic dampers (modulating) shall be designed for face velocity that varies from 1,200 fpm to 2,000 fpm in most cases as approved by the design engineer. Dampers to be selected by the supplier with blade shaft lengths that prevent torsion that will create a leakage of more than 2 percent of the rated leakage capacity. Beyond that point, the dampers shall be broken into multiple sections. Field supplied mullions are required on large dampers exceeding 200 square feet.
5. Individual damper section actuators are preferred unless access to actuators is difficult and then jack shafting is acceptable. TCC to note that drive shafts between dampers of different air paths (i.e., outdoor air and return air or return air and exhaust air) is not acceptable. Jack shafting between sections is permitted when such shafting is designed to accommodate and eliminate the effects of torsion.
6. TCC to note that free access to all actuators is the responsibility of the TCC.
7. Each damper shall be equipped with an individual damper operator of the size and style required for the service intended.
8. Actuators to be designed for modulating control with spring return to the fail "safe" position. Actuators to be low voltage with 100% surplus torque (submittals to incorporate calculations to prove 100 percent closure under 4.0" wg status pressure differential for modulating service and 2.0" wg for two position application).
9. Terminal box/AFCV damper actuators to be low voltage, non-spring return and incremental control with 200 percent torque. All control actuators to utilize auto zero program to insure total accuracy of damper actuator. The feature to be activated during periods of low or no occupancy.

F. Insertion Turbine Flow Meters for Closed Loop Condenser Water:
1. Provide dual turbine flow meter complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand insertable up to 400 psi. The flow meter shall have two contra-rotating axial turbines, with electronic impedance-based sensing and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion.
2. The flow meter shall be installed in accordance with the manufacturer’s installation guide including meter orientation and straight pipe recommendations.
3. Wetted metal components shall be nickel-plated brass for applications operating below 250 degrees F, 316L SS construction for DW applications, HTHW applications operating over 250 degrees F, and for any application in non-metallic pipe. The maximum operating temperature shall be 280 degrees F, 300 F peak.
4. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST. The manufacturer’s certificate of calibration shall be provided with each flow meter.

5. Accuracy shall be within ± 0.5% of rate at the calibrated velocity, within ± 1% of rate over a 10:1 turndown (3.0 to 30 ft/s) and within ± 2% of rate over a 50:1 turndown (from 0.4 to 20 ft/s).
6. The flow meter shall include integral analog output(s), 4-20 mA, 0-10V, or 0-5V, and a high resolution frequency output for use with peripheral devices (remote display or BTU Meter). FB-1210 for Bi-directional applications shall include an isolated contact closure output for direction.
7. The flow meter shall be covered by the manufacturer's three-year warranty.
8. Turbine meter shall be ONICON Incorporated Model F-1210 Dual Turbine, or equivalent as approved by the Engineer.

G. Energy BTU Measurement System:
1. The entire energy BTU measurement system shall be built and calibrated by a single manufacturer and shall consist of a flow meter, two temperature sensors, a BTU meter, temperature thermowells, and all required mechanical installation hardware. The BTU meter and associated sensors and flow meter shall be installed in accordance with the manufacturer's installation guide.
2. The BTU meter shall provide the following points both at the integral LCD and as outputs to the building control system: Energy total, Energy rate, flow rate, supply temperature and return temperature. Output signals shall be either serial network (protocol conforming to BACnet® MS/TP, JCI-N2, MODBUS RTU, MODBUS TCP, or Siemens-P1) and/or via individual analog and pulse outputs.
3. Each BTU meter shall be factory programmed and tagged for its specific application, and shall be re-programmable using the front panel keypad (no special interface device or computer required).
4. Temperature sensors shall be loop-powered current based (mA) sensors and shall be bath-calibrated and matched (NIST traceable) for the specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within $\pm$0.15°F (including the error from individual temperature sensors, sensor matching, input offsets, and calculations).
5. A certificate of NIST traceable calibration shall be provided with each system.
6. Flow meter shall be in accordance with paragraph A, B, C, or D, refer to meter schedule for specific flow meter type.
7. All equipment shall be covered by the manufacturer's three-year warranty.
8. Energy BTU measurement system shall be ONICON Incorporated System-10 BTU Meter, or equivalent as approved by the Engineer.

H. Differential Pressure Transmitter:
1. Liquid: Furnish field mounted differential pressure transmitters as indicated on plans for measuring differential pressure and transmitting an isolated 4 to 20 mA DC output linear differential pressure signal.
    a. The unit shall be accurate to ±0.20% of calibrated span. It shall withstand static pressures of 1000 psig with negligible change in output. The flanges shall be made of stainless steel with stainless steel wetted sensing components, wetted parts all stainless steel and a silicone fill fluid. A brass or stainless 3 valve bypass manifold and bracket mounting kit shall be utilized for easier on-site equalization and calibration. Unit shall be protected against radio frequency interference and shall have a water-tight (NEMA Type 4) electrical enclosure with 1/2" NPT conduit connection. An LCD display is not required.
        1) The Type A transmitter shall be a standard process grade loop powered transmitter as manufactured by:
            a) Rosemount Model 3051C.
            b) Foxboro Model IDP10.
            c) Yokogawa Model EJA110A.
2. Air: Furnish field mounted differential pressure transmitters using a 4-20 mA (or 0-10 VDC) output linear with measured differential pressure. Accuracy shall be ±0.8% of calibrated

span. Response time shall be 250 milliseconds. Transmitter shall be in a standard grade transmitter manufactured by Ashcroft or Setra.

I. Airflow Measuring Stations:
   1. All air flow measuring stations to be furnished under this contract as shown on control schematics and as scheduled.
      a. Approved manufacturers are Tek-Air Systems, Air Monitor, Paragon, Ebtron, Farr, and Airflow Wing.
   2. Duct-mounted stations shall be installed by the Sheet Metal Contractor while fan inlet station installation responsibility shall be by this Contractor.
   3. Sizing and physical location of stations shall be the responsibility of this Contractor. TCC to ensure that sufficient distance is available both upstream and downstream such that turbulence is not a factor in the velocity pressure measurement. Sizing shall insure that the minimum velocity across the station affords accuracy of measurement and the design engineer shall be notified within 30 days of contract award if any modifications are required to the field ductwork.
   4. TCC to ensure that a proper access door upstream of the station is provided in the ductwork such that the inlet face of the unit may be cleaned as necessary.
   5. Duct-mounted air flow measuring stations:
      a. Furnish and install air flow measuring stations constructed of 16 gage sheet metal casing and a copper velocity pressure traverse section.
      b. The velocity pressure traverse section shall consist of air straightening tubes, total pressure sensors and static pressure sensors, all interconnected to form a traverse by copper manifolds which shall equalize and integrate each type sensor measurement into one (1) total pressure and one (1) static pressure metering port. There shall be one static pressure sensor for each total pressure sensor.
      c. A minimum of one static and one total pressure sensor shall be used for every 16 square feet in cross section. For larger ducts, a minimum of one static and one total pressure sensor shall be used for every 36" of duct cross sectional area up to a maximum as recommended by ASHRAE guide for traverse measurement.
      d. Identification: Each air flow measuring station shall have a nameplate with the following information:
         1) Unit size.
         2) Unit designation.
         3) Design air quantity.
         4) Direction of air flow.
         5) Design air velocity.
   6. Fan inlet air flow sensing (non-intrusive piezometer type):
      a. Accuracy: Within 2% throughout the velocity range of 600 fpm and over, when installed in accordance with published recommendations
      b. Temperature: 350 deg F continuous operation; 400 deg F intermittent operation
      c. Humidity: 0-100% continuous operation
      d. Corrosion resistance: Good salt air and mild acid resistance, excellent solvent and aromatic hydrocarbon resistance
      e. Material: 6063-T5 anodized aluminum, galvanized mounting brackets

J. Thermal Dispersion Air Flow Measurement:
   1. Air volume measurement system to consist of multiple sensors designed to average velocity using thermal dispersion principles. System to be designed to be totally independent of temperature, density, and humidity. Tek-Air or Ebtron.
   2. The quantity of sensing tubes shall conform to manufacturer’s requirements for spacing based on the specified accuracy and the actual inlet and outlet conditions.
   3. Unit to be accurate to 1.5% between 50 fpm and 6000 fpm. Output to be 4-20 mA.

K. VAV/CAV Terminal Unit Control Components (DDC Control):

Component	Furnished By	Installed By	Wired By
Disconnect Switch	Manufacturer	Manufacturer	Manufacturer
Transformer	TCC	Manufacturer	Manufacturer
Damper Actuator	TCC	Manufacturer	Manufacturer
Flow Controller	TCC	Manufacturer	Manufacturer
Flow Sensing	Manufacturer	Manufacturer	Manufacturer
Misc Accessories	TCC	TCC	TCC

L. Gas Instruments:
   1. Dual Carbon Monoxide (CO) & Nitrogen Dioxide (No2) Sensor and Controller.
      a. Comply with UL 61010-1.
      b. Wall mounted.
      c. 24 VAC power.
      d. BACnet MS/TP protocol.
      e. Programmable fan and alarm relays.
      f. Integrated display with LED indicators for status and adjustable parameters for warning and alarm setpoints.
      g. Audible alarm.
      h. 2 analog outputs.
      i. Field replaceable sensing elements with a 7-year minimum life expectancy on each element.
      j. Standard water/dust tight, corrosion resistant drip proof enclosure.
      k. Carbon Monoxide accuracy to be plus or minus 5% between 0-100 ppm and cover up to 7500 SF.
      l. Nitrogen Dioxide accuracy to be plus or minus 5% between 0-10 ppm and cover up to 7500 SF.
      m. Include standard 7-year warranty on sensor electronics and 2-year warranty on replaceable elements.
      n. Similar or equivalent to Senva TG Series.
   2. Carbon Monoxide (CO) Sensor and Controller.
      a. Comply with UL 61010-1.
      b. Wall mounted.
      c. 24 VAC power.
      d. BACnet MS/TP protocol.
      e. Programmable fan and alarm relays.
      f. Integrated display with LED indicators for status and adjustable parameters for warning and alarm setpoints.
      g. Audible alarm.
      h. 2 analog outputs.
      i. Field replaceable sensing elements with a 7-year minimum life expectancy on each element.
      j. Standard water/dust tight, corrosion resistant drip proof enclosure.
      k. Carbon Monoxide accuracy to be plus or minus 5% between 0-100 ppm and cover up to 7500 SF.
      l. Include standard 7-year warranty on sensor electronics and 2-year warranty on replaceable elements.
      m. Similar or equivalent to Senva TG Series.
      n. Application
         1) Locate in any mechanical room with condensing boilers.

M. Control Valves:
   1. Source Limitations: Obtain valves from single manufacturer.
   2. Selection Criteria:
      a. Control valves shall be suitable for operation at following conditions:
         1) Refer to specification section 232113 – Hydronic Piping for system pressures.
      b. Fail positions unless otherwise indicated:

1) Condenser Water: Open.

c. In water systems, select modulating control valves for a design Cv based on a pressure drop of:
   1) 1 psig for two-position unless otherwise indicated.
   2) 5 psig for two way modulating unless otherwise indicated.
   3) 5 psig for three way modulating unless otherwise indicated.

d. Actuators:
   1) Actuators for Steam Control Valves: Shutoff against 1.5 times design pressure.

2.21 BALL-STYLE CONTROL VALVES

A. Ball Valves with Single Port and Characterized Disk:
   1. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
   2. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
   3. Close-off Pressure: 200 psig.
   4. Process Temperature Range: Zero to 212 deg F.
   5. Body and Tail Piece: Cast bronze ASTM B 61, ASTM B 62, ASTM B 584, or forged brass with nickel plating.
   6. End Connections: Threaded (NPT) ends.
   7. Ball: 300 series stainless steel.
   8. Stem and Stem Extension:
      a. Material to match ball.
      b. Blowout-proof design.
      c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.
   9. Ball Seats: Reinforced PTFE.
   10. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
   11. Flow Characteristic: Equal percentage.

B. Ball Valves with Two Ports and Characterized Disk:
   1. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
   2. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
   3. Close-off Pressure: 200 psig.
   4. Process Temperature Range: Zero to 212 deg F.
   5. Body and Tail Piece: Cast bronze ASTM B 61, ASTM B 62, ASTM B 584, or forged brass with nickel plating.
   6. End Connections: Threaded (NPT) ends.
   7. Ball: 300 series stainless steel.
   8. Stem and Stem Extension:
      a. Material to match ball.
      b. Blowout-proof design.
      c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.
   9. Ball Seats: Reinforced PTFE.
   10. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
   11. Flow Characteristics for A-Port: Equal percentage.
   12. Flow Characteristics for B-Port: Modified for constant common port flow.

2.22 GLOBE-STYLE CONTROL VALVES

A. General Globe-Style Valve Requirements:
   1. Globe-style control valve body dimensions shall comply with ISA 75.08.01.
   2. Construct the valves to be serviceable from the top.

3. For cage guided valves, trim shall be field interchangeable for different valve flow characteristics, such as equal percentage, linear, and quick opening.
4. Reduced trim for one nominal size smaller shall be available for industrial valves NPS 1 and larger.
5. Replaceable seats and plugs.
6. Furnish each control valve with a corrosion-resistant nameplate indicating the following:
    a. Manufacturer's name, model number, and serial number.
    b. Body and trim size.
    c. Arrow indicating direction of flow.

B. Two-Way Globe Valves NPS 2 and Smaller:
1. Globe Style: Single port.
2. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
3. End Connections: Threaded.
4. Bonnet: Screwed.
5. Packing: PTFE V-ring.
6. Plug: Top guided.
7. Plug, Seat, and Stem: stainless steel.
8. Process Temperature Range: 35 to 248 deg F.
9. Ambient Operating Temperature: 35 to 150 deg F.
10. Leakage: FCI 70-2, Class IV.
11. Rangeability: 25 to 1.
12. Equal percentage flow characteristic.

C. Three-Way Globe Valves NPS 2 and Smaller:
1. Globe Style: Mix flow pattern.
2. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
3. End Connections: Threaded.
4. Bonnet: Screwed.
5. Packing: PTFE V-ring.
6. Plug: Top guided.
7. Plug, Seat, and Stem: stainless steel.
8. Process Temperature Range: 35 to 248 deg F.
9. Ambient Operating Temperature: 35 to 150 deg F.
10. Leakage: FCI 70-2, Class IV.
11. Rangeability: 25 to 1.
12. Linear flow characteristic.

D. Two-Way Globe Valves NPS 2-1/2 to NPS 6:
1. Globe Style: Single port.
2. Body: Cast iron complying with ASME B61.1, Class 125.
3. End Connections: Flanged, suitable for mating to ASME B16.5, Class 150 flanges.
4. Bonnet: Bolted.
5. Packing: PTFE cone-ring.
6. Plug: Top or bottom guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Rating: 35 to 281 deg F.
9. Leakage: 0.1 percent of maximum flow.
10. Rangeability: Varies with valve size between 6 and 10 to 1.
11. Modified linear flow characteristic.

2.23 ACCESSORIES

A. Damper Blade Limit Switches:
1. Sense positive open and/or closed position of the damper blades.
2. NEMA 250, Type 13, oil-tight construction.
3. Arrange for the mounting application.
4. Additional waterproof enclosure when required by its environment.
5. Arrange to prevent "over-center" operation.

2.24 IDENTIFICATION

A. Instrument Air Pipe and Tubing:
   1. Engraved tag shall bear the following information:
      a. Service (Example): "Instrument Air."
      b. Pressure Range (Example): 0 to 30 psig.
   2. Letter size shall be a minimum of 0.25 inch high.
   3. Tag shall consist of white lettering on blue background.
   4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded blue with contrasting white center exposed by engraving through outer layer.
   5. Include tag with a brass grommet, chain and S-hook.

B. Control Equipment, Instruments, and Control Devices:
   1. Engraved tag bearing unique identification.
      a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.
   2. Letter size shall be as follows:
      a. Operator Workstations: Minimum of 0.5 inch high.
      b. Printers: Minimum of 0.5 inch high.
      c. DDC Controllers: Minimum of 0.5 inch high.
      d. Gateways: Minimum of 0.5 inch high.
      e. Repeaters: Minimum of 0.5 inch high.
      f. Enclosures: Minimum of 0.5 inch high.
      g. Electrical Power Devices: Minimum of 0.25 inch high.
      h. UPS units: Minimum of 0.5 inch high.
      i. Accessories: Minimum of 0.25 inch high.
      j. Instruments: Minimum of 0.25 inch high.
      k. Control Damper and Valve Actuators: Minimum of 0.25 inch high.
   3. Tag shall consist of white lettering on black background.
   4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer.
   5. Tag shall be fastened with drive pins.
   6. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

C. Valve Tags:
   1. Brass tags and brass chains attached to valve.
   2. Tags shall be at least 1.5 inches diameter.
   3. Include tag with unique valve identification indicating control influence such as flow, level, pressure, or temperature; followed by location of valve, and followed by three-digit sequential number. For example: TV-1.001.
   4. Valves with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

D. Raceway and Boxes:
   1. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.
   3. For raceways housing pneumatic tubing, add a phenolic tag labeled "HVAC Instrument Air Tubing."
   4. For raceways housing air signal tubing, add a phenolic tag labeled "HVAC Air Signal Tubing."

E. Equipment Warning Labels:
   1. Acrylic label with pressure-sensitive adhesive back and peel-off protective jacket.
   2. Lettering size shall be at least 14-point type with white lettering on red background.
   3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
   4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch beyond white border.

2.25 SOURCE QUALITY CONTROL

A. Product(s) and material(s) will be considered defective if they do not pass tests and inspections.
B. Prepare test and inspection reports.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify compatibility with and suitability of substrates.
B. Examine roughing-in for products to verify actual locations of connections before installation.
   1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
   2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.
D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Communication Interface to Equipment with Integral Controls:
   1. DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.
   2. Equipment to Be Connected:
      a. Air-terminal units specified in Section 233600 "Air Terminal Units."
      b. Boilers specified in Section 235216 "Condensing Boilers."
      c. Chillers specified in Section 236416 “Centrifugal Water Chillers.”
      d. Cooling towers specified in Section 236514.14 "Cooling Towers."
      e. Air-handling units specified in Section 237313 "Modular Indoor Central-Station Air-Handling Units."
      f. Ductless Splits in Section 238126 “Split-System Air-Conditioners.”
      g. Refrigerator and Freezer/Coolers – see KEC plans.
      h. Switchboards specified in Section 262300 "Low-Voltage Switchgear."
      i. Motor-control centers specified in Section 262419 "Motor-Control Centers."
      j. Variable-frequency controllers specified in Section 262923 "Variable-Frequency Motor Controllers."
      k. Generator sets specified in Section 263213 "Engine Generators."
      l. UPS specified in Section 263353 "Static Uninterruptible Power Supply."
      m. Refrigerant monitoring.
B. Communication Interface to Other Building Systems:
   1. DDC system shall have a communication interface with systems having a communication interface.
   2. Systems to Be Connected:

      a. Automated water treatment systems specified in Section 232500 "HVAC Water Treatment."

b. Power monitoring specified in Section 260913 "Electrical Power Monitoring and Control."
c. Lighting controls specified in Section 260943.23 "Relay-Based Lighting Controls."
d. Fire-alarm system specified in Section 283111 "Digital, Addressable Fire Alarm System."
e. Access controls specified in Section 281300 "Access Control."

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.
B. Install products level, plumb, parallel, and perpendicular with building construction.
C. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment when subjected to a force.
D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.
E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
F. Firestop penetrations made in fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079200 "Joint Sealants."
H. Welding Requirements:
   1. Restrict welding and burning to supports and bracing.
   2. No equipment shall be cut or welded without approval. Welding or cutting will not be approved if there is risk of damage to adjacent Work.
   3. Welding, where approved, shall be by inert-gas electric arc process and shall be performed by qualified welders according to applicable welding codes.
   4. If requested on-site, show satisfactory evidence of welder certificates indicating ability to perform welding work intended.
I. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.
J. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.
K. Corrosive Environments:
   1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:
      a. Laboratory exhaust-air streams.
      b. Process exhaust-air streams.
   2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
   3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.04 OPERATOR WORKSTATION INSTALLATION

A. Desktop Operator Workstations Installation:
   1. Install operator workstation(s) at location(s) directed by Owner.
   2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.

