Addendum

App Architecture
creative focused design

615 Woodside Drive, Englewood, Ohio 45322
T 937.836.8898 F 937.832.3696
www.app-arch.com

DATE: 08/13/2020

PROJECT: Beavercreek Township Fire Station No. 65

PROJECT ADDRESS: 1777 Trebein Road
Beavercreek Township, Ohio 45385

ADDENDUM NO. 1

RECEIPT OF THIS ADDENDUM MUST BE NOTED ON THE FORM OF PROPOSAL

TO ALL BIDDERS:

This addendum supplements and amends the original Plans and Specifications and shall be taken into account in preparing proposals and shall become part of the Contract Documents.

GENERAL ITEMS:

ITEM G1 PRE-BID MEETING MINUTES
1. Refer to attached.

ITEM G2 PRE-BID CHAT-LOG
1. Refer to attached.

ITME G3 BIIDER QUESTIONS & ANSWERS

Q1. Is there a spec on the solid surface shower enclosers?
A1. Information for the showers is in 06 4023 Interior Architectural Woodwork.

Q2. Is there a certain style of Cherry Gravel you are looking for? Can it be substituted?
A2. The landscaper can propose a locally available decorative gravel and submit the 5 lb. sample for Client approval.

Q3. Are there soil borings available?
A3. Yes- Refer to attached.

Q4. Sheet A1.51 on the Equipment Schedules specifically the CFCI schedule, I need specifications for items EQ 40, 41, 42 (42).
A4. EQ-40: ¾" diameter eye-bolt, galvanized.
To be epoxied into CMU. Through bolting is also acceptable.

EQ-41: Repelling anchor, swivel, 10,000 lbs.
Product is based on CMC, CT swivel, 5/8" anchor, 10k, steel. Bolt length to be long enough to bolt through wall, aluminum tread plate, and swivel.
https://www.cmcpro.com/equipment/swivel-steel-anchor/
Alternate manufacturers are acceptable if approved by architect during construction.

EQ-42: 1/8" aluminum tread plate
Type 6061 Aluminum diamond plate – mill finish.

Q5. Will you provide a Glass Awning specification?
A5. Detailed glass awning information is called out on sheet A5.09.

Q6. Will you provide a signage specification?
A6. Refer to item AS1 and the attached specification section 10 1419.

Q7. The Dovetail Structural Roof Deck on sheets A5.06 and A5.12, is that simply a dovetail metal deck?
A7. Dovetail roof deck is called out on the structural sheet S1.12.

Q8. The Insulated Nail Base Panel System is shown specifically at F2/A5.06. Is this specified in section 061600 item 2.5 Composite Nail Base Insulated Roof Sheathing? 5" thick? Also, where is this used?
A8. The insulated nail base panel system is specified in specification section 06 1600, part 2.5 Composite nail base insulated roof sheathing.
The overall thickness of the composite nail base insulated roof sheathing is 5" as called out in specification section 06 1600, part 2.5, A.,5.
Sheet A1.31 indicated the limits of the composite nail base insulated roof sheathing. Refer to the roof plan legend.

Q9. Who is responsible for the Radio Tower? Are we to install concrete footings?
A9. The Owner will be hiring a turn-key contractor to provide and install the radio tower, including the concrete footings.

Q10. Please confirm Material testing is by the Owner.
A10. Yes- all testing and special inspections are by the Owner.

Q11. Can we visit the site? Will there be an official site visit?
A11. Yes- you can visit at any time without contacting the Township.

ARCHITECTURAL SPECIFICATIONS:

ITEM AS1 SECTION 10 1419 – DIMENSIONAL LETTER SIGNAGE
This specification section is added to the project manual. Refer to attached.

ARCHITECTURAL DRAWINGS:

ITEM A1 Drawing Sheet A3.01
Construction note 21 is revised to read, "METAL DIMENSIONAL LETTERING. 1" DEEP, NON-ILLUMINATED CHANNEL LETTERS WITH 1/8" THICK FACES SET UP TO BE STUD MOUNTED TO BUILDING. PROVIDE SPACERS TO ALLOW LETTERING TO BE OFFSET 1" FROM FACE OF BUILDING FAÇADE. ARIAL BOLD TYPE FACE, HEIGHT AND JUSTIFICATION AS SHOWN."

SUBSTITUTION REQUESTS:

ITEM SR1 Snow guard approved equal substitution request: Sno-Gem iClad-S Clamp to Seam Snow Retention. Refer to attached.

END OF ADDENDUM NO. 1

ATTACHMENTS:
Pre-Bid meeting minutes
Pre-Bid Chat Log
Drawing sheets – A3.01
Substitution Requests – SR1
Specifications – 10 1419 Dimensional Letter Signage
Geotechnical Report

Pre-Bid Meeting Minutes

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615 Woodside Drive, Englewood, Ohio 45322
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DATE: 08/05/20

PROJECT: **New Fire/EMS Station 65**

SIGN-IN &INTRODUCTIONS: Owner – App Architecture/Consultants – Contractors
Township Administrator Alex Zaharieff
Fire Chief David VandenBos
Division Chief Nathan Hiester
Tim Bement – App Architecture Principal in Charge
Curt Sparks – Project Manager
Brenda Lynn- Construction Administrator
Nauman & Zelinski, LLC- PME Design
Choice One Engineering- Civil/Site Design

GENERAL SCOPE OF PROJECT:

- Single Prime Contract covering all branches of Work.
- Project History – the project was originally designed using a Construction Manager at Risk approach. It was bid in August of 2018, but was subsequently shelved due to the high cost of construction at the time. The Township was successful at passing a bond levy in November, 2019 to fund the project. In early 2020, the Township explored a new financing method working with a Developer in a lease to own arrangement. The Township ultimately decided to not pursue that avenue and is now bidding the project under the normal Bid-Build project delivery approach.

REVIEWED PROJECT DESIGN RENDERINGS

BID REQUIREMENTS:

- Bid due date – Wednesday, August 26 at 11:00am
- Bids due at Beavercreek Township Fire Administration 851 Orchard Lane
- Use bid forms provided in the Project Manual.
- Bid Bond required.
- Performance and Payment Bond required.
- Use of local subcontractors and suppliers is encouraged.
- Last day for substitution requests – Tuesday, August 18.
- Last day for questions is Thursday, August 20 at 5:00 pm.

REVIEW DRAWINGS AND SPECS

Forcemain- there is a forcemain sewage system that will be directionally bored for about ¾ mile south on Trebein Road.

Storm shelter- this room doubles as an enlarged restroom located within the clean-up/decon. room.

SUPPLEMENTARY CONDITIONS:

- Permits- the general building permit is ready for pick-up at Greene County. Permit fee will be paid for by the Owner. All other permit costs are the responsibility of the GC.
- Owner is sales tax exempt.
- Payment of Prevailing Wages is required.

TEMPORARY FACILITIES:

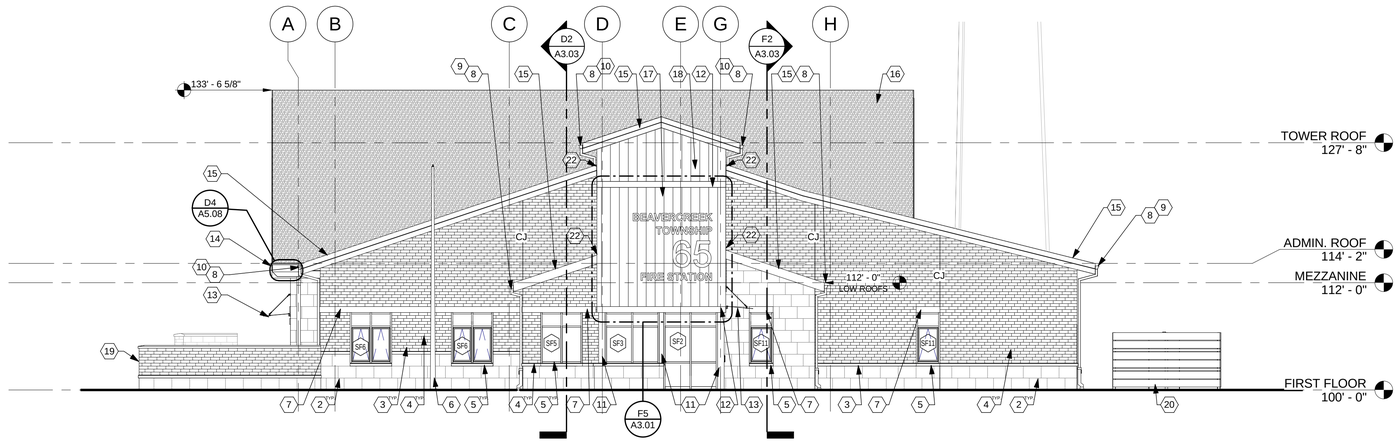
- Temporary Utilities – temporary electric will be by the GC.
- Field offices, storage trailers by the GC.
- Temporary toilets by the GC.
- Organization and the use of site will be the responsibility of the GC.

CONTRACTOR QUESTIONS:

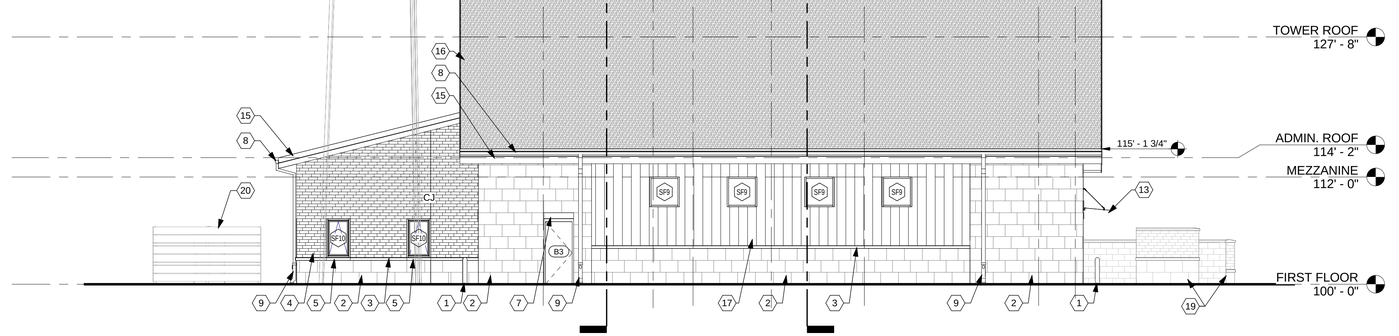
Direct architectural, structural and site bid questions to Curt Sparks at App Architecture via email: curt.sparks@app-arch.com and tim.bement@app-arch.com . Direct mechanical and electrical bid questions to Nauman & Zelinski.

Contractors may visit the site at any time without making an appointment. 1777 Trebein Road

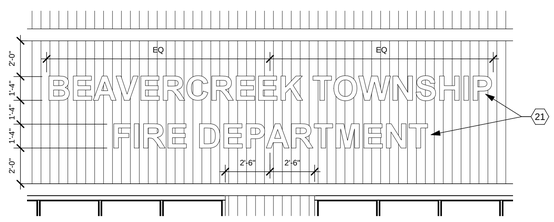
All necessary clarifications will be made by Addendum.



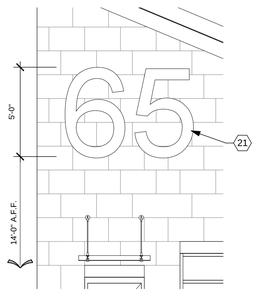
B2 NORTH ELEVATION
1/8" = 1'-0"



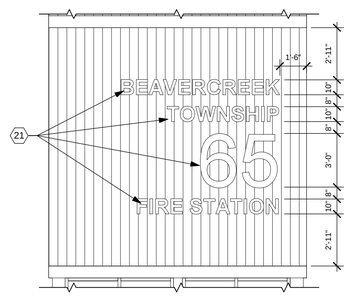
E2 SOUTH ELEVATION
1/8" = 1'-0"



F2 DIMENSIONAL LETTERING DETAIL
1/4" = 1'-0"



F4 DIMENSIONAL LETTERING DETAIL
1/4" = 1'-0"



F5 DIMENSIONAL LETTERING DETAIL
1/4" = 1'-0"

CONSTRUCTION NOTES

00 INDICATES CONSTRUCTION NOTE.

1 METAL PIPE BOLLARD (TYP) AT ALL OVERHEAD DOORS AND WHERE NOTED. REFER TO SHEET A5.04 FOR DETAILS.

2 16"x 24"x 4" BURNISHED FACE CMU VENEER.

3 CAST STONE WATER TABLE.

4 UTILITY BRICK VENEER.

5 CAST STONE SILL.

6 FLAG POLE.

7 8" TALL CAST STONE TRIM BAND.

8 7" PREFINISHED GALVALUME GUTTER.

9 4"x 6" PREFINISHED GALVALUME DOWNSPOUT WITH ADAPTOR. BASIS OF DESIGN: PIEDMONT MANUFACTURING, PIEDMONT PIPE DOWNSPOUT - MODEL SO. REFER TO SHEET A5.08 FOR DETAILS. DOWNSPOUT COLOR TO MATCH GUTTER. ADAPTOR COLOR TO BE PICKED BY ARCHITECT FROM MANUFACTURER'S STANDARD OPTIONS.

10 4"x 6" PREFINISHED GALVALUME DOWNSPOUT. DISCHARGE ON TO ROOF BELOW. COLOR TO MATCH GUTTER.

11 BREAK METAL TO MATCH STOREFRONT MULLIONS.

12 8" PHENOLIC PLANKING SIDING (PPS3) INSTALLED HORIZONTALLY. REFER TO SHEET A5.11 FOR TYPICAL DETAILS.

13 GLASS AWNING CENTERED ABOVE DOOR OPENING. REFER TO SHEET A5.09 FOR DETAILS.

14 PREFINISHED GALVALUME CONDUCTOR HEAD.

15 PREFINISHED GALVALUME FASCIA. COLOR TO BE SELECTED BY ARCHITECT FROM MANUFACTURER'S STANDARD COLORS.

16 ASPHALT SHINGLES OVER 30# FELT.

17 PHENOLIC PLANK SIDING (PPS1). REFER TO SHEET A5.11 FOR TYPICAL DETAILS.

18 PHENOLIC PLANK SIDING (PPS2). REFER TO SHEET A5.11 FOR TYPICAL DETAILS.

19 MASONRY SCREEN WALL. REFER TO SHEET A5.10 FOR DETAILS.

20 WOOD SCREEN FENCE. REFER TO SHEET A5.10 FOR DETAILS.

21/2 METAL DIMENSIONAL LETTERING. 1" DEEP, NON ILLUMINATED CHANNEL LETTERS WITH 1/8" THICK ALUMINUM FACES SET UP TO BE STUD MOUNTED TO BUILDING. PROVIDE SPACERS TO ALLOW LETTERING TO BE OFFSET 1" FROM FACE OF BUILDING FACADE. ARIAL BOLD TYPE FACE, HEIGHT AND JUSTIFICATION AS SHOWN.

22 VENT AT ROOF/WALL CONNECTION. REFER TO F1/A5.08 FOR DETAILS.

GENERAL NOTES

A. ALL MASONRY VENEER IS 1/3 RUNNING BOND.

B. FOR SIDEWALKS AND EXTERIOR PADS REFER TO CIVIL SITE PLAN AND LANDSCAPE PLAN.

C. "CJ" = MASONRY CONTROL JOINT

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STATE OF OHIO TIMOTHY J. BERNERT REGISTERED ARCHITECT 12305
Timothy J. Bernert, License #12305
Expiration Date 12/31/2021

Beavercreek Township
Fire Station No. 65
1777 Trebein Road, Beavercreek Township, Ohio 45385

ISSUE:

NO.	DATE	DESCRIPTION
	04/03/2020	FOR CONSTRUCTION
2	08/12/2020	ADDENDUM 1

DATE	04/03/2020
JOB NO.	3541.01
DRAWN	CMS
CHECKED	TJB
CAD	-

TITLE
EXTERIOR ELEVATIONS

SHEET NO.
A3.01

8/12/2020 4:55:24 PM

SUBSTITUTION REQUEST FORM

(During Procurement)

To App Architecture Date: 8/7/20

Project Fire Station No. 65 Project

We hereby submit for your consideration for the following product instead of the specified item(s) for the above project:

Section	Article/Paragraph (Page)	Specified Item
07 7253 - 2	2.2 A.	Seam-Mounted, Rail-Type Snow Guards

Proposed Substitution: Sno-Gem iClad-S Clamp to Seam Snow Retention

Manufacturer: SNO-GEM INC. Phone: 815-477-4367

Attach complete technical data including laboratory test if applicable.

Include complete information changes to Drawings and/or Specifications which proposed substitution require for proper installation.

Fill in blanks below, use additional sheets if necessary:

A. Does the substitution affect dimensions shown on drawings?

No

B. Will the undersigned pay for changes to building design, including engineering and detailing costs caused by substitution, if any?

No

C. What effect does substitution have on other trades?

None

D Difference between proposed substitution and specified item?

None

E. Manufacturer's guarantees of proposed and specified items are:

X Same _____ Different (explain on attachment)

The undersigned certifies that the function, appearance and quality are equivalent or superior to the specified item

Submitted By:

Michael Dorrington

Signature

Firm Sno-Gem Inc.

Address 4800 Metalmaster Way

McHenry, IL 60050

Telephone 815-477-4367

Fax 815-455-4367

For Use By Design Consultant

Accepted as Noted Accepted

Not Accepted Received too Late

PM

Specifier

Date 08/07/2020

Remarks

Telephone

Curt Sparks

App Architecture

creative focused design

SNO GEM®

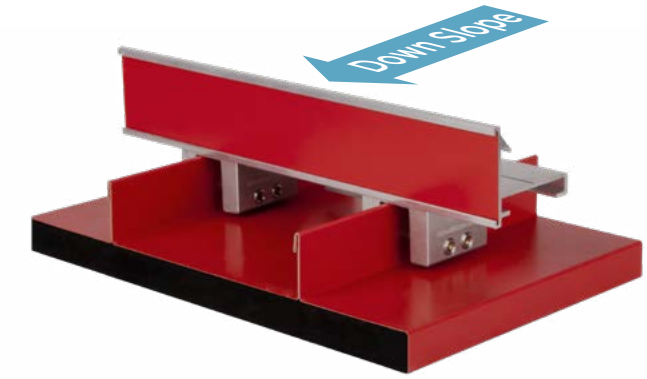
Raising the Bar in Snow Retention

SELL SHEET

2” iClad-S™ Snow Retention System

For Standing Seam Metal Roof Systems

- Aircraft-Grade Aluminum Extrusion
- Utilizes Patent-Pending WaveLock™ Technology
- Attach to Virtually Any Standing Seam Profile
- Unparalleled Strength & Easy-to-Install
- No Painting Required
- Non-Penetrating Seam Attachment
- iPlate™ for Sliding Snow & Ice
- Made in the USA



Typical 2” iClad-S™ Assembly

Overview

Sno Gem’s® 2” iClad-S™ is an innovative clamp to the seam bar/fence snow retention system that utilizes the Sno Cube™ Clamp. The Sno Cube™ can attach to virtually any standing seam profile and provides unparalleled strength using Sno Gem’s® WaveLock™ Technology with 3 points of attachment. Offering easy installation, Sno Cube’s™ Silver Bullet™ set screws include a rounded bullet tip to maximize strength that won’t damage the paint finish or pierce the seam. Additionally, the iClad-S™ system comes in standard mill finish aluminum material, making it an item you can easily keep in stock when the need arises. Once installed, it only takes seconds to attach the pre-finished metal strip from the material that was used to install the panels (not included) onto the face of the iBeam™ to have an aesthetically pleasing and effective snow retention system that matches your standing seam roof system.

For additional details, engineered layouts (if desired), technical questions, or to get an estimate, visit snogem.com or call 888-SNO-GEMS.

Full Line of Sno Cubes™ for Various Standing Seam Profiles

Sno Cube™

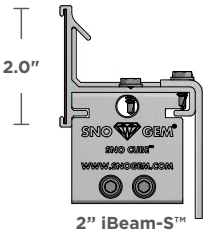
Sno Cube™ Mini

Sno Cube™ KLOC

Sno Cube™ KLOC Mini

Sno Cube™ Wide

Side Profile



2” iBeam-S™

Front View

HD Clamps

Sno Cube™ HD

All Sno Cubes™ also available in HD (Heavy Duty) with 5 set screws for heavy snow load applications.

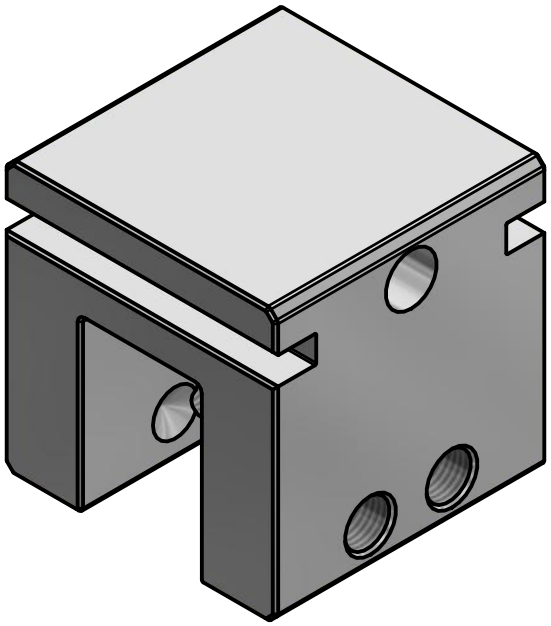
*Seller assumes no responsibility for the warranty. Check your roof manufacturer’s warranty information before installation.