3. Install software on workstation(s) and verify software functions properly.
4. Develop Project-specific graphics, trends, reports, logs and historical database.
5. Power workstation through a UPS unit. Locate UPS adjacent to workstation.

B. Portable Operator Workstations Installation:
1. Turn over portable operator workstations to Owner at Substantial Completion.
2. Install software on workstation(s) and verify software functions properly.

C. Color Graphics Application:
1. Use system schematics indicated as starting point to create graphics.
2. Develop Project-specific library of symbols for representing system equipment and products.
3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
4. Submit sketch of graphic layout with description of all text for each graphic for Owner's review before creating graphic using graphics software.
5. Seek Owner input in graphics development once using graphics software.
6. Final editing shall be done on-site with Owner's review and feedback.
7. Refine graphics as necessary for Owner acceptance.
8. On receiving Owner acceptance, print a hard copy for inclusion in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of DDC system operation and maintenance manual.

3.05 GATEWAY INSTALLATION

A. Install gateways if required for DDC system communication interface requirements indicated.
1. Install gateway(s) required to suit indicated requirements.

B. Test gateway to verify that communication interface functions properly.

3.06 ROUTER INSTALLATION

A. Install routers if required for DDC system communication interface requirements indicated.
1. Install router(s) required to suit indicated requirements.

B. Test router to verify that communication interface functions properly.

3.07 CONTROLLER INSTALLATION

A. Install controllers in enclosures to comply with indicated requirements.

B. Connect controllers to field power supply.

C. Install controller with latest version of applicable software and configure to execute requirements indicated.

D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

E. Installation of Network Controllers:
1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. Install controllers in a protected location that is easily accessible by operators.
3. Top of controller shall be within 72 inches of finished floor.

F. Installation of Programmable Application Controllers:
1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. Install controllers in a protected location that is easily accessible by operators.
3. Top of controller shall be within 72 inches of finished floor.

G. Application-Specific Controllers:
1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

3.08 ENCLOSURES INSTALLATION

A. Install the following items in enclosures, to comply with indicated requirements:
1. Gateways.
2. Routers.

3. Controllers.
4. Electrical power devices.
5. UPS units.
6. Relays.
7. Accessories.
8. Instruments.
9. Actuators

B. Attach wall-mounted enclosures to wall using the following types of steel struts:
1. For NEMA 250, Type 1 Enclosures: Use galvanized-steel strut and hardware.
2. For NEMA 250, Type 4 Enclosures and Enclosures Located Outdoors: Use stainless-steel strut and hardware.
3. Install plastic caps on exposed cut edges of strut.

C. Align top of adjacent enclosures of like size.

D. Install floor-mounted enclosures located in mechanical equipment rooms on concrete housekeeping pads. Attach enclosure legs using galvanized steel anchors.

E. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

3.09 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to DDC system products requiring electrical power connections.

B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.

C. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.

D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.

E. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

3.10 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification products and installation.

B. Install engraved phenolic nameplate with unique identification on face for each of the following:
1. Operator workstation.
2. Printer.
3. Gateway.
4. Router.
5. DDC controller.
6. Enclosure.
7. Electrical power device.
8. UPS unit.
9. Accessory.

C. Install engraved phenolic nameplate with unique instrument identification on face of each instrument connected to a DDC controller.

D. Install engraved phenolic nameplate with identification on face of each control damper and valve actuator connected to a DDC controller.

E. Where product is installed above accessible tile ceiling, also install matching engraved phenolic nameplate with identification on face of ceiling grid located directly below.

F. Where product is installed above an inaccessible ceiling, also install engraved phenolic nameplate with identification on face of access door directly below.

G. Warning Labels:
1. Shall be permanently attached to equipment that can be automatically started by DDC control system.
2. Shall be located in highly visible location near power service entry points.

3.11 NETWORK INSTALLATION

A. Install copper cable when connecting between the following network devices located in same building:
   1. Operator workstations.
   2. Operator workstations and network controllers.
   3. Network controllers.

B. Install copper cable when connecting between the following:
   1. Gateways.
   2. Gateways and network controllers or programmable application controllers.
   3. Routers.
   4. Routers and network controllers or programmable application controllers.
   5. Network controllers and programmable application controllers.
   6. Programmable application controllers.
   7. Programmable application controllers and application-specific controllers.
   8. Application-specific controllers.

C. Install network cable in continuous raceway.
   1. Where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

3.12 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

B. ASHRAE 135 Networks:
   1. MAC Address:
      a. Every network device shall have an assigned and documented MAC address unique to its network.
      b. Ethernet Networks: Document MAC address assigned at its creation.
      c. ARCNET or MS/TP networks: Assign from 00 to 64.
   2. Network Numbering:
      a. Assign unique numbers to each new network.
      b. Provide ability for changing network number through device switches or operator interface.
      c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.
   3. Device Object Identifier Property Number:
      a. Assign unique device object identifier property numbers or device instances for each device network.
      b. Provide for future modification of device instance number by device switches or operator interface.
      c. LAN shall support up to 4,194,302 unique devices.
   4. Device Object Name Property Text:
      a. Device object name property field shall support 32 minimum printable characters.
      b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.
         1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."
         2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102".
   5. Object Name Property Text for Other Than Device Objects:
      a. Object name property field shall support 32 minimum printable characters.
      b. Assign object name properties with plain-English names descriptive of application.
         1) Example 1: "Zone 1 Temperature."
         2) Example 2 "Fan Start and Stop."
   6. Object Identifier Property Number for Other Than Device Objects:
      a. Assign object identifier property numbers according to Drawings indicated.

b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

3.13 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NECA 1.

B. Comply with TIA 568-C.1.

C. Wiring Method: Install cables in raceways and cable trays except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
   3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

E. Field Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

F. Conduit Installation:
   1. Install conduit expansion joints where conduit runs exceed 200 feet, and conduit crosses building expansion joints.
   2. Coordinate conduit routing with other trades to avoid conflicts with ducts, pipes and equipment and service clearance.
   3. Maintain at least 3-inch separation where conduits run axially above or below ducts and pipes.
   4. Limit above-grade conduit runs to 100 feet without pull or junction box.
   5. Do not install raceways or electrical items on any "explosion-relief" walls, or rotating equipment.
   6. Do not fasten conduits onto the bottom side of a metal deck roof.
   7. Flexible conduit is permitted only where flexibility and vibration control is required.
   8. Limit flexible conduit to 3 feet long.
   9. Conduit shall be continuous from outlet to outlet, from outlet to enclosures, pull and junction boxes, and shall be secured to boxes in such manner that each system shall be electrically continuous throughout.
   10. Direct bury conduits underground or install in concrete-encased duct bank where indicated.
       a. Use rigid, nonmetallic, Schedule 80 PVC.
       b. Provide a burial depth according to NFPA 70, but not less than 24 inches.
   11. Secure threaded conduit entering an instrument enclosure, cabinet, box, and trough, with a locknut on outside and inside, such that conduit system is electrically continuous throughout. Provide a metal bushing on inside with insulated throats. Locknuts shall be the type designed to bite into the metal or, on inside of enclosure, shall have a grounding wedge lug under locknut.
   12. Conduit box-type connectors for conduit entering enclosures shall have an insulated throat.
   13. Connect conduit entering enclosures in wet locations with box-type connectors or with watertight sealing locknuts or other fittings.
   14. Offset conduits where entering surface-mounted equipment.
   15. Seal conduit runs used by sealing fittings to prevent the circulation of air for the following:
       a. Conduit extending from interior to exterior of building.
       b. Conduit extending into pressurized duct and equipment.
       c. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.

G. Wire and Cable Installation:

1. Cables serving a common system may be grouped in a common raceway. Install control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
2. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.
    a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.
3. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
5. UTP Cable Installation:
    a. Comply with TIA 568-C.2.
    b. Do not untwist UTP cables more than 1/2 inch from the point of termination, to maintain cable geometry.
6. Installation of Cable Routed Exposed under Raised Floors:
    a. Install plenum-rated cable only.
    b. Install cabling after the flooring system has been installed in raised floor areas.
    c. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.
7. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.
8. Provide strain relief.
9. Terminate wiring in a junction box.
    a. Clamp cable over jacket in junction box.
    b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.
10. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
11. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
12. Keep runs short. Allow extra length for connecting to terminal boards. Do not bend flexible coaxial cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
13. Ground wire shall be copper and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
14. Wire and cable shall be continuous from terminal to terminal without splices.
15. Use insulated spade lugs for wire and cable connection to screw terminals.
16. Use shielded cable to transmitters.
17. Use shielded cable to temperature sensors.
18. Perform continuity and meager testing on wire and cable after installation.
19. Do not install bruised, kinked, scored, deformed, or abraded wire and cable. Remove and discard wire and cable if damaged during installation, and replace it with new cable.
20. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
21. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
22. Protection from Electro-Magnetic Interference (EMI): Provide installation free of (EMI). As a minimum, comply with the following requirements:
    a. Comply with BICSI TDMM and TIA 569-C for separating unshielded cable from potential EMI sources, including electrical power lines and equipment.
    b. Separation between open cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

c. Separation between cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

d. Separation between cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
1) Electrical Equipment Rating Less Than 2 kVA: No requirement.
2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
3) Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

e. Separation between Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.

f. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Testing of Pneumatic and Air-Signal Tubing:
a. Test for leaks and obstructions.
b. Disconnect each pipe and tubing line before a test is performed, and blowout dust, dirt, trash, condensate and other foreign materials with compressed air. Use commercially pure compressed air or nitrogen as distributed in gas cylinders. Air from an oil-free compressor with an air dryer is an acceptable alternative for the test.
c. After foreign matter is expelled and line is free from obstructions, plug far end of tubing run.
d. Connect a pressure source to near end of run with a needle valve between air supply and tubing run.
e. Connect a pressure gage accurate to within 0.5 percent of test between the shutoff needle valve and tubing run under test.
f. For system pressures above 30 psig, apply a pressure of 1.5 times operating pressure. Record pressure in tubing run every 10 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 1 psig.
g. For system pressures 30 psig and below, apply a pressure of 2.0 times operating pressure to piping and tubing run. Record pressure in tubing run every 5 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 0.5 psig.

D. Testing:
1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.
2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.
3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished

and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.

4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
5. Test Equipment: Use a fiber-optic time domain reflectometer for testing of length and optical connectivity.
6. Test Results: Record test results and submit copy of test results for Project record.

3.15 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.
B. Check instruments for proper location and accessibility.
C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.
E. For pneumatic products, verify that air supply for each product is properly installed.
F. Control Damper Checkout:
   1. Verify that control dampers are installed correctly for flow direction.
   2. Verify that proper blade alignment, either parallel or opposed, has been provided.
   3. Verify that damper frame attachment is properly secured and sealed.
   4. Verify that damper actuator and linkage attachment is secure.
   5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
   6. Verify that damper blade travel is unobstructed.
G. Control Valve Checkout:
   1. For pneumatic valves, verify that pressure gages are provided in each air line to valve actuator and positioner.
   2. Verify that control valves are installed correctly for flow direction.
   3. Verify that valve body attachment is properly secured and sealed.
   4. Verify that valve actuator and linkage attachment is secure.
   5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
   6. Verify that valve ball, disc or plug travel is unobstructed.
   7. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.
H. Instrument Checkout:
   1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
   2. Verify that attachment is properly secured and sealed.
   3. Verify that conduit connections are properly secured and sealed.
   4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
   5. Inspect instrument tag against approved submittal.
   6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
   7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
   8. For temperature instruments:
      a. Verify sensing element type and proper material.
      b. Verify length and insertion.

3.16 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.
E. Provide diagnostic and test equipment for calibration and adjustment.
F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.
J. Analog Signals:
    1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
    2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
    3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.
K. Digital Signals:
    1. Check digital signals using a jumper wire.
    2. Check digital signals using an ohmmeter to test for contact making or breaking.
L. Control Dampers:
    1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
    2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
    3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
    4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
M. Control Valves:
    1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
    2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
    3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
    4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
N. Meters: Check sensors at zero, 50, and 100 percent of Project design values.
O. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.
P. Switches: Calibrate switches to make or break contact at set points indicated.
Q. Transmitters:
    1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
    2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.17 DDC SYSTEM CONTROLLER CHECKOUT

A. Verify power supply.
    1. Verify voltage, phase and hertz.

2. Verify that protection from power surges is installed and functioning.
3. Verify that ground fault protection is installed.
4. If applicable, verify if connected to UPS unit.
5. If applicable, verify if connected to a backup power source.
6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.

B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.

C. Verify that spare I/O capacity is provided.

3.18 DDC CONTROLLER I/O CONTROL LOOP TESTS

A. Testing:
1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
2. Test every I/O point throughout its full operating range.
3. Test every control loop to verify operation is stable and accurate.
4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5. Test and adjust every control loop for proper operation according to sequence of operation.
6. Test software and hardware interlocks for proper operation. Correct deficiencies.
7. Operate each analog point at the following:
   a. Upper quarter of range.
   b. Lower quarter of range.
   c. At midpoint of range.
8. Exercise each binary point.
9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

3.19 DDC SYSTEM VALIDATION TESTS

A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.

B. After approval of Test Plan, execute all tests and procedures indicated in plan.

C. After testing is complete, submit completed test checklist.

D. Pretest Checklist: Submit the following list with items checked off once verified:
1. Detailed explanation for any items that are not completed or verified.
2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
3. HVAC equipment motors operate below full-load amperage ratings.
4. Required DDC system components, wiring, and accessories are installed.
5. Installed DDC system architecture matches approved Drawings.
6. Control electric power circuits operate at proper voltage and are free from faults.
7. Required surge protection is installed.
8. DDC system network communications function properly, including uploading and downloading programming changes.
9. Using BACnet protocol analyzer, verify that communications are error free.
10. Each controller's programming is backed up.
11. Equipment, products, tubing, wiring cable and conduits are properly labeled.
12. All I/O points are programmed into controllers.
13. Testing, adjusting and balancing work affecting controls is complete.
14. Dampers and actuators zero and span adjustments are set properly.

15. Each control damper and actuator goes to failed position on loss of power.
16. Valves and actuators zero and span adjustments are set properly.
17. Each control valve and actuator goes to failed position on loss of power.
18. Meter, sensor and transmitter readings are accurate and calibrated.
19. Control loops are tuned for smooth and stable operation.
20. View trend data where applicable.
21. Each controller works properly in standalone mode.
22. Safety controls and devices function properly.
23. Interfaces with fire-alarm system function properly.
24. Electrical interlocks function properly.
25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
26. Record Drawings are completed.

E. Test Plan:
1. Prepare and submit a validation test plan including test procedures for performance validation tests.
2. Test plan shall address all specified functions of DDC system and sequences of operation.
3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation 10 business days before start of tests.

F. Validation Test:
1. Verify operating performance of each I/O point in DDC system.
   a. Verify analog I/O points at operating value.
   b. Make adjustments to out-of-tolerance I/O points.
      1) Identify I/O points for future reference.
      2) Simulate abnormal conditions to demonstrate proper function of safety devices.
      3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.
2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
4. After 24 Hours following Initial Validation Test:
   a. Re-check I/O points that required corrections during initial test.
   b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.
5. After 24 Hours of Second Validation Test:
   a. Re-check I/O points that required corrections during second test.
   b. Continue validation testing until I/O point is normal on two consecutive tests.
6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.
7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

G. DDC System Response Time Test:
1. Simulate HLC.
   a. Heavy load shall be an occurrence of 50 percent of total connected binary COV, one-half of which represent an "alarm" condition, and 50 percent of total connected analog COV, one-half of which represent an "alarm" condition, that are initiated simultaneously on a one-time basis.

2. Initiate 10 successive occurrences of HLC and measure response time to typical alarms and status changes.
3. Measure with a timer having at least 0.1-second resolution and 0.01 percent accuracy.
4. Purpose of test is to demonstrate DDC system, as follows:
    a. Reaction to COV and alarm conditions during HLC.
    b. Ability to update DDC system database during HLC.
5. Passing test is contingent on the following:
    a. Alarm reporting at printer beginning no more than two seconds after the initiation (time zero) of HLC.
    b. All alarms, both binary and analog, are reported and printed; none are lost.
    c. Compliance with response times specified.
6. Prepare and submit a report documenting HLC tested and results of test including time stamp and print out of all alarms.

H. DDC System Network Bandwidth Test:
1. Test network bandwidth usage on all DDC system networks to demonstrate bandwidth usage under DDC system normal operating conditions and under simulated HLC.
2. To pass, none of DDC system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

3.20 FINAL REVIEW

A. Submit written request to Architect and Construction Manager when DDC system is ready for final review. Written request shall state the following:
1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
4. DDC system is complete and ready for final review.

B. Review by Architect and Construction Manager shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.

E. Prepare and submit closeout submittals when no deficiencies are reported.

F. A part of DDC system final review shall include a demonstration to parties participating in final review.
1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
3. Demonstration shall include, but not be limited to, the following:
    a. Accuracy and calibration of 10 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
    b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to 10 I/O points shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.

c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.
d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.
e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
f. Trends, summaries, logs and reports set-up for Project.
g. For up to three HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.
h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.
i. Software's ability to edit control programs off-line.
j. Data entry to show Project-specific customizing capability including parameter changes.
k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
l. Execution of digital and analog commands in graphic mode.
m. Spreadsheet and curve plot software and its integration with database.
n. Online user guide and help functions.
o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.
p. System speed of response compared to requirements indicated.
q. For Each Network and Programmable Application Controller:
    1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.
    2) Operator Interface: Ability to connect directly to each type of digital controller with a portable operator workstation and PDA. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.
    3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
    4) Electric Power: Ability to disconnect any controller safely from its power source.
    5) Wiring Labels: Match control drawings.
    6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.
    7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.
r. For Each Operator Workstation:
    1) I/O points lists agree with naming conventions.
    2) Graphics are complete.
    3) UPS unit, if applicable, operates.
s. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Use ASHRAE 135 protocol analyzer to help identify devices, view network traffic, and verify interoperability. Requirements must be met even if only one manufacturer's equipment is installed.
    1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
    2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.

3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated. Modifications are made with messages and write services initiated by an operator using workstation graphics, or by completing a field in a menu with instructional text.
4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
10) Device and Network Management:
    a) Display of network device status.
    b) Display of BACnet Object Information.
    c) Silencing devices transmitting erroneous data.
    d) Time synchronization.
    e) Remote device re-initialization.
    f) Backup and restore network device programming and master database(s).
    g) Configuration management of routers.

3.21 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.22 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12-month full maintenance by DDC system manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.23 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for one year(s).
B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within one year from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
    1. Upgrade Notice: At least 30 days to allow Owner to schedule and access system and to upgrade computer equipment if necessary.

3.24 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.
B. Extent of Training:

1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:
    a. Provide not less than 24 hours of training total.
    b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
    c. Total days of training shall be broken into not more than five separate training classes. Coordinate with owner.

C. Training Schedule:
1. Schedule training with Owner 20 business days before expected Substantial Completion.
2. Schedule training to provide Owner with at least 15 business days of notice in advance of training.
3. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays, with two morning sessions and two afternoon sessions. Each morning session and afternoon session shall be split in half with 15 minute break between sessions. Morning and afternoon sessions shall be separated by 60 minute lunch period. Training, including breaks and excluding lunch period, shall not exceed eight hours per day.
4. Provide staggered training schedule as requested by Owner.

D. Training Attendee List and Sign-in Sheet:
1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
5. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Attendee Training Manuals:
1. Provide each attendee with a color hard copy of all training materials and visual presentations.
2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

F. Organization of Training Sessions:
1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate the following three levels of operators:
    a. Daily operators.
    b. Advanced operators.
    c. System managers and administrators.
2. Plan and organize training sessions to group training content to protect DDC system security. Some attendees may be restricted to some training sessions that cover restricted content for purposes of maintaining DDC system security.

G. Training Outline:

1. Submit training outline for Owner review at least 10 business day before scheduling training.
2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.