4800 Metalmaster Way, McHenry, IL 60050 | www.snogem.com | info@snogem.com
Phone: 815-477-4367 | Toll-Free: 888-SNO-GEMS (766-4367) | Fax: 815-455-4367

*** SNO GEM PRODUCT CUT SHEET ***

GENERAL NOTES:

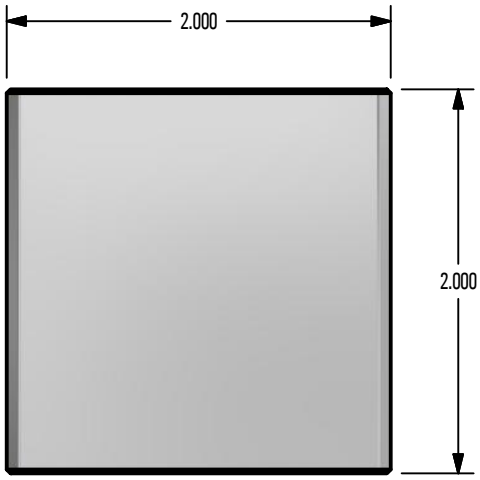
1. FOR CLARITY THIS DRAWING IS NOT TO SCALE.
2. CONTACT THE MANUFACTURER FOR RECOMMENDED LAYOUTS, SPACING, AND ADDITIONAL DETAILS.
3. INSTALLATION MUST BE COMPLETED WITH MANUFACTURERS WRITTEN SPECIFICATIONS AND INSTALLATION INSTRUCTIONS.
4. THESE DRAWINGS ARE SUBJECT TO CHANGE WITHOUT NOTICE.



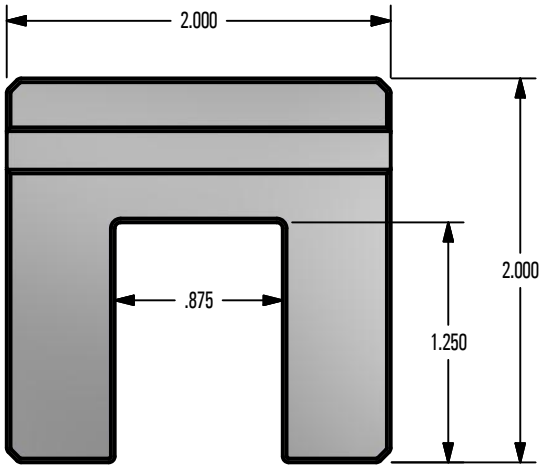
FINISH SELECTION:

☐ MILL FINISH

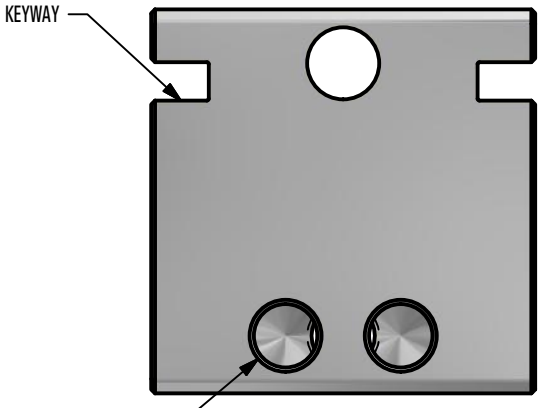
☐ COLOR TO CLOSELY MATCH



TOP VIEW



FRONT VIEW



RIGHT VIEW

SNO GEM®
Raising the Bar in Snow Retention
4800 METALMASTER WAY - McHENRY, IL 60050
PHONE: 815.477.GEMS WEBSITE: WWW.SNOGEM.COM
FAX: 815.455.GEMS E-MAIL: INFO@SNOGEM.COM

SNO CUBE

DRAWN BY:	rhoeffleur
DATE:	1/27/2018
SCALE:	N.T.S.
MATERIAL:	Aluminum

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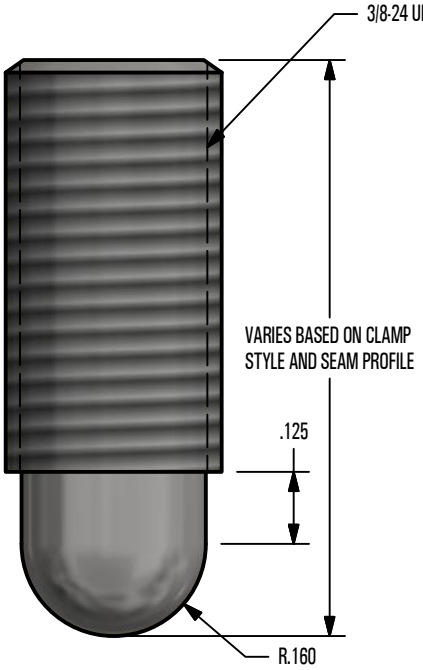
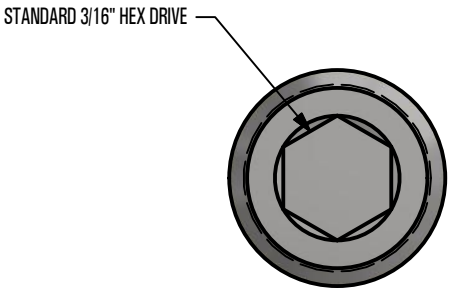
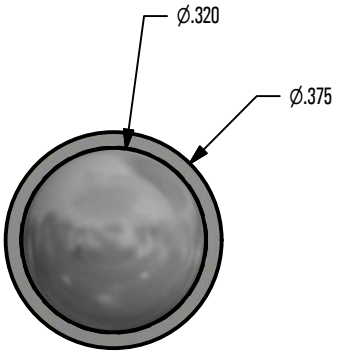


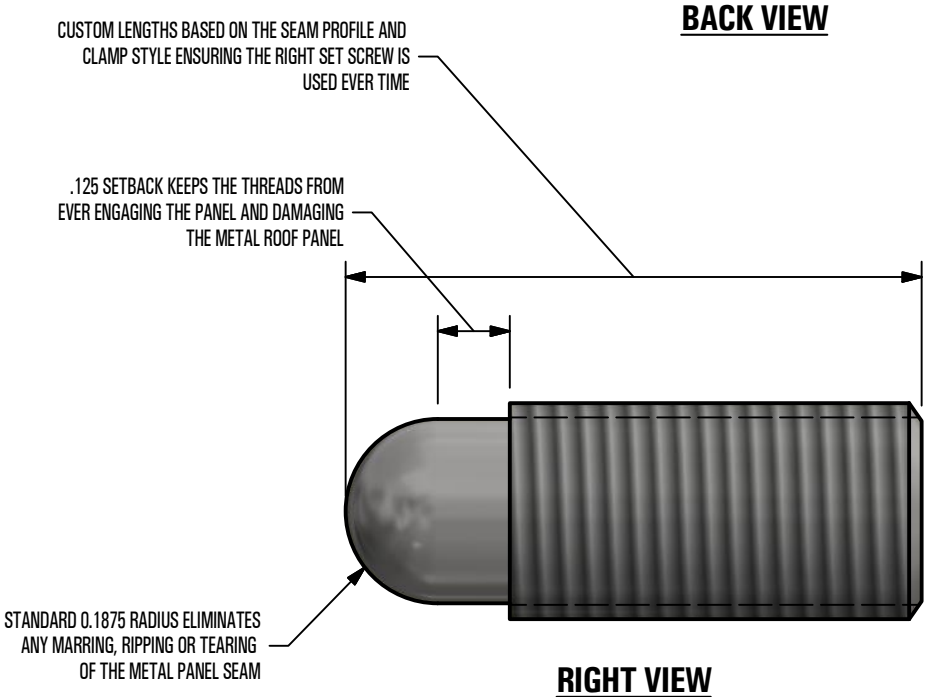
TOP VIEW



BACK VIEW



FRONT VIEW



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FAX: 815.455.GEMS E-MAIL: INFO@SNOGEM.COM

SILVER BULLET

DRAWN BY:	rhoeffleur
DATE:	1/27/2018
SCALE:	N.T.S.
MATERIAL:	Stainless Steel

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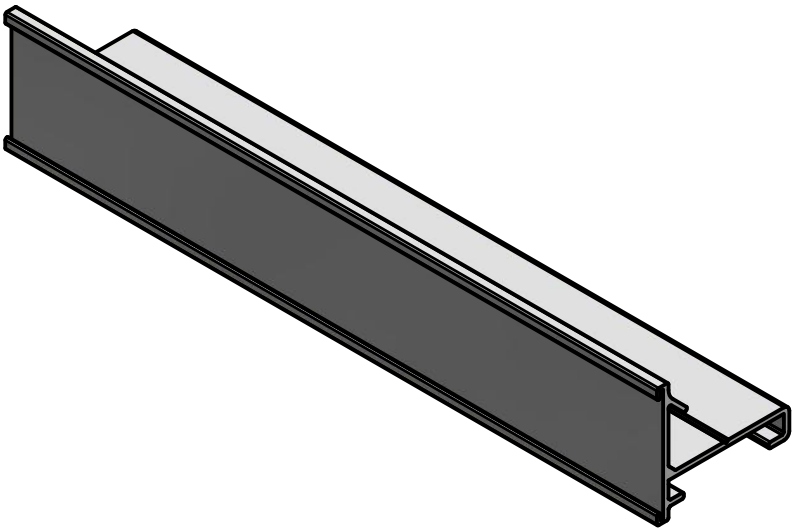
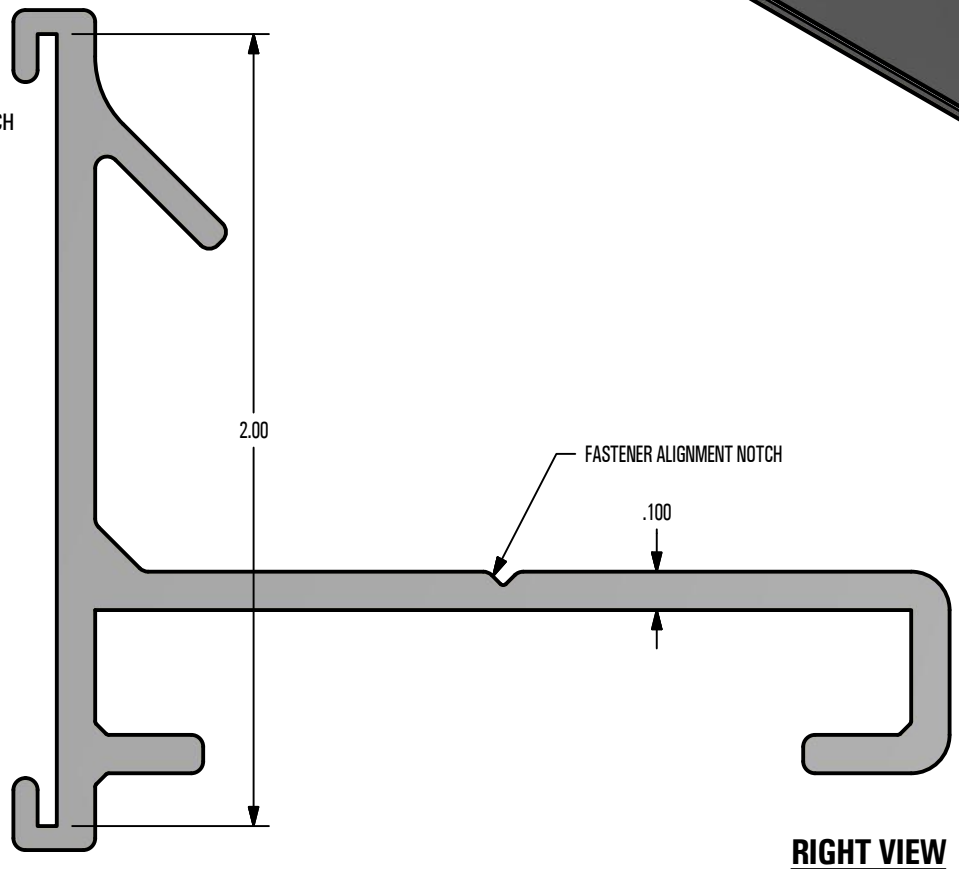


FINISH SELECTION:

☐ MILL FINISH

☐ COLOR TO CLOSELY MATCH



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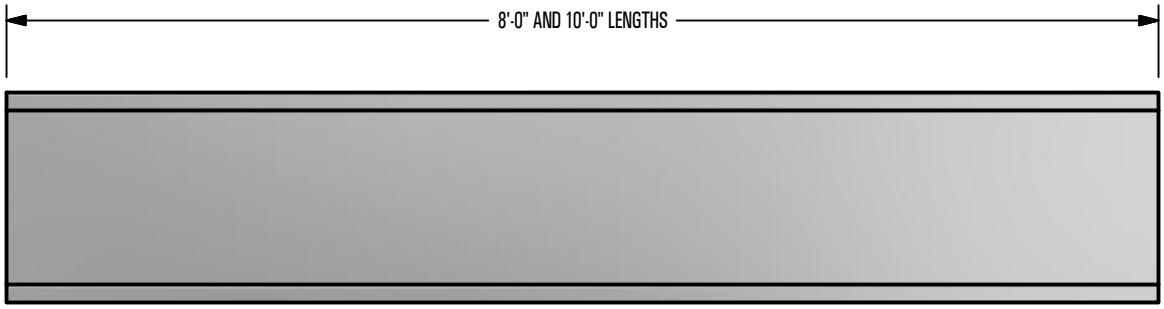

FRONT VIEW

SNO GEM®

Raising the Bar in Snow Retention

4800 METALMASTER WAY - McHENRY, IL 60050

PHONE: 815.477.GEMS WEBSITE: WWW.SNOGEM.COM
FAX: 815.455.GEMS E-MAIL: INFO@SNOGEM.COM

2 in iBEAM-S

DRAWN BY:	rhoeffleur
DATE:	1/27/2018
SCALE:	N.T.S.
MATERIAL:	Aluminum

*** SNO GEM PRODUCT CUT SHEET ***

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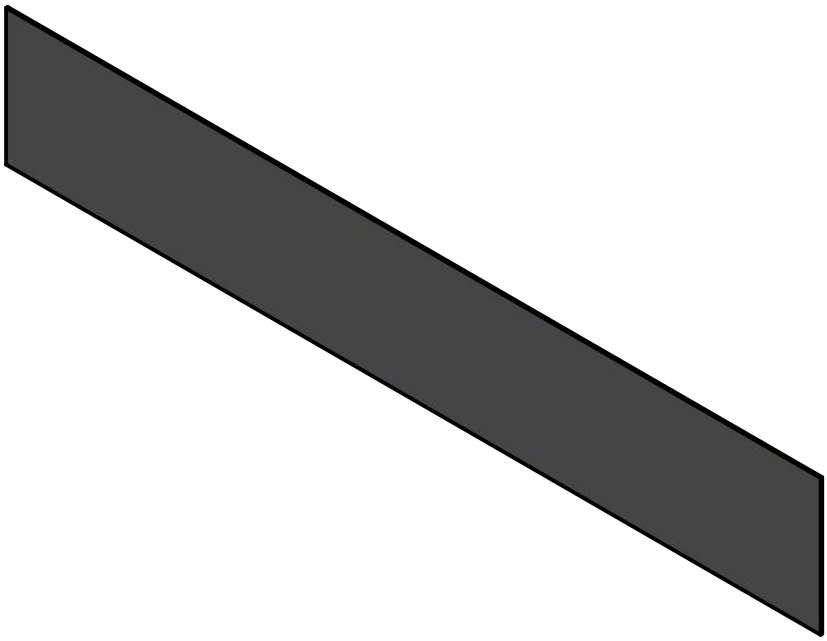

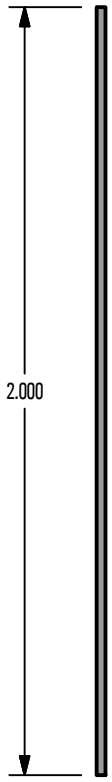

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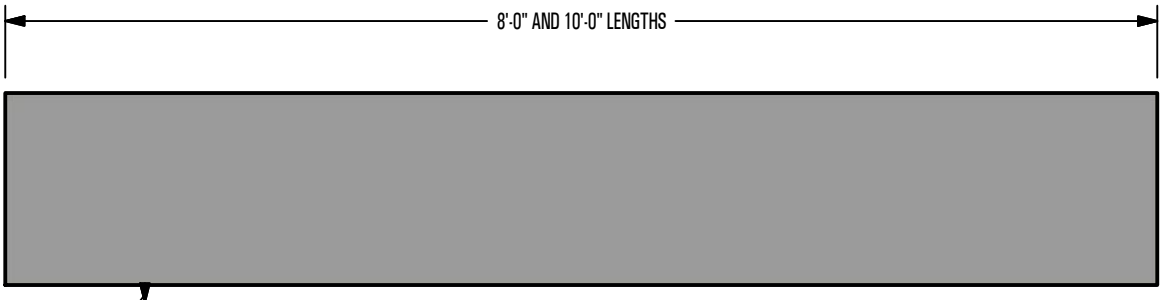

FABRICATE FROM SAME MATERIAL AS STANDING SEAM ROOF

FRONT VIEW

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FAX: 815.455.GEMS E-MAIL: INFO@SNOGEM.COM

2 in METAL COLOR STRIP

DRAWN BY:	rhoeffleur
DATE:	1/27/2018
SCALE:	N.T.S.
MATERIAL:	Generic

*** SNO GEM PRODUCT CUT SHEET ***

GENERAL NOTES:

1. FOR CLARITY THIS DRAWING IS NOT TO SCALE.
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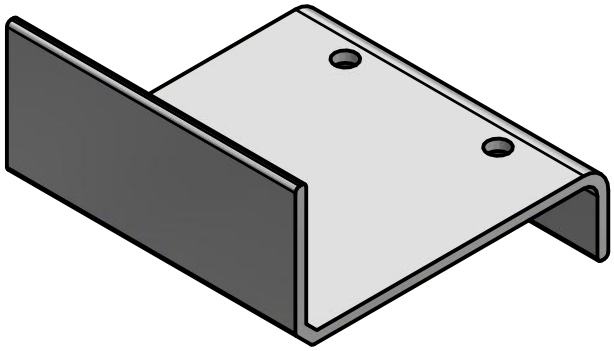
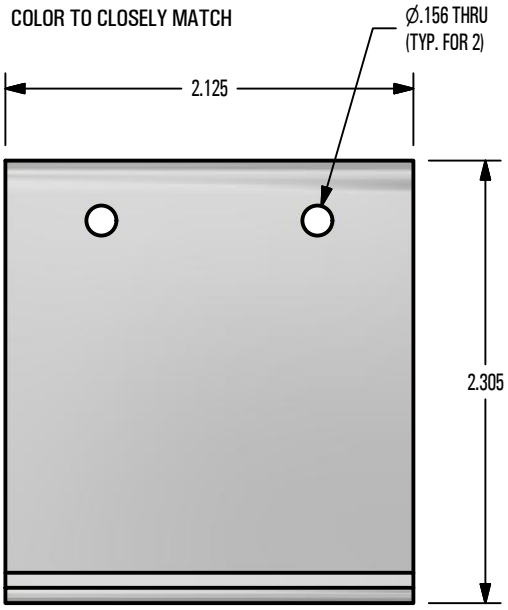
3. INSTALLATION MUST BE COMPLETED WITH MANUFACTURERS WRITTEN SPECIFICATIONS AND INSTALLATION INSTRUCTIONS.
4. THESE DRAWINGS ARE SUBJECT TO CHANGE WITHOUT NOTICE.



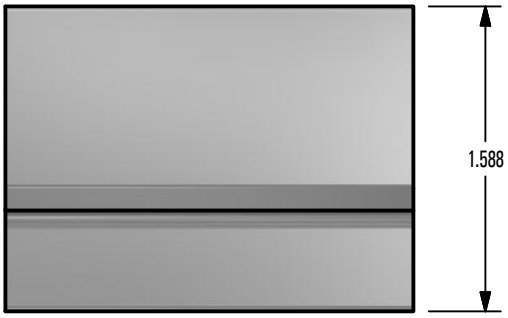
FINISH SELECTION:

☐ MILL FINISH

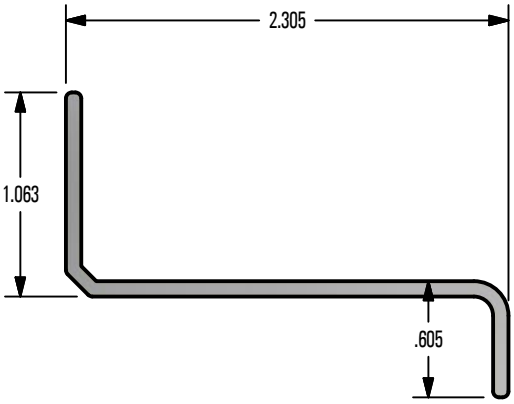
☐ COLOR TO CLOSELY MATCH



TOP VIEW



FRONT VIEW



RIGHT VIEW

SNO GEM®
Raising the Bar in Snow Retention
4800 METALMASTER WAY - McHENRY, IL 60050
PHONE: 815.477.GEMS WEBSITE: WWW.SNOGEM.COM
FAX: 815.455.GEMS E-MAIL: INFO@SNOGEM.COM

2 in iSPLICE

DRAWN BY:	rhoeffleur
DATE:	1/27/2018
SCALE:	N.T.S.
MATERIAL:	Aluminum

*** SNO GEM PRODUCT CUT SHEET ***

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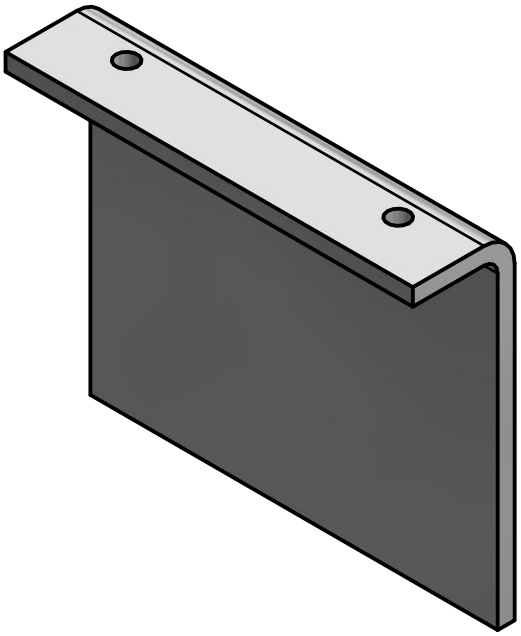
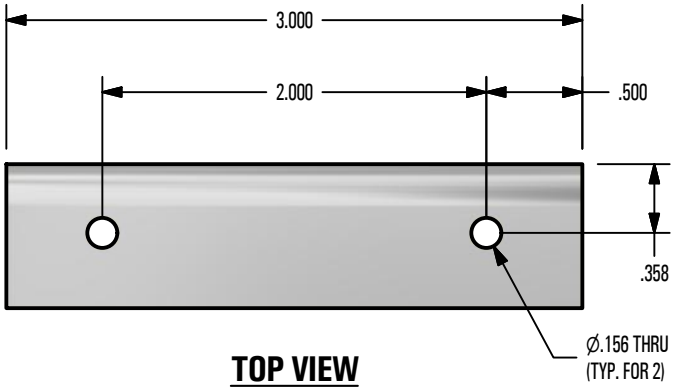


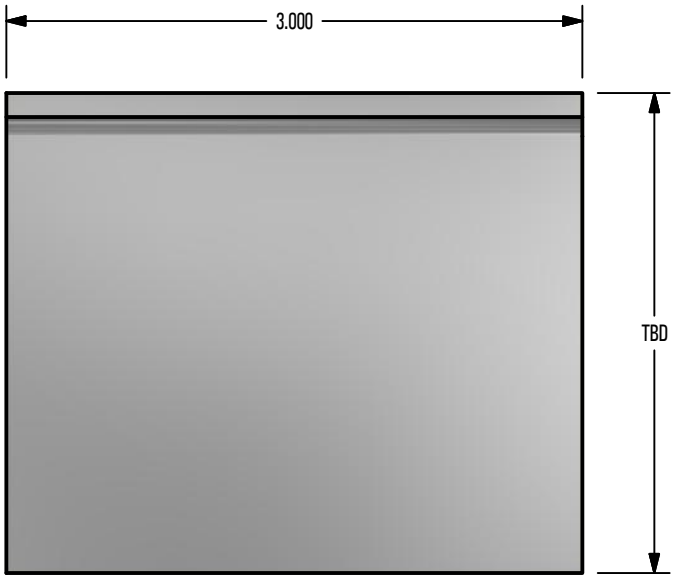
FINISH SELECTION:

☐ MILL FINISH

☐ COLOR TO CLOSELY MATCH



TOP VIEW



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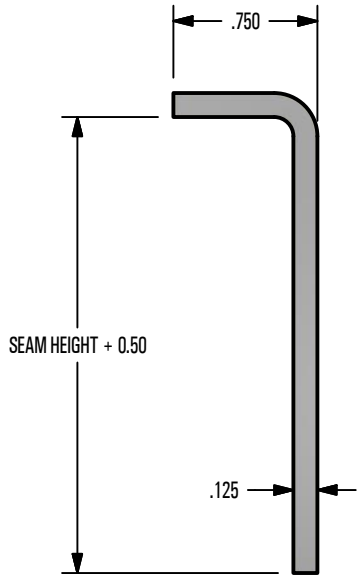

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iPLATE

DRAWN BY:	rhoeffleur
DATE:	1/27/2018
SCALE:	N.T.S.
MATERIAL:	Aluminum

*** SNO GEM PRODUCT CUT SHEET ***

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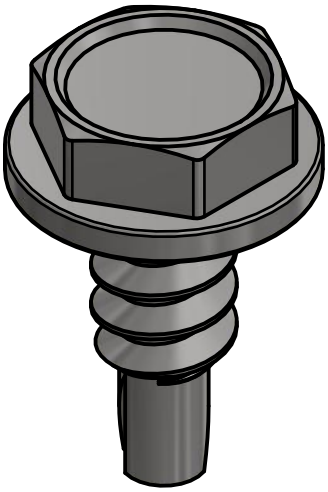
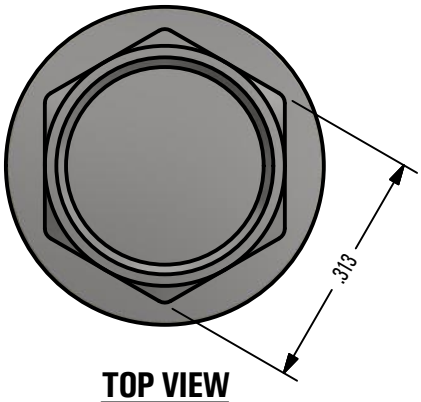
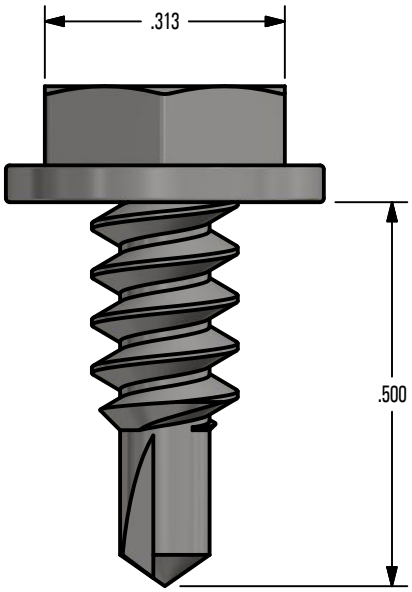




TOP VIEW



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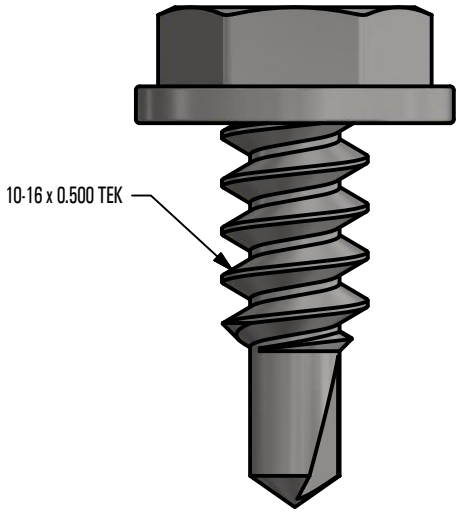

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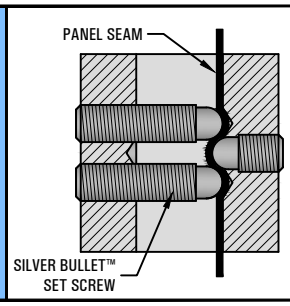
0.500 TEK FASTENER

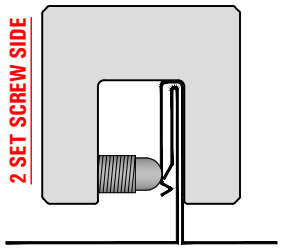
DRAWN BY:	rhoeffleur
DATE:	1/27/2018
SCALE:	N.T.S.
MATERIAL:	Stainless Steel

*** iCLAD-S™ INSTALLATION INSTRUCTIONS ***

TYP. WAVELOCK™ DETAIL

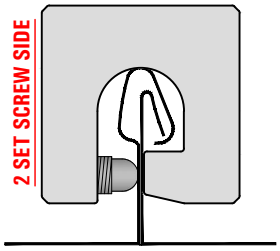


SNAP LOCK PROFILE



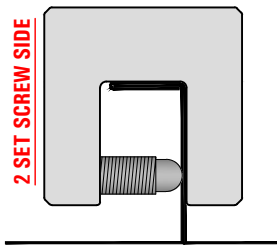
SNO CUBE™ SHOWN

CEE-LOCK PROFILE



SNO CUBE™ ZIP SHOWN

SINGLE LOCK PROFILE



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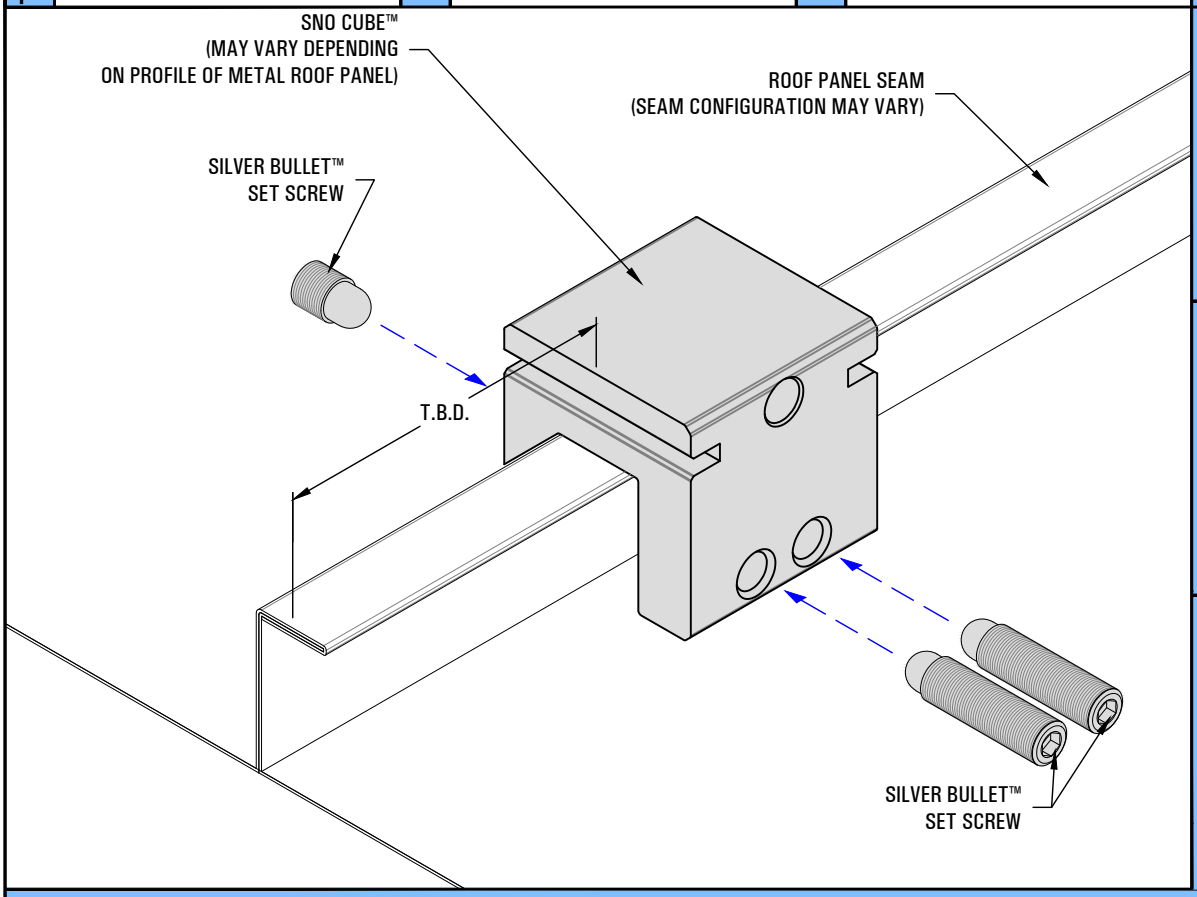
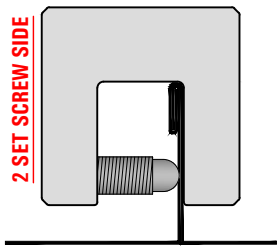
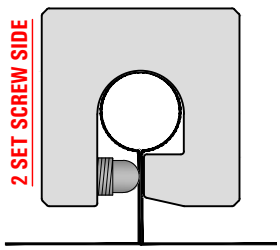


DOUBLE LOCK PROFILE



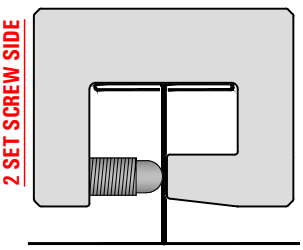
SNO CUBE™ SHOWN

BULB STYLE PROFILE



SNO CUBE™ ZIP SHOWN

T-SEAM PROFILE



SNO CUBE™ WIDE SHOWN

SNO CUBE™ INSTALLATION INSTRUCTIONS

1. MEASURE THE DISTANCE FROM THE EAVE TO THE LOCATION OF THE FIRST ROW AND USE A STRING LINE OVER THE ROOF PANEL SEAMS TO ESTABLISH A STRAIGHT GUIDELINE FOR INSTALLATION.

2. ALIGN THE SNO CUBE™ CLAMP ON THE SEAM EXACTLY AS SHOWN IN THE ORIENTATION ON THE RIGHT SIDE OF THIS PAGE, DEPENDING ON THE APPLICABLE SEAM PROFILE.

3. SET THE FIRST (2) SET SCREWS THAT ARE LOCATED ON THE SIDE OF THE CLAMP WITH THE (2) THREADED HOLES LOCATED AT THE BOTTOM OF THE CLAMP. THE TORQUE SHOULD BE VERIFIED WITH A CALIBRATED TORQUE WRENCH WITHIN THE RECOMMENDED GUIDELINES SET FORTH IN STEP 4 BELOW.
   NOTE: IF THERE ARE (2) DIFFERENT SIZE SET SCREWS, ALWAYS USE THE LONGER SIZE ONES FOR THIS STEP.

4. USING A CALIBRATED TORQUE WRENCH, TIGHTEN THE THIRD AND FINAL SET SCREW WHICH IS LOCATED ON THE SIDE OF THE CLAMP OPPOSITE THE (2) SET SCREWS SET IN THE PREVIOUS STEP. SET SCREWS SHOULD BE TORQUED AND VERIFIED PER THE FOLLOWING RECOMMENDATIONS:
   NOTE: CONTACT SNO GEM, INC. FOR THE RECOMMENDED TORQUE REQUIREMENTS OF ANY METAL GAUGE AND/OR MATERIAL NOT LISTED BELOW.
   A. 24 Ga. STEEL = 150 IN/LBS - 160 IN/LBS B. 22 Ga. STEEL = 180 IN/LBS - 200 IN/LBS

5. VERIFY THAT THE SNO CUBE™ CLAMP IS SECURE, STRAIGHT AND LEVEL, THEN REPEAT STEPS 2-5 FOR REMAINING CLAMPS. BE SURE TO FOLLOW THE ARCHITECT'S AND/OR ENGINEER'S REQUIRED SPACING AND/OR LAYOUT, INCLUDING THEIR ADJUSTMENTS FOR FIELD CONDITIONS, IF ANY. (A RECOMMENDED LAYOUT IS FURNISHED BY SNO GEM, INC. ONLY UPON WRITTEN REQUEST)

iCLAD-S™ INSTALLATION INSTRUCTIONS

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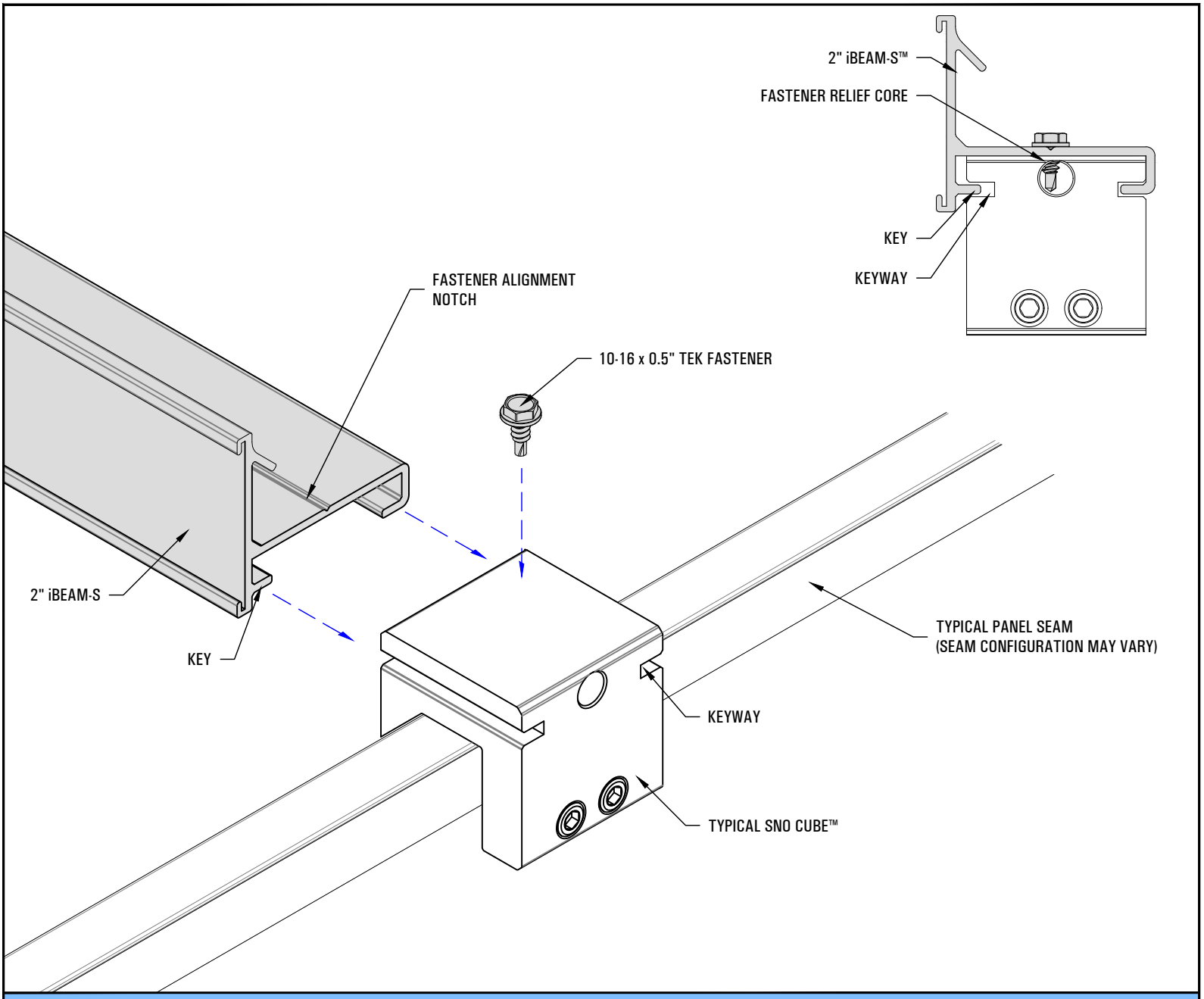
FAX: 815.455.GEMS E-MAIL: INFO@SNOGEM.COM

DRAWN BY:	RJH
DATE:	10/7/15
SCALE:	N.T.S.

*** iCLAD-S™ INSTALLATION INSTRUCTIONS ***



2" iBEAM-S™ INSTALLATION INSTRUCTIONS

1. ONCE THE SNO CUBE™ CLAMPS HAVE BEEN INSTALLED AND VERIFIED TO BE PROPERLY TORQUED TO THE MANUFACTURER'S RECOMMENDATIONS, SLIDE A SECTION OF THE 2" BEAM-S™ ONTO THE CLAMPS BY ALIGNING THE KEYS ON THE 2" iBEAM-S™ TO THE KEYWAYS ON THE SNO CUBE™.

2. SLIDE THE ENTIRE 2" iBEAM-S™ SECTION SO THAT THE END IS NO MORE THAN 6" FROM / PAST THE LAST SNO CUBE CLAMP™.

3. ONCE A SECTION OF 2" iBEAM-S™ HAS BEEN COMPLETELY SLID ONTO THE SNO CUBE™ CLAMPS, ALIGN THE 10-16 x 0.5" TEK FASTENER WITH THE FASTENER ALIGNMENT NOTCH ON THE 2" iBEAM-S™ AND THE PANEL SEAM, PULL THE iBEAM-S™ DOWNSLOPE, THEN FASTEN THROUGH THE 2" iBEAM-S™ AND INTO THE SNO CUBE™ CLAMP.