H. On-Site Training:
1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

I. Off-Site Training:
1. Provide conditioned training rooms and workspace with ample tables desks or tables, chairs, power and data connectivity for each attendee.
2. Provide capability to remotely access to Project DDC system for use in training.
3. Provide a workstation for use by each attendee.

J. Training Content for Daily Operators:
1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals including control drawings.
11. Understanding physical location and placement of DDC controllers and I/O hardware.
12. Accessing data from DDC controllers.
13. Operating portable operator workstations.
14. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
15. Running each specified report and log.
16. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
17. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
18. Executing digital and analog commands in graphic mode.
19. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
20. Demonstrating DDC system performance through trend logs and command tracing.
21. Demonstrating scan, update, and alarm responsiveness.
22. Demonstrating spreadsheet and curve plot software, and its integration with database.
23. Demonstrating on-line user guide, and help function and mail facility.
24. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.

25. Demonstrating the following for HVAC systems and equipment controlled by DDC system:
    a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
    b. For HVAC equipment with factory-installed software, show that integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.
    c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.
    d. Hardware interlocks and safeties function properly and DDC system performs correct sequence of operation after electrical power interruption and resumption after power is restored.
    e. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.
    f. Each control loop responds to set point adjustment and stabilizes within time period indicated.
    g. Sharing of previously graphed trends of all control loops to demonstrate that each control loop is stable and set points are being maintained.

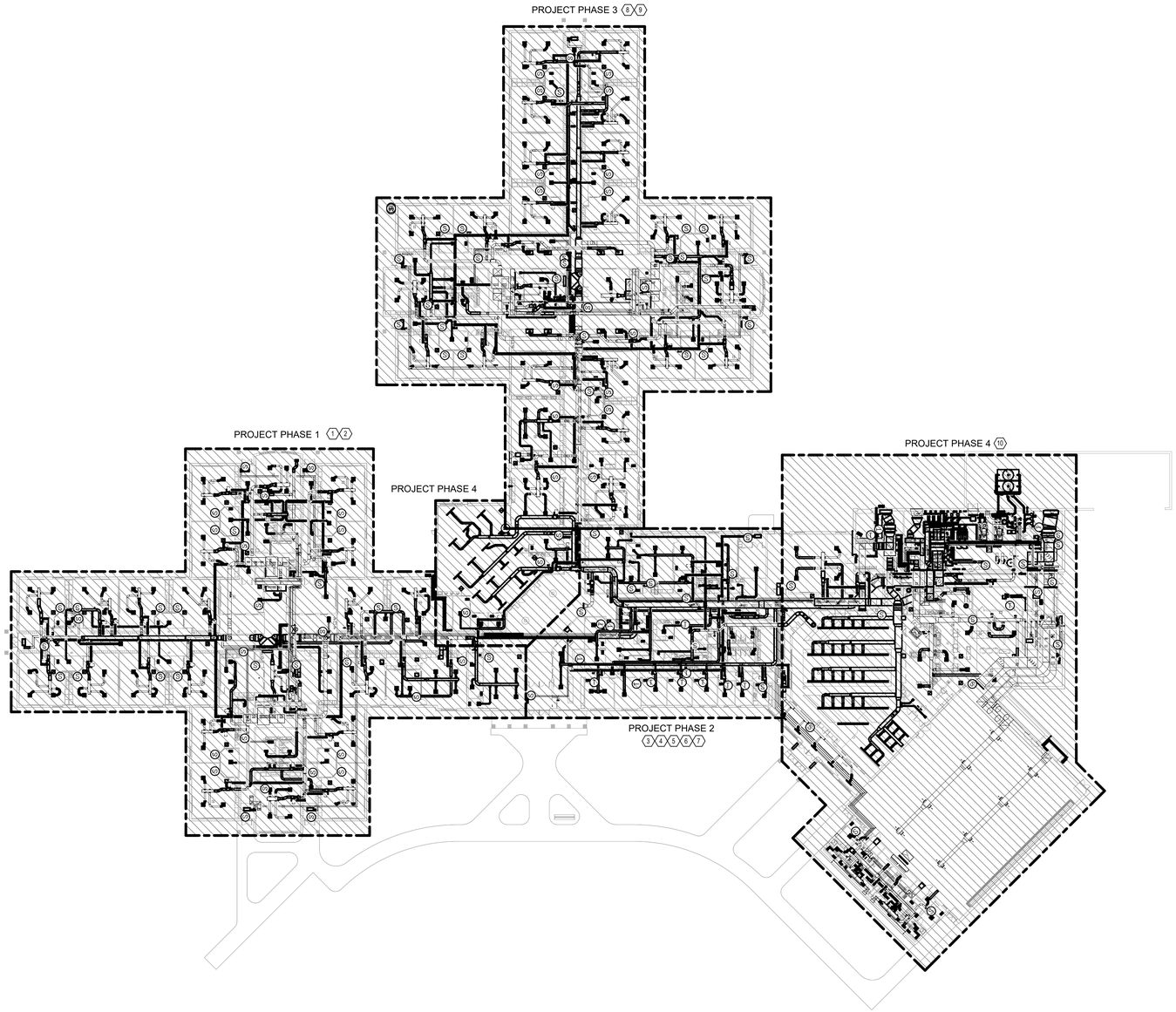
K. Training Content for Advanced Operators:
1. Making and changing workstation graphics.
2. Creating, deleting and modifying alarms including annunciation and routing.
3. Creating, deleting and modifying point trend logs including graphing and printing on an ad-hoc basis and operator-defined time intervals.
4. Creating, deleting and modifying reports.
5. Creating, deleting and modifying points.
6. Creating, deleting and modifying programming including ability to edit control programs off-line.
7. Creating, deleting and modifying system graphics and other types of displays.
8. Adding DDC controllers and other network communication devices such as gateways and routers.
9. Adding operator workstations.
10. Performing DDC system checkout and diagnostic procedures.
11. Performing DDC controllers operation and maintenance procedures.
12. Performing operator workstation operation and maintenance procedures.
13. Configuring DDC system hardware including controllers, workstations, communication devices and I/O points.
14. Maintaining, calibrating, troubleshooting, diagnosing and repairing hardware.
15. Adjusting, calibrating and replacing DDC system components.

L. Training Content for System Managers and Administrators:
1. DDC system software maintenance and backups.
2. Uploading, downloading and off-line archiving of all DDC system software and databases.
3. Interface with Project-specific, third-party operator software.
4. Understanding password and security procedures.
5. Adding new operators and making modifications to existing operators.
6. Operator password assignments and modification.
7. Operator authority assignment and modification.
8. Workstation data segregation and modification.

M. Video of Training Sessions:
1. Provide a digital video and audio recording of each training session. Create a separate recording file for each session.
2. Stamp each recording file with training session number, session name and date.
3. Provide Owner with two copies of digital files on DVDs or flash drives for later reference and for use in future training.

4. Owner retains right to make additional copies for intended training purposes without having to pay royalties.

END OF SECTION



N 1 MECHANICAL PHASING PLAN
1" = 32'-0"

GENERAL NOTES

A REFER TO ARCHITECTURAL DRAWINGS AND COORDINATE WITH GENERAL CONTRACTOR ON ALL SEQUENCE AND PHASING REQUIRED FOR THIS PROJECT.

PHASE 1 NOTES

1 ROUTE NEW HHS/HHR THROUGH PHASE 2 AREA, VALVE AND CAP FUTURE PHASE TAKE-OFFS.
2 REBALANCE CHILLED WATER AND HEATING WATER PUMPS.

PHASE 2 NOTES

3 DEMOLISH EXISTING AHU-3. INSTALL NEW AHU-8 IN BOILER ROOM. PROVIDE TEMPORARY CONNECTIONS TO EXISTING HHS/HHR AND CWS/CWR AS REQUIRED.
4 REMOVE DUAL DUCT BOX IN EXISTING F106 BAND ROOM. REPLACE WITH NEW VAV BOX (VAV-8-212) WITH REHEAT. ROUTE NEW HHS/HHR PIPING TO VAV BOX AS SHOWN ON NEW WORK PLANS.
5 PROVIDE NEW DUCTWORK AND PIPING IN SERVICE CORRIDOR SOUTEAST OF PHASE 2 BOUNDARY OUTSIDE OF BOILER ROOM. VALVE AND CAP HHS/HHR AND CWS/CWR PIPING FOR FUTURE PHASE 3 CONNECTION.
6 REBALANCE HEATING HOT WATER AND CHILLED WATER PUMPS.
7 REBALANCE EXISTING ACU-2 FOR REMANING DUAL DUCT FAN POWERED BOXES.

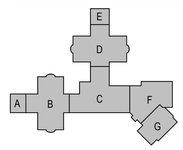
PHASE 3 NOTES

8 CONNECT TO THE NEW VALVED AND CAPPED FUTURE PHASE TAKE-OFFS THAT WERE INSTALLED IN PREVIOUS PHASES.
9 REBALANCE CHILLED WATER AND HEATING WATER PUMPS.

PHASE 4 NOTES

10 CONNECT TO THE NEW VALVED AND CAPPED FUTURE PHASE TAKE-OFFS THAT WERE INSTALLED IN PREVIOUS PHASES.

KEY PLAN



krM Architecture+

RDC

kbsd CONSULTING

REVISIONS

1	8/06/24	Addendum #2

07.12.2024
HAMILTON SOUTHEASTERN SCHOOL CORPORATION
23055 - FALL CREEK INTERMEDIATE RENOVATIONS
12011 Olio Rd. Fishers, IN 46037
CONSTRUCTION DOCUMENTS

DAVID HERNANDEZ JR. REGISTERED No. 12200632 STATE OF INDIANA PROFESSIONAL ENGINEER 07.12.2024

CONSTRUCTION DOCUMENTS
07.12.2024
krM JOB NO.
23055
DRAWN BY
CME

DRAWING NAME
MECHANICAL SEQUENCE & PHASING PLAN

DRAWING NO.
M0-1

TECHNOLOGY SYMBOLS LEGEND

SYMBOL	DESCRIPTION	ROUGH-IN REQUIREMENTS	MOUNTING HEIGHT (UNO)	ROUGH-IN DETAIL
xD	TELECOMMUNICATIONS OUTLET. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE RANDL T-55017-USA WITH SINGLE GANG OR DOUBLE GANG MUD RING. PROVIDE ONE (1) 1" C. AND ONE (1) 1.25" C. STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+18"	1, 2/T5-1
W xD	TELECOMMUNICATIONS OUTLET WITH WALL PLATE. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE RANDL T-55017-USA WITH SINGLE GANG OR DOUBLE GANG MUD RING. PROVIDE ONE (1) 1" C. AND ONE (1) 1.25" C. STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+44"	1, 2/T5-1
VI xD	VIDEO INPUT LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE RANDL T-55017-USA WITH SINGLE GANG OR DOUBLE GANG MUD RING. PROVIDE ONE (1) 1" C. AND ONE (1) 1.25" C. STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+18"	1, 2/T5-1
VO xD	VIDEO OUTPUT LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE RANDL T-55017-USA WITH SINGLE GANG OR DOUBLE GANG MUD RING. PROVIDE ONE (1) 1" C. AND ONE (1) 1.25" C. STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+18"	1, 2/T5-1
VO xD	VIDEO OUTPUT WALL BOX LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE FSR PWB-250 PROJECT WALL BOX (FOR METAL STUD WALLS) OR FSR PWB-CMU8 (FOR CMU WALLS) OR APPROVED EQUALS. PROVIDE ONE (1) 1" C. AND ONE (1) 1-1/4"C. STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+60"	-
VP xD	CEILING MOUNTED VIDEO PROJECTOR LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE 4" SQUARE BOX WITH BLANK METAL COVER PLATE. METAL BOX SHALL BE SUPPORTED FROM WALL ABOVE ACCESSIBLE CEILING, OR STRUCTURE, OR UNISTRUT. METAL BOX SHALL NOT BE INSTALLED LOOSE ON THE CEILING TILES.	-	-
VP xD	WALL MOUNTED VIDEO PROJECTOR LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE RANDL T-55017-USA WITH SINGLE GANG OR DOUBLE GANG MUD RING. PROVIDE ONE (1) 1" C. AND ONE (1) 1.25" C. STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+96"	1, 2/T5-1
TP	CONTROL TOUCHPANEL LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE RANDL T-55017-USA WITH SINGLE GANG OR DOUBLE GANG MUD RING. PROVIDE ONE (1) 1" C. AND ONE (1) 1.25" C. STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+48"	1, 2/T5-1
xD	FLOORBOX DATA LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE FLOORBOX WITH TWO (2) 1-1/4" C.'S STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS. REFER TO ROUGH-IN DETAILS FOR MORE INFORMATION.	-	4/T5-3
WAP xD	CEILING MOUNTED WIRELESS ACCESS POINT LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE 4" SQUARE BOX WITH BLANK METAL COVER PLATE. METAL BOX SHALL BE SUPPORTED FROM WALL ABOVE ACCESSIBLE CEILING), OR STRUCTURE, OR UNISTRUT. METAL BOX SHALL NOT BE INSTALLED LOOSE ON CEILING TILES.	-	-
WAP xD	WALL MOUNTED WIRELESS ACCESS POINT LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE RANDL T-55017-USA WITH SINGLE GANG OR DOUBLE GANG MUD RING. PROVIDE ONE (1) 1" C. AND ONE (1) 1.25" C. STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+96"	1, 2/T5-1
J	JUNCTION BOX FOR FURNITURE FEED	REFER TO FURNITURE FEED ROUGH-IN DETAILS FOR MORE INFORMATION ON EXACT ROUGH-IN REQUIREMENTS. PROVIDE PLASTIC BUSHING AND PULL STRINGS IN ALL CONDUITS.	-	-
	TELECOMMUNICATIONS CONDUIT SLEEVE. CONDUIT SIZE SHALL BE 2" UNLESS NOTED OTHERWISE.	-	-	-
	18" WIDE WIRE MESH CABLE TRAY PROVIDED BY ELECTRICAL CONTRACTOR. REFER TO SECTION 27 05 28 FOR MORE INFORMATION.	-	-	-
	18" TELECOMMUNICATIONS ROOM LADDER TRAY.	-	-	-

SECURITY SYSTEM SYMBOLS LEGEND

SYMBOL	DESCRIPTION	ROUGH-IN REQUIREMENTS	MOUNTING HEIGHT (UNO)	ROUGH-IN DETAIL
CR	CARD READER.	PROVIDE RANDL T-55017-USA WITH SINGLE GANG MUD RING. PROVIDE ONE (1) 1" C.'S STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+44"	3, 4/T5-2
EL	ELECTRONIC LATCH.	COORDINATE ROUGH-IN AND CONDUIT INTO DOOR FRAME WITH DOOR HARDWARE MANUFACTURER.	-	-
IC	DOOR INTERCOM STATION. DOOR INTERCOM IS PROVIDED BY OTHERS.	COORDINATE ROUGH-IN AND CONDUIT WITH DOOR INTERCOM STATION MANUFACTURER REQUIREMENTS.	-	-
DC	DOOR CONTACT.	COORDINATE ROUGH-IN AND CONDUIT INTO DOOR FRAME WITH DOOR HARDWARE MANUFACTURER.	-	-
MI	DOOR INTERCOM MASTER STATION. DOOR INTERCOM MASTER STATION IS PROVIDED BY OTHERS.	COORDINATE ROUGH-IN AND CONDUIT WITH DOOR INTERCOM STATION MANUFACTURER REQUIREMENTS.	-	-
	PUSH-TO-RELEASE PUSHBUTTON. PUSH-TO-RELEASE PUSHBUTTON IS PROVIDED BY OTHERS.	PROVIDE RANDL T-55017-USA WITH SINGLE GANG MUD RING. PROVIDE ONE (1) 1" C.'S STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	-	4/T5-1
J xD	ABOVE CEILING JUNCTION BOX FOR DOOR CONTROLLER. DOOR CONTROLLER PROVIDED BY OTHERS. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	12"X12"X6" JUNCTION BOX WITH HINGED COVER IN ACCESSIBLE CEILING SPACE.	-	-
xD	CEILING MOUNTED IP VIDEO SURVEILLANCE CAMERA LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE 4" SQUARE BOX WITH BLANK METAL COVER PLATE. METAL BOX SHALL BE SUPPORTED FROM WALL ABOVE ACCESSIBLE CEILING), OR STRUCTURE, OR UNISTRUT. METAL BOX SHALL NOT BE INSTALLED LOOSE ON CEILING TILES.	-	-
xD	WALL MOUNTED IP VIDEO SURVEILLANCE CAMERA LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE RANDL T-55017-USA WITH SINGLE GANG MUD RING. PROVIDE ONE (1) 1" C.'S STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+96"	4/T5-1
xD	CEILING MOUNTED IP VIDEO MULTI-SENSOR SURVEILLANCE CAMERA LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE 4" SQUARE BOX WITH BLANK METAL COVER PLATE. METAL BOX SHALL BE SUPPORTED FROM WALL ABOVE ACCESSIBLE CEILING, OR STRUCTURE, OR UNISTRUT. METAL BOX SHALL NOT BE INSTALLED LOOSE ON CEILING TILES.	-	-
xD	WALL MOUNTED IP VIDEO MULTI-SENSOR SURVEILLANCE CAMERA LOCATION. WHEN INDICATED WITH xD, x INDICATES THE QUANTITY OF COMMUNICATIONS COPPER HORIZONTAL CABLE.	PROVIDE RANDL T-55017-USA WITH SINGLE GANG MUD RING. PROVIDE ONE (1) 1" C.'S STUBBED ABOVE ACCESSIBLE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+96"	4/T5-1

SOUND SYSTEM SYMBOLS LEGEND

SYMBOL	DESCRIPTION	ROUGH-IN REQUIREMENTS	MOUNTING HEIGHT (UNO)	ROUGH-IN DETAIL
SP	SOUND SYSTEM SPEAKER	-	-	-
A.I.X	WALL MOUNTED AUDIO INPUT PLATE LOCATION. WHEN INDICATED WITH A.I.x, x INDICATES THE AUDIO INPUT NUMBER INDICATED ON DETAIL.	PROVIDE RANDL T-55017-USA WITH DOUBLE GANG MUD RING. PROVIDE ONE (1) 1" C.'S STUBBED ABOVE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+18"	5/T5-1
VC	WALL MOUNTED VOLUME LOCATION.	PROVIDE RANDL T-55017-USA WITH DOUBLE GANG MUD RING. PROVIDE ONE (1) 1" C.'S STUBBED ABOVE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+48"	4/T5-1
	WIRELESS MICROPHONE ANTENNA.	-	-	-

1

INTERCOMMUNICATIONS AND PROGRAM SYSTEM SYMBOLS LEGEND

SYMBOL	DESCRIPTION	ROUGH-IN REQUIREMENTS	MOUNTING HEIGHT (UNO)	ROUGH-IN DETAIL
IC	RECESSED CEILING SPEAKER	-	-	-
IC VC	RECESSED CEILING SPEAKER W/ VOLUME CONTROL KNOB	-	-	-
IC	WALL MOUNTED METAL BOX SPEAKER	PROVIDE RANDL T-55017-USA WITH SINGLE GANG MUD RING. PROVIDE ONE (1) 1" C. STUBBED ABOVE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+9'-0"	-
IC	WALL MOUNTED HORN LOUDSPEAKER	PROVIDE RANDL T-55017-USA WITH SINGLE GANG MUD RING. PROVIDE ONE (1) 1" C. STUBBED ABOVE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+9'-0"	-
VC	WALL MOUNTED VOLUME CONTROL PLATE	PROVIDE RANDL T-55017-USA WITH SINGLE GANG MUD RING. PROVIDE ONE (1) 1" C. STUBBED ABOVE CEILING WITH PLASTIC BUSHING AND PULL STRINGS.	+44"	-

CLOCK SYSTEM SYMBOLS LEGEND

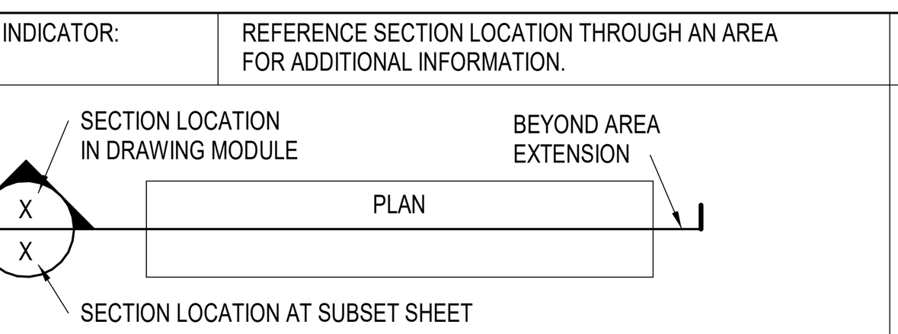
SYMBOL	DESCRIPTION	ROUGH-IN REQUIREMENTS	MOUNTING HEIGHT (UNO)	ROUGH-IN DETAIL
C	WALL MOUNTED SINGLE FACE ANALOG CLOCK.	-	CENTERED ABOVE DOOR	-

TELECOMMUNICATIONS COLOR LEGEND

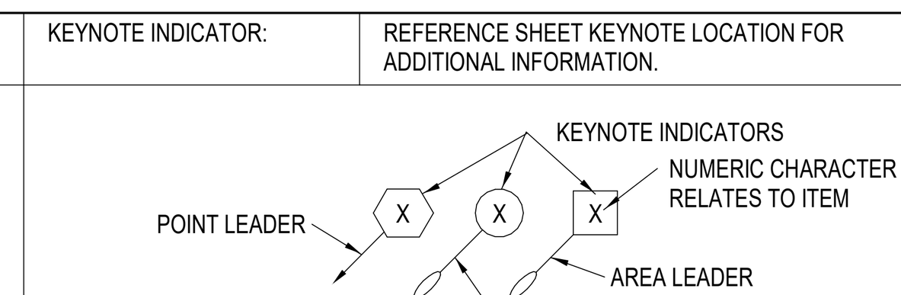
SYSTEM	TERMINATION (RJ-45)	CABLE	PATCH CABLE
DATA	BLUE	BLUE	BLUE
WIRELESS	ORANGE	BLUE	ORANGE
IP CAMERA	ORANGE	BLUE	ORANGE

REFERENCE SYMBOLS

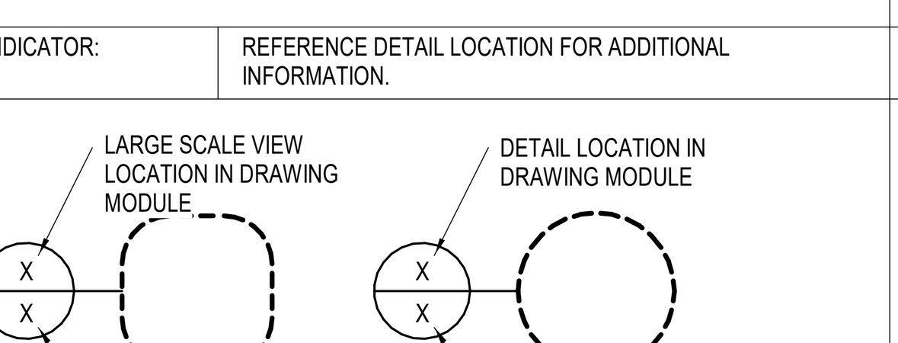
SECTION INDICATOR: REFERENCE SECTION LOCATION THROUGH AN AREA FOR ADDITIONAL INFORMATION.



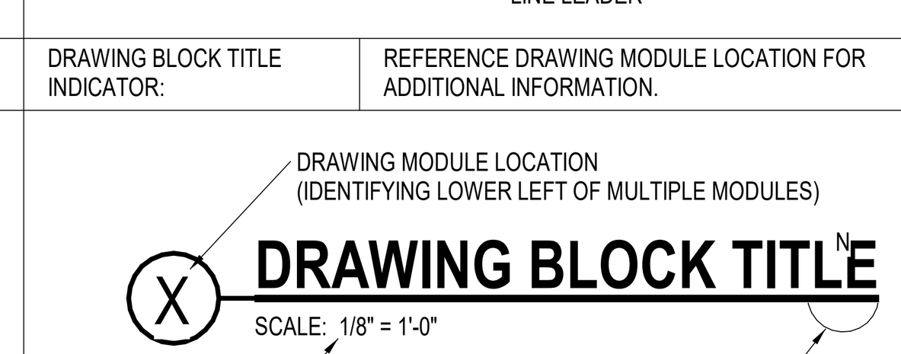
KEYNOTE INDICATOR: REFERENCE SHEET KEYNOTE LOCATION FOR ADDITIONAL INFORMATION.



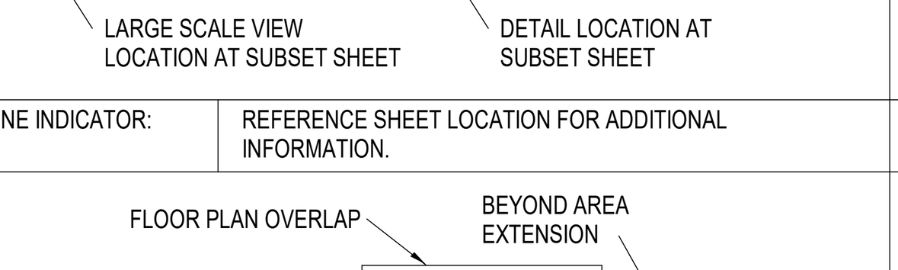
DETAIL INDICATOR: REFERENCE DETAIL LOCATION FOR ADDITIONAL INFORMATION.



DRAWING BLOCK TITLE INDICATOR: REFERENCE DRAWING MODULE LOCATION FOR ADDITIONAL INFORMATION.



MATCH LINE INDICATOR: REFERENCE SHEET LOCATION FOR ADDITIONAL INFORMATION.



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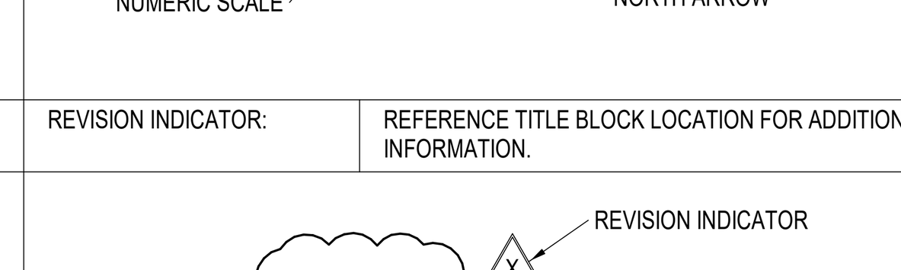
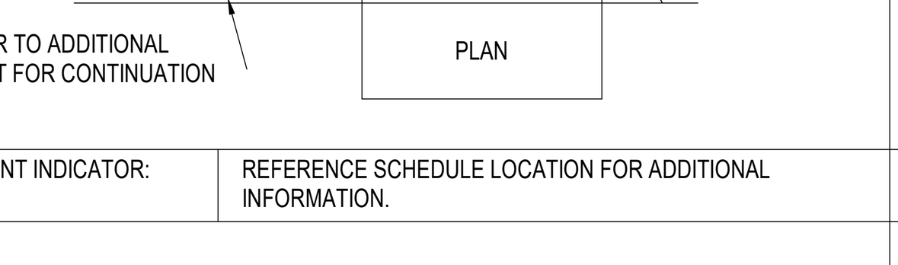
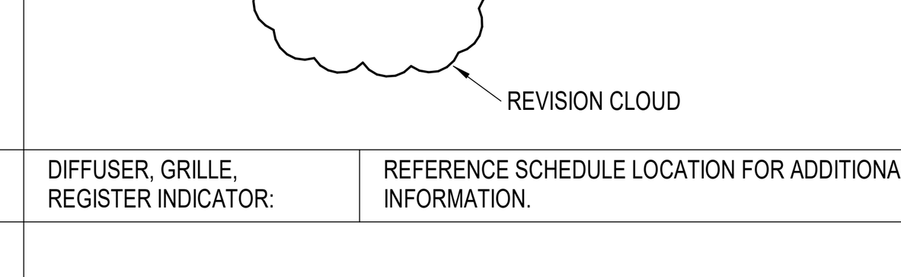


EQUIPMENT INDICATOR: REFERENCE SCHEDULE LOCATION FOR ADDITIONAL INFORMATION.



DIFFUSER, GRILLE, REGISTER INDICATOR: REFERENCE SCHEDULE LOCATION FOR ADDITIONAL INFORMATION.



ABBREVIATIONS AND TERMS

&	AND	LBS	POUNDS
°F	DEGREES FAHRENHEIT	MAX	MAXIMUM
AFC	ABOVE FINISHED COUNTER	MC	MECHANICAL CONTRACTOR
AFF	ABOVE FINISHED FLOOR	MFR	MANUFACTURER
AFG	ABOVE FINISHED GRADE	MIN	MINIMUM
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE	MISC	MISCELLANEOUS
ARCH	ARCHITECT	MTD	MOUNTED
AVG	AVERAGE	NA	NOT APPLICABLE
BAS	BUILDING AUTOMATION SYSTEM	NEC	NATIONAL ELECTRIC CODE
BLDG	BUILDING	NIC	NOT IN CONTRACT
BMS	BUILDING MANAGEMENT SYSTEM	NOM	NOMINAL
BSMT	BASEMENT	NTS	NOT TO SCALE
C	CONDUIT	OD	OUTSIDE DIAMETER
CLG	CEILING	OF/CI	OWNER FURNISHED/CONTRACTOR INSTALLED
DWG	DRAWING	PVC	POLYVINYL CHLORIDE CONDUIT/PIPE
EA	EACH	RGS	RIGID GALVANIZED CONDUIT
EC	ELECTRICAL CONTRACTOR	RM	ROOM
EL	ELEVATION	SF	SQUARE FOOT
EMT	ELECTRICAL METALLIC TUBING	SPEC	SPECIFICATION
ETR	EXISTING TO REMAIN	SQ	SQUARE
EX	EXISTING	STD	STANDARD
FLR	FLOOR	TBD	TO BE DETERMINED
FT	FOOT, FEET	TBI	TO BE INSTALLED
G	GROUND	TBR	TO BE REMOVED
GC	GENERAL CONTRACTOR	TC	TEMPERATURE CONTROLS
GRD	GROUND	TCC	TEMPERATURE CONTROLS CONTRACTOR
GND	GROUND	TEMP	TEMPERATURE
HORIZ	HORIZONTAL	TYP	TYPICAL
HR	HOUR(S)	UON	UNLESS OTHERWISE NOTED
Hz	HERTZ	VERT	VERTICAL
ID	INSIDE DIAMETER	WP	WEATHERPROOF
IN	INCH, INCHES	W/	WITH
INT	INTERIOR	W/O	WITHOUT

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Technology Responsibility Matrix

Project: Fall Creek Intermediate School

Date:

Item	By Contractor		By Owner		Notes
	Furnished	Installed	Furnished	Installed	
Data System					
Data System Rough-ins	X	X			
Data System Conduits, Penetrations, and Seals	X	X			
Data System AC Power Wiring and Outlets	X	X			
Wire Mesh Cable Tray	X	X			
J-hook Supports			X	X	DataCom is the Owner's Preffered Contractor
Telecommunications Grounding (Primary Bonding Busbar to Secondary Bonding Busbar)	X	X			
Telecommunications Grounding (telecommunications equipment to busbars)			X	X	DataCom is the Owner's Preffered Contractor
Telecommunications Room Racks/Cabients			X	X	DataCom is the Owner's Preffered Contractor
Telecommunications Room Ladder Trays			X	X	DataCom is the Owner's Preffered Contractor
Data System Cabling (Fiber and Copper)			X	X	DataCom is the Owner's Preffered Contractor
Data System Jacks, Patch Panels, Faceplates, Labels, and Testing			X	X	DataCom is the Owner's Preffered Contractor
Demo of Existing Data Cabling Infrastructure			X	X	DataCom is the Owner's Preffered Contractor
J-hook supports			X	X	DataCom is the Owner's Preffered Contractor
Network Switches			X	X	
Wireless Access Points			X	X	
UPS			X	X	
AV Systems					
AV System Rough-ins	X	X			
AV System Conduits, Penetrations, and Seals	X	X			
AV System AC Power Wiring and Outlets	X	X			
Intercommunications and Program System (Paging). Includes Speakers, Amplifiers, Cabling, Volume Controls, etc.)			X	X	Blades AV is the Owner's Preffered Contractor
Specialty Sound Systems (Gymansium, Mutli-purpose Room, etc.). Includes Speakers, Amplifiers, Cabling, DSP's, Microphones, Etc.			X	X	Blades AV is the Owner's Preffered Contractor
Video Displays (TV monitor, Video Projector, Mounts, Etc.)			X	X	Blades AV is the Owner's Preffered Contractor
AV Systems Inputs/Outputs/Switching. Includes Encoders, Decoders, Video Inputs and Outputs			X	X	Blades AV is the Owner's Preffered Contractor
AV Control System (touchpanels)			X	X	Blades AV is the Owner's Preffered Contractor
AV System Cabling			X	X	Blades AV is the Owner's Preffered Contractor
Clock System			X	X	Blades AV is the Owner's Preffered Contractor
Demo of Existing AV Equipment			X	X	Blades AV is the Owner's Preffered Contractor
Security Systems					
Security System Rough-ins	X	X			
Security System Conduits, Penetrations, and Seals	X	X			
Security System AC Power Wiring and Outlets	X	X			
Access Control System			X	X	Presidio is the Owner's Preffered Contractor
Intrusion Detection System			X	X	
IP Video Surveillance System Cabling			X	X	DataCom is the Owner's Preffered Contractor
IP Video Surveillance System Camera			X	X	
IP Video Surveillance System Server/VMS			X	X	

1

TECHNOLOGY GENERAL NOTES

A. DRAWINGS ARE DIAGRAMMATIC. ALL DIMENSIONS SHOWN ARE APPROXIMATE. ALL LOCATIONS SHALL BE FIELD VERIFIED.

B. CONTRACT DOCUMENTS CONSIST OF BOTH THE PROJECT MANUAL AND DRAWINGS, AND BOTH ARE INTENDED TO BE COMPLEMENTARY. ANYTHING APPEARING ON EITHER MUST BE EXECUTED THE SAME AS IF SHOWN ON BOTH.

C. THE CONTRACTOR SHALL INCLUDE IN BID PROPOSAL ALL COSTS REQUIRED TO COMPLETELY AND PROPERLY INSTALL ALL WORK REQUIRED FOR THE PROJECT, AND SHALL EXAMINE THE SCOPE OF WORK OF OTHER TRADES PRIOR TO SUBMITTING A BID PROPOSAL.

D. CONSTRUCTION DOCUMENTS SHALL BE FOLLOWED AS CLOSELY AS POSSIBLE, HOWEVER, SYSTEMS HAVE BEEN SHOWN DIAGRAMMATICALLY AND IN SOME CASES, ENLARGED FOR CLARITY. ANY OFFSETS, ADDITIONAL FITTINGS, AND/OR APPURTENANCES REQUIRED TO PROVIDE A COMPLETE AND COORDINATED SYSTEM SHALL BE BORNE BY THE CONTRACTOR.

E. THE TECHNOLOGY DRAWINGS ARE OF EQUAL IMPORTANCE WITH THE ARCHITECTURAL AND ENGINEERING DRAWINGS IN DEFINING THE WORK OF THE CONTRACT DOCUMENTS. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO CHECK WITH THE ARCHITECTURAL AND ENGINEERING DRAWINGS BEFORE THE INSTALLATION OF ENGINEERING WORK. SHOULD THERE BE A DISCREPANCY BETWEEN THE ARCHITECTURAL AND ENGINEERING DRAWINGS AND THE TECHNOLOGY DRAWINGS THAT WOULD CAUSE AN AWKWARD OR IMPROPER INSTALLATION, THE DISCREPANCY SHALL BE BROUGHT TO THE ARCHITECTS/ENGINEERS ATTENTION FOR CLARIFICATION PRIOR TO INSTALLATION OF SAID WORK. ANY WORK INSTALLED IN CONFLICT WITH THE ARCHITECTURAL AND ENGINEERING DRAWINGS SHALL BE CORRECTED BY THE CONTRACTOR AT HIS EXPENSE AND AT NO ADDITIONAL COST TO THE OWNER OR ARCHITECT/ENGINEER.

F. DO NOT SCALE THE DRAWINGS. THE DRAWINGS ARE NOT NECESSARILY TO SCALE. THE CONTRACTOR SHALL VERIFY ALL CONDITIONS AND DIMENSIONS AT THE JOB SITE PRIOR TO THE START OF CONSTRUCTION. IF DISCREPANCIES ARE FOUND, THE ARCHITECT/ENGINEER SHALL BE NOTIFIED FOR CLARIFICATION BEFORE COMMENCING THE WORK. EXPLICIT DIMENSIONS SHALL HAVE PRECEDENCE OVER SCALE.

G. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO BIDDING OR BEGINNING WORK ON THIS PROJECT.

H. DETAILS NOT SHOWN ARE SIMILAR IN CHARACTER TO THOSE SHOWN. WHERE SPECIFIC DIMENSIONS, DETAILS OR DESIGN INTENT CANNOT BE DETERMINED, CONSULT THE ARCHITECT/ENGINEER BEFORE PROCEEDING WITH THE WORK.

I. ANY DETAILS, SYSTEMS AND/OR MATERIALS WHICH ARE PROPOSED TO BE CHANGED MUST FIRST BE REVIEWED BY THE OWNER AND ARCHITECT/ENGINEER PRIOR TO THE PREPARATION OF SHOP DRAWINGS.

J. ALL WORK SHALL BE IN CONFORMANCE WITH THE NATIONAL ELECTRICAL CODE - LATEST EDITION ADOPTED BY STATE HAVING JURISDICTION, AND THE STATE HAVING JURISDICTION ELECTRICAL CODE AMENDMENTS, LOCAL/MUNICIPAL CODES, AND THE AUTHORITY HAVING JURISDICTION.

K. CONTRACTOR SHALL COORDINATE WITH ALL OTHER TRADES. NO ADDITIONAL COMPENSATION WILL BE ALLOWED FOR INCORRECT WORK, OR FOR INFRINGEMENT UPON OTHERS WORK, DUE TO A LACK OF COORDINATION.

L. COORDINATE LOCATION OF ALL DEVICES TO BE INSTALLED IN CEILINGS WITH THE ARCHITECTURAL REFLECTED CEILING PLANS. NOTIFY ENGINEER OF AN CONFLICTS PRIOR TO INSTALLATION.

M. CONTRACTOR SHALL BE RESPONSIBLE FOR CLEANING THEIR AREAS OF CONSTRUCTION. PROJECT AREAS SHALL BE THOROUGHLY CLEANED AND TRASH DISPOSED OF AT THE END OF EACH WORK DAY. THE OWNER'S FACILITIES SHALL NOT BE USED FOR TRASH DISPOSAL.

N. CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING THEIR WORK FROM DUST AND DEBRIS. CONTRACTOR SHALL PROVIDE DUST BARRIERS FOR ALL TECHNOLOGY EQUIPMENT AS REQUIRED TO PROTECT THE TECHNOLOGY EQUIPMENT.

O. CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTION OF ALL SURFACES AND FINISHED OF THE CONSTRUCTION SITE DURING THE INSTALLATION OF THE TECHNOLOGY SYSTEMS. DAMAGED SURFACES OR FINISHES RESULTING FROM THE PERFORMANCE OF THE WORK OR NEGLIGENCE SHALL BE REPAIRED AT NO COST TO THE OWNER BY THE RESPONSIBLE CONTRACTOR. FINISHES AND SURFACES SHALL BE MADE TO MATCH THE EXISTING FINISHES OR SURFACES TO THE SATISFACTION OF THE OWNER AND ARCHITECT/CONSTRUCTION MANAGER.