4. REPEAT STEP 3 FOR EACH SNO CUBE™ WITHIN THE FIRST SECTION OF THE 2" iBEAM-S™.

5. REPEAT STEPS 1-4 FOR THE REMAINING SECTIONS OF 2" iBEAM-S'S™ LEAVING A 0.25" OF GAP IN BETWEEN EACH iBEAM™ TO ALLOW FOR THERMAL EXPANSION.

iCLAD-S™ INSTALLATION INSTRUCTIONS

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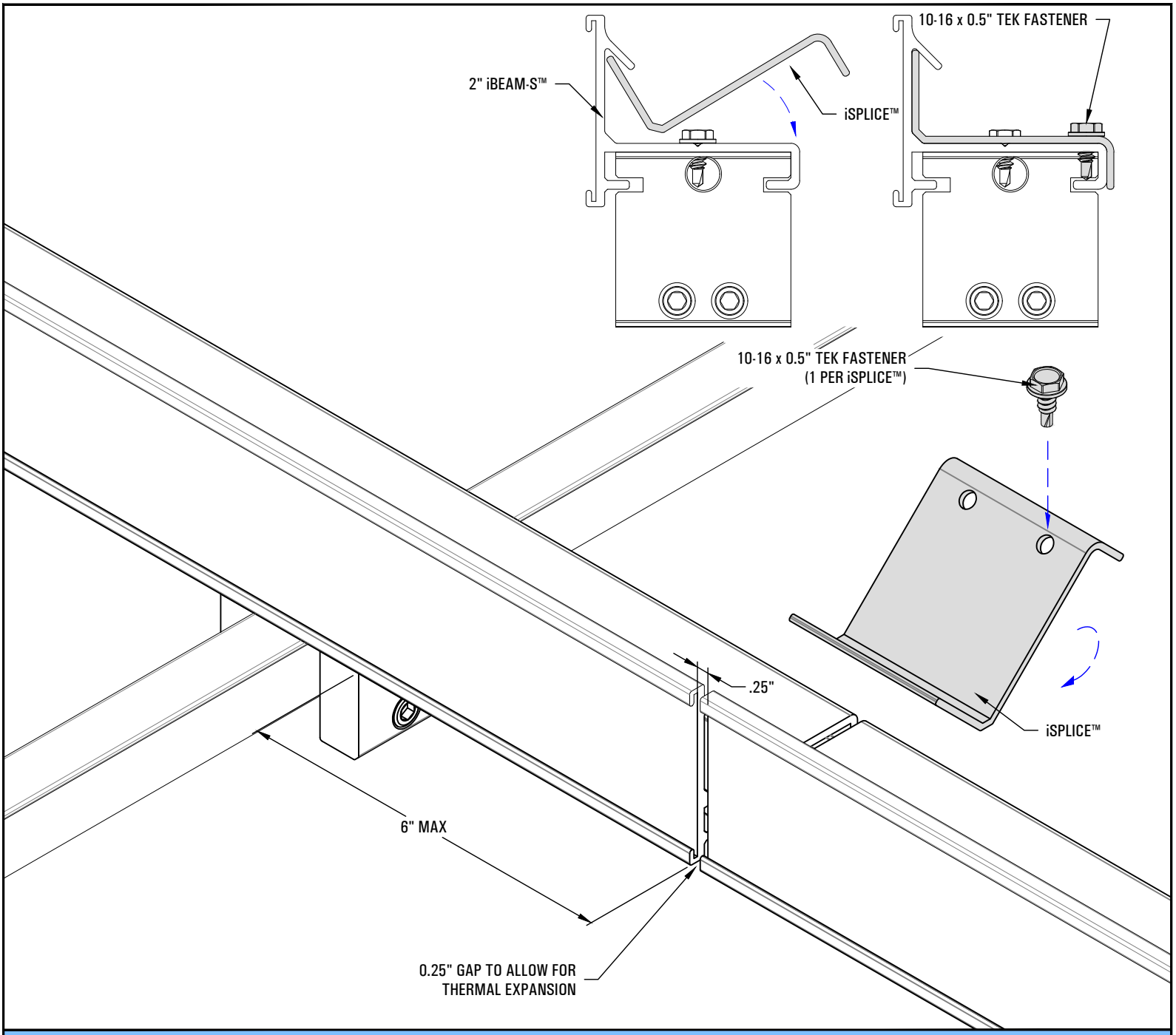
DRAWN BY:	RJH
DATE:	11/7/15
SCALE:	N.T.S.

*** iCLAD-S™ INSTALLATION INSTRUCTIONS ***



iSPLICE™ INSTALLATION INSTRUCTIONS

1. ONCE EACH OF THE 2" iBEAM-S™ HAS BEEN FULLY INSTALLED, PLACE AN iSPLICE™ AT EACH JOINT. MAKE SURE THERE IS AT AT LEAST A 0.25" GAP BETWEEN EACH ADJOINING 2" iBEAM-S'S™ TO ALLOW FOR THERMAL EXPANSION.

2. INSTALL THE iSPLICE™ BY SIMPLY PLACING THE END WITHOUT THE PRE-PUNCHED HOLES UP INTO THE iBEAM™ AND ROTATE INTO PLACE (SEE ABOVE DETAIL).

3. USING A 10-16 x 0.5" TEK FASTENER, FASTEN THE iSPLICE™ TO THE 2" iBEAM-S™. USE ONLY (1) TEK FASTENER PER iSPLICE™ AND FASTEN THROUGH THE PRE-PUNCHED HOLE FURTHEST FROM THE CLOSET SNO CUBE™ CLAMP.

4. REPEAT STEPS 1-3 FOR EACH JOINT WHERE (2) 2" iBEAM-S'S™ MEET.

iCLAD-S™ INSTALLATION INSTRUCTIONS

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DRAWN BY:	RJH
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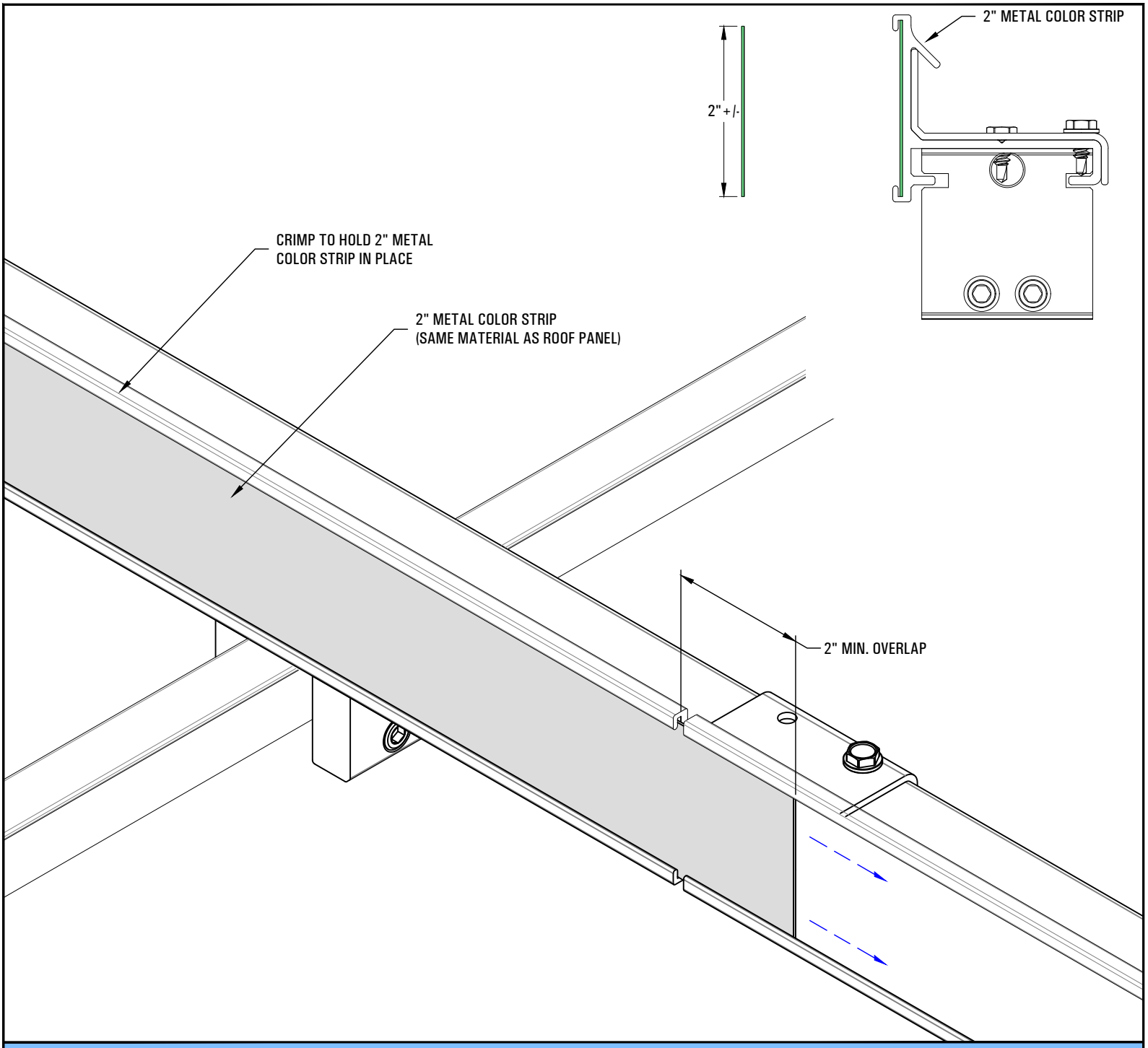

METAL COLOR STRIP INSTALLATION INSTRUCTIONS

1. USING THE SAME MATERIAL AS THE ROOF PANEL, CUT 2" STRIPS TO MATCH THE LENGTH OF THE 2" iBEAM-S™ AND ENOUGH TO CLAD EACH ROW FULLY.
2. TAKE EACH STRIP AND SLIDE THROUGH THE 2" iBEAM-S™ UNTIL THE EDGE OVERLAPS THE ADJOINING 2" iBEAM-S™ A MINIMUM OF 2".
3. AFTER EACH 2" METAL COLOR STRIP HAS BEEN SLID INTO PLACE, USE A PAIR OF PLIERS TO CRIMP THE TOP EDGE OF THE 2" iBEAM-S™.
   NOTE: THE INSTALLER SHOULD CRIMP EACH 2" iBEAM-S™ SECTION (3) TIMES, EQUALLY SPACED.

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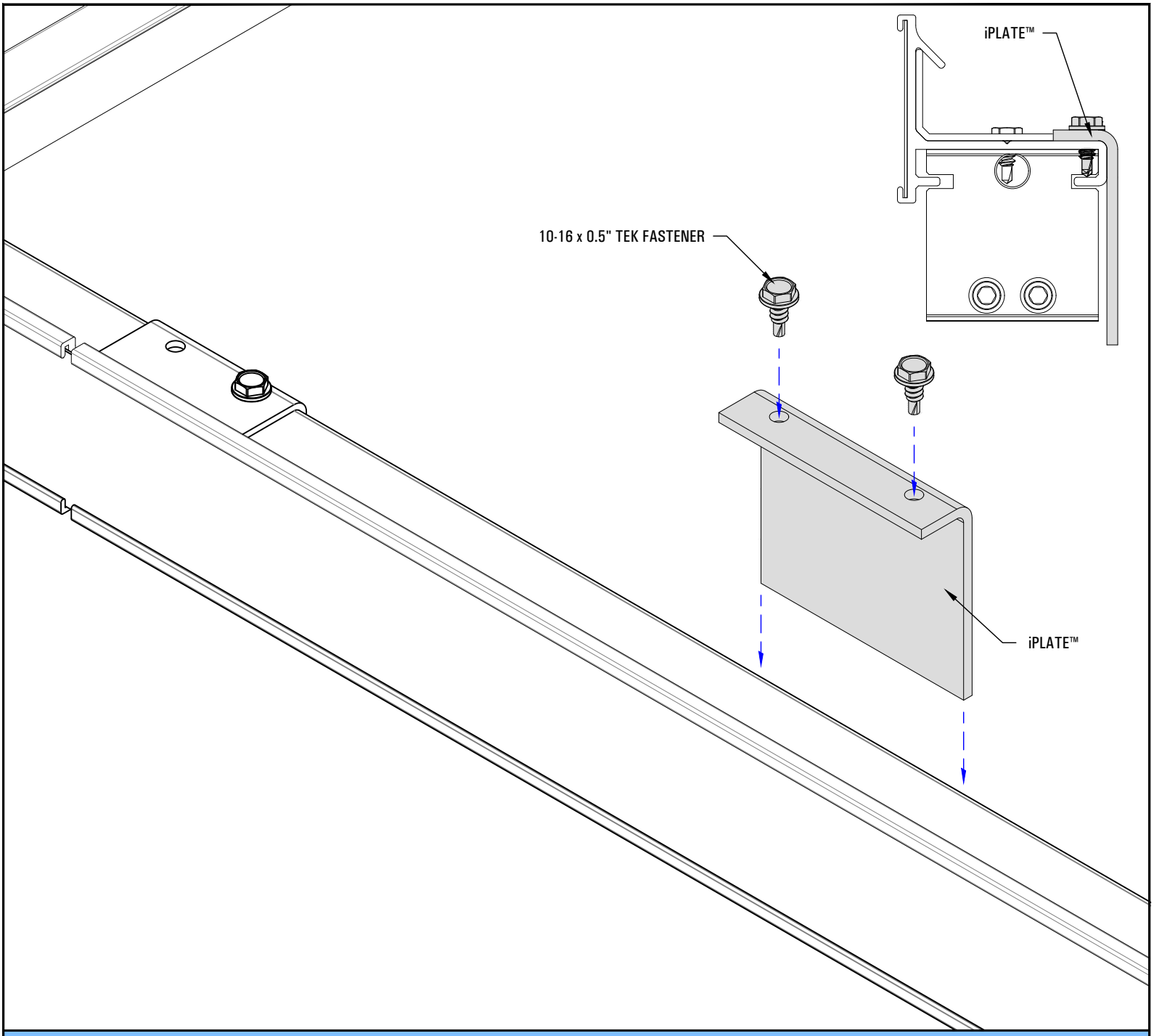

iPLATE™ INSTALLATION INSTRUCTIONS

1. ALIGN THE iPLATE™ ALONG THE BACK EDGE OF THE 2" iBEAM™ AS SHOWN IN THE ABOVE DETAIL PER THE ARCHITECT'S AND/OR ENGINEER'S REQUIRED SPACING AND/OR LAYOUT, INCLUDING THEIR ADJUSTMENTS FOR FIELD CONDITIONS, IF ANY. (A RECOMMENDED LAYOUT IS FURNISHED BY SNO-GEM®, INC. ONLY UPON WRITTEN REQUEST)
2. USING (2) 10-16 x 0.5" TEK FASTENERS, ATTACH THE iPLATE™ TO THE 2" iBEAM-S™.
3. MAKE SURE THAT THE iPLATE™ IS SECURELY FASTENED.
4. REPEAT STEPS 1-3 FOR THE REMAINING iPLATES™.

iCLAD-S™ INSTALLATION INSTRUCTIONS

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DRAWN BY:	RJH
DATE:	10/7/15
SCALE:	N.T.S.

SNO GEM®

Raising the Bar in Snow Retention

SNOW RETENTION SYSTEM MAINTENANCE

All snow retention products require regular and ongoing maintenance throughout their useful life as they are subject to varying, and sometimes harsh and extreme weather conditions on a daily basis. Sno Gem® products are no exception, regardless of whether using any of our Sno Gem® snow guards or our Sno Barricade® bar system. Sno Gem®, Inc. strongly recommends that your Sno Gem® products be inspected by a qualified roofing contractor as part of an annual or bi-annual roofing inspection or following severely inclement weather. Sno Gem®, Inc. is not responsible for any Sno Gem® products which have not been properly serviced and maintained.

Sno Gem® must be contacted immediately upon the owner becoming aware of any issues including, but not limited to: product release, product shift and looseness or breakage. Failure to timely address any such issues may result in the entire snow retention system being compromised. Please keep in mind that the architect or engineer designed the project utilizing, in part, historical data to project the snow load which could reasonably be expected in that particular geographic region. Excessive snow loads beyond the Architect and/or Engineer's projections may impact the performance of the Sno Gem® product.

Below are some general maintenance suggestions for each type of Sno Gem product:

Polycarbonate and/or Metal Snow Guards – Fastened Using Mechanical Fasteners:

- Inspect each snow guard to insure assembly is intact.
- Inspect fasteners into the roof deck are properly secure and in place.

Polycarbonate and/or Metal Snow Guards – Tube Adhesive and/or Tape Mounted:

- Inspect each snow guard to insure assembly is intact.
- Inspect consistent sealant around the perimeter. Re-apply any areas as needed.
- Inspect snow guards for slippage or any peeling of the tape.

Metal Snow Guards – Soldered and Plate Attachment:

- Inspect each snow guard to insure assembly is intact.
- Inspect snow guards for any slippage or looseness.

Deck Mount Bar System Models – Fastened To Roof Deck:

- Inspect each bracket/base plate to insure assembly is intact.
- Inspect all fasteners in to the roof deck are properly secure and in place.
- Inspect any snow guard related waterproofing and replace or repair where necessary.
- Inspect tubing has bent or shows any other evidence of failure or damage, contact the manufacturer immediately.
- Inspect Barricade Plate set screw for tightness.

Rail Type Snow Retention Systems – Clamp-On To Standing Seam:

- Inspect each clamp to insure assembly is intact.
- Inspect and check each set screw to insure proper fastening and torque requirements have been maintained.
- Inspect tubing has bent or shows any other evidence of failure or damage, contact the manufacturer immediately.
- Inspect Barricade Plate set screw for tightness.

If you discover any issues with your Sno Gem product, please contact our office immediately.

4800 Metalmaster Way, McHenry, IL 60050 | www.snogem.com | info@snogem.com
Phone: 815-477-4367 | Toll-Free: 888-SNO-GEMS (766-4367) | Fax: 815-455-4367

#

SNO GEM®

Raising the Bar in Snow Retention

IClad-S™ Specifications for Standing Seam Metal Roof Systems

To be used with the iClad-S™ Snow Retention System

PART 1 - GENERAL

1.1 SUMMARY:

A. WORK INCLUDES:
1. Snow guards for standing seam metal roofs.
2. Non-penetrating attachment system.
3. Provide clamps, set screws and all other component parts that make up the snow retention system.

B. RELATED SECTIONS:
1. Division 1: General Requirements
2. Division 7: Thermal and Moisture Protection
    a. Section 07410: Performed Metal Roofing
    b. Section 07600: Flashing and Sheet Metal
    c. Section 07610: Sheet Metal Roofing
    d. Section 077253: Snow Guards
3. Division 13: Pre-Engineered Structures

1.2 SYSTEM DESCRIPTION:

A. COMPONENTS:
1. Sno Cube™
2. Ball Point Set Screw (Silver Bullet™)
3. iBeam-S™
4. iSplice™
5. iPlate™

B. DESIGN REQUIREMENTS:
1. Spacing to be recommended by an Architect and/or Engineer.
2. Spacing will vary based on several factors including geographical region, snow load and building characteristics.
3. Our office does not perform an independent site inspection and strongly recommends that an Architect and/or Engineer review the project and any contemplated snow retention layout to ascertain and confirm the projected loads applicable to this project.

1.3 SUBMITTAL:

A. REVIEW OF SUBMITTALS:
1. Show locations of the snow retention system on the roof plan and specify clamp spacing as required by an Architect and/or Engineer.
2. Include detailed product cut sheets, installation instructions and specifications.

1.4 QUALITY ASSURANCE:

A. CERTIFICATION:
1. Sno Gem® strongly recommends that these products be installed by a qualified Roofing Contractor who will have the knowledge and ability to properly install the product.

2. Install the snow retention system in accordance with an approved layout, installation instructions and approved submittals.

1.5 DELIVERY / STORAGE / HANDLING:

A. PROCEDURE:
1. Inspect material upon delivery and provide notice of any missing or defective items within 24 hours.
2. Adequately secure and protect the material until installation.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. SNO GEM® iCLAD™:
1. A division of Sno Gem®, Inc., 4800 Metalmaster Way, McHenry, IL 60050, (888) 766-4367, www.snogem.com

2.2 MATERIALS:

A. COMPONENTS:
1. Sno Cube™: 6061-T6 or 6063-T6 Aluminum
2. iBeam-S™: 6061-T6 Aluminum
3. iSplice™: 6061-T6 or 6063-T6 Aluminum
4. Silver Bullet™: 300 Series Stainless Steel
5. iPlate™: Aluminum
6. Fastener: Stainless Steel

2.3 FINISH:

A. MATERIALS:
1. Standard mill finish.
2. Powder Coating or Kynar available upon request.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. SUBSTRATE:
1. Inspect the roof system in its entirety to verify proper attachment, completion and the ability of the building structure to withstand additional loading applied by the snow retention system.

3.2 INSTALLATION:

A. PROCEDURE:
1. Install the snow retention system in accordance with an approved layout, installation instructions and approved submittals.

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SNO GEM®

Raising the Bar in Snow Retention

Terms and Conditions

1. Payment Terms. Payment terms are as set forth above. All amounts past due are subject to interest at the rate of 1 ½% per month compounded monthly. Buyer shall be solely responsible for the payment of any and all costs Sno Gem, Inc. incurs to collect any amounts due and owing including, but not limited to, collection agency fees, court costs and attorney's fees and costs. Buyer acknowledges that Sno Gem, Inc. may at any time and in its sole and absolute discretion, for any reason or for no reason, suspend or refuse credit to Buyer and/or require full payment prior to shipment. Sno Gem, Inc. is not obligated to fulfill any order(s) if Buyer is in default under this or any other contract with Sno Gem, Inc., or upon the insolvency or dissolution of Buyer, or in the event the Buyer is involved with litigation of any kind in which Sno Gem, Inc..is a party to that litigation.

2. Shipping. All shipping costs are paid by Buyer. Risk of loss shall pass to Buyer upon delivery by Sno Gem, Inc. to the carrier at the point of shipment and at the time and location the carrier first takes possession of the product. Sno Gem, Inc. shall not be liable for damage to the product during shipping, which damage shall be the sole and absolute responsibility of the Buyer Sno Gem, Inc. shall not be obligated to provide or pay for insurance for the product insuring damage during shipping, which said obligation shall belong solely to the Buyer. The Buyer must notify Sno Gem, Inc. within 24 hours of Buyer's receipt of the product of any missing or damaged items. The Buyer is responsible for all shipping costs relating to missing or damaged items. Under no circumstance will Sno Gem, Inc. be liable to any party for damages of any nature whatsoever including, but not limited to, those resulting from the delivery of the product.

3. Controlling Provision. In the event of a conflict between the provisions of these Terms and Conditions and the provisions of any other oral or written understanding or agreement between the parties, Sno Gem, Inc. and Buyer hereby agree that the provisions of these Terms and Conditions shall forever prevail and dictate.

4. Indemnification. Buyer hereby agrees to indemnify, defend and hold harmless Sno Gem, Inc. and its officers, directors, shareholders, affiliates, employees, agents and assigns from and against any and claims, demands, costs, liabilities and expenses (including, without limitation attorney's fees and court costs) arising in whole or in part from a third party claim involving any product purchased by Buyer from Sno Gem, Inc. Buyer further agrees to indemnify, defend and hold harmless Sno Gem, Inc. and its officers, directors, shareholders, affiliates, employees, agents and assigns from and against any and claims, demands, costs, liabilities and expenses arising in whole or in part from the negligent act or omission of the Buyer, or any negligent act or omission of Buyer's agents employees in connection with: (i) formulating and/or preparing drawings and specifications for the product; and/or (ii) the installation of the product by the Buyer or the Buyer's agent, employee or contractor, including without limitation all materials, methods and techniques associated with installation of the product.; or (iii) Buyer's use and enjoyment of the product.

5. Return. Subject to the remaining conditions of this paragraph 5, Sno Gem, Inc. will accept the return of its' CLEAR POLYCARBONATE products only and will not accept the return of any other product. Any such clear polycarbonate products returned will be accepted only if deemed to be defective at the sole discretion of Sno Gem, Inc. As a condition of Sno Gem, Inc.'s acceptance of the return of any polycarbonate product, said returns must be received by Sno-Gem, Inc. within 30 days of Buyer's receipt of the order of poly carbonate product being returned. Products returned must be in the original packaging, unused by Sno Gem, Inc. at the time of return. As a condition precedent to Buyer's right to return any product pursuant to the terms of this paragraph 5, the product must be in physical production by Sno Gem, Inc. as of the date the product is shipped back to Sno Gem, Inc. by the Buyer. Buyer shall be responsible for all shipping fees to return product back to Sno Gem, Inc. All returns are subject to a restocking fee equal to 20% of the total cost of the original order. For all products other than clear polycarbonate Sno-Gems, ALL SALES ARE FINAL AND NO RETURNS WILL BE ACCEPTED.

6. Layout. SNO GEM, INC. DOES NOT PERFORM AN INDEPENDENT SITE INSPECTION. ALL SNO GEM, INC. LAYOUTS INCLUDING, BUT NOT LIMITED TO, NUMBER OF ROWS AND PRODUCT QUANTITIES ARE RECOMMENDATIONS ONLY BASED SOLELY ON THE INFORMATION PROVIDED BY THE BUYER, IN ADDITION TO THE PROJECT'S GEOGRAPHICAL LOCATION, ROOF PITCH, LENGTH OF RUN AND TYPE OF ROOF SYSTEM. BUYER MAKES THIS PURCHASE BASED ON PROJECT SPECIFICATIONS AND ITS OWN EVALUATION AND NOT BY REASON OF ANY STATEMENT MADE OR PURPORTED TO HAVE BEEN MADE BY OR ON BEHALF OF SNO GEM, INC. SNO GEM, INC. MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

7. Architect/Engineer/Structural Engineer Review. Sno Gem, Inc. is not licensed to provide design, architecture or engineering services and does not provide stamped or otherwise certified calculations or engineering drawings of any kind. Sno Gem, Inc. is not required to ascertain that any Sno Gem, Inc. recommendations or products are in compliance with applicable laws, statutes, building codes, ordinances, best industry practices or rules and regulations of any kind. All Sno Gem, Inc. recommendations are simply recommendations only which are subject to verification by the project Architect/Engineer and by the project's structural engineer to ensure that the building structure can withstand the projected snow load. If professional design services or certifications are required, such services and certification shall be specified in advance by Buyer and performed by a licensed design professional for an additional expense payable by Buyer. Sno Gem, Inc. does not assume any liability therefore. Buyer warrants that Buyer has consulted with Buyer's properly licensed structural engineer and/or properly licensed architect prior to purchasing any product from Sno Gem, Inc. Buyer warrants to Sno Gem, Inc. that Buyer has conducted all necessary due diligence with Buyer's properly licensed structural engineer and architect prior to ordering any product from Sno Gem, Inc. so as to: (a) allow Buyer to confirm the product is suitable for Buyer's use at Buyer's premises and (b) make certain that the product purchased from Sno Gem, Inc. by Buyer, once installed, will be in full compliance with all applicable building codes, ordinances, laws and regulations and can be installed in safe and proper manner.

8. Project Specifications and Drawings. Any review of project specifications or preparation of drawings by Sno Gem, Inc. is as a material supplier only and not as a licensed design professional. Sno Gem, Inc. is not liable for discovering errors, omissions or inconsistencies in the specifications, or for ascertaining if the specifications are in compliance with applicable laws, statutes, building codes, ordinances or rules and regulations of any kind. Drawings prepared by Sno Gem, Inc. are upon request only to illustrate Sno Gem, Inc. products only and do not constitute a representation by Sno Gem, Inc. that it has verified field measurements, field

conditions or any other construction criteria applicable to the project. Sno Gem, Inc. is not liable for coordination of drawings prepared by Sno Gem, Inc. with any other project requirements or contract documents.

9. Installation. As a condition precedent to Buyers use of the product, Buyer warrants to Sno Gem, Inc. and further agrees that the products will be installed by Buyer utilizing a qualified roofing contractor retained by Buyer which said roofing contractor will install the product in accordance with best industry standards and practices that these products be installed by a qualified roofing contractor who will have the knowledge and ability to properly install the product. Sno Gem, Inc. does not take any responsibility for acts, errors or omissions of the installer and cannot be held responsible in any way for product installation. Sno Gem, Inc. does not provide any warranty on the installation of any of its product. Installation using an adhesive/sealant, tape, solders, or fastener application/product product should be performed in accordance with the applicable manufacturer's published instructions. Sno Gem, Inc. does not warrant against adhesive/sealant, tape, solder, fastener failure and the purchaser must rely on the applicable manufacturer's applicable warranty, if any. Sno Gem, Inc. will not be responsible for misapplication of the product, incorrect materials or defects that were obvious at the time of installation.

10. Warranties and Limits of Liability. Any warranty claim shall be limited to Sno Gem, Inc.'s cost of material on the product determined to have a manufacturer's defect. In no event shall Sno Gem, Inc. be liable to any party for any direct, indirect, consequential, incidental or special damages, whether in contract or tort and expressly disclaims liability for any damages of any kind arising under any theory of law whatsoever. The performance of the product depends on the Purchaser's adherence to Sno Gem Inc.'s recommended spacing and layout and an installation in conformance with Sno Gem, Inc.'s installation instructions. Sno Gem, Inc. will not be responsible to Buyer for any deviations therefrom. Sno Gem, Inc. makes no warranty of any kind, express or implied, including but not limited to, any warranty of merchantability or warranty of fitness for a particular purpose. Subject to all other provisions and limitations set forth in these Terms and Conditions, Buyer and Sno Gem, Inc. further agree that in no event shall Sno Gem, Inc. have liability to Buyer in an amount in excess of the purchase price of product purchased by Buyer in the calendar year in which a claim is made by Buyer, and only to the extend such damage claim is paid through a policy of insurance held by Sno Gem, Inc. (the "Damage Limitation"). Additionally as part of the Damage Limitation, Sno Gem, Inc. shall have no liability arising in whole or in part out of the sale of any product by Sno Gem, Inc. to Buyer, whether sounding in contract or tort, or otherwise, for any amount in excess of that sum paid by an insurance company through a policy of insurance held by Sno Gem, Inc.

11. Governing Law and Jurisdiction. This Agreement shall be governed by the laws of the State of Illinois. Any and all disputes arising hereunder shall be heard and resolved in the appropriate court of McHenry County, Illinois and Buyer submits to personal jurisdiction in Illinois and agrees that such court shall have exclusive jurisdiction over the subject matter. Buyer waives any objection to such jurisdiction including, but not limited to, forum non conveniens. In the event of a dispute between the parties, the prevailing party shall be entitled to collect legal fees from the non-prevailing party.

12. Severability Provision. If any phrase, clause or provision of these Terms and Conditions is declared invalid or unenforceable by a court of competent jurisdiction, such phrase, clause or provision shall be deemed severed from this Agreement, but will not affect any other provisions of this Agreement, which shall otherwise remain in full force and effect. If any restriction or limitation of these Term and Conditions is deemed to be unreasonable, onerous and unduly restrictive by a court of competent jurisdiction, it shall not be stricken, in its entirety and held totally void and unenforceable, but shall be deemed rewritten and shall remain effective to the maximum extent permissible under applicable law within reasonable bounds.

13. Entire Agreement and Acceptance. These terms and conditions constitute the entire agreement of the parties and any and all modifications hereto are to be in writing signed by both parties. Execution of this Agreement, the Buyer's placement of an order and/or payment of any amount to Sno Gem, Inc. shall constitute a binding acceptance of this Agreement and the aforesaid terms and conditions and shall bind Buyer to Sno Gem, Inc. for all amounts due and owing.

SECTION 10 1419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fabricated channel dimensional characters.

1.3 COORDINATION

A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign.

C. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

PART 2 - PRODUCTS

2.1 DIMENSIONAL CHARACTERS

A. Fabricated Channel Characters, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners; and as follows.

1. Character Material: Sheet or plate aluminum or stainless steel.
2. Material Thickness: As indicated on drawings.
3. Character Height: As indicated on drawings.
4. Character Depth: As indicated on drawings
   a. Characters over 1" depth to have backs.
5. Finishes:
   a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 1419

Project Number: 01051248
April 10, 2018

Professional Service Industries, Inc.
5599 Webster Street, Dayton, OH 45414
Phone: (937) 898-1200
Fax: (937) 898-1230

Battalion Chief Nathan Hiester
Beavercreek Township Fire Department
2195 Dayton Xenia Road
Beavercreek, Ohio 45434

Re: **Geotechnical Exploration Report**
Proposed Fire Station No. 65
Southwest Corner of the Intersection of Fairground Road and Trebein Road
Beavercreek Township, Greene County, Ohio

Dear Mr. Hiester:

Thank you for choosing Professional Service Industries, Inc. (PSI), and Intertek Company, as your consultant for the Proposed Fire Station No. 65 at the Southwest Corner of the Intersection of Fairground Road and Trebein Road in Beavercreek, Greene County, Ohio. Per your authorization, PSI has completed a geotechnical exploration for the referenced project. The results of the study are discussed in the accompanying report.

It is considered imperative that the geotechnical engineer and/or their representative be present during earthwork operations, foundation and floor slab installations to observe the field conditions with respect to the design assumptions and specifications. PSI will not be held responsible for interpretations and field quality control observations made by others.

If you have any questions pertaining to this report, please contact our office at (937) 898-1200. PSI would be pleased to continue providing geotechnical services throughout the implementation of the project, and we look forward to working with you and your organization on this and future projects.

Respectfully submitted,
PROFESSIONAL SERVICE INDUSTRIES, INC.

STATE OF OHIO
R. ANDREW SCHLARMAN II
E-81240
REGISTERED PROFESSIONAL ENGINEER

4-10-2018

R. Andrew Schlarman, P.E.
Branch Manager
The above Professional Engineering Seal and signature is an electronic reproduction of the original seal and signature. This electronic reproduction shall not be construed as an original or certified document.

Alagaiya Veeramani, P.E.
Vice President

cc: Client – Electronic Copy
Enclosures

Geotechnical Exploration Report

of

Proposed Fire Station No. 65
Fairground Road and Trebein Road
Beavercreek Township, Greene County,
Ohio

Prepared for
Beavercreek Township Fire Department
2195 Dayton Xenia Road
Beavercreek, Ohio 45434

Prepared by

Professional Service Industries, Inc.
5599 Webster Street
Dayton, Ohio 45414

Report Date: April 10, 2018
PSI Project No. 01051248

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PROJECT INFORMATION

Project Authorization

The following Table summarizes (in chronological order) the Project Authorization History for the services performed and represented in this report by Professional Service Industries, Inc. (PSI):

PROJECT TITLE: PROPOSED FIRE STATION NO. 65 – BEAVERCREEK TOWNSHIP, OHIO		
Document and Reference Number	**Date**	**Requested/Provided By**
Request for Proposal	3/07/2018	Mr. Nathan Hiester, Battalion Chief, Beavercreek Township Fire Department
PSI Proposal 0105-228473	3/07/2018	Andy Schlarman, P.E. and Alagaiya Veeramani, P.E. of PSI
Signed PSI Proposal No. 238039	3/12/2018	Mr. Alex Zaharieff, Township Administrator, Beavercreek Township

Project Description

Project information was provided by Mr. Nathan Hiester, Battalion Chief of Beavercreek Township Fire Department via telephone call and follow-up email on March 7, 2018. The email included the following documents:

- A document titled, "*New Fire Station 65 Geotechnical Services Request*" dated November 20, 2017 from Mr. Timothy J. Bement, Principal of App Architecture. The document included the requested scope of services for the geotechnical exploration and a "*Preliminary Site Plan Concept*" drawing.
- A drawing titled "*Beavercreek Township Fire Station No. 65*" dated February 26, 2018 from App Architecture. The drawing shows the proposed boring locations requested by the client.

Based on the information provided, PSI understands the project will involve construction of a new fire station in a vacant lot on the southwest corner of the intersection of Fairground Road and Trebein Road in Beavercreek Township, Ohio. The new fire station will be a single-story structure measuring approximately 7,400 square feet in plan area with a possible mezzanine over a portion of the building. It will be constructed of concrete masonry walls for the apparatus bays and metal studs with wood trusses for the living quarters and support spaces. The maximum calculated uniform wall load will be in the range of 5 kips per foot. The maximum concentrated load will be approximately 100 kips.

There will be a concrete apron off Trebein Road and an entrance drive off Fairground Road with fifteen (15) parking spaces located on the west side of the proposed building. A detention area is planned near the entrance drive off Fairground Road. Additionally, based on the information in the email correspondence from Mr. Nathan Hiester, a 180' self-supporting antenna tower is planned for the rear of the new fire station. The new antenna tower is not shown on either drawing provided to PSI.

According to our review of Google Earth™ historical imagery dating back to 1994, there has been no development on the site. No other information relative to the spatial geometry or other aspects of the project is available at this time.

The geotechnical recommendations presented in this report are based on the available project information, boring location and the subsurface materials described in this report. If any of the information noted above is incorrect, please inform PSI in writing so that we may amend the recommendations presented in this report, if necessary. PSI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

Purpose and Scope of Services

The purpose of this study was to explore the subsurface conditions at the site and to prepare recommendations for foundation and pavement section systems for the proposed construction. PSI's contracted scope of services included drilling eight (8) soil test borings including five (5) borings in the new building footprint drilled to depths of approximately 25 feet each, one (1) boring in the parking area drilled to a depth of 10 feet, one (1) boring in the detention area drilled to a depth of 10 feet and one (1) boring in the proposed self-supporting antenna tower drilled to a depth of 40 feet below the existing surface grades, select laboratory testing, and preparation of this geotechnical report. This report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and presents recommendations regarding the following:

- A general assessment of area geology based on our local knowledge and study of available geological literature
- Foundation system evaluations and the assessment of the feasibility of utilizing shallow foundations
- Design parameters required for the foundation system, including allowable bearing pressure, minimum foundation width, foundation bearing levels, and estimated total and differential settlements
- Site preparation as needed for support of foundations, slabs and pavements
- General location, description of materials encountered in the borings which may interfere with construction progress or structure performance, including existing fills, cobbles/boulders, or organic soils
- Identification of water levels encountered at the time of drilling
- Recommendation of modulus of subgrade reaction, and analysis of the swell potential of surface soil based on index tests
- Recommendations for fill including the selection of materials for use and procedures for placement
- Recommendations for pavement thickness based on assumed design traffic information and estimated CBR value.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on, below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

PSI's scope also did not provide any service to investigate or detect the presence of moisture, mold or other biological contaminants in or around any structure, or any service that was designed or intended to prevent or lower the risk of the occurrence or the amplification of the same. Client should be aware that mold is ubiquitous to the environment with mold amplification occurring when building materials are impacted by moisture. The client should be aware that site conditions are outside of PSI's control, and that mold amplification will likely occur, or continue to occur, in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence or reoccurrence of mold amplification.

SITE AND SUBSURFACE CONDITIONS

Site Location and Description

The site for the Proposed Fire Station No. 65 is located at at the southwest corner of the intersection of Fairground Road and Trebein Road in Beavercreek, Greene County, Ohio. The site latitude and longitude are approximately N 39.7364° and W -83.9889°, respectively. At the time of drilling, the property was currently undeveloped and consisted of a maintained grass field.

No topographical information available at the time of this report. However, based on the site visit by PSI, the existing grade variance within the existing building footprint and new parking lot was about 2 to 3 feet. The site drainage was through surface infiltration and sloped from southeast to northwest.

Site Geology

Based on the on-line geologic map provided by the Ohio Geological Survey (available at http://www.dnr.state.oh.us/OhioGeologicalSurvey/SurficialGeology/tabid/23586/Default.aspx), the proposed site area is located in the Central Lowland Province, Till Plains Section, Southern Ohio Loamy Till Plain Region, with predominately ground moraine topography, kames and eskers and outwash underlain by underlain by Silurian age bedrock (as part of the Wisconsinan Glaciation Period).

Subsurface Conditions

The site subsurface conditions were explored with eight (8) borings including five (5) borings in the new building footprint drilled to depths of approximately 25 feet each, one (1) boring in the parking area drilled to a depth of 10 feet, one (1) boring in the detention area drilled to a depth of 10 feet and one (1) boring in the proposed self-supporting antenna tower drilled to a depth of 40 feet below the existing surface grades.

The boring locations and depths were requested by App Architecture in their "Geotechnical Services Request" dated November 20, 2017, modified by PSI and reviewed with the client prior to drilling. PSI staked the borings in the field with the aid of a handheld GPS device and by measuring distances from available surface features. The surface elevations at the borings should be surveyed prior to construction activities.

The borings were advanced utilizing 2 ¼ inch inside diameter, hollow-stem auger drilling methods. Soil samples were routinely obtained during the drilling process. Selected soil samples were later tested in the laboratory to obtain soil material properties for the foundation and pavement recommendations. Drilling, sampling, and laboratory testing was accomplished in general accordance with ASTM procedures.

The surface material at soil test boring locations consisted of 3 to 4 inches of topsoil. It should be expected that the surficial material thicknesses will vary between the boring locations.

Below the surficial materials, natural soils consisting of Lean Clay (CL) with variable fractions of sand and gravel, Clayey Sand (SC), Well Graded Sand with Clay and Gravel (SW-SC), Well Graded Sand (SW), and Clayey Gravel (GC), Sandy Silty Clay (CL-ML), and Silt (ML) with variable fractions of sand and gravel, were encountered. The natural soils extended to depths ranging from 10 to 40 feet below the existing surface grades and exhibited Standard Penetration test values (N_{60}-values) ranging from 7 to 103 blows per foot (bpf) and moisture contents ranging from 3 to 27 percent.