TECHNOLOGY PATHWAY NOTES

1. ALL HORIZONTAL CABLING RUNS SHALL BE SUPPORTED NEATLY WITH CABLE TRAY, CONDUITS, OR J-HOOKS. ALL HORIZONTAL CABLING THAT IS NOT INSTALLED IN CABLE TRAY OR CONDUIT SHALL BE SUPPORTED WITH J-HOOKS. CABLES SHALL NOT LIE ON THE STRUCTURAL STEEL OR SYSTEMS OF THE FACILITY.
2. ALL CONDUIT PENETRATIONS SHALL BE SEALED WITH APPROPRIATE CONDUIT SEALING MATERIAL AND SHALL MATCH FIRE RATING OF BARRIER BEING PENETRATED.
3. FIELD VERIFY LOCATIONS OF BUILDING EXPANSION JOINTS WHEN ROUTING CONDUIT. ALL CONDUITS CROSSING EXPANSION JOINTS SHALL BE INSTALLED WITH EXPANSION FITTINGS. EXPANSION FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH THE NEC, AND MANUFACTURER'S WRITTEN RECOMMENDATIONS.
4. WHEN CABLE TRAY IS SHOWN ON THE PLANS AND PORTIONS OF CABLE TRAY CANNOT BE INSTALLED DUE TO CONFLICT WITH STRUCTURE, THE CONTRACTOR SHALL PROVIDE (2) 4" C. WITH INSULATED BUSHINGS THAT OVERLAP 1" INTO THE TRAY.
5. CONDUITS 2" AND LARGER THAT PENETRATE EXTERIOR WALLS SHALL USE LINK-SEALS.
6. DEVICES IN GENERAL SHALL BE CENTERED IN WALL SPACE IN WHICH THEY ARE INSTALLED OR THEY SHALL BE SPACED SYMMETRICALLY (FOR EXAMPLE, CENTER DEVICES WHEN MOUNTED ON FACE OF COLUMNS).
7. COORDINATE AND VERIFY LOCATIONS OF DEVICES WITH BLOCK COURSING, FINISH MATERIALS, CASEWORK, ETC. PRIOR TO ROUGH-IN.
8. ALL DEVICE BOXES SHALL BE FLUSH MOUNTED AND ALL RACEWAYS SHALL BE CONCEALED UNLESS NOTED OTHERWISE. CONTRACTOR SHALL CUT AND PATCH EXISTING WALLS WITH EXTREME CAUTION, SO AS TO MINIMIZE INVASIVENESS OF INSTALLATION. ROUTE RACEWAYS SO AS TO MINIMIZE THE AMOUNT OF CUTTING AND PATCHING REQUIRE. PATCHING SHALL COMPLY WITH ALL BID DOCUMENT REQUIREMENTS.
9. CONDUIT RUNS SHALL HAVE NO MORE THAN 180 DEGREES OF BENDS WITHOUT A PULL BOX. WHERE CONDUIT IS SHOWN AND/OR SPECIFIED, CONTRACTOR SHALL PROVIDE ALL PULL BOXES SHOWN ON THE DRAWINGS AND ADDITIONAL PULL BOXES AS FOLLOWS:
   A. EVERY 180 DEGREES OF CONDUIT BEND
   B. EVERY 100 FEET OF CONDUIT PATH
10. PROVIDE PLASTIC INSULATED BUSHINGS ON ALL CONDUIT STUB'S. BUSHINGS SHALL ALSO BE PROVIDED FOR ALL CONDUITS WHETHER ABOVE OR BELOW CEILING OR AT FLOOR LEVEL. IT IS THE COMMUNICATIONS CABLING CONTRACTORS RESPONSIBILITY TO ENSURE BUSHINGS HAVE BEEN PROVIDED ON ALL CONDUITS PRIOR TO PULLING CABLES. IF CONDUITS ARE FOUND TO BE WITHOUT BUSHINGS, COMMUNICATIONS CABLING CONTRACTOR SHALL REMOVE CABLING, PROVIDE BUSHINGS AND REPLACE WITH NEW CABLING.

FIRESTOPPING NOTES

1. THE CONTRACTOR SHALL FIRESTOP ALL PENETRATIONS OF ALL FLOORS AND ALL WALLS WHICH EXTEND TO THE UNDERSIDE OF THE FLOOR OR ROOF DECK ABOVE. FIRESTOPPING SHALL BE ACCOMPLISHED AFTER ALL CABLES ARE PULLED (ALL SYSTEMS) USING UL CLASSIFIED SYSTEMS WITH FIRE RATING EQUAL TO OR GREATER THAN THE FIRE RATING OF THE FLOOR OR WALL ASSEMBLY PENETRATED. INSTALL IN ACCORDANCE WITH THE MANUFACTURER'S PRINTED INSTRUCTIONS. THE CONTRACTOR SHALL SUBMIT A MANUFACTURER'S STANDARD DETAIL FOR EACH TYPE OF FLOOR AND WALL PENETRATION REQUIRED FOR THIS PROJECT. ALL OTHER PENETRATIONS OR OPENINGS IN NON-FIRE RATED WALLS SHALL BE REPAIRED AND SEALED WITH MATERIALS TO MATCH THE EXISTING CONSTRUCTION.

LINETYPE DESIGNATIONS

DEMOLITION	- - - - - - - - - -
EXISTING	――――――
NEW WORK	――――――
FUTURE	— — — — — —

TECHNOLOGY ADDITIONAL CABLING NOTE

A. PROVIDE TEN (10) ADDITIONAL 200 FOOT COPPER COMMUNICATIONS COPPER HORIZONTAL CABLING RUNS. INCLUDE JACKS AT BOTH ENDS, LABELING, AND TESTING. THE ADDITIONAL DROPS ARE TO BE INSTALLED AS DIRECTED BY THE ENGINEER. REFER TO SPECIFICATION 271513 FOR MORE INFORMATION.

NOT ALL NOTES, DESIGNATORS, SYMBOLS OR ABBREVIATIONS MAY APPLY TO THIS PROJECT

krM Architecture+

kbso CONSULTING

REVISIONS

1	8/06/24	Addendum #2

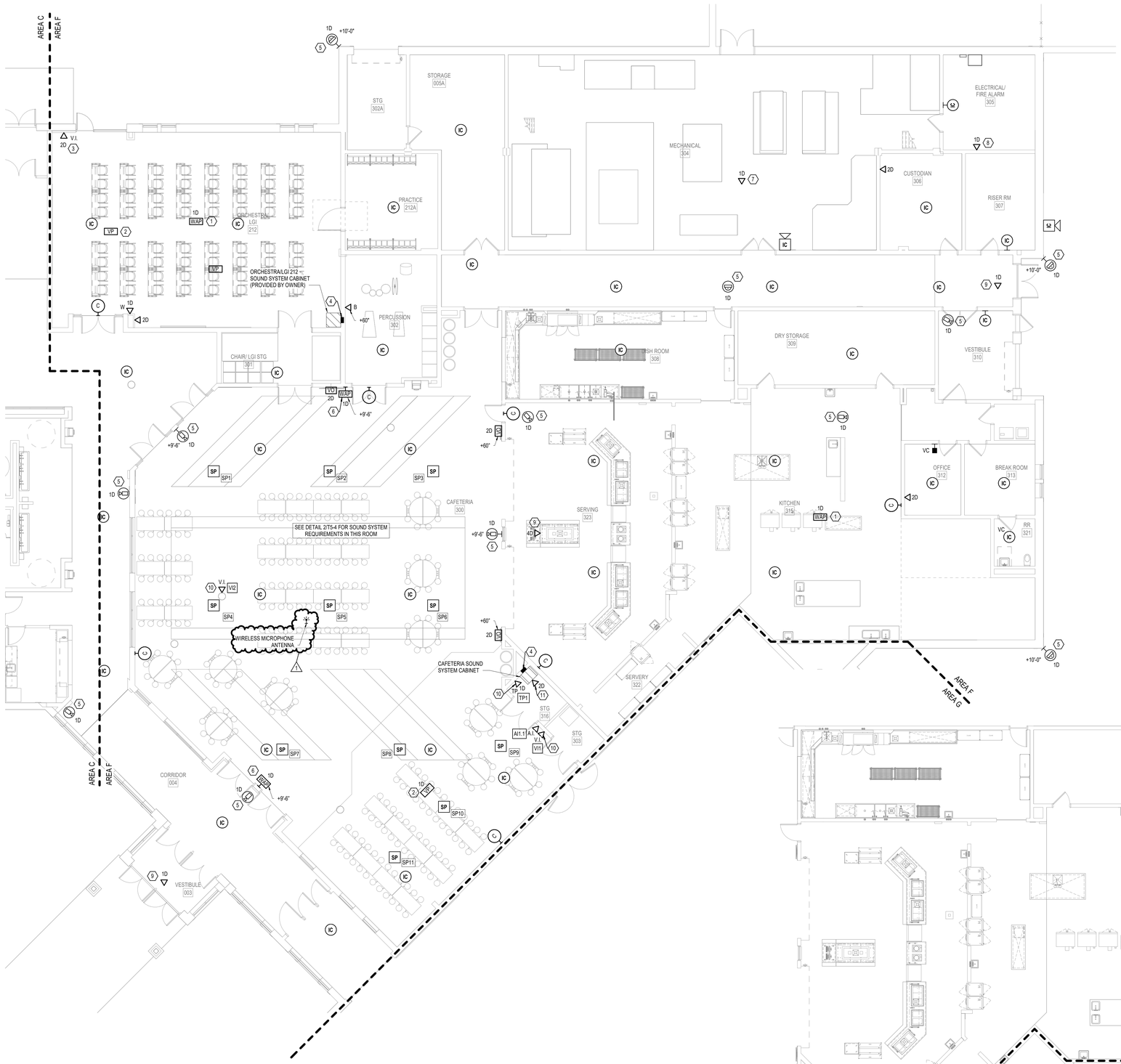
07.12.2024
HAMILTON SOUTHEASTERN SCHOOL CORPORATION
23055 - FALL CREEK INTERMEDIATE RENOVATIONS
12011 Olio Rd, Fishers, IN 46037
CONSTRUCTION DOCUMENTS

DAVID HERNANDEZ, JR. REGISTERED No. 12200632 STATE OF INDIANA PROFESSIONAL ENGINEER
07.12.2024

CONSTRUCTION DOCUMENTS
07.12.2024
krM JOB NO.
23055
DRAWN BY
EAG

DRAWING NAME
SYMBOLS AND ABBREVIATIONS

DRAWING NO.
T0-0



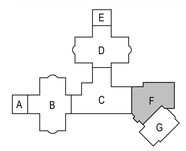
1 FIRST FLOOR TECHNOLOGY PLAN - AREA F
1/8" = 1'-0"

2 FIRST FLOOR TECHNOLOGY PLAN - KITCHEN ALTERNATE
1/8" = 1'-0"

SHEET KEYNOTES

1. PROVIDE CATGEORY 6A DROP FOR WIRELESS ACCESS POINT. PROVIDE 20FT. SLACK LOOP COILED NEATLY AND SUPPORTED ABOVE THE CEILING. TERMINATE CABLES WITH RJ45 MODULAR JACKS AND TEST PER SPECIFICATIONS. NOTE LOCATION ON THE RECORD DRAWINGS AND MARK LOCATION ON THE CEILING WITH A GREEN DOT STICKER.
2. PROVIDE NEW 2'X2' PROJECTOR CEILING PAN FOR OWNER PROVIDED PROJECTOR. COORDINATE EXACT LOCATION WITH OWNER PRIOR TO INSTALLATION.SEE DETAIL 5/T5-2 FOR MORE INFORMATION.
3. PROVIDE PLENUM RATED HDMI CABLE TO CEILING PROJECTOR PAN. SEE DETAIL 3/T5-4 FOR MORE INFORMATION.
4. PROVIDE 12"X12"X4" RECESSED JUNCTION BOX AT +18" A.F.F. FOR ROUTING OF SOUND SYSTEM CABLING. PROVIDE THREE (3) 1-1/2" CONDUITS INTO ACCESSIBLE CEILING SPACE.
5. PROVIDE CATGEORY 6A DROP FOR VIDEO SURVEILLANCE CAMERA.
6. PROVIDE CATGEORY 6A DROP FOR WALL MOUNTED WIRELESS ACCESS POINTS.
7. PROVIDE ONE (1) CATGEORY 6 FOR TEMPERATURE CONTROL PANEL IN THIS ROOM. COORDINATED EXACT ROUGH-IN LOCATION, CONDUIT ROUTING, AND TERMINATIONS WITH MECHANICAL CONTRACTOR PRIOR TO INSTALLATION.
8. PROVIDE ONE (1) DATA DROP FOR FIRE ALARM CONTROL PANEL. COORDINATE FINAL LOCATION AND TERMINATION WITH FIRE ALARM CONTRACTOR.
9. PROVIDE TWO (2) 1" CONDUITS IN SLAB TO NEAREST ACCESSIBLE CEILING.
10. REFER TO DETAIL 2/T5-4 FOR MORE INFORMATION ON AV SYSTEM REQUIREMENTS.
11. PROVIDE TWO (2) CATEGORY 6 CABLES TO SOUND SYSTEM CABINET. TERMINATE CABLING ON SURFACE MOUNTED BISCUIT IN CABINET.

KEY PLAN



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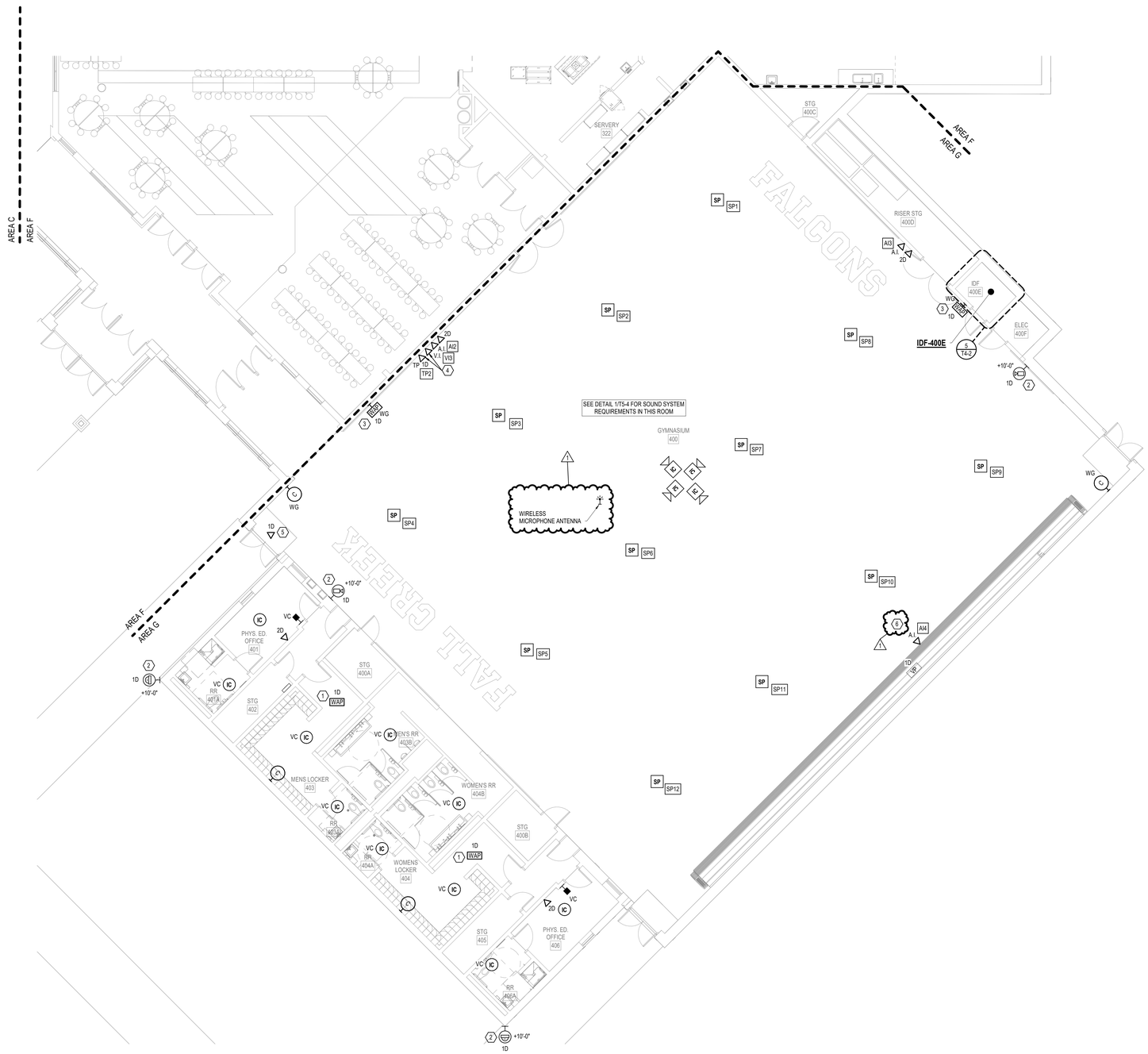
DRAWN BY
EAG

DRAWING NAME
FIRST FLOOR TECHNOLOGY PLAN - AREA F

DRAWING NO.
T1-5



N

1 FIRST FLOOR TECHNOLOGY PLAN - AREA G
1/8" = 1'-0"

SHEET KEYNOTES

1. PROVIDE CATGEORY 6A DROP FOR WIRELESS ACCESS POINT. PROVIDE 20FT. SLACK LOOP COILED NEATLY AND SUPPORTED ABOVE THE CEILING. TERMINATE CABLES WITH RJ45 MODULAR JACKS AND TEST PER SPECIFICATIONS. NOTE LOCATION ON THE RECORD DRAWINGS AND MARK LOCATION ON THE CEILING WITH A GREEN DOT STICKER.
2. PROVIDE CATGEORY 6A DROP FOR VIDEO SURVEILLANCE CAMERA.
3. PROVIDE CATGEORY 6A DROP FOR WALL MOUNTED WIRELESS ACCESS POINTS.
4. REFER TO DETAIL 2/T5-5 FOR MORE INFORMATION ON AV SYSTEM EQUIPMENTS.
5. PROVIDE CATEGORY 6 DROP FOR EXISTING ACCESS CONTROL AT THIS DOOR. COORDINATE EXACT LOCATION AND TERMINATION WITH OWNER PRIOR TO INSTALLATION.
6. INSTALL MICROPHONE OUTLETS IN EXISTING FLOOR BOX. PROVIDE TWO (2) 1" CONDUITS IN SLAB TO NEAREST ACCESSIBLE CEILING.

krM Architecture+
RDG
kbsd CONSULTING

DAVID HERNANDEZ JR.
REGISTERED
No. 12200632
STATE OF INDIANA
PROFESSIONAL ENGINEER
07.12.2024

ABBREVIATIONS AND TERMS

ø	DIAMETER, PHASE
°F	DEGREES FAHRENHEIT
A	COMPRESSED AIR
AD	AREA DRAIN, ACCESS DOOR
AFF	ABOVE FINISHED FLOOR
AGA	AMERICAN GAS ASSOCIATION
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
AP	ACID PROOF, ACCESS PANEL
APPROX.	APPROXIMATELY
ARCH	ARCHITECT
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASPE	AMERICAN SOCIETY OF PLUMBING ENGINEERS
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AUTO	AUTOMATIC
AVG	AVERAGE
AVS	ACID VENT STACK
AW	ACID WASTE
AWWA	AMERICAN WATER WORKS ASSOCIATION
BF	BARRIER FREE
BFC	BELOW FINISHED CEILING
BHP	BRAKE HORSEPOWER
BLDG	BUILDING
BOP	BOTTOM OF PIPING
BSMT	BASEMENT
BT	BATHTUB
BTM	BOTTOM
BtuH	BRITISH THERMAL UNIT PER HOUR
CA	COMPRESSED AIR
CB	CATCH BASIN
CD	CONDENSATE DRAIN
CO	CARBON DIOXIDE
CFM	CUBIC FEET PER MINUTE
CI	CAST IRON
CMP	CORRUGATED METAL PIPE
CO	CLEANOUT
CP	CIRCULATOR PUMP
CPVC	CHLORINATED POLYVINYL CHLORIDE
CW	COLD WATER
DBP	DOMESTIC BOOSTER PUMP
DCVA	DOUBLE CHECK VALVE ASSEMBLY
DF	DRINKING FOUNTAIN
DH	DRENCH HOSE
DIA	DIAMETER
DN	DOWN
DS	DOWNSPOUT
DW	DISTILLED WATER
DWG	DRAWING
DWV	DRAIN, WASTE & VENT
EA	EACH
EC	ELECTRICAL CONTRACTOR
ECO	EXTERIOR CLEANOUT
EFF	EFFICIENCY
EL	ELEVATION
ES	EMERGENCY SHOWER
EEW	EMERGENCY EYEWASH
EWC	ELECTRIC WATER COOLER
EX	EXISTING
FCO	FLOOR CLEANOUT
FD	FLOOR DRAIN, FIRE DAMPER
FDC	FIRE DEPARTMENT CONNECTION
FH	FUME HOOD
FHC	FIRE HOSE CABINET
FLR	FLOOR
FM	FACTORY MUTUAL
FPM	FEET PER MINUTE
FSC	FIRE SUPPRESSION CONTRACTOR
FT	FOOT, FEET
FTG	FOOTING
G	NATURAL GAS
GA	GAGE OR GAUGE
GAL	GALLON
GC	GENERAL CONTRACTOR
GPD	GALLONS PER DAY
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GT	GREASE TRAP
GW	GREASE WASTE
HB	HOSE BIBB
HD	HEAD (FT.)
Hg	MERCURY
HO	HUB OUTLET
HP	HORSEPOWER, HEAT PUMP
HR	HOUR(S)
HW	HOT WATER
HWR	HOT WATER RETURN
HX	HEAT EXCHANGER
HYD	WALL HYDRANT
Hz	HERTZ
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IN	INCH, INCHES
INT	INTERIOR
INV	INVERT
IPS	INTERNATIONAL PIPE STANDARD
IW	INDIRECT WASTE
KEC	KITCHEN EQUIPMENT CONTRACTOR
kW	KILOWATT
LAB	LABORATORY
L	LAVATORY
LBS	POUNDS
LF	LINEAR FEET
LP	LIQUID PETROLEUM
MAX	MAXIMUM
MB	MOP BASIN
MBH	THOUSAND Btu PER HOUR
MC	MECHANICAL CONTRACTOR
MCA	MINIMUM CIRCUIT AMPS
MFR	MANUFACTURER
MH	MANHOLE
MIN	MINIMUM
MISC	MISCELLANEOUS
N	NITROGEN
NA	NOT APPLICABLE
NC	NORMALLY CLOSED
NEC	NATIONAL ELECTRIC CODE
NFC	NATIONAL FIRE CODE
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN, NITROUS OXIDE
NOM	NOMINAL
NP	NON-POTABLE WATER
NTS	NOT TO SCALE
O	OXYGEN
OD	OUTSIDE DIAMETER
OF/CI	OWNER FURNISHED/CONTRACTOR INSTALLED
OSD	OPEN SITE DRAIN
OW	OIL WASTE
OZ	OUNCE
P	PUMP
RCP	REINFORCED CONCRETE PIPE
RD	ROOF DRAIN
PE	POLYETHYLENE
PH	PHASE
PIV	POST INDICATOR VALVE
PP	POLYPROPYLENE
PPM	PARTS PER MILLION
PRV	PRESSURE REDUCING VALVE
PSI	POUNDS PER SQUARE INCH
PSIG	POUNDS PER SQUARE INCH GAUGE
PVC	POLYVINYL CHLORIDE
PW	PURE WATER
RM	ROOM
RPBP	REQUIRED PRESSURE BACKFLOW PREVENTER
RPM	REVOLUTIONS PER MINUTE
SAN	SANITARY
SF	SQUARE FOOT
SG	SPECIAL GAS
SH	SHOWER
SK	SINK
SPEC	SPECIFICATION
SS	SERVICE SINK, STAINLESS STEEL
STD	STANDARD
T	TURRET
TD	TRENCH DRAIN
TDH	TOTAL DYNAMIC HEAD
TEMP	TEMPERATURE
TET	THERMAL EXPANSION TANK
TMV	THERMOSTATIC MIXING VALVE
TP	TRAP PRIMER
TS	TAMPER SWITCH
TYP	TYPICAL
UL	UNDERWRITERS LABORATORIES
UON	UNLESS OTHERWISE NOTED
UR	URINAL
V	VOLTS, VENT
VAC	VACUUM
VB	VACUUM BREAKER
VFD	VARIABLE FREQUENCY DRIVE
VTR	VENT THROUGH ROOF
W	WASTE, WATT
WB	WASHER BOX
WC	WATER COLUMN, WATER CLOSET
WCO	WALL CLEANOUT
WSB	WATER SUPPLY BOX
YD	YARD DRAIN

PIPING IDENTITY SYMBOLS

Symbol	Description
	FLOW DIRECTION ARROW, PITCH DIRECTION ARROW
	PIPE RISE
	PIPE DROP
	PIPE CAP
	PIPE CONTINUES (REFERENCE ELSEWHERE)
	PIPE GUIDE
	PIPE ANCHOR
	EXPANSION LOOP
	UNION, FLANGED UNION
	GATE VALVE
	BALL VALVE
	GLOBE VALVE
	BUTTERFLY VALVE
	PLUG VALVE
	CHECK VALVE
	PRESSURE REDUCING VALVE
	REDUCED PRESSURE BACKFLOW PREVENTER
	DOUBLE CHECK BACKFLOW PREVENTER
M	DOUBLE DETECTOR CHECK VALVE ASSEMBLY
	ANGLE VALVE
	RELIEF VALVE
	VALVE WITH OUTSIDE STEM & YOKE
S	SOLENOID VALVE
F	FLOW SWITCH
P	PRESSURE SWITCH
T	AQUASTAT
	BALANCE VALVE
	STRAINER
	STRAINER WITH CAPPED BLOWDOWN
	MANUAL AIR VENT
	AUTOMATIC AIR VENT
	VACUUM BREAKER
	TEMPERATURE/PRESSURE TAP
	THERMOMETER
	PRESSURE GAUGE
	AIR FILTER/DRYER
	INLINE PUMP
WHA-A	WATER HAMMER ARRESTER WITH SCHEDULE TYPE
FD	P-TRAP AND RISER
2"FD-1	FLOOR DRAIN WITH SIZE & SCHEDULE TYPE
CO	END OF PIPE CLEANOUT
FCO	FLOOR CLEANOUT
WCO	WALL CLEANOUT
ECO	EXTERIOR CLEANOUT OR RODDING HOLE
HB-1 HYD-1	HOSE BIBB, WALL HYDRANT WITH SCHEDULE TYPE
M	WATER METER
G	GAS METER
4"RD	ROOF DRAIN, OVERFLOW DRAIN WITH SIZE
	POST INDICATOR VALVE
	FIRE DEPARTMENT CONNECTION
TS	VALVE TAMPER SWITCH
	UPRIGHT SPRINKLER HEAD
	PENDANT SPRINKLER HEAD
	DRY PENDANT SPRINKLER HEAD
	CONCEALED SPRINKLER HEAD
	SIDEWALL SPRINKLER HEAD

PIPING LINE SYMBOLS

STORM DRAIN	ST
CONDENSATE DRAIN	CD
SANITARY WASTE (W)	W
GREASE WASTE	GW
SANITARY FORCED MAIN	FM
SANITARY VENT (V)	V
ACID WASTE	AW
ACID VENT	AV
DRAIN	D
INDIRECT WASTE	IW
PUMP DISCHARGE	PD
DOMESTIC COLD WATER (CW)	
DOMESTIC HOT WATER SUPPLY (HW)	
DOMESTIC HOT WATER RETURN (HWR)	
140°F HOT WATER	140°F
140°F HOT WATER RETURN	140°F
NON-POTABLE WATER	NPW
CONDITIONED SOFT WATER	CSW
CHLORINATED WATER	CL
DISTILLED WATER	DI
DEIONIZED WATER	DE
FIRE SUPPRESSION	F
NATURAL GAS (WC OR PSIG)	G
GAS VENT	GV
LIQUID PETROLEUM	LP
MEDICAL COMPRESSED AIR (WC OR PSIG)	MA
MEDICAL VACUUM	MV
OXYGEN	0
NITROGEN	N
NITROUS OXIDE	N0
CARBON DIOXIDE	CO_2
WET VACUUM CLEANING	WVC
DRY VACUUM CLEANING	DVC
COMPRESSED AIR (WC OR PSIG)	A
TEMPERED WATER SUPPLY	TW
RADON	R
OIL WASTE	OW

LINETYPE DESIGNATORS

———	THIN CONTINUOUS LINETYPE INDICATE EXISTING ITEMS TO REMAIN.
– – – –	INTERMEDIATE DASHED LINETYPE INDICATE EXISTING ITEMS TO BE REMOVED.
═══	INTERMEDIATE OR WIDE CONTINUOUS LINETYPE INDICATE NEW ITEMS.
———	THIN HALFTONE LINETYPE INDICATE ITEMS BY OTHER DISCIPLINE.
	INDICATES POINT OF NEW CONNECTION TO EXISTING EQUIPMENT, PIPING OR MATERIALS.
	INDICATES POINT OF DISCONNECTION TO EXISTING EQUIPMENT, PIPING OR MATERIALS.

PLUMBING NOTES

A. ALL WORK ON THE PLUMBING DRAWINGS IS NEW AND BY THIS CONTRACTOR UNLESS OTHERWISE INDICATED.
B. THE PLUMBING CONTRACTOR SHALL INCLUDE IN HIS BID ALLOWANCES, FEES, AND COSTS TO COMPLETE THIS PROJECT.
C. THE PLUMBING CONTRACTOR SHALL FURNISH ALL REQUIRED LABOR AND PROVIDE ALL MATERIAL, EQUIPMENT INCLUDING ALL CONTRACTOR'S SERVICES NECESSARY TO COMPLETE INSTALLATION OF THE REQUIRED SYSTEMS IN FULL CONFORMITY WITH APPLICABLE CODES AND ORDINANCES. THE FINISHED INSTALLATION SHALL BE FUNCTIONAL AND COMPLETE IN EVERY DETAIL INCLUDING ANY AND ALL SUCH ITEMS FOR COMPLETE AND OPERATIONAL SYSTEMS.
D. ALL PLUMBING SYSTEMS TO BE INSTALLED TO MEET THE REQUIREMENTS OF THE INDIANA PLUMBING CODE (2006 INTERNATIONAL PLUMBING CODE WITH THE LATEST INDIANA AMENDMENTS).
E. ALL SOIL, WASTE, VENT, AND STORM PIPING SHALL BE INSTALLED AT THE FOLLOWING MINIMUM SLOPE:1/8" (1%) PER FOOT GRADE FOR PIPE SIZES 3" AND LARGER. 1/4" (2%) PER FOOT GRADE FOR PIPE SIZES 21/2" AND SMALLER.
F. CUTTING AND PATCHING, AND CORE DRILLING FOR PLUMBING WORK SHALL BE THE RESPONSIBILITY OF THE PLUMBING CONTRACTOR.
G. PIPING AND/OR EQUIPMENT SHALL NOT BE SUPPORTED FROM STRUCTURAL MEMBERS WITHOUT PRIOR REVIEW AND APPROVAL FROM THE STRUCTURAL ENGINEER.
H. ALL DOMESTIC WATER PIPING SHALL BE INSULATED. REFER TO INSULATION SCHEDULE IN SPECIFICATIONS.
I. ALL PLUMBING FIXTURES AND EQUIPMENT SHALL CONFORM TO ALL APPLICABLE ENERGY CONSERVATION CODES.
J. ALL PIPING, VALVES, AND ACCESSORIES SERVING EQUIPMENT SHALL CONFORM TO ALL APPLICABLE ENERGY CONSERVATION CODES.
K. ANCILLARY SYSTEMS NOT ASSOCIATED WITH EQUIPMENT SHALL NOT BE INSTALLED SO AS TO INHIBIT SERVICING AND/OR REMOVAL OF SAID EQUIPMENT.
L. STERILIZE DOMESTIC WATER PIPING SYSTEM IN ACCORDANCE WITH STATE AND LOCAL CODES, AND BASE BUILDING SPECIFICATIONS.
M. PRIOR TO THE INSTALLATION, FABRICATION, REMOVAL, OR RELOCATION OF ANY WORK, THE CONTRACTORS SHALL FAMILIARIZE THEMSELVES WITH THE ACTUAL CONDITIONS UNDER WHICH THE WORK IS TO BE PERFORMED AND SHALL FULLY COORDINATE ALL WORK WITH THE ARCHITECTURAL PLANS, BUILDING STRUCTURE, AND WORK OF ALL OTHER TRADES. CONTRACTOR SHALL VERIFY EXISTING INVERTS PRIOR TO CONSTRUCTION.
N. FOUNDATION AND FOOTINGS SHALL NOT BE DISTURBED WITHOUT OBTAINING PERMISSION FROM THE ARCHITECT AND/OR STRUCTURAL ENGINEER. PROPER UNDERPINNING METHODS SHALL BE USED TO PROTECT AFFECTED FOUNDATION COMPONENTS.
O. PROVIDE PIPE ESCUTCHEONS AT EXPOSED PIPE PENETRATIONS AT ALL FINISHED WALLS AND CEILINGS.
P. PROVIDE SLEEVES FOR ALL PIPING THAT PENETRATES FULL HEIGHT WALLS.
Q. PROVIDE A CHECK VALVE ON HOT AND COLD WATER BRANCH LINES SERVING ALL MOP SINKS.
R. PROVIDE WATER HAMMER ARRESTERS PRIOR TO QUICK-CLOSING VALVES (ie: ELECTRIC, PNEUMATIC, SPRING LOADED VALVES OR DEVICES, QUICK HAND CLOSURE VALVES OR FIXTURE TRIM). SIZE ARRESTERS PER SCHEDULE ON DRAWINGS AND PDI-WH 201 CERTIFIED STANDARD.
S. INSULATE ALL PLASTIC PIPING IN RETURN AIR PLENUMS TO MAINTAIN 25/50 FIRE SMOKE RATING AND AS DIRECTED IN SPECIFICATIONS. INSULATION MATERIAL SHALL BE 1/2" CLOSED CELL ELASTOMERIC, UNLESS OTHERWISE INDICATED IN PART 3 OF SPECIFICATION SECTION 220700.
T. COORDINATE VENT PENETRATIONS WITH MECHANICAL ROOF TOP EQUIPMENT, REFER TO "H" SERIES DRAWINGS. OFFSET VENTS AS REQUIRED TO MAINTAIN MINIMUM 10'-0" SEPARATION FROM AIR INTAKES.
U. PROVIDE "LEAD-FREE", "NO-LEAD", AND/OR "LOW-LEAD" PLUMBING FITTINGS COMPLIANT WITH THE FEDERAL LAW IN EFFECT ON JANUARY 4, 2014 - MAXIMUM 0.25% LEAD CONTENT.
V. TELECOMMUNICATIONS ROOMS: (MDF AND IDF) DO NOT ROUTE ANY SYSTEMS OVER EQUIPMENT OR ELECTRICAL COMPONENTS. DO NOT HINDER SERVICE ACCESS.
W. ELECTRICAL EQUIPMENT ROOMS: DO NOT ROUTE ANY SYSTEMS OVER ELECTRICAL EQUIPMENT OR ELECTRICAL COMPONENTS. DO NOT HINDER SERVICE ACCESS.
X. DO NOT ROUTE ANY SYSTEMS ABOVE ELECTRICAL EQUIPMENT OR ELECTRICAL COMPONENTS.

GENERAL NOTES

A. ALL WORK SHALL BE IN ACCORDANCE WITH THE BEST QUALITY STANDARDS OF THE TRADE, AND SHALL CONFORM WITH ALL FEDERAL, STATE, AND LOCAL CODES AND STANDARDS. THE SAME ARE MADE A PART OF THESE CONTRACT DOCUMENTS AS IF REPEATED HEREIN.
B. CONTRACT DOCUMENTS CONSIST OF BOTH THE PROJECT MANUAL AND DRAWINGS, AND BOTH ARE INTENDED TO BE COMPLEMENTARY. ANYTHING APPEARING ON EITHER MUST BE EXECUTED THE SAME AS IF SHOWN ON BOTH.
C. THE CONTRACTOR SHALL INCLUDE IN BID PROPOSAL ALL COSTS REQUIRED TO COMPLETELY AND PROPERLY INSTALL ALL WORK REQUIRED FOR THE PROJECT, AND SHALL EXAMINE THE SCOPE OF WORK OF OTHER TRADES PRIOR TO SUBMITTING A BID PROPOSAL.
D. CONSTRUCTION DOCUMENTS SHALL BE FOLLOWED AS CLOSELY AS POSSIBLE, HOWEVER, SYSTEMS HAVE BEEN SHOWN DIAGRAMATICALLY AND IN SOME CASES, ENLARGED FOR CLARITY. ANY OFFSETS, ADDITIONAL FITTINGS, AND/OR APPURTENANCES REQUIRED TO PROVIDE A COMPLETE AND COORDINATED SYSTEM SHALL BE BORNE BY THE CONTRACTOR.
E. THE ENGINEERING DRAWINGS ARE OF EQUAL IMPORTANCE WITH THE ARCHITECTURAL DRAWINGS IN DEFINING THE WORK OF THE CONTRACT DOCUMENTS. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO CHECK WITH THE ARCHITECTURAL DRAWINGS BEFORE THE INSTALLATION OF ENGINEERING WORK. SHOULD THERE BE A DISCREPANCY BETWEEN THE ARCHITECTURAL DRAWINGS AND THE ENGINEERING DRAWINGS THAT WOULD CAUSE AN AWKWARD OR IMPROPER INSTALLATION, THE DISCREPANCY SHALL BE BROUGHT TO THE ARCHITECTS/ENGINEERS ATTENTION FOR CLARIFICATION PRIOR TO INSTALLATION OF SAID WORK. ANY WORK INSTALLED IN CONFLICT WITH THE ARCHITECTURAL DRAWINGS SHALL BE CORRECTED BY THE CONTRACTOR AT HIS EXPENSE AND AT NO ADDITIONAL COST TO THE OWNER OR ARCHITECT/ENGINEER.
F. DO NOT SCALE THE DRAWINGS. THE DRAWINGS ARE NOT NECESSARILY TO SCALE. THE CONTRACTOR SHALL VERIFY ALL CONDITIONS AND DIMENSIONS AT THE JOB SITE PRIOR TO THE START OF CONSTRUCTION. IF DISCREPANCIES ARE FOUND, THE ARCHITECT/ENGINEER SHALL BE NOTIFIED FOR CLARIFICATION BEFORE COMMENCING THE WORK. EXPLICIT DIMENSIONS SHALL HAVE PRECEDENCE OVER SCALE.
G. DETAILS NOT SHOWN ARE SIMILAR IN CHARACTER TO THOSE SHOWN. WHERE SPECIFIC DIMENSIONS, DETAILS OR DESIGN INTENT CANNOT BE DETERMINED, CONSULT THE ARCHITECT/ENGINEER BEFORE PROCEEDING WITH THE WORK.
H. ANY DETAILS, SYSTEMS AND/OR MATERIALS WHICH ARE PROPOSED TO BE CHANGED MUST FIRST BE REVIEWED BY THE OWNER AND ARCHITECT/ENGINEER PRIOR TO THE PREPARATION OF SHOP DRAWINGS.
I. ALL CONFLICTS, WHICH MAY PREVENT THE COMPLETION OF WORK AS INTENDED, SHALL BE BROUGHT TO THE ARCHITECT'S ATTENTION. THE CONTRACTOR SHALL NOT PROCEED WITH ANY RELATED WORK UNTIL ALL CONFLICTS ARE RESOLVED AND THE CLARIFYING INFORMATION IS ISSUED TO THE CONTRACTOR BY THE ARCHITECT.
J. PROVIDE NFPA APPROVED FIRE STOPPING WHERE PIPES PENETRATE FIRE RATED FLOORS AND WALLS.
K. FIELD VERIFICATION: CONTRACTOR SHALL INSPECT AND VERIFY ALL EXISTING FIELD CONDITIONS, CLEARANCES AND DIMENSIONS BEFORE STARTING CONSTRUCTION. COMMENCEMENT OF WORK CONSTITUTES ACCEPTANCE OF EXISTING CONDITIONS. SHOULD DIFFERENT CONDITIONS BE ENCOUNTERED, CONTACT ARCHITECT/ENGINEER BEFORE PROCEEDING WITH ANY WORK.