The following Table briefly summarizes the range of results from the field and laboratory testing programs. Please refer to the attached boring logs and laboratory data sheets for more specific information:

Table 1
Soil Test Boring Field Result s and Lab Moisture Summary

SUMMARY OF SPT N VALUES, MOISTURE CONTENT & GROUND WATER LEVELS																			
Top of Soil Sampling Depth (ft)	SPT N Values (Blows/ft)									Top of Soil Sampling Depth (ft)	Moisture Content (%)								
	B-01	B-02	B-03	B-04	B-05	B-06	B-07	B-08	Average		B-01	B-02	B-03	B-04	B-05	B-06	B-07	B-08	Average
1.0	13	8	10	11	8	11	10	11	***10***	**1.0**	12	21	27	21	21	22	23	21	***21***
3.5	18	20	17	14	14	7	10	8	***14***	**3.5**	8	10	12	13	12	22	10	25	***14***
6.0	25	18	24	25	14	13	27	16	***20***	**6.0**	11	10	10	13	12	18	10	19	***13***
8.5	18	21	13	13	8	17	13	14	***15***	**8.5**	15	12	16	15	14	11	12	11	***13***
13.5	16	14	10	21	14	10			***14***	**13.5**	23	13	12	11	13	16			***15***
18.5	28	68	30	34	10	54			***37***	**18.5**	10	7	12	9	12	12			***10***
23.5	72	66	76	71	99	73			***76***	**23.5**	4	6	4	4	3	4			***4***
28.5						78			***78***	**28.5**						8			***8***
33.5						103			***103***	**33.5**						4			***4***
38.5						SSR			***SSR***	**38.5**						5			***5***
Groundwater Level Reading and Borehole Caving Depth (ft)																			
Water Level Encountered While Drilling											NE	NE	NE	NE	NE	17.0	NE	NE	
Water Level Reading Encountered Upon Completion											NE	NE	NE	NE	NE	20.0	NE	NE	
Cave Depth of Boring Upon Completion											20.0	19.5	20.5	21.0	20.0	21.0	8.0	8.0	

NE - Not Encountered

SSR - Split Spoon Refusal

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in the Appendix should be reviewed for specific information at individual boring locations. These records include soil descriptions, stratifications, penetration resistances, and locations of the samples and laboratory test data. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on these boring logs. The samples that were not altered by laboratory testing will be retained for sixty (60) days from the date of this report and then will be discarded.

Laboratory Testing

Laboratory index testing was conducted on samples obtained during the field drilling operations. The results are listed in Table 2 and Table 3 below.

Table 2
Soil Index Tests

Boring No.	Sample Depth	Liquid Limit	Plastic Limit	Plasticity Index	Moisture Content
B-01	3-1/2 to 5	21	14	7	8
B-05	1 to 2-1/2	43	18	25	21

Table 3
Soil Grain Size Analysis

Boring No.	Sample Depth	Gravel %	Sand %	Silt and Clay %
B-01	8-1/2 to 10	7.3	28.5	64.2
B-05	1 to 2-1/2	0.5	20.4	79.0
B-06	6 to 7-1/2	17.4	71.8	10.8
B-09	1 to 2-1/2	7.7	8.9	83.5

The forgoing tables are summaries of the field and laboratory data. Please refer to the boring logs and laboratory data sheets for specific information found in the appendix of this report.

Groundwater Level Measurements

Groundwater was observed during the drilling operations at a depth of 17.0 feet at soil test boring B-06. Upon completion of drilling at soil test boring B-06, water was observed at 20.0 feet. It must be recognized that free groundwater levels can significantly fluctuate (seasonally) as a function of rainfall. During a time of year or weather different from the time of drilling, there may be a considerable change in the water table or the occurrence of water where not previously encountered. Furthermore, the free groundwater levels in the boreholes often are not representative of the actual groundwater level, because the boreholes remain open for a relatively short time. To obtain longer-term measurements, it is necessary to install water level observation wells or piezometers. The water level measurements presented in this report are the levels that were measured at the time of PSI's field activities. Therefore, we recommend that the contractor determine the actual groundwater levels at the time of construction to evaluate groundwater impact on the construction procedures.

GEOTECHNICAL EVALUATION

Geotechnical Discussion

There is one (1) geotechnical-related issues at this site which will affect design and performance of the structure and pavements. The following summarizes these concerns:

1. **If necessary, aeration and drying of some of the wetter on-site natural soils may be required during site grading and compacting operations. Reducing the moisture content of the clay soils may be necessary to achieve proper compaction and establish stable subgrade conditions.**

Soil Compaction

Since this site contains some fine-grained clay soils, during periods of wet weather or decreased drying time (such as the spring and fall) it may become difficult to achieve the desired compaction of the soils due to high moisture contents. The soils may need to be scarified and dried to a moisture content that will facilitate compaction in accordance with the structural fill requirements of this report. **Lime, kiln dust, or fly ash stabilization may be necessary to expedite the work and achieve the required level of soil compaction.**

GEOTECHNICAL RECOMMENDATIONS

The following geotechnical related recommendations have been developed on the basis of the subsurface conditions encountered and PSI's understanding of the proposed development. Should changes in the project criteria occur, a review must be made by PSI to determine if modifications to our recommendations will be required.

Site Preparation

Prior to placing concrete floors or engineered fill on this site, general site area clearing should be performed. All existing topsoil, trees, brush, excessively wet soils, highly organic soils, and soft/loose or obviously compressible materials, should be completely removed from the proposed construction areas. Additionally, any undocumented fill materials encountered during site clearing should be removed to a level of suitable soil. All excavations created during the removal process should be backfilled with compacted and tested structural fill. It is not unusual for the topsoil or other surficial material thicknesses to vary from the values observed. The decision regarding the precise extent of required undercutting and backfilling should be determined in the field by a representative of PSI following observation of the exposed subgrades and proof rolling operations.

In this region, otherwise competent clays can undergo a significant loss of stability when construction activities are performed during wetter portions of the year. PSI anticipates that the soils in the project area can become easily disturbed if subjected to conventional rubber tire or narrow track-type equipment. Soils that become disturbed would need to be excavated and replaced; however, this remedial excavation may expose progressively wetter soils with depth, thus compounding the problem condition. Thus, a normal approach to subgrade preparation may not be possible. Appropriate wide-track equipment selection should aid in minimizing potential disturbance.

After stripping to the proposed subgrade level, as outlined in the paragraphs above, the building and pavement areas should be proof-rolled with a loaded tandem axle dump truck or similar heavy rubber-tired vehicle (typically with an axial load greater than nine (9) tons). Soils that are observed to rut or deflect excessively (typically greater than one (1) inch) under the moving load should be undercut and replaced with properly compacted low plasticity fill material. The proof-rolling and undercutting activities should be witnessed by a representative of the geotechnical engineer and should be performed during a period of dry weather. Care should be taken during construction activities not to allow excessive drying or wetting of exposed soils. The subgrade soils should be scarified and compacted to at least 98% of the materials' standard Proctor maximum dry density, in general accordance with ASTM procedures, to a depth of at least twelve (12) inches below the surface. New fill for building structures, asphalt, and concrete should not be placed on frozen ground.

After subgrade preparation and observation have been completed, fill placement required to establish grade may begin. **Low-plasticity structural fill materials placed beneath the structural features or slabs should be free of organic or other deleterious materials and have a maximum particle size of less than three (3) inches. Low-plasticity soils are defined as having a liquid limit less than forty-five (45) and plasticity index of twenty (20) or below. The in-situ soils appear to be suitable for reuse as engineered fill if they are free of any organic material and meet the requirements outlined in this report.** A representative of PSI should be on-site to observe, test, and document the placement of the fill. If the fill is too dry, water should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Close moisture content control will be required to achieve the recommended degree of compaction. If wet or cool season earthwork is necessary, PSI recommends the use of imported fill materials meeting the requirements of Ohio Department of Transportation (ODOT) No. 304 aggregate.

Fill should be placed in maximum loose lifts of eight (8) inches and compacted to at least 98% of the materials' standard Proctor maximum dry density, and within a range of the optimum moisture content as designated in the table below, as determined in general accordance with ASTM procedures. Each lift of compacted-engineered fill should be tested and documented by a representative of the geotechnical engineer prior to placement of subsequent lifts. The edges of compacted fill should extend a minimum of five (5) feet beyond the building footprint, or a distance equal to the depth of fill beneath the footings, whichever is greater. The measurement should be taken from the outside edge of the footing to the toe of the excavation prior to sloping.

In utility trenches, shallow foundation excavations, and other areas where large compaction equipment cannot be used, granular engineered fill should be placed as backfill. PSI recommends the use of material meeting Ohio Department of Transportation (ODOT) No. 304, for use as granular engineered fill. Engineered fill should be placed in accordance with the recommendations stated in this section of the report.

The fill placed should be tested and documented by a geotechnical technician and directed by a geotechnical engineer to evaluate the placement of fill material. It should be noted that the geotechnical engineer of record can only certify the testing that is performed and the work observed by that engineer or staff in direct report to that engineer. The fill should be evaluated in accordance with the following Table:

Table 5
Compaction Requirements

MATERIAL TESTED	PROCTOR TYPE	MIN % DRY DENSITY	PLACEMENT MOISTURE CONTENT RANGE	FREQUENCY OF TESTING *[1]
Structural Lean Clay Fill (Cohesive)	Standard	98%	-2 to +2 %	1 per 5,000 ft^2 of fill placed / lift
Structural Fill (Granular)	Standard	98%	-2 to +2 %	1 per 5,000 ft^2 of fill placed / lift
Random Fill (non load bearing)	Standard	90%	-3 to +3 %	1 per 6,000 ft^2 of fill placed / lift
Utility Trench Backfill	Standard	98%	-2 to +2 %	1 per 150 lineal foot / lift

*[1] Minimum 2 per lift.

Tested fill materials that do not achieve either the required dry density or moisture content range shall be recorded, the location noted, and reported to the Contractor and Owner. A re-test of that area should be performed after the Contractor performs remedial measures and prior to placement of additional fill.

Foundation Recommendations

New Fire Station

The planned construction can be supported on conventional spread-type footing foundations bearing on either **competent naturally deposited undisturbed soils, properly compacted, tested, and documented engineered fill, or lean concrete monoliths bearing on competent natural soils**. **Spread footings for building columns and continuous footings for bearing walls can be designed for an allowable soil bearing pressure of 3,000 pounds per square foot (psf)** based on anticipated dead load plus design live load. PSI recommends a minimum dimension of thirty (30) inches for square footings and eighteen (18) inches for continuous footings to reduce the potential of a local bearing capacity failure.

Exterior footings and footings in unheated areas should be located at a depth of thirty-two (32) inches or deeper below the final exterior grade to provide adequate frost protection. If the building is to be constructed during the winter months or if footings will likely be subjected to freezing temperatures after foundation construction, then the footings should be protected from freezing. PSI recommends that interior footings be a minimum depth of eighteen (18) inches below the finished floor elevation.

New Self-Supporting Antenna Tower

PSI understands there will be a new 180-foot, self-supporting antenna tower located in the rear of the proposed new fire station. Our findings indicate the tower can be supporting on drilled shafts of a mat-type foundation.

Drilled Pier Foundations

A drilled shaft foundation system may be used to support the proposed tower. We recommend that the design parameters shown in Tables 6 and 7 be used to design the drilled shaft foundation. The upper 5 feet of soil will likely provide little resistance to the applied loads, and therefore should not be included in the foundation design calculations. The following parameters are based on the data collected during this Geotechnical Exploration, published data and our experience with the local geology. A Factor of Safety of 3.0 and 2.0 was used to develop the allowable design values for end bearing and side resistance, respectively.

TABLE 6: Design Values for Boring B-06

Layer No.	Depth (feet)	SPT "N" Range	Probable Soil Classification (USCS)/Material Type	Approximate Unit Weight (pcf)		Angle of Internal Friction (ϕ^o)
				γmoist	γsub	
1	0-5	7 - 11	Stiff, Lean Clay and Silty Clay	120	-	-
2	5-8	13	Medium Dense, Clayey Sand	130	-	26
3	8-17	10 - 17	Stiff to Very Stiff, Sandy Silty Clay	125	-	24
4	17-40	54 – 103	Very Dense to Extremely Dense, Clayey Gravel and Well-Graded Sand with Clay and Gravel	140	77.6	35

TABLE 7: Additional Design Values for Boring B-06

Layer No.	Earth Pressure* Coefficients		Allowable Unit Capacity (psf)		Lateral Modulus, k Pci	E_{50} Strain Parameter
	Active (K_a)	Passive (K_p)	Side Resistance	End Bearing		
1	-	-	ignore	ignore	-	-
2	0.39	2.56	400	4000	100	0.01
3	0.42	2.37	500	5000	125	0.007
4	0.27	3.68	1000	32,500	200	-

*Earth pressure coefficients are based upon the angle of internal friction only and assume a level grade. Design water level is 17.0 feet. Minimum depth is 4B; B=shaft diameter.

The construction of drilled shafts should be specified in accordance with ACI 336.1-01, “Specification for the Construction of Drilled Piers”. In addition, drilled shafts should be constructed following the guidelines in ACI 336.3 Chapter 4. A representative of *PSI* should determine that drilled shafts are founded on competent bearing materials and that the drilled shaft installation procedures comply with the specifications.

There are numerous factors which play a significant role in the behavior of pier groups subjected to axial load. Several of these factors are pier type, size and length, spacing, overall group size, loading conditions, installation procedures and soil type and strength. The drilled shafts will transfer load by both end bearing and skin friction. Group effects are anticipated to be relatively insignificant regarding load reduction if the piers are installed with a center-to-center spacing of at least 2.5 to 3 pier diameters (width). Assuming the suggested spacing, the group capacity for axial load may be taken as the sum of the individual pier capacities in the group.

Prior to placement of the reinforcement cage or concrete, the bottom of the drilled shaft excavation must be thoroughly cleaned and free of all loose or soft materials. This is critical for end-bearing shafts. For end bearing shafts a final bottom check should be performed just before concrete placement to check for small cave-ins or accumulated sediment. Steel reinforcing should be placed after the Geotechnical Engineer has approved the shaft for concrete placement. The reinforcement should be centered using spacers as needed and should not contact the side walls of the shaft.

Concrete should be placed into the drilled shaft as soon as possible after the completion of drilling operations. We recommend placing the drilled shaft concrete on the same day that the shaft is drilled. During the placement of concrete, we recommend that the slump be between 5 to 7 inches; this will allow for proper distribution of the concrete and limit the potential for segregation and air pockets. The concrete should be placed using a tremie and not allowed to free fall during placement which may result in segregation.

If groundwater infiltration can be controlled so that concrete is placed “in the dry” (less than ¼ inch rise per minute), then the concrete can be placed by buckets, chuting, tremie pipe, or elephant trunk in a way to reduce segregation of aggregate.

It should be noted that groundwater was encountered in borings B-02 through B-10 at depths ranging from 6 to 14.5 feet. It may be necessary to use a drilling slurry to maintain a stable excavation during the drilling process in addition to a temporary casing if the shaft excavation is terminated above the rock.

A temporary casing, which is removed when concrete is placed, should be utilized to prevent collapse of the overburden and infiltration of the groundwater. When temporary casing is utilized, extreme care should be given as to limit the amount of disturbance along the sides of the drilled shaft. The contractor must fill any voids or enlargements in the shaft excavations with concrete at the time of concrete placement. When removing the casing, a minimum head of 5 feet of concrete should be maintained above the bottom of the casing at all times, and in some instances, a much higher head is required. The volume of concrete placed in the excavation should be checked to confirm that no substantial sloughing of the excavation occurred during concrete placement or removal of the casing. If any discrepancies are noted, the geotechnical engineer should be notified immediately.

Mat Foundation

Alternately, the proposed antenna tower can be supported on a conventional mat foundation. The proposed foundation can be designed for a maximum allowable bearing pressures of 4,000 pounds per square foot (psf) when bearing on the medium dense, clayey sand layer at a depth of approximately 5 feet below existing grades. A friction coefficient of 0.35 between the soil and concrete can be used for design. The proposed mat foundation should be designed to resist overturn by embedding the foundation into the subgrade soils and providing adequate soil cover to resist overturn. Additionally, skin friction between

the walls of the mat foundation and the perimeter soils should be neglected for design. Placed and compacted onsite clay soils or imported, dense graded, crushed aggregate can be designed to have a minimum unit weight of 115 pcf and 135 pcf, respectively, if used as the cover material.

The proposed mat foundation should be located at a depth of at least 36 inches below the final exterior grade to provide adequate frost protection. If the tower is to be constructed during the winter months or if footings will likely be subjected to freezing temperatures after foundation construction, then the footings should be protected from freezing.

General Foundation Considerations

The foundation excavations must be observed and documented by a representative of PSI prior to steel or concrete placement to assess that the foundation materials are consistent with the materials discussed in this report, and therefore are capable of supporting the design loads. **Soft or loose soil zones encountered at the bottom of the footing excavations, should be removed to the level of suitable natural soils, and replaced with adequately compacted and tested structural fill or lean concrete.** It should be noted that the soft or loose material may be encountered in other areas of the site and to greater depths than observed in the soil test borings. Fill placed below the foundations where unsuitable materials are removed should extend one (1) foot outside the foundation limits for every one (1) foot in thickness between the intended bearing surface and the underlying, suitable natural soils. Alternately, the foundations may be extended through unsuitable soils to bear on the underlying suitable material. Cavities formed as a result of excavation of soft or loose soil zones should be backfilled with lean concrete or dense graded compacted crushed stone.

After opening, footing excavations should be observed and concrete placed as quickly as possible to avoid exposure of the footing bottoms to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond in or adjacent to the excavation. If possible, the foundation concrete should be placed during the same day the excavation is made. If it is required that footing excavations be left open for more than one day, they should be protected to reduce evaporation or entry of moisture.

Based on the known subsurface conditions and site geology, laboratory testing and past experience, PSI anticipates that properly designed and constructed footings supported on the recommended materials should experience total and differential settlement between adjacent columns of less than one (1) inch and ½ inch, respectively.

Be advised that as a part of the foundation selection process, there is a cost/benefit evaluation. Although PSI is recommending a specific foundation type, we have not accomplished the cost/benefit evaluation.

Earthquake and Seismic Design Consideration

The 2009 International Building Code requires a site class for the calculation of earthquake design forces. This class is a function of soil type (i.e., depth of soil and strata types). Based on the depth to rock and the estimated shear strength of the soil at the boring locations, **Site Class "D"** is recommended. The USGS-NEHRP probabilistic ground motion values near latitude 39.7364° and longitude -83.9889 ° are as follows:

Period (seconds)	**2% Probability of Event in 50 years * (%g)**	**Site Coefficients**	**Max. Spectral Acceleration parameters**	**Design Spectral Acceleration parameters**	
0.2 (S_s)	18.3	F_a = 1.6	S_{ms} = 0.292	S_{DS}= 0.195	T_0= 0.111
1.0 (S_1)	6.8	F_v = 2.4	S_{m1} = 0.162	S_{D1}= 0.108	T_s= 0.554

The Site Coefficients, F_a and F_v were interpolated from IBC 2009 Tables 1613.5.3(1) and 1613.5.3(2) as a function of the site classifications and the mapped spectral response acceleration at the short (S_s) and 1 second (S_1) periods.

According to Section 1802.2.6 and 1802.2.7 of IBC 2009, sites supporting structures in design category "B" and below must be evaluated for slope instabilities, liquefaction and surface rupture due to faulting or lateral spreading. A detailed study of these effects was beyond PSI's scope of services. However, the following table presents a qualitative assessment of these issues considering the site class, the subsurface soil properties, the groundwater elevation, and probabilistic ground motions:

Hazard	**Relative Risk**	**Comments**
Liquefaction	Low	The soil within the upper 50 feet of the subsurface profile is a relatively dense and/or cohesive soil
Slope Stability	Low	The site is relatively flat and does not/will not incorporate significant cut or fill slopes
Surface Rupture	Low	The site is not underlain by a mapped Holocene-aged fault

A more detailed evaluation of these issues can be performed for an additional scope and/or fee.

Floor Slab Recommendations

Once the site area has been prepared in accordance with the "Site Preparation" section of this report, the floor slab can be grade supported on a minimum 2 feet non-expansive engineered fill or native undisturbed soil. Proof-rolling, as discussed earlier in this report, should be accomplished to identify soft or unstable soils that should be removed from the floor slab area prior to fill placement and/or floor slab construction. These soils should be replaced with properly compacted and tested structural fill as described earlier in this report.

PSI recommends that a minimum four (4) inch thick trimmable, compactable granular material be placed beneath the floor slab to enhance drainage. The soil surface shall be graded to drain away from the building without low spots that can trap water prior to placing the granular drainage layer. Polyethylene sheeting should be placed to act as a vapor retarder where the floor will be in contact with moisture sensitive equipment or products such as tile, wood, carpet, etc., as directed by the design engineer. The decision to locate the vapor retarder in direct contact with the slab or beneath the layer of granular fill should be made

by the design engineer after considering the moisture sensitivity of subsequent floor finishes, anticipated project conditions, and the potential effects of slab curling and cracking. The floor slabs should have an adequate number of joints to reduce cracking resulting from differential movement and shrinkage.

For subgrade prepared as recommended and properly compacted fill, a modulus of subgrade reaction, *k* value, of **125 pounds per cubic inch (pci)** may be used in the grade slab design based on correlation to values typically resulting from a 1 ft. x 1 ft. plate load test. However, depending on how the slab load is applied, the value will have to be geometrically modified. The value should be adjusted for larger areas using the following expression for cohesive and cohesionless soil:

Modulus of Subgrade Reaction, $k_s = \left(\frac{k}{B}\right)$ for cohesive soil and

$$k_s = k\left(\frac{B+1}{2B}\right)^2 \text{ for cohesionless soil}$$

where: k_s = coefficient of vertical subgrade reaction for loaded area,
k = coefficient of vertical subgrade reaction for 1 square foot area, and
B = effective width of area loaded, in feet

The precautions listed below should be followed for construction of slab-on-grade pads. These details will not reduce the amount of movement, but are intended to reduce potential damage should some settlement of the supporting subgrade take place. Some increase in moisture content is inevitable as a result of development and associated landscaping. However, extreme moisture content increases can be largely controlled by proper and responsible site drainage, building maintenance and irrigation practices.

- Cracking of slab-on-grade concrete is normal and should be expected. Cracking can occur not only as a result of heaving or compression of the supporting soil and/or bedrock material, but also as a result of concrete curing stresses. The occurrence of concrete shrinkage crack , and problems associated with concrete curing may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement, finishing, and curing, and by the placement of crack control joints at frequent intervals, particularly where re-entrant slab corners occur. The American Concrete Institute (ACI) recommends a maximum panel size (in feet) equal to approximately three times the thickness of the slab (in inches) in both directions. For example, joints are recommended at a maximum spacing of twelve (12) feet based on having a four-inch slab. PSI also recommends that the slab be independent of the foundation walls. Using fiber reinforcement in the concrete can also control shrinkage cracking.
- Areas supporting slabs should be properly moisture conditioned and compacted. Backfill in all interior and exterior water and sewer line trenches should be carefully compacted to reduce the shear stress in the concrete extending over these areas.

Exterior slabs should be isolated from the building. These slabs should be reinforced to function as independent units. Movement of these slabs should not be transmitted to the building foundation or superstructure.

Utilities Trenching

Excavation for utility trenches shall be performed in accordance with OSHA regulations as stated in 29 CFR Part 1926. It should be noted that utility trench excavations have the potential to degrade the properties of the adjacent fill materials. Utility trench walls that are allowed to move laterally can lead to reduced bearing capacity and increased settlement of adjacent structural elements and overlying slabs.

Backfill for utility trenches is as important as the original subgrade preparation or structural fill placed to support either a foundation or slab. Therefore, it is imperative that the backfill for utility trenches be placed to meet the project specifications for the structural fill of this project. PSI recommends that flowable fill or lean mix concrete be utilized for utility trench backfill. If on-site soils are placed as trench backfill, the backfill for the utility trenches should be placed in four (4) to six (6) inch loose lifts and compacted to a minimum of 98% of the maximum dry density achieved by the standard Proctor test. The backfill soil should be moisture conditioned to be within 2% of the optimum moisture content as determined by the standard Proctor test. Up to four (4) inches of bedding material placed directly under the pipes or conduits placed in the utility trench can be compacted to the 98% compaction criteria with respect to the standard Proctor. Compaction testing should be performed for every 200 cubic yards of backfill place or each lift within 150 linear feet of trench, whichever is less. Backfill of utility trenches should not be performed with water standing in the trench. If granular material is used for the backfill of the utility trench, the granular material should have a gradation that will filter protect the backfill material from the adjacent soils. If this gradation is not available, a geosynthetic non-woven filter fabric should be used to reduce the potential for the migration of fines into the backfill material. Granular backfill material shall be compacted to meet the above compaction criteria. The clean granular backfill material should be compacted to achieve a relative density greater than 75% or as specified by the geotechnical engineer for the specific material used.

Siltation Control

The Clean Water Act, implemented in 1990 includes a federal permit program called the National Pollutant Discharge Elimination System (NPDES). This program requires that projects sites in excess of one (1) acre or are part of a development which exceeds one (1) acre be covered under a permit. This typically includes the development of a storm water pollution prevention plan (SWPPP) as well as period inspections (typically once a week plus after significant rainfall). PSI is available to assist with these services.

Pavement Recommendations

PSI's scope of services did not include extensive sampling and CBR testing of existing subgrade or potential sources of imported fill for the specific purpose of detailed pavement analysis. Instead, this report is based on pavement-related design parameters that are typical for the area soils types. In large areas of pavement, or where pavements are subject to significant traffic, a more detailed analysis of the subgrade and traffic conditions should be made. The results of such a study will provide information necessary to design an economical and serviceable pavement.

No traffic information was available for the proposed development. However, the pavement design is based on the anticipated design 18-kip EAL's of 50,000 and 200,000 for Flexible Standard Duty Pavement areas and Heavy-Duty Pavement areas, respectively, and an anticipated design life is 20 years. The PSI recommendation is based on the subgrade soils being prepared to achieve a minimum CBR of five (5). On this basis, it is possible to use a locally typical "standard" pavement section consisting of the following:

RECOMMENDED THICKNESSES (INCHES)		
PAVEMENT MATERIALS *	**LIGHT DUTY**	**HEAVY DUTY**
Asphaltic Surface Course	1½	1½
Asphaltic Binder Course	1½	3½
Crushed stone ($^3/_4$-inch minus)	6	10
Or		
Portland Cement Concrete	5	8
Crushed stone ($^3/_4$-inch minus)	6	6

*Pavement materials should conform to local and state guidelines, if applicable.

Asphalt Pavement

PSI recommends that the bituminous concrete mix meet the general guidelines as outlined in ODOT Item 448 for the base and surface courses. The granular base course should be built at least 2 feet wider than the pavement on each side to support the tracks of the slipform paver. This extra width is structurally beneficial for wheel loads applied at pavement edge. The asphalt surface and binder course should be compacted to a minimum of 92% of the Maximum Theoretical Density as determined by ASTM D2041.

Concrete Pavement

Because the pavement at this site will be subjected to freeze-thaw cycles, PSI recommends that an air entrainment admixture be added to the concrete mix to achieve an air content in the range of 5% to 7% to provide freeze-thaw durability in the concrete. Concrete with a minimum 28 day specified compressive strength of 4,000 psi should be used. The mixture should have a maximum slump of four (4) inches. If a water reducing admixture is used in the mix design, then the slump can be increased. It is recommended that a concrete mix design including any admixtures be submitted to the owner in advance of use at the project site.

Pavement for any dumpster areas or areas subject to consistent heavy loads should be constructed of a minimum 7 inches of Portland cement concrete with load transfer devices installed where construction joints are required. A thickened edge is recommended on the outside of slabs subjected to wheel loads. This thickened edge usually takes the form of an integral curb. Fill material should be compacted behind the curb or the edge of the outside slabs should be thickened. The following are recommended to enhance the quality of the pavement.

- Moisten subgrade just prior to placement of concrete
- Cure fresh concrete with a liquid membrane-forming curing compound
- Keep automobile traffic off the slab for three (3) days and truck traffic off the slab for seven (7) days, unless tests are made to determine that the concrete has gained adequate strength (i.e., usually 70% of design strength)

Pavement Subgrade Preparation

If encountered, undocumented fill materials should be removed to a minimum depth of 12 inches below the proposed pavement subgrade elevation and replaced with compacted and tested engineered fill. The engineered fill should be compacted to a minimum 98 percent of maximum dry density and within +/- 2 percent of optimum moisture in accordance with ASTM D-698 (Standard) in the top **12** inches of subgrade and then proof-rolled using a loaded tandem axle dump truck or similar type of pneumatic tired equipment with a minimum gross weight of nine (9) tons per single axle. Localized soft areas identified should be repaired prior to paving. Moisture content of the subgrade should be maintained between –2% and +2% of the optimum at the time of paving. It may require rework when the subgrade is either desiccated or wet.

Construction traffic should be minimized to prevent unnecessary disturbance of the pavement subgrade. Disturbed areas, as verified by PSI, should be removed and replaced with properly compacted material.

The edges of compacted fill should extend a minimum two (2) feet beyond the edges of the pavement, or a distance equal to the depth of fill beneath the pavement, whichever is greater. The measurement should be taken from the outside edge of the pavement to the toe of the excavation prior to sloping.

Pavement Drainage & Maintenance

PSI recommends pavements be sloped to provide rapid surface drainage. Water allowed to pond on or adjacent to the pavement could saturate the subgrade and cause premature deterioration of the pavements, and removal and replacement may be required. **It must be emphasized that if water can pond beneath the pavement, then freeze-thaw cycles will cause subsequent heaving of the pavement section (and ultimately failure).** Consideration should be given to the use of interceptor drains to collect and remove water collecting in the granular base. The interceptor drains could be incorporated with the storm drains of other utilities located in the pavement areas.

Periodic maintenance of the pavement should be anticipated. This should include sealing of cracks and joints and by maintaining proper surface drainage to avoid ponding of water on or near the pavement areas. Underdrains, sub-drains and underslab drains presented in this report will not prevent moisture vapor that can cause mold growth.

CONSTRUCTION CONSIDERATIONS

PSI should be retained to provide observation and testing of construction activities involved in the foundation, earthwork, and related activities of this project. PSI cannot accept responsibility for conditions that deviate from those described in this report, nor for the performance of the foundation system if not engaged to also provide construction observation and testing for this project.

Moisture Sensitive Soils/Weather Related Concerns

The upper fine-grained soils encountered at this site will be sensitive to disturbances caused by construction traffic and to changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather.

Drainage and Groundwater Considerations

PSI recommends that the Contractor determine the actual groundwater levels at the site at the time of the construction activities to assess the impact groundwater may have on construction. Water should not be allowed to collect in the foundation excavation, on floor slab areas, or on prepared subgrades of the construction area either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of collected rainwater, groundwater, or surface runoff. Positive site drainage should be provided to reduce infiltration of surface water around the perimeter of the building and beneath the floor slabs. The grades should be sloped away from the building and surface drainage should be collected and discharged such that water is not permitted to infiltrate the backfill and floor slab areas of the building.

Excavations

In Federal Register, Volume 54, Number 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better enhance the safety of workers entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new OSHA guidelines. It is PSI's understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

PSI is providing this information solely as a service to our client. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations. A trench safety plan was beyond the scope of our services on this project.

GEOTECHNICAL RISK

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned. The engineering recommendations presented in the preceding section constitutes PSI's professional estimate of those measures that are necessary for the proposed structure to perform according to the proposed design based on the information generated and referenced during this evaluation, and PSI's experience in working with these conditions.

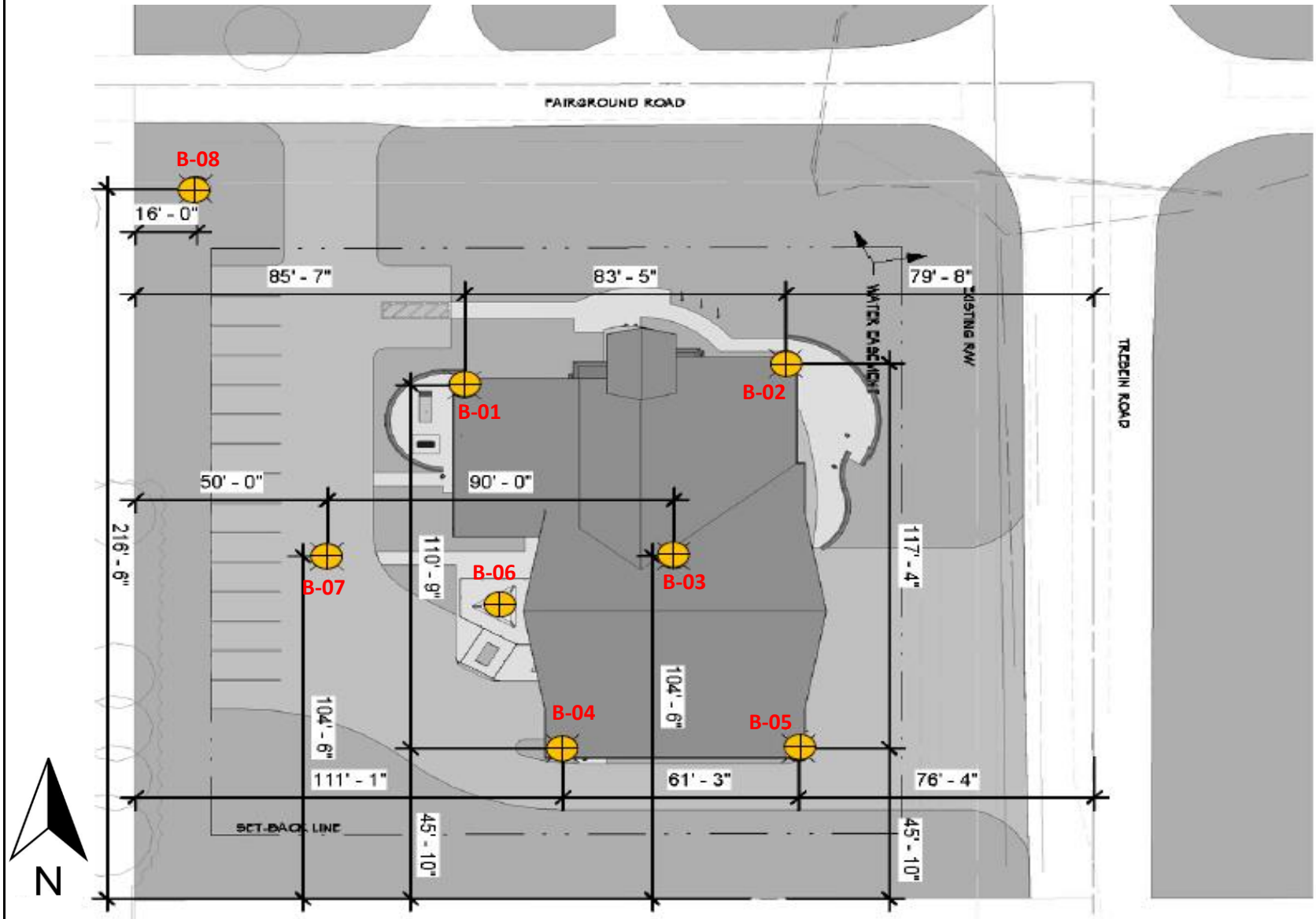
REPORT LIMITATIONS

The recommendations submitted are based on the available subsurface information obtained by PSI and design details furnished by Beavercreek Township Fire Department. If there are revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the project.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the geotechnical engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of Beavercreek Township Fire Department for the specific application to the proposed Fire Station No. 65 to be located at the Southwest Corner of the Intersection of Fairground Road and Trebein Road in Beavercreek Township, Greene County, Ohio.

Appendix



intertek psi	**Boring Location Plan** Firestation No. 65 Fariground Rd and Trebein Rd Beavercreek, Greene County, Ohio	Drawing Provided By: Beavercreek Township Fire Department Project No.: 01051248 Date: 4/10/2018

BORING B-01

DATE STARTED:	3/23/18	**DRILL COMPANY:**	Central Star
DATE COMPLETED:	3/23/18	**DRILLER:** TG	**LOGGED BY:** JK
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	CME 55LC
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:	39.7364°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-83.9889°	**EFFICIENCY**	85%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	RAS

Water

While Drilling	N/A feet
Upon Completion	N/A feet
Cave Depth	20 feet

BORING LOCATION:
See boring location plan

REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					TOPSOIL (3")	TOPSOIL				
				1	18	Stiff to Very Stiff, Moist, Brown, **SANDY SILTY CLAY**		2-4-5 N_{60}=13	12		
	5			2	18		CL-ML	7-7-6 N_{60}=18	8		LL = 21 PL = 14 Fines=52.2%
				3	18			10-9-9 N_{60}=25	11		
	10			4	18	Very Stiff, Moist, Brown, **CLAYEY SILT**	ML	5-7-6 N_{60}=18	15		
						Very Stiff, Wet, Brown, **GRAVELLY SILT**					
	15			5	18		ML	4-5-6 N_{60}=16	23		
	20			6	16	Medium Dense, Moist, Brown, **WELL GRADED SAND WITH CLAY AND GRAVEL**	SW-SC	3-5-15 N_{60}=28	10		
						Very Dense, Damp, Brown, **WELL GRADED SAND**	SW				
	25			7	15			25-25-26 N_{60}=72	4	>>◎	
						End of boring, 25'					

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Professional Service Industries, Inc.
5599 Webster Street
Dayton, OH 45414
Telephone: (937) 898-1200

PROJECT NO.: 01051248
PROJECT: Fire Station No. 65
LOCATION: Fairground Road and Trebein Road
Beavercreek, Ohio 45385

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-02

DATE STARTED:	3/23/18	**DRILL COMPANY:**	Central Star
DATE COMPLETED:	3/23/18	**DRILLER:** TG	**LOGGED BY:** JK
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	CME 55LC
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:	39.7364°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-83.9886°	**EFFICIENCY**	85%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	RAS

Water

While Drilling	N/A feet
Upon Completion	N/A feet
Cave Depth	19.5 feet

BORING LOCATION:
See boring location plan

REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					TOPSOIL (3")	TOPSOIL				
				1	8	Stiff, Moist, Brown, **LEAN CLAY WITH SAND**	CL	3-3-3 N_{60}=8	21		
				2	18	Very Stiff, Moist, Brown, **SANDY LEAN CLAY**	CL	5-7-7 N_{60}=20	10		
	5			3	18	Very Stiff, Moist, Brown, **SANDY SILTY CLAY WITH GRAVEL**		4-5-8 N_{60}=18	10		
				4	18			5-7-8 N_{60}=21	12		
	10						CL-ML				
				5	18			3-4-6 N_{60}=14	13		
	15										
				6	17	Very Dense, Moist, Brown, **WELL GRADED SAND WITH CLAY AND GRAVEL**		4-13-35 N_{60}=68	7	× >>◎	
	20						SW-SC				
				7	18			12-12-35 N_{60}=66	6	× >>◎	
	25					End of boring, 25'					

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PROJECT NO.: 01051248
PROJECT: Fire Station No. 65
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Beavercreek, Ohio 45385

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-03

DATE STARTED:	3/23/18	**DRILL COMPANY:**	Central Star
DATE COMPLETED:	3/23/18	**DRILLER:** TG	**LOGGED BY:** JK
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	CME 55LC
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:	39.7363°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-83.9888°	**EFFICIENCY**	85%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	RAS

Water

While Drilling	N/A feet
Upon Completion	N/A feet
Cave Depth	20.5 feet

BORING LOCATION:
See boring location plan

REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ / Moisture × / PL ◪ / LL ✚ (0, 25, 50) / STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					TOPSOIL (3")	TOPSOIL				
				1	16	Stiff, Moist, Brown, **LEAN CLAY WITH SAND**	CL	2-3-4 N_{60}=10	27		
	5			2	18	Very Stiff, Moist, Brown, **SANDY SILTY CLAY** Grading to **SANDY SILTY CLAY WITH GRAVEL**	CL-ML	5-6-6 N_{60}=17	12		
				3	18			6-7-10 N_{60}=24	10		
	10			4	18	Stiff, Moist, Brown, **SANDY SILTY CLAY**		4-4-5 N_{60}=13	16		
	15			5	18		CL-ML	3-3-4 N_{60}=10	12		
	20			6	18	Dense to Very Dense, Moist to Damp, Brown, **WELL GRADED SAND WITH CLAY AND GRAVEL**	SW-SC	4-4-17 N_{60}=30	12		
	25			7	16			37-27-27 N_{60}=76	4	>>	
						End of boring, 25'					

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PROJECT NO.: 01051248
PROJECT: Fire Station No. 65
LOCATION: Fairground Road and Trebein Road
Beavercreek, Ohio 45385

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-04

DATE STARTED:	3/23/18	**DRILL COMPANY:**	Central Star
DATE COMPLETED:	3/23/18	**DRILLER:** TG	**LOGGED BY:** JK
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	CME 55LC
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:	39.7361°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-83.9889°	**EFFICIENCY**	85%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	RAS

Water

While Drilling	N/A feet
Upon Completion	N/A feet
Cave Depth	21 feet

BORING LOCATION:
See boring location plan

REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					TOPSOIL (3")	TOPSOIL				
				1	8	Stiff, Moist, Brown, **LEAN CLAY WITH SAND**	CL	2-4-4 N_{60}=11	21		
	5			2	18			4-4-6 N_{60}=14	13		
				3	18	Very Stiff, Moist, Brown, **SANDY SILTY CLAY**	CL-ML	6-7-11 N_{60}=25	13		
	10			4	18	Stiff, Moist, Brown, **SANDY CLAYEY SILT WITH GRAVEL**	ML	5-4-5 N_{60}=13	15		
	15			5	18	Very Stiff, Moist, Brown, **SANDY SILTY CLAY**	CL-ML	4-7-8 N_{60}=21	11		
				6	5	Dense to Very Dense, Moist to Damp, Brown, **WELL GRADED SAND WITH CLAY AND GRAVEL**	SW-SC	6-7-17 N_{60}=34	9		
	20										
	25			7	15			14-25-25 N_{60}=71	4	>>◎	
						End of boring, 25'					

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PROJECT NO.: 01051248
PROJECT: Fire Station No. 65
LOCATION: Fairground Road and Trebein Road
Beavercreek, Ohio 45385

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-05

DATE STARTED:	3/23/18	**DRILL COMPANY:**	Central Star
DATE COMPLETED:	3/23/18	**DRILLER:** TG	**LOGGED BY:** JK
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	CME 55LC
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:	39.7361°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-83.9887°	**EFFICIENCY**	85%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	RAS

Water

While Drilling	N/A feet
Upon Completion	N/A feet
Cave Depth	20 feet

BORING LOCATION:
See boring location plan

REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					TOPSOIL (3")	TOPSOIL				
				1	12	Stiff, Moist, Brown, **LEAN CLAY WITH SAND**	CL	2-3-3 N_{60}=8	21		LL = 43 PL = 18 Fines=77.7%
				2	16	Stiff, Moist, Brown, **SANDY SILTY CLAY**	CL-ML	3-5-5 N_{60}=14	12		
	5			3	18			4-5-5 N_{60}=14	12		
				4	18	Stiff, Moist, Brown, **SANDY SILT**	ML	3-3-3 N_{60}=8	14		
	10			5	18			4-4-6 N_{60}=14	13		
	15			6	18 ▼			2-3-4 N_{60}=10	12		
	20			7	15	Extremely Dense, Damp, Brown, **WELL GRADED SAND WITH CLAY AND GRAVEL**	SW-SC	16-32-38 N_{60}=99	3	× >>◎	
	25					End of boring, 25'					