PIPE FITTING REPLACEMENT SCOPE OF WORK

A. THE PLUMBING CONTRACTOR SHALL INCLUDE IN HIS BID, ALL MATERIAL AND LABOR TO REPLACE EXISTING GROOVED MECHANICAL FITTINGS WITH NEW PRESS CONNECT FITTINGS FOR PIPE SIZES 2" AND LARGER. PRESS CONNECT FITTINGS TO BE MANUFACTURERED BY VIEGA.
B. 3" AND 4" FITTINGS: (ELBOWS, TEES, COUPLINGS)
   a. VIEGA PRESS FITTINGS (3" AND 4") WILL PRESS DIRECTLY OVER ROLL GROOVES.
   b. REMOVE EXISTING GROOVED FITTING, CLEAN PIPE, INSPECT FOR DAMAGE, INSPECT NEW PRESS CONNECT FITTING, INSTALL FITTING, MARK PIPE, MAKE PRESS.
C. 2" AND 2-1/2" FITTINGS: (ELBOWS, TEES, COUPLINGS)
   a. REMOVE EXISTING GROOVED FITTING, CUT-OFF GROOVED ENDS, CLEAN ENDS, CLEAN PIPE, INSPECT FOR DAMAGE, INSPECT NEW PRESS CONNECT FITTING, INSTALL FITTING, MARK PIPE, MAKE PRESS.
D. INCLUDE THE FOLLOWING AMOUNT OF FITTINGS IN THE BASE BID:
   a. 2" - ELBOWS: 24, TEES: 12
   b. 2-1/2" - ELBOWS: 13, TEES: 6
   c. 3" - ELBOWS: 33, TEES: 18
   d. 4" - ELBOWS: 16, TEES: 6
   e. 6"- ELBOWS: 1, TEES: 0
E. INLCUDE AND ALLOWANCE FOR THE COST TO PROVIDE AND INSTALL ELBOWS, TEES, AND COUPLINGS OF EACH SIZE.
F. INCLUDE AN ALLOWANCE FOR THE COST TO PROVIDE AND INSTALL NEW DOMESTIC WATER WALL HYDRANTS OF THE SAME TYPE AND MANUFACTURER AS CURRENTLY INSTALLED.

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VALVE REPLACEMENT SCOPE OF WORK

A. THE PLUMBING CONTRACTOR SHALL INCLUDE IN HIS BID, ALL MATERIAL AND LABOR TO REPLACE EXISTING VALVES (BUTTERFLY AND BALL) WITH NEW PRESS CONNECT BALL VALVES. PRESS CONNECT BALL VALVES TO BE MANUFACTURERED BY VIEGA.
B. 2" THROUGH 4" VALVES:
   a. REMOVE EXISTING VALVE, CUT-OFF GROOVED ENDS, CLEAN ENDS, CLEAN PIPE, INSPECT FOR DAMAGE, INSPECT NEW PRESS CONNECT BALL VALVE, INSTALL BALL VALVE, MARK PIPE, MAKE PRESS.
   b. AN ADDITIONAL COUPLING WILL BE REQUIRED AT EACH VALVE.
C. 1/2" THROUGH 1-1/2" VALVES:
   a. REMOVE EXISTING VALVE, CLEAN ENDS, CLEAN PIPE, INSPECT FOR DAMAGE, INSPECT NEW PRESS CONNECT BALL VALVE, INSTALL BALL VALVE, MARK PIPE, MAKE PRESS.
   b. AN ADDITIONAL COUPLING WILL BE REQUIRED AT EACH VALVE.
D. INCLUDE THE FOLLOWING AMOUNT OF VALVES IN THE BASE BID:
   a. 1/2" - 0
   b. 3/4" - 85
   c. 1" - 11
   d. 1-1/4" - 0
   e. 1-1/2" - 9
   f. 2" - 12
   g. 2-1/2" - 6
   h. 3" - 7
   i. 4" - 3
E. INCLUDE AND ALLOWANCE FOR THE COST TO PROVIDE AND INSTALL VALVES OF EACH SIZE.

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NOTATION DESIGNATORS

GENERAL NOTES:	NOTES THAT APPLY EQUALLY TO ALL DISCIPLINES WITHIN THE DRAWING SET.
GENERAL PLUMBING NOTES:	NOTES THAT APPLY EQUALLY TO ALL SHEETS WITHIN THE DISCIPLINE.
GENERAL SHEET NOTES:	NOTES THAT APPLY ONLY TO THE SPECIFIC SHEET ON WHICH THEY APPEAR.
SHEET KEYNOTES:	NOTES THAT APPLY ONLY TO THE SPECIFIC SHEET ON WHICH THEY APPEAR AND USE A KEYNOTE INDICATOR TO IDENTIFY ITEMS.

FIRE PROTECTION NOTES

A. ALL FIRE PROTECTION WORK ON THE DRAWINGS IS NEW AND BY THIS CONTRACTOR UNLESS OTHERWISE INDICATED.
B. THE FIRE PROTECTION CONTRACTOR SHALL FURNISH ALL REQUIRED LABOR AND PROVIDE ALL MATERIAL, EQUIPMENT INCLUDING ALL CONTRACTOR'S SERVICES NECESSARY TO COMPLETE THE INSTALLATION OF THE REQUIRED SYSTEMS IN FULL CONFORMITY WITH APPLICABLE CODES AND ORDINANCES. THE FINISHED INSTALLATION SHALL BE FUNCTIONAL AND COMPLETE IN EVERY DETAIL INCLUDING ANY AND ALL SUCH ITEMS FOR COMPLETE AND OPERATIONAL SYSTEMS.
C. FIRE PROTECTION SYSTEM FOR BUILDING SHALL BE DESIGNED FOR LIGHT HAZARD, 0.10 GPM PER SQUARE FOOT OVER 1,500 SQUARE FEET. MECHANICAL, STORAGE AND LAB AREAS SHALL BE DESIGNED FOR ORDINARY HAZARD, 0.15 GPM PER SQUARE FOOT OVER 1,500 SQUARE FEET.
D. SPRINKLER SYSTEM SHALL BE HYDRAULLICALLY CALCULATED, FULLY SUPERVISED AND INSTALLED ACCORDING TO NFPA 13.
E. THE FIRE PROTECTION CONTRACTOR SHALL OBTAIN FLOW TEST DATA BY MEANS OF A FLOW TEST PRIOR TO DESIGN HYDRAULIC CALCULATION OF SPRINKLER SYSTEM.
F. CUTTING AND PATCHING, AND CORE DRILLING FOR FIRE PROTECTION WORK SHALL BE THE RESPONSIBILITY OF THE FIRE PROTECTION CONTRACTOR.
G. THE FIRE PROTECTION CONTRACTOR SHALL BE RESPONSIBLE FOR FINAL COORDINATION, LAYOUT, CODE COMPLIANCE AND DESIGN.
H. PROVIDE UPRIGHT HEADS IN UNFINISHED SPACES (I.E.: THOSE WITH EXPOSED STRUCTURE), RECESSED PENDENT HEADS IN FINISHED SPACES (I.E.: THOSE WITH LAY-IN OR HARD CEILINGS), SIDEWALL HEADS WHERE IMPRACTICAL TO INSTALL PENDENT OR UPRIGHT TYPE, OR AS INDICATED OTHERWISE ON THE DRAWINGS.
I. REFER TO ARCHITECTURAL REFLECTED CEILING PLANS FOR COORDINATION OF CEILING MOUNTED ITEMS.
J. FIRE PROTECTION CONTRACTOR IS RESPONSIBLE TO ATTEND ALL BUILDING WALK-THRU'S (AFTER BUILDING IS OCCUPIED AND PRIOR TO THE END OF THE 1 YEAR WARRANTY PERIOD) BY THE BUILDING FIRE MARSHAL AND IS RESPONSIBLE FOR MAKING ANY MODIFICATIONS TO THE SYSTEM REQUIRED AS A RESULT OF THIS BUILDING INSPECTION.
K. ELECTRICAL EQUIPMENT ROOMS: DO NOT ROUTE ANY SYSTEMS OVER ELECTRICAL EQUIPMENT OR ELECTRICAL COMPONENTS. DO NOT HINDER SERVICE ACCESS.
L. DO NOT ROUTE ANY SYSTEMS ABOVE ELECTRICAL EQUIPMENT OR ELECTRICAL COMPONENTS.
M. INSTALL SPRINKLER HEADS IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS. HEADS SHALL BE INSTALLED TO SATISFY ALL CODE REQUIREMENTS FOR HEAD SPACING.
N. CENTER SPRINKLER HEADS IN GRID OR LAY-IN CEILINGS IN BOTH DIRECTIONS.
O. COORDINATE LOCATIONS OF SPRINKLER HEADS WITH CEILING GRID, DIFFUSERS, LIGHT FIXTURES, AND OTHER OBSTRUCTIONS. PROVIDE ADDITIONAL SPRINKLER HEADS WHICH MAY BE REQUIRED FOR THE COORDINATED CEILING PATTERN AND OR CENTERING, EVEN THOUGH IT MAY EXCEED THE MINIMUM CODE REQUIREMENTS. SHOW ACTUAL SPRINKLER HEAD LOCATIONS IN THE SUBMITTAL AND CLOSEOUT SUBMITTAL.
P. PROVIDE SPRINKLER HEAD GUARDS ON ALL HEADS WHERE THEY MAY BE EXPOSED OR SUBJECT TO DAMAGE.
Q. PROTECT FINISHES AGAINST SCRATCHES, DENTS AND DISCOLORATION. DEFECTIVE ITEMS WILL NOT BE ACCEPTED.
R. ONLY NEW SPRINKLERS SHALL BE INSTALLED. WHEN SPRINKLER HEAD HAS BEEN REMOVED FROM THE PIPING FOR ANY REASON, IT SHALL NOT BE REINSTALLED. INSTALL A NEW SPRINKLER HEAD THAT MATCHES THE SPECIFICATIONS OF THER SPIRNKLER HEADS IN THE SAME COMPARTMENT.
S. PROVIDE ORDINARY TEMPERATURE SPRINKLER HEADS, EXCEPT WHERE HIGHER TEMPERATURE HEADS ARE REQUIRED. SPRINKLER HEADS SHALL BE COLOR CODED.
T. SPRINKLER HEADS LOCATED IN ELECTRICAL SWITCHGEAR ROOMS SHALL BE 212 DEG. F.

REFERENCE SYMBOLS

SECTION INDICATOR:	REFERENCE SECTION LOCATION THROUGH AN AREA FOR ADDITIONAL INFORMATION.	KEYNOTE INDICATOR:	REFERENCE SHEET KEYNOTE LOCATION FOR ADDITIONAL INFORMATION.
SECTION LOCATION IN DRAWING MODULE; BEYOND AREA EXTENSION; PLAN; SECTION LOCATION AT SUBSET SHEET		KEYNOTE INDICATORS; NUMERIC CHARACTER RELATES TO ITEM; POINT LEADER; AREA LEADER; LINE LEADER	
DETAIL INDICATOR:	REFERENCE DETAIL LOCATION FOR ADDITIONAL INFORMATION.	DRAWING BLOCK TITLE INDICATOR:	REFERENCE DRAWING MODULE LOCATION FOR ADDITIONAL INFORMATION.
LARGE SCALE VIEW LOCATION IN DRAWING MODULE; DETAIL LOCATION IN DRAWING MODULE; LARGE SCALE VIEW LOCATION AT SUBSET SHEET; DETAIL LOCATION AT SUBSET SHEET		DRAWING MODULE LOCATION (IDENTIFYING LOWER LEFT OF MULTIPLE MODULES); DRAWING BLOCK TITLE; SCALE: 1/8" = 1'-0"; NUMERIC SCALE; NORTH ARROW	
MATCH LINE INDICATOR:	REFERENCE SHEET LOCATION FOR ADDITIONAL INFORMATION.	REVISION INDICATOR:	REFERENCE TITLE BLOCK LOCATION FOR ADDITIONAL INFORMATION.
FLOOR PLAN OVERLAP; BEYOND AREA EXTENSION; SEE P-102; REFER TO ADDITIONAL SHEET FOR CONTINUATION; PLAN		REVISION INDICATOR; REVISION CLOUD	
EQUIPMENT INDICATOR:	REFERENCE SCHEDULE LOCATION FOR ADDITIONAL INFORMATION.		
TU-XL.## — NUMERIC CHARACTER RELATES TO ITEM; ALPHANUMERIC CHARACTER RELATES TO BUILDING LEVEL (OPTIONAL); ALPHANUMERIC CHARACTER RELATES TO ASSOCIATED AIR HANDLER (OPTIONAL); EQUIPMENT TYPE			

DEMOLITION NOTES

A. CONTRACTOR SHALL COORDINATE WORK WITH ALL OTHER TRADES PRIOR TO INSTALLATION.
B. CONTRACTOR SHALL COORDINATE SHUT DOWN OF ANY PLUMBING SYSTEM WITH THE OWNER AND ANY AUTHORITY HAVING JURISDICTION.
C. CONTRACTOR SHALL PROVIDE TEMPORARY CAPS FOR ALL SERVICES AS REQUIRED SO EXISTING SYSTEMS WILL REMAIN OPERATIONAL.
D. CONTRACTORS SHALL PROTECT ALL EXISTING OWNER FACILITIES DURING CONSTRUCTION. ANY FACILITIES DAMAGED OR DISCONNECTED BY CONTRACTOR OPERATIONS SHALL BE FULLY RESTORED TO PREVIOUS OPERATING AND APPEARANCE CONDITION.
E. CONTRACTOR SHALL REPAIR OR REPLACE PIPE INSULATION DAMAGED DURING DEMOLITION OR RENOVATION WORK TO MATCH ORIGINAL CONDITION.
F. CONTRACTOR SHALL COORDINATE WITH APPROPRIATE TRADE TO CUT AND PATCH FINISHED AREAS AS REQUIRED, UNLESS OTHERWISE NOTED ON DOCUMENTS.
G. CONTRACTOR SHALL REMOVE AND REPLACE CEILINGS, LIGHT FIXTURES, ETC. IN EXISTING BUILDING AS REQUIRED TO PERFORM DEMOLITION AND RENOVATION WORK. AFTER WORK IS COMPLETE, DAMAGED ITEMS SHALL BE REPAIRED TO ORIGINAL CONDITION OR REPLACED.
H. CONTRACTOR SHALL REMOVE ALL PIPING, VALVES, ETC. MADE OBSOLETE AS A RESULT OF NEW CONSTRUCTION AND/OR RENOVATION.
I. CONTRACTOR SHALL THOROUGHLY REVIEW ALL DRAWINGS PRIOR TO ANY DEMOLITION WORK. ANY DEVICES REMOVED ACCIDENTALLY WILL BE REPLACED AT NO ADDITIONAL COST TO OWNER.
J. DISPOSAL OF DEMOLISHED MATERIALS SHALL COMPLY WITH ALL LOCAL, STATE AND FEDERAL REGULATIONS.

NOT ALL NOTES, DESIGNATORS, SYMBOLS OR ABBREVIATIONS MAY APPLY TO THIS PROJECT

krM Architecture+

kbso CONSULTING

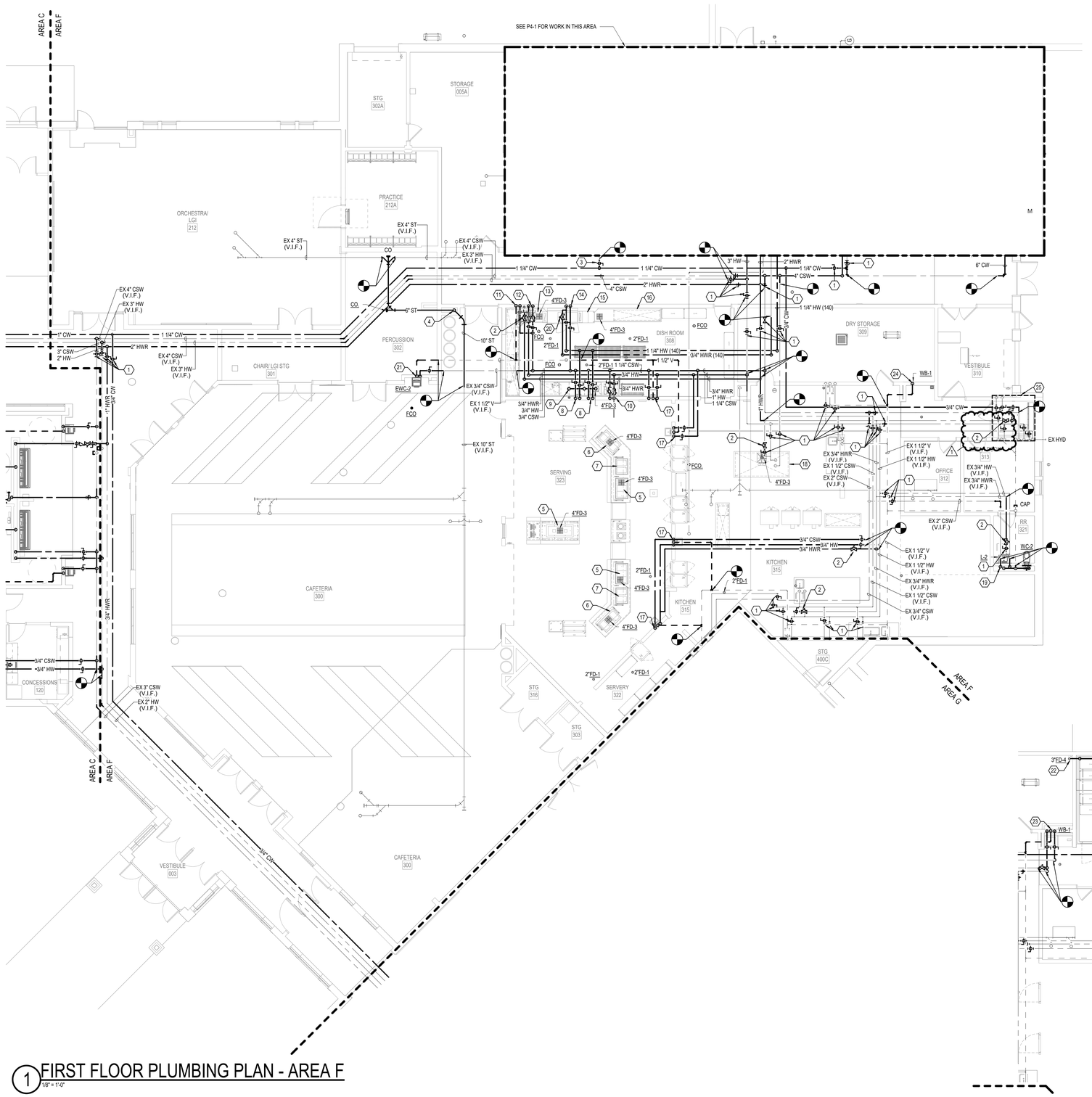
REVISIONS

1	8/06/24	Addendum #2

07.12.2024
HAMILTON SOUTHEASTERN SCHOOL CORPORATION
23055 - FALL CREEK INTERMEDIATE RENOVATIONS
12011 Olio Rd, Fishers, IN 46037
CONSTRUCTION DOCUMENTS

DAVID HERNANDEZ, JR. REGISTERED No. 12200632 STATE OF INDIANA PROFESSIONAL ENGINEER
07.12.2024

CONSTRUCTION DOCUMENTS
07.12.2024
krM JOB NO.
23055
DRAWN BY
MP/SE
DRAWING NAME
SYMBOLS AND ABBREVIATIONS
DRAWING NO.
P000



1 FIRST FLOOR PLUMBING PLAN - AREA F
1/8" = 1'-0"

2 FIRST FLOOR PLUMBING PLAN - KITCHEN ALTERNATE
1/8" = 1'-0"

GENERAL NOTES

A AVOID ALL CONFLICTS BETWEEN PLUMBING SYSTEMS, AND CONDUIT, DUCT, EQUIPMENT, PIPING, STRUCTURAL MEMBERS, AND ANY OTHER OBSTRUCTIONS ENCOUNTERED. PIPING LAYOUTS ARE DIAGRAMMATIC AND SHOW SYSTEM INTENT. PIPING MAY REQUIRE ADDITIONAL OFFSETS, DROPS, RISERS, AND FITTINGS, ETC.

B REFER TO THE "PLUMBING FIXTURE ROUGH-IN SCHEDULE" TO SIZE BRANCH LINES SERVING INDIVIDUAL PLUMBING FIXTURES.

C PROVIDE AN ACCESS PANEL WHERE SHUT-OFF VALVES ARE LOCATED ABOVE INACCESSIBLE CEILINGS OR BEHIND CHASE WALLS.

D PATCH HOLES IN EXISTING WALLS WHERE PIPE WAS REMOVED AND THE HOLE IS NOT REUSED. REFER TO ARCHITETURAL DRAWINGS AND SPECS FOR PATCH METHODS.

E HAMILTON SOUTHEASTERN SCHOOLS HAVE FIRST RIGHT OF REFUSAL OF ALL EQUIPMENT AND FIXTURES BEING REMOVED.

F INSTALL PIPE RESTRAINTS ON ALL WASTE AND STORM PIPING OVER 4" IN DIAMETER. SEE PIPE RESTRAINT DETAIL 11/P5-1.

PIPE FITTING REPLACEMENT SCOPE OF WORK

A THE PLUMBING CONTRACTOR SHALL INCLUDE IN HIS BID, ALL MATERIAL AND LABOR TO REPLACE EXISTING GROOVED MECHANICAL FITTINGS WITH NEW PRESS CONNECT FITTINGS FOR PIPE SIZES 2" AND LARGER. PRESS CONNECT FITTINGS TO BE MANUFACTURED BY VIEGA.

B 3" AND 4" FITTINGS (ELBOWS, TEES, COUPLINGS)
a. VIEGA PRESS FITTING (3" AND 4") WILL PRESS DIRECTLY OVER ROLL GROOVES.
b. REMOVE EXISTING GROOVED FITTING. CEAN PIPE. INSPECT FOR DAMAGE, INSPRECT NEW PRESS CONNECT FITTING, INSTALL FITTING, MARK PIPE, MAKE PRESS.

C 2" AND 2-1/2" FITTINGS: (ELBOWS, TEES, COUPLINGS)
a. REMOVE EXISTING GROOVED FITTING, CUT-OFF GROOVED ENDS, CLEAN ENDS, CLEAN PIPE, INSPECT FOR DAMAGE, INSPECT NEW PRESS CONNECT FITTING, INSTALL FITTING, MARKING PIPE, MAKE PRESS.

D INCLUDE THE FOLLOWING AMOUNT OF FITTINGS IN THE BASE BID:
a. 2" - ELBOWS: 24, TEES: 12
b. 2-1/2" - ELBOWS: 13, TEES: 6
c. 3" - ELBOWS: 33, TEES: 18
d. 4" - ELBOWS: 16, TEES: 6
e. 6"- ELBOWS: 1, TEES: 0

E INCLUDE AN ALLOWANCE FOR THE COST TO PROVIDE AND INSTALL ELBOWS, TEES AND COUPLINGS OF EACH SIZE.

F INCLUDE AN ALLOWANCE FOR THE COST TO PROVIDE AND INSTALL NEW DOMESTIC WATER WALL HYDRANTS OF THE SAME TYPE AND MANUFACTURER AS CURRENTLY INSTALLED.

VALVE REPLACEMENT SCOPE OF WORK

A THE PLUMBING CONTRACTOR SHALL INCLUDE IN HIS BID, ALL MATERIAL AND LABOR TO REPLACE EXISTING VALVES (BUTTERFLY AND BALL) WITH NEW PRESS CONNECT BALL VALVES. PRESS CONNECT BALL VALVES TO BE MANUFACTURED BY VIEGA.

B 2" THROUGH 4" VALVES:
a. REMOVE EXISTING VALVE, CUT-OFF GROOVED ENDS, CLEAN ENDS, CLEAN PIPING, INSPECT FOR DAMAGE, INSPECT NEW PRESS CONNECT BALL VALVE, INSTALL BALL VALVE, MARKE PIPING, MAKE PRESS.
b. AN ADDITIONAL COUPLING WILL BE REQUIRED AT EACH VALVE.

C 1/2" THROUGH 1-1/2" VALVES:
a. REMOVE EXISTING VALVE, CLEAN ENDS, CLEAN PIPE, INSPECT FOR DAMAGE, INSPECT NEW PRESS CONNECT BALL VALVE, INSTALL BALL VALVE, MARK PIPE, MAKE PRESS.
b. AN ADDITIONAL COUPLING WILL BE REQUIRED AT EACH VALVE.

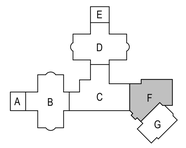
D INCLUDE THE FOLLOWING AMOUNT OF VALVES IN THE BASE BID:
a.1/2" - 0
b. 3/4" - 85
c. 1" - 11
d. 1-1/4" - 0
e. 1-1/2" - 9
f. 2" - 12
g. 2-1/2" - 6
h. 3" - 7
i. 4" - 3

E INCLUDE AN ALLOWANCE FOR THE COST TO PROVIDE AND INSTALL VALVES OF EACH SIZE

SHEET KEYNOTES

1 INSTALL NEW SHUT-OFF VALVE.
2 HOT WATER BALANCING STATION, SET AT 0.5 GPM. SEE HOT WATER BALANCING STATION DETAIL 6/P5-1.
3 3/4" CW.
4 10" ST DOWN IN CHASE. INSTALL CLEANOUT AT THE BASE OF THE STORM RISER.
5 CONNECT 3/4" DRAIN LINE TO KEC SUPPLIED COLD WELL AND EXTEND TO FLOOR DRAIN.
6 CONNECT 3/4" DRAIN LINE TO KEC SUPPLIED HOT WELL AND EXTEND TO FLOOR DRAIN.
7 CONNECT 3/4" DRAIN LINE TO KEC SUPPLIED COLD/HOT WELL AND EXTEND TO FLOOR DRAIN.
8 3/4" CSW DROP AND 3/4"HW (140°) DROP IN WALL. EXTEND TO KEC SUPPLIED FAUCET AND MAKE FINAL CONNECTION.
9 CONNECT 2" DRAIN(S) TO KEC SUPPLIED 3-COMPARTMENT SINK AND EXTEND TO FLOOR DRAIN.
10 3/4" CSW DROP AND 3/4" HW DROP IN WALL. EXTEND TO KEC SUPPLIED WALL MOUNDED HOSE REEL AND MAKE FINAL CONNECTIONS.
11 3/4" CSW DROP, 2" W. DN., AND 1-1/2" V. RISE IN WALL. EXTEND WATER, WASTE, AND VENT TO KEC SUPPLIED GARBAGE DISPOSER AND MAKE FINAL CONNECTIONS.
12 3/4" CSW DROP AND 3/4" HW DROP IN WALL. EXTEND TO KEC SUPPLIED SPLASH MOUNTED PRE-RINSE FAUCET AND MAKE FINAL CONNECTIONS.
13 CONNECT 2" DRAIN LINE FROM KEC SUPPLIED SOILED DISH TABLE AND PIPE TO FLOOR DRAIN.
14 3/4" CSW DROP AND 3/4" HW (140°) DROP IN WALL. CONNECT TO DISHWASHER AND MAKE FINAL CONNECTIONS.
15 CONNECT 1" DRAIN LINE FROM KEC SUPPLIED DISH MACHINE BLOWER DRYER AND PIPE TO FLOOR DRAIN.
16 CONNECT 2" DRAIN LINE FROM KEC SUPPLIED DISH TABLE AND PIPE TO FLOOR DRAIN.
17 3/4" CSW DROP, 3/4" HW DROP, 2" W. DN., AND 1-1/2" V. RISE IN WALL. INSTALL KEC SUPPLIED LAVATORY AND FAUCET AND CONNECT TO WATER, WASTE, AND VENT.
18 EXTEND EXISTING 3/4" CSW AND 3/4" HW DOWN THROUGH CHASE AND RECONNECT TO EXISTING. EXTEND DRAIN TO NEW FLOOR DRAIN.
19 1-1/2" CSW DROP AND 3/4" HW DROP IN CHASE. BRANCH AND EXTEND WATER THROUGH CHASE TO FIXTURES. PROVIDE WHA-B ON CW PIPING BEFORE WATER CLOSET CONNECTION.
20 HOT WATER BALANCING STATION, SET AT 1.5 GPM. SEE HOT WATER BALANCING STATION DETAIL 6/P5-1.
21 2" W. DN., 1-1/2" V. RISE, 3/4" CSW DROP.
22 ALTERNATE BID: CONNECT 3/4" DRAIN LINE TO KEC SUPPLIED COOLER BLOWER COIL AND EXTEND TO FLOOR DRAIN.
23 ALTERNATE BID: 2" W. DN., 1-1/2"V. RISE, 3/4" CSW DROP AND 3/4" HW DROP IN WALL. SEE WASHING MACHINE BOX DETAIL 10/P5-1.
24 BASE BID: 2" W. DN., 1-1/2" V. RISE. SEE MECHANICAL PLANS (M-SERIES) FOR CONDENSATE ROUTING.
25 BASE BID: ALL DOMESTIC WATER, GAS, VENT, AND WASTE IN THIS AREA SHALL REMAIN

KEY PLAN



REVISIONS

1	8/06/24	Addendum #2

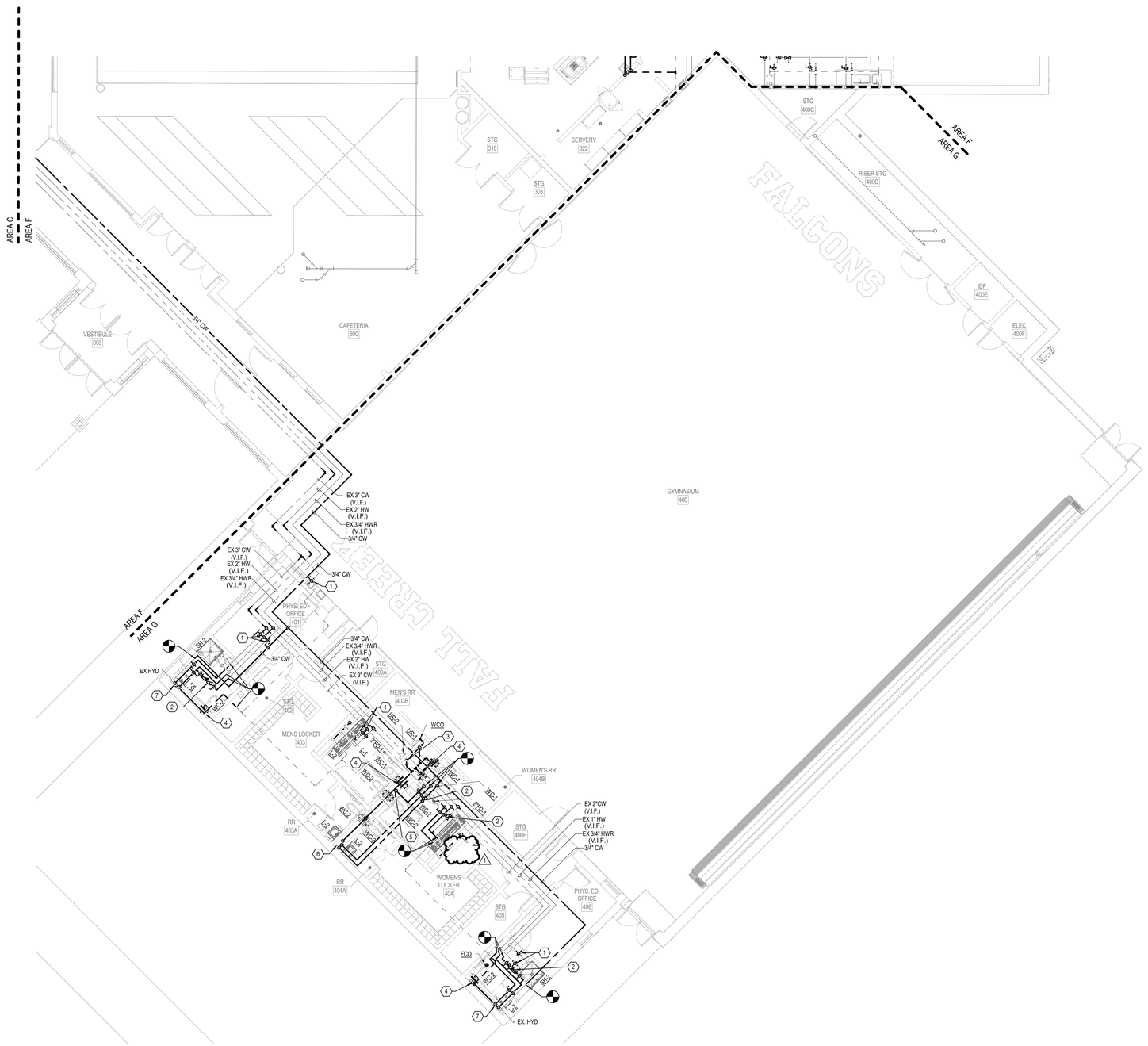
07.12.2024
HAMILTON SOUTHEASTERN SCHOOL CORPORATION
23055 - FALL CREEK INTERMEDIATE RENOVATIONS
12011 Olio Rd. Fishers, IN 46037
CONSTRUCTION DOCUMENTS

DAVID HERNANDEZ JR. REGISTERED No. 12200632 STATE OF INDIANA PROFESSIONAL ENGINEER 07.12.2024

CONSTRUCTION DOCUMENTS
07.12.2024
krM JOB NO.
23055
DRAWN BY
MP/SE

DRAWING NAME
FIRST FLOOR PLUMBING PLAN - AREA F

DRAWING NO.
P1-5



1 FIRST FLOOR PLUMBING PLAN - AREA G
1/8" = 1'-0"

GENERAL NOTES

A AVOID ALL CONFLICTS BETWEEN PLUMBING SYSTEMS, AND CONDUIT, DUCT, EQUIPMENT, PIPING, STRUCTURAL MEMBERS, AND ANY OTHER OBSTRUCTIONS ENCOUNTERED. PIPING LAYOUTS ARE DIAGRAMMATIC AND SHOW SYSTEM INTENT. PIPING MAY REQUIRE ADDITIONAL OFFSETS, DROPS, RISERS, AND FITTINGS, ETC.

B REFER TO THE "PLUMBING FIXTURE ROUGH-IN SCHEDULE" TO SIZE BRANCH LINES SERVING INDIVIDUAL PLUMBING FIXTURES.

C PROVIDE AN ACCESS PANEL WHERE SHUT-OFF VALVES ARE LOCATED ABOVE INACCESSIBLE CEILINGS OR BEHIND CHASE WALLS.

D PATCH HOLES IN EXISTING WALLS WHERE PIPE WAS REMOVED AND THE HOLE IS NOT REUSED. REFER TO ARCHITETURAL DRAWINGS AND SPECS FOR PATCH METHODS.

E HAMILTON SOUTHEASTERN SCHOOLS HAVE FIRST RIGHT OF REFUSAL OF ALL EQUIPMENT AND FIXTURES BEING REMOVED.

F INSTALL PIPE RESTRAINTS ON ALL WASTE AND STORM PIPING OVER 4" IN DIAMETER. SEE PIPE RESTRAINT DETAIL 11/P5-1.

PIPE FITTING REPLACEMENT SCOPE OF WORK

A THE PLUMBING CONTRACTOR SHALL INCLUDE IN HIS BID, ALL MATERIAL AND LABOR TO REPLACE EXISTING GROOVED MECHANICAL FITTINGS WITH NEW PRESS CONNECT FITTINGS FOR PIPE SIZES 2" AND LARGER. PRESS CONNECT FITTINGS TO BE MANUFACTURED BY VIEGA.

B 3" AND 4" FITTINGS (ELBOWS, TEES, COUPLINGS)
a. VIEGA PRESS FITTING (3" AND 4") WILL PRESS DIRECTLY OVER ROLL GROOVES.
b. REMOVE EXISTING GROOVED FITTING. CEAN PIPE. INSPECT FOR DAMAGE, INSPRECT NEW PRESS CONNECT FITTING, INSTALL FITTING, MARK PIPE, MAKE PRESS.

C 2" AND 2-1/2" FITTINGS: (ELBOWS, TEES, COUPLINGS)
a. REMOVE EXISTING GROOVED FITTING, CUT-OFF GROOVED ENDS, CLEAN ENDS, CLEAN PIPE, INSPECT FOR DAMAGE, INSPECT NEW PRESS CONNECT FITTING, INSTALL FITTING, MARKING PIPE, MAKE PRESS.

1 D INCLUDE THE FOLLOWING AMOUNT OF FITTINGS IN THE BASE BID:
a. 2" - ELBOWS: 24, TEES: 12
b. 2-1/2" - ELBOWS: 13, TEES: 6
c. 3" - ELBOWS: 33, TEES: 18
d. 4" - ELBOWS: 16, TEES: 6
e. 6" - ELBOWS: 1, TEES: 0

E INCLUDE AN ALLOWANCE FOR THE COST TO PROVIDE AND INSTALL ELBOWS, TEES, AND COUPLINGS OF EACH SIZE.

F CONTRACTOR SHALL REMOVE AND REPLACE ALL EXISTING NEW DOMESTIC WATER WALL HYDRANTS OF THE SAME TYPE AND MANUFACTURER AS CURRENTLY INSTALLED.

VALVE REPLACEMENT SCOPE OF WORK

A THE PLUMBING CONTRACTOR SHALL INCLUDE IN HIS BID, ALL MATERIAL AND LABOR TO REPLACE EXISTING VALVES (BUTTERFLY AND BALL) WITH NEW PRESS CONNECT BALL VALVES. PRESS CONNECT BALL VALVES TO BE MANUFACATURED BY VIEGA.

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b. AN ADDITIONAL COUPLING WILL BE REQUIRED AT EACH VALVE.

C 1/2" THROUGH 1-1/2" VALVES:
a. REMOVE EXISTING VALVE, CLEAN ENDS, CLEAN PIPE, INSPECT FOR DAMAGE, INSPECT NEW PRESS CONNECT BALL VALVE, INSTALL BALL VALVE, MARK PIPE, MAKE PRESS.

1 D INCLUDE THE FOLLOWING AMOUNT OF VALVES IN THE BASE BID:
a. 1/2" - 0
b. 3/4" - 85
c. 1" - 11
d. 1-1/4" - 0
e. 1-1/2" - 9
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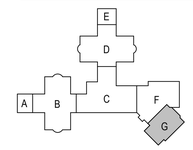
E INCLUDE AN ALLOWANCE FOR THE COST TO PROVIDE AND INSTALL VALVES OF EACH SIZE

SHEET KEYNOTES

1 INSTALL NEW SHUT-OFF VALVE.
2 HOT WATER BALANCING STATION, SET AT 0.5GPM. SEE HOT WATER BALANCING STATION DETAIL 6/P5-1.
3 3" W. DN. AND 1-1/2" V RISE.
4 4" W. DN. AND 2" V. RISE.
5 2-1/2" CSW DROP IN CHASE. BRANCH CSW PIPING THROUGH CHASE TO FIXTURES. PROVIDE WHA-B BEFORE LAST FIXTURE CONNECTION.
6 3/4" HW DROP AND 3/4" HWR DROP IN CHASE. CONNECT TO HWR TO HW PIPING IN CHASE. SEE TYPICAL WATER SUPPLY HEADER PIPING DETAIL 12/P5-1.
7 1-1/2" CSW DROP IN CHASE. BRANCH CSW PIPING THROUGH CHASE TO FIXTURES. PROVIDE WHA-B BEFORE LAST FIXTURE CONNECTION.

KEY PLAN



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P1-6