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PROJECT NO.: 01051248
PROJECT: Fire Station No. 65
LOCATION: Fairground Road and Trebein Road
Beavercreek, Ohio 45385

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-06

DATE STARTED:	3/23/18	**DRILL COMPANY:**	Central Star
DATE COMPLETED:	3/23/18	**DRILLER:** TG	**LOGGED BY:** JK
COMPLETION DEPTH	40.0 ft	**DRILL RIG:**	CME 55LC
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:	39.7363°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-83.9889°	**EFFICIENCY**	85%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	RAS

Water

While Drilling	17 feet
Upon Completion	20 feet
Cave Depth	21 feet

BORING LOCATION:
See boring location plan

REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0 25 50) STRENGTH, tsf ▲ Qu ✳ Qp (0 2.0 4.0)	Additional Remarks
	0					TOPSOIL (4")	TOPSOIL				
				1	15	Stiff, Moist, Brown, **LEAN CLAY WITH SAND**	CL	3-4-4 N_{60}=11	22		
				2	18	Stiff, Moist, Brown, **SANDY SILTY CLAY**	CL-ML	2-2-3 N_{60}=7	22		
	5			3	18	Medium Dense, Moist, Brown, **CLAYEY SAND**	SC	4-4-5 N_{60}=13	18		Fines=43.8%
				4	18	Very Stiff to Stiff, Moist to Wet, Brown, **SANDY SILTY CLAY**		5-6-6 N_{60}=17	11		
	10						CL-ML				
				5	18			2-3-4 N_{60}=10	16		
	15										
				6	13	Very Dense, Wet, Brown, **SANDY CLAYEY GRAVEL**	GC	5-20-18 N_{60}=54	12	>>	
	20					Very Dense to Extremely Dense, Damp, Brown, **WELL GRADED SAND WITH CLAY AND GRAVEL**					
				7	17			17-27-25 N_{60}=73	4	>>	Fines=7.6%
	25										
				8	16		SW-SC	15-30-25 N_{60}=78	8	>>	
	30										
				9	16			32-31-42 N_{60}=103	4	>>	
	35										
				10	10			16-50/6	5	>>	
	40					End of boring, 40'					

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PROJECT NO.: 01051248
PROJECT: Fire Station No. 65
LOCATION: Fairground Road and Trebein Road
Beavercreek, Ohio 45385

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-07

DATE STARTED:	3/23/18	**DRILL COMPANY:**	Central Star
DATE COMPLETED:	3/23/18	**DRILLER:** TG	**LOGGED BY:** JK
COMPLETION DEPTH	10.0 ft	**DRILL RIG:**	CME 55LC
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:	39.7363°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-83.9891°	**EFFICIENCY**	85%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	RAS

Water

While Drilling	N/A	feet
Upon Completion	N/A	feet
Cave Depth	8	feet

BORING LOCATION:
See boring location plan

REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					TOPSOIL (3")	TOPSOIL				
				1	14	Stiff, Moist, Brown, **LEAN CLAY WITH SAND**	CL	3-3-4 N_{60}=10	23		
				2	18	Stiff to Very Stiff, Moist, Brown, **SANDY SILTY CLAY** Grading to **SANDY SILTY CLAY WITH GRAVEL**		3-3-4 N_{60}=10	10		
	5			3	18		CL-ML	6-7-12 N_{60}=27	10	>>✳	
				4	18			5-4-5 N_{60}=13	12		
	10					End of boring, 10'					

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PROJECT NO.: 01051248
PROJECT: Fire Station No. 65
LOCATION: Fairground Road and Trebein Road
Beavercreek, Ohio 45385

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-08

DATE STARTED:	3/23/18	**DRILL COMPANY:**	Central Star
DATE COMPLETED:	3/23/18	**DRILLER:** TG	**LOGGED BY:** JK
COMPLETION DEPTH	10.0 ft	**DRILL RIG:**	CME 55LC
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:	39.7366°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-83.9892°	**EFFICIENCY**	85%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	RAS

Water

While Drilling	N/A feet
Upon Completion	N/A feet
Cave Depth	8 feet

BORING LOCATION:
See boring location plan

REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ / STRENGTH, tsf	Additional Remarks
	0					TOPSOIL (3")	TOPSOIL				
				1	15	Stiff to Very Stiff, Moist, Brown, **LEAN CLAY WITH SAND** Grading to **SANDY LEAN CLAY**		3-3-5 N_{60}=11	21		
				2	18		CL	2-3-3 N_{60}=8	25		
	5			3	18			4-4-7 N_{60}=16	19		
				4	18	Stiff, Moist, Brown, **SANDY SILTY CLAY WITH GRAVEL**	CL-ML	3-5-5 N_{60}=14	11		
	10					End of boring, 10'					

Moisture ✕ PL ◪ LL (0 – 25 – 50)

Qu ▲ Qp ✳ (0 – 2.0 – 4.0)

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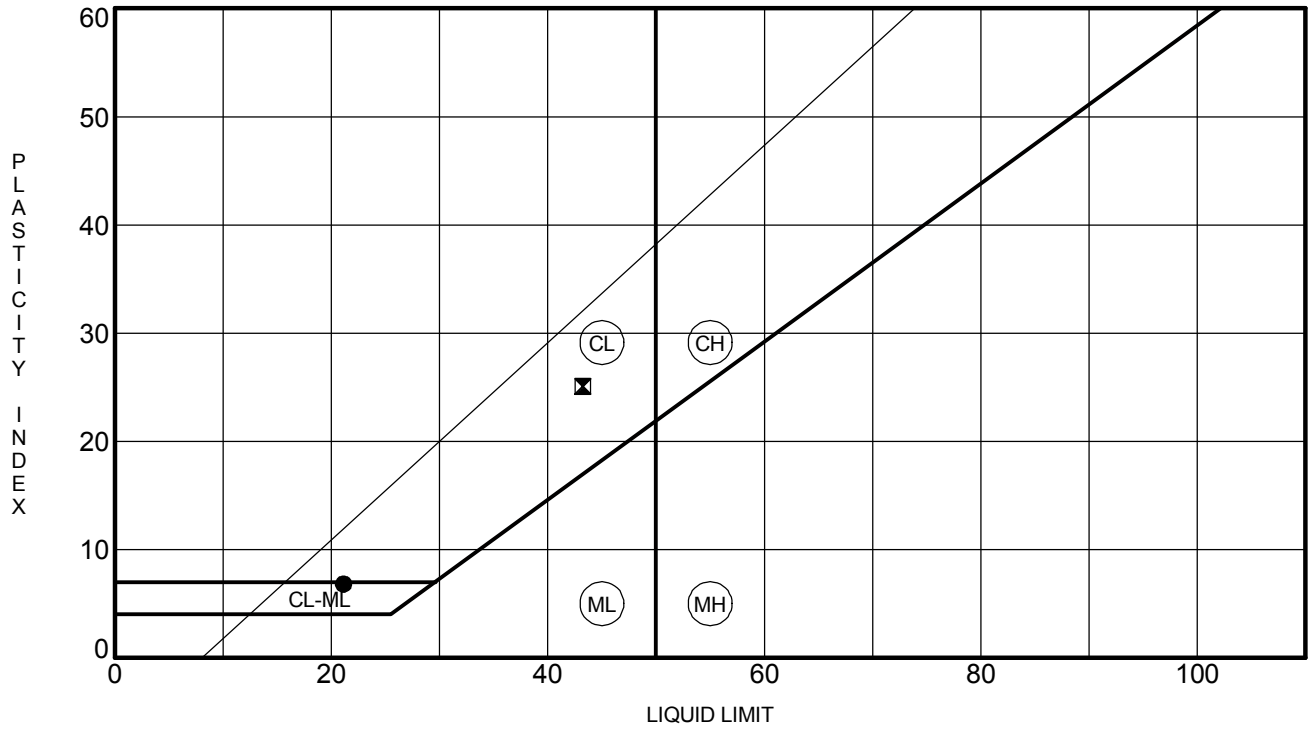
PROJECT NO.: 01051248
PROJECT: Fire Station No. 65
LOCATION: Fairground Road and Trebein Road
Beavercreek, Ohio 45385

The stratification lines represent approximate boundaries. The transition may be gradual.



	Boring	Depth (ft)	LL	PL	PI	Fines	Classification (*Visual)
●	**B-01**	**4.3**	**21**	**14**	**7**	**52.2**	**SANDY SILTY CLAY (CL-ML)**
⊠	**B-05**	**1.8**	**43**	**18**	**25**	**77.7**	**LEAN CLAY WITH SAND (CL)**

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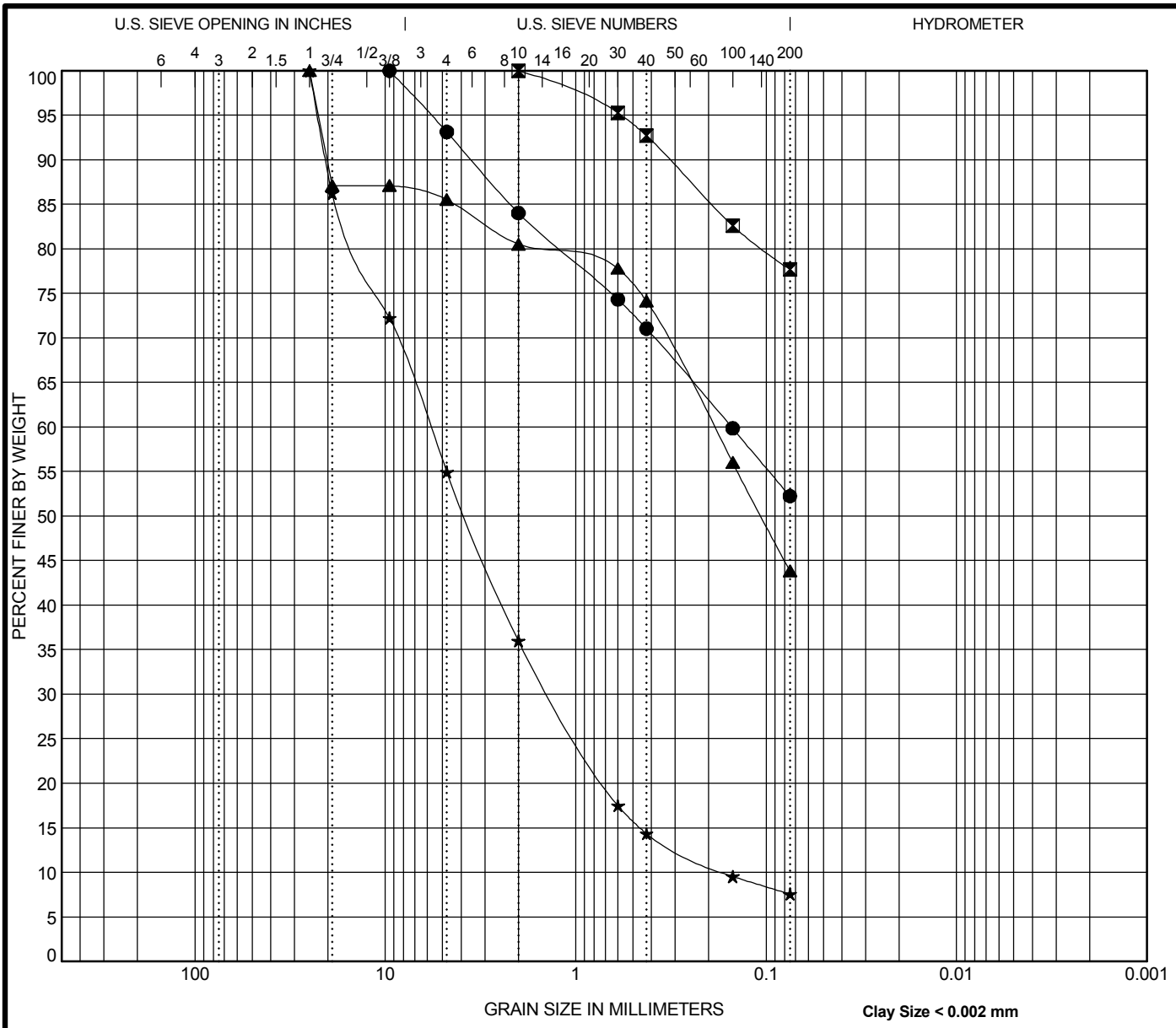
ATTERBERG LIMIT RESULTS

PSI Job No.: 01051248
Project: Fire Station No. 65
Location: Fairground Road and Trebein Road
Beavercreek, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-01	4.3	SANDY SILTY CLAY (CL-ML)	21	14	7		
⊠	B-05	1.8	LEAN CLAY WITH SAND (CL)	43	18	25		
▲	B-06	6.8	CLAYEY SAND (SC)					
★	B-06	24.3	WELL GRADED SAND WITH CLAY AND GRAVEL (SW-SC)				1.90	34.98

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-01	4.3	9.5	0.152			6.9	40.9	52.2	
⊠	B-05	1.8	2				0.0	22.3	77.7	
▲	B-06	6.8	25	0.189			14.5	41.7	43.8	
★	B-06	24.3	25	5.816	1.355	0.166	45.0	47.4	7.6	

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GRAIN SIZE DISTRIBUTION

Project: Fire Station No. 65
PSI Job No.: 01051248
Location: Fairground Road and Trebein Road
Beavercreek, Ohio

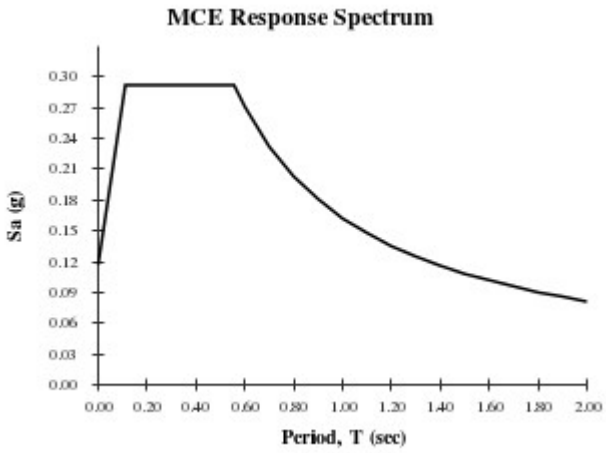
USGS Design Maps Summary Report

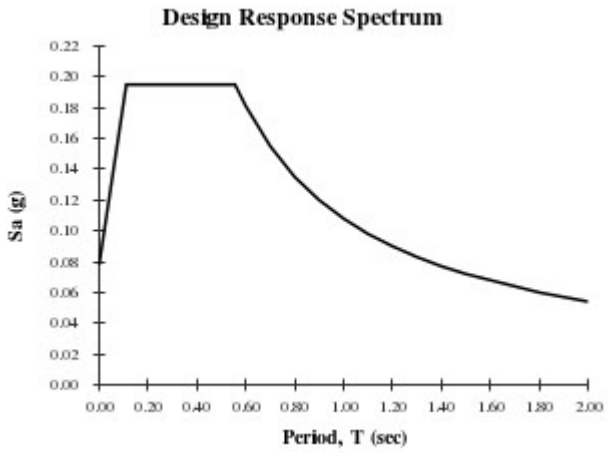
User–Specified Input

Report Title	Fire Station No. 65 -Beavercreek Township Tue April 10, 2018 03:27:28 UTC
Building Code Reference Document	2006/2009 International Building Code (which utilizes USGS hazard data available in 2002)
Site Coordinates	39.7364°N, 83.9889°W
Site Soil Classification	Site Class D – "Stiff Soil"
Occupancy Category	I/II/III

USGS–Provided Output

S_S =	0.183 g	S_{MS} =	0.292 g	S_{DS} =	0.195 g
S_1 =	0.068 g	S_{M1} =	0.162 g	S_{D1} =	0.108 g





USGS Design Maps Detailed Report

2006/2009 International Building Code (39.7364°N, 83.9889°W)

Site Class D – "Stiff Soil", Occupancy Category I/II/III

Section 1613.5.1 — Mapped acceleration parameters

Note: Maps in the 2006 and 2009 International Building Code are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 1613.5.3.

From Figure 1613.5(1) [1]	S_S = 0.183 g
From Figure 1613.5(2) [2]	S_1 = 0.068 g

Section 1613.5.2 — Site class definitions

SITE CLASS	SOIL PROFILE NAME	Soil shear wave velocity, $\overline{v}_s$, (ft/s)	Standard penetration resistance, $\overline{N}$	Soil undrained shear strength, $\overline{s}_u$, (psf)
A	Hard rock	$\overline{v}_s$ > 5,000	N/A	N/A
B	Rock	2,500 < $\overline{v}_s$ ≤ 5,000	N/A	N/A
C	Very dense soil and soft rock	1,200 < $\overline{v}_s$ ≤ 2,500	$\overline{N}$ > 50	>2,000 psf
D	Stiff soil profile	600 ≤ $\overline{v}_s$ < 1,200	15 ≤ $\overline{N}$ ≤ 50	1,000 to 2,000 psf
E	Stiff soil profile	$\overline{v}_s$ < 600	$\overline{N}$ < 15	<1,000 psf
E	—	Any profile with more than 10 ft of soil having the characteristics: 1. Plasticity index *PI* > 20, 2. Moisture content *w* ≥ 40%, and 3. Undrained shear strength $\overline{s}_u$ < 500 psf		
F	—	Any profile containing soils having one or more of the following characteristics: 1. Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils. 2. Peats and/or highly organic clays (*H* > 10 feet of peat and/or highly organic clay where *H* = thickness of soil) 3. Very high plasticity clays (*H* > 25 feet with plasticity index *PI* > 75) 4. Very thick soft/medium stiff clays (*H* > 120 feet)		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 1613.5.3 — Site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters

TABLE 1613.5.3(1)
VALUES OF SITE COEFFICIENT F_a

Site Class	Mapped Spectral Response Acceleration at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_s = 0.183 g, F_a = 1.600

TABLE 1613.5.3(2)
VALUES OF SITE COEFFICIENT F_v

Site Class	Mapped Spectral Response Acceleration at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.068 g, F_v = 2.400

In the equations below, the equation number corresponding to the 2006 edition is listed first, and that corresponding to the 2009 edition is listed second.

Equation (16-37; 16-36): $S_{MS} = F_a S_S = 1.600 \times 0.183 = 0.292$ g

Equation (16-38; 16-37): $S_{M1} = F_v S_1 = 2.400 \times 0.068 = 0.162$ g

Section 1613.5.4 — Design spectral response acceleration parameters

Equation (16-39; 16-38): $S_{DS} = ⅔ S_{MS} = ⅔ \times 0.292 = 0.195$ g

Equation (16-40; 16-39): $S_{D1} = ⅔ S_{M1} = ⅔ \times 0.162 = 0.108$ g

Section 1613.5.6 — Determination of seismic design category

TABLE 1613.5.6(1)
SEISMIC DESIGN CATEGORY BASED ON SHORT-PERIOD RESPONSE ACCELERATION

VALUE OF S_{DS}	OCCUPANCY CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Occupancy Category = I and S_{DS} = 0.195 g, Seismic Design Category = B

TABLE 1613.5.6(2)
SEISMIC DESIGN CATEGORY BASED ON 1-SECOND PERIOD RESPONSE ACCELERATION

VALUE OF S_{D1}	OCCUPANCY CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Occupancy Category = I and S_{D1} = 0.108 g, Seismic Design Category = B

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Occupancy Categories I, II, and III, and **F** for those in Occupancy Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 1613.5.6(1) or 1613.5.6(2)" = B

Note: See Section 1613.5.6.1 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 1613.5(1)*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2006-Figure1613_5(01).pdf
2. *Figure 1613.5(2)*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2006-Figure1613_5(02).pdf

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,▼ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.002 mm to 0.075 mm
Clay:	<0.002mm to <0.005 mm depending on agency

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

DEGREE OF WEATHERING

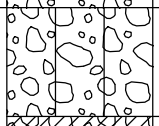
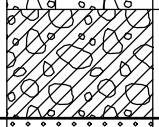
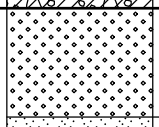
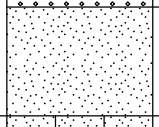
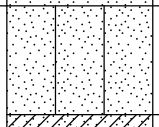
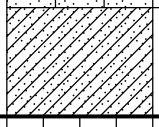
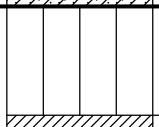
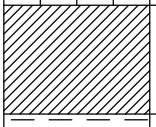
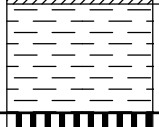
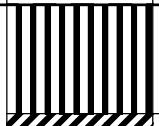
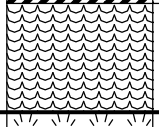
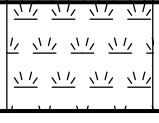
Slightly Weathered: Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.

Weathered: Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.

Highly Weathered: Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS