

# PROJECT MANUAL

## Track & Field Improvements Hallsville R-IV School District Hallsville, Missouri

**ISSUED FOR BIDDING**

**A/E Project No. 21-5052**

**Klingner & Associates, P.C.  
907 East Ash Street  
Columbia, MO 65201  
(573) 355-5988**

**Date of Issue:**

**January 2023**



**SECTION 000103**  
**PROJECT DIRECTORY**

**OWNER:** **HALLSVILLE R-IV SCHOOL DISTRICT**  
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Hallsville, MO 65255  
John Downs, Superintendent  
(573) 696-5512

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END OF SECTION 000103

**SECTION 000107**  
**SEALS PAGE**

1.1 DESIGN PROFESSIONALS OF RECORD

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2. 2012009233.
3. Responsible for Division 00 and 02



B. Civil Engineer:

1. **Curt S. Wavering**
2. 2011009046.  
Responsible for Divisions 11, 31, 32, and 33



C. Structural Engineer:

1. **Nathan R. Marold**
2. 2022017792.  
Responsible for Divisions 03, 07, and 13



D. Electrical:

1. **Josiah B. Moore**
2. 2022038556.
3. Responsible for Division 26



END OF SECTION 000107

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END OF SECTION 000110

## SECTION 024120 SUBSURFACE CONDITIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This section describes soils investigation at the site and use of data resulting from that investigation.

#### 1.2 SOILS INVESTIGATION REPORT

- A. General:

- 1. A soils investigation report has been prepared for the site by the soil investigation engineer/architect selected by the Owner.

- B. Use of Data:

- 1. Information on the nature of the soil conditions previously encountered at the site, which may be shown on the drawings or contained in the *Soils Report*, has been provided for bidder's information and shall not be construed as a guarantee of the subsurface conditions.
  - 2. The Contractor should visit the site and shall be responsible for determining to his/her satisfaction, prior to bidding, the actual site conditions.
  - 3. A copy of the Geotechnical Investigation, *Middle School Classroom, Athletic Track/Field and Improvements – Hallsville, Missouri (9/8/2022)*, performed by Geotechnics Soil & Material Testing, a Division of Klingner & Associates, P.C., is attached at the end of the specifications, solely for the Contractor's information.

#### 1.3 QUALITY ASSURANCE

- A. Readjust work performed that does not meet technical or design requirements, but make no deviation from the Contract Documents without specific and written approval from the Owner.

#### 1.4 UNDERGROUND UTILITIES

- A. The drawings indicate the best knowledge of the Owner and Engineer/Architect on the general location and nature of the existing and/or proposed underground utilities in the area of construction. Exploratory excavations at the site to determine insitu locations were not conducted.
- B. The Contractor shall be responsible for locating all utilities on site prior to the start of construction. The Contractor shall contact Missouri One Call at 1-800-344-7483, 48 hours before scheduled work.
- C. Damages to utilities caused by the Contractor's failure to properly investigate existence in the area shall be the sole responsibility of the Contractor.

END OF SECTION 024120

## MIDDLE SCHOOL CLASSROOM, ATHLETIC TRACK/FIELD AND IMPROVEMENTS

Hwy 124  
Hallsville, MO 65255

September 8<sup>th</sup>, 2022

*Prepared for:*

### HALLSVILLE R-IV SCHOOL DISTRICT

521 East Highway 124  
Hallsville, MO 65255

*Prepared by:*

### GEOTECHNICS, A DIVISION OF KLINGNER & ASSOCIATES, P.C.

4510 Paris Gravel Road  
Hannibal, MO 63401

Project No. 21-5052

September 8, 2022

Hallsville R-IV School District  
Attn: Mr. John Downs  
421 East Highway 124  
Hallsville, MO 65255

RE: Geotechnical Investigation: Middle School Classroom,  
Athletic Track/Field and Improvements - Hallsville, Missouri

Dear Mr. Downs:

In accordance with your request, our firm has conducted the geotechnical investigation for the proposed New Middle School Classroom, Athletic Track/Field and Improvements at the existing Hallsville School campus in Hallsville, Missouri. The geotechnical exploration and report has been conducted in general accordance with the agreement dated May 18<sup>th</sup>, 2022. The report presents the investigation findings and provides recommendations for foundation, slabs on grade, backfill, subgrade, pavement subgrade, soil parameter estimates, seismicity, and related site earthwork recommendations.

We appreciate the opportunity to provide geotechnical services for your project. As always, if you have any questions please do not hesitate to contact us.

Sincerely,

GEOTECHNICS, A DIVISION OF KLINGNER



Brian Joseph Sick, P.E.  
Geotechnical Department Services Manager  
Missouri P.E. No. 2005022155



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## 1.0 SCOPE OF SERVICES

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The scope of our services for this project consisted of investigating the site's subsurface conditions by drilling a total of thirty (30) test borings near the perimeter of the new construction areas of the separate additions and improvements for the Hallsville New Middle School Classroom, Athletic Track/Field and Improvements in Hallsville, MO. Nine (9) borings were scheduled to be drilled in the middle school classroom addition, and twenty-one (21) borings were performed for the athletic track/field and site improvements. The test borings were drilled to depths of 6½ to 26½ feet (elev. 866.6 to 883.4) below the existing ground surface.

The locations and ground surface elevations at the boring locations were staked and graded in the field by our drill crew and are indicated on the enclosed test boring location sketch and test boring logs. The elevations for the Middle School addition were determined by referencing the finish floor elevation at the south entry doors of the building wing just north of the new building addition at the reported elevation of 899.92, while the elevations for the track and field improvements was determined by referencing the top of flange bolt south of boring 15 (BM#1) with reported elevation of 890.16. The scope of services also consisted of a laboratory testing program and an engineering analysis of the soil-structure interaction with subsequent foundation, slabs on grade, subgrade, pavement subgrade, soil parameter estimate recommendations, seismicity, and backfill and related site earthwork recommendations.

## 2.0 SITE DESCRIPTION

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The proposed project site is at the existing school building track and field located at 6401 East Hwy 124 and at the Middle School at 421 East Hwy 124. The sites are north of Hwy 124 and south of North Street. The site is covered in track and field, grass lawn, concrete sidewalk, playground, pavement and gravel sections of the existing school facilities. The site is relatively flat to gently sloping and generally drains away from the existing structures toward the existing drainage structures/features and generally to the south toward Hwy 124. The ground surface elevations at the borings ranged from 883.3 to 899.1. The topsoil and recent fill section summary at the individual boring locations follows below:

Table 1: Topsoil and Recent Fill Thickness Summary

Boring	Topsoil/Aggregate Thickness	Estimated Recent Fill Thickness, ft. (bot. elev.)
1	±5" Topsoil	± 7½/891½
2	±3" Topsoil	± 6/892½
3	±6" Topsoil	± 5/894
4	±5" Topsoil	± 2½/896
5	±5" Topsoil	± 5/893
6	±6" Topsoil	n/a
7	±4" Aggregate	n/a
8	±8" Aggregate	n/a
9	±7" Aggregate	n/a
10	±5" Topsoil	n/a
11	±2" Topsoil	n/a
12	±7" Topsoil	n/a
13	±8" Aggregate	n/a
14	±6" Topsoil	n/a
15	±7" Aggregate	n/a
16	±8" Aggregate	± 7½/882
17	±7" Topsoil	n/a
18	±7" Topsoil	± 7½/878 (Possible Fill)
19	±7" Topsoil	± 5/883 (Possible Fill below 2½)
20	±3" Topsoil	n/a
21	±7" Topsoil	± 5/878½ (Possible Fill below 2½)
22	±7" Topsoil	n/a
23	±7" Topsoil	n/a
24	±6" Topsoil	n/a
25	±4" Topsoil	n/a
26	±4" Topsoil	n/a
27	±4" Topsoil	n/a
28	±6" Topsoil	± 5/894
29	±6" Topsoil	± 4/895
30	±6" Topsoil	n/a

### 3.0 SITE GEOLOGY

In the vicinity of the proposed project site the terrain is underlain by recent fill and natural soil deposits of glacial origin. Although it did not appear that the boring locations encountered loessial soils, this area may have loessial soils present in isolated areas of the site. The loessial soils, if encountered, were deposited by the prevailing winds and, in general, consist of an upper mantle of fat clay that is underlain by a thin seam of lean clay.

The glacial soils were deposited by melting ice and flowing melt water as ice-marginal sediment from glacial events from the Pre-Illinoian Age glaciers. The glacial soils predominantly consist of fine-grained soils that many times are interspersed with coarse grained soils in isolated seams and pockets. This region of Missouri is found in the Smooth Plains Sub-Section in the Dissected Till Plains Section of the Central Lowland Province of the Interior Plains Physiographic Division. The area in general is characterized by gently to moderately rolling, grass and tree covered plains with areas of heavy timber found alongside the creeks and rivers in this area. The drainage features in this area around Hallsville, MO are dendritic in structure and is part of the Missouri River Drainage Basin; regionally the area flows to the south toward the Missouri River. The topography and drainage can trace its origin back to the glaciation events of the Pre-Illinoian stage. Generally, in this area of Boone County, Pennsylvanian Age bedrock will be found at depths greater than 40 feet.

## **4.0 PROPOSED DEVELOPMENT**

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We understand that the project scope for the Hallsville R-IV School District Capital Improvement Program is to include a Middle School Classroom addition consisting of an approximate 15,000 SF single-story addition with 8 classrooms and support spaces. The classroom will be constructed of severe weather resistant construction, provide connectivity between the current middle school and intermediate school and have the capability to support a future second level addition. We presume grade will be similar to the existing slab elevations ( $\pm 900$ ); therefore grade changes should be less than 2 feet. Foundation reactions and construction plans have not been provided to us for our review. We have presumed the classroom addition will utilize a combination of bearing walls and isolated column footings for support. We have presumed relatively light foundation loads for the addition, with our geotechnical engineering analyses considering maximum bearing wall loads of up to 5 kips per foot and maximum isolated column loads of up to 60 kips.

The Athletic Track/Field and Improvements will be constructed in the vicinity of the existing football field. The existing locker room will be demolished, the field will be adjusted, field lighting will be relocated and a revised drive for the bus barn will be provided. The improvements will consist of new artificial turf, visitor's bleachers, new locker room, stadium parking and concourse, and relocate home bleachers and press box. We have presumed foundation loads will be light and that the grade changes will be minor for the improvements, considering structural fills and excavations approximately 3 feet or less. If our understanding of the new construction addition or any of our estimates and/or presumptions do not accurately represent this project, we should be notified to provide a revision to this report.

## 5.0 SUBSURFACE CONDITIONS

The results of the geotechnical investigation indicated that the proposed Hallsville New Middle School Classroom, Athletic Track/Field and Improvements site was covered by a thin veneer of topsoil/aggregate and recent fill (classroom addition) over natural soil deposits of Pre-Illinoian Age glacial soils. Topsoil and aggregate thickness at the borings ranged from approximately 2 to 8 inches. We interpreted that the recent fill was encountered in all of the classroom addition borings except boring 6 and 30 to depths of approximately 2½ to 7½ feet (elev. ±891½ to 896). For the Track/Field area, we interpreted that the recent fill or potential recent fill was encountered in borings 16, 18, 19, and 21 to depths of approximately 2½ to 7½ feet (elev. ±878 to 883); discernment of fill soils of like composition to the natural soil profile can be difficult. The fill soils consisted of lean clay (CL), fat clay (CH), and lime fines (SM), with varying amounts of sand, gravel and construction debris in the classroom area. The fill soils were soft to hard in consistency and medium dense in apparent relative density with N values ranging from 2 to 22 blows per foot and 50 blows for half an inch in boring 29 in concrete debris. Please see the individual boring logs in the appendix for detailed information.

Below the topsoil/aggregate veneer and recent fill, glacial soils were encountered to the boring completion depths. The glacial soil was composed of fine-grained soils and consisted of oxidized yellow brown, brown, gray and light gray mottled fat clay sand (CH) and lean clay with sand (CL). These soils were medium to very stiff in consistency with N values ranging from 4 to 17 blows per foot and unconfined compressive strength values varying from 0.72 to 2.81 T.S.F. Portions of the till were composed of lean clays and high plasticity fat clays with liquid limit values on select samples ranging from 43% to 89% and plasticity indices ranging from 24% to 56% as indicated by Atterberg Limits testing performed in the top 5 feet in depth. A bulk sample was collected from the athletic field in borings 24 to 27 for laboratory testing of the soil. The bulk sample was then processed and mixed/combined to represent a cross section of the soil types present in the athletic field to a depth of approximately 4 to 5 feet. Results of the testing of the athletic field soils indicated a maximum dry density of 102.1 P.C.F. at an optimum moisture content of 20.4% with an Atterberg Limit determination on the bulk sample indicating a liquid limit of 55% with a plasticity index of 34% with an as-received moisture content of 17.7%. A table of laboratory data from the bulk sample follows:

Table 2: Bulk Sample Value Summary

Boring No.	Maximum Density / Optimum Moisture PCF/%	Moisture Content %	Atterberg % (LL/PL)	%<#200
24 to 27	102.1 / 20.4	17.7	55/34	91.3

Previous studies near the site and published geologic information suggest that the glacial soil generally increases in strength with depth and extends to Pennsylvanian Age bedrock at depths typically below 40 feet. The till extended to the boring's completion depths of 6½ to 26½ feet (elev. 866.6 to 883.4) below the existing ground surface.

## 6.0 GROUNDWATER OBSERVATIONS

Observations to determine the apparent presence of groundwater were conducted during drilling, at completion and up to 24 hours after completion of the test borings. The groundwater levels at the borings were as follows:

Table 3: Groundwater Depth Observations Summary

Boring No.	Groundwater Depth/Elev. During Drilling	Groundwater Depth/Elev. @ Completion	Groundwater Depth/Elev. @ Hours After Completion
1	Dry	Dry	Dry @ 24 Hrs.
2	Dry	Dry	Dry @ 24 Hrs.
3	Dry	Dry	n/a
4	Dry	Dry	Dry @ 3¼ Hrs.
5	Dry	Dry	Dry @ 2¼ Hrs.
6	Dry	Dry	n/a
7	Dry	Dry	n/a
8	Dry	Dry	n/a
9	Dry	Dry	n/a
10	Dry	Dry	n/a
11	Dry	Dry	n/a
12	Dry	Dry	n/a
13	Dry	Dry	n/a
14	Dry	Dry	n/a
15	Dry	Dry	n/a
16	Dry	Dry	n/a
17	Dry	Dry	Dry @ 6 Hrs.
18	Dry	Dry	Dry @ 6½ Hrs.
19	Dry	Dry	n/a
20	Dry	Dry	n/a
21	Dry	Dry	n/a
22	Dry	Dry	n/a
23	Dry	Dry	n/a
24	Dry	Dry	n/a
25	Dry	Dry	n/a
26	±7/882	±8/881	n/a
27	±4/885	Dry	n/a
28	Dry	Dry	Dry @ 1½ Hrs.
29	Dry	Dry	Dry @ 1 Hr.
30	Dry	Dry	Dry @ ½ Hr.

These findings indicate that static water level and/or perched groundwater is anticipated to be below the expected depth of excavation. Due to the composition of the soils at the site and the poor surface drainage, it is expected that perched or trapped groundwater can be found at depths above these measurements, especially during seasonally wet periods. In view of the low permeability of the soils at the site, dewatering of perched groundwater and/or trapped surface water from shallow, temporary excavations can typically be accomplished by pumping from sump pits.

## **7.0 GEOTECHNICAL ENGINEERING ANALYSES AND FOUNDATION RECOMMENDATIONS**

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The results of the geotechnical investigation indicate that the proposed Hallsville New Middle School Classroom, Athletic Track/Field and Improvements, proportioned as presumed, may be supported by shallow reinforced concrete footings based in the natural soils or new structural fill or backfill, provided that the following recommendations are implemented. Total settlements of foundations proportioned as recommended should be less than approximately 1" while differential settlements between adjacent foundation elements should be less than about  $\frac{3}{4}$ ". Exterior footings and footings in unheated areas should be based at least 36 inches beneath the finished exterior grade for frost protection.

Unsuitable (soft or unstable) soils, if encountered, should be removed from the footing excavations, and consequently the footing extended the additional depth or replaced with suitable material as recommended below. For spread footings the depth of overexcavation should be at least 3 feet or to suitable soil whichever is shallower and at least 50% wider than the design width for lateral stress dissipation. For bearing wall footings, the over-excavations, if needed, should extend to at least 2 feet (or to adequate bearing material, whichever is shallower) and should be at least 50% wider than the design width for lateral stress dissipation. Once the limit of the overexcavation is reached, the exposed surface should be compacted with suitable compaction equipment prior to backfilling. Replacement material (if required) for unsuitable soils in the footings may consist of suitable granular material that is placed in 8" or less lifts and compacted to at least 98% of the standard proctor maximum dry density (ASTM D 698) or flowable fill (Controlled Low Strength Material, CLSM). If flowable fill or lean concrete is utilized for backfill then the recommendation for overwidening the overexcavation is not necessary. Observation by a geotechnical engineer is recommended at the time of excavation to determine the presence and competency of the expected bearing strata and to document removal of unsuitable soils, if encountered. We suggest that a unit price be obtained for overexcavation and replacement prior to construction in the event that remediation is required during the foundation construction phase of the project. If the final grading plan differs from our presumptions at the time of this report, we should be consulted to review how the changes may impact our recommendations.

Footings excavations should be made to the required lines and grades as rapidly as possible. We recommend that footing excavations be left open for a minimum of time to prevent disturbance to the foundation soils. Foot traffic should be prevented on the base of the footing excavations if disturbance is noted. Hand cleaning, if required and setting of reinforcing steel should then be accomplished from the sides of the excavation. Surface drainage from the site and gutter/roof drainage from the existing structures should be diverted away from the construction area during construction activities.

Based on the soils encountered in the borings and our interpretation of site conditions, the lateral footing capacity, due to base shear, should be calculated using an allowable coefficient of friction between the base of the footing and the soil of 0.35. Passive resistance is formed as an object (shear key, footing, pile cap, etc.) plows through the soil. All calculations of passive resistance are based on the condition that the soil on the passive side of the footing will always be present. If at some future time, some of the soil on the passive side is removed, the passive resistance will decrease. Therefore, the possibility of some soil being removed should be considered when determining passive resistance to lateral loads.

If a minimum of 3 feet of soil is present, an equivalent fluid pressure of 225 pounds per cubic foot may be used to calculate the net allowable passive soil resistance. For less than 3 feet of soil passive resistance should not be used. The ground surface adjacent to the wall or footing should be horizontal in the direction of movement to a distance equal to at least twice the embedment depth. If the ground is sloped downwards away from the structure, a reduced equivalent fluid pressure should be used.

## 7.1 Middle School Classroom

For the Middle School Classroom, continuous bearing wall footings may be proportioned for a maximum net allowable soil pressure (FS=3) of 2,000 P.S.F., while spread footings may be proportioned for a maximum net allowable soil pressure (FS=3) of 2,500 P.S.F. The net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Spread footings should be a minimum of 36 inches in the least dimension, while continuous bearing wall footings should be at least 24 inches wide. A summary of the foundation recommendations is shown below:

Table 4a: Foundation Recommendation Summary - Middle School Classroom

Description	Continuous Bearing Wall Footings	Isolated Column Footings
Net Allowable Soil Pressure	2,000 PSF	2,500 PSF
Minimum Width, in.	24"	36"
Recommended Founding Depth	Nominal Depth Interior, 36" below Finished Exterior Grade	Nominal Depth Interior, 36" below Finished Exterior Grade
Coefficient of Sliding Friction	0.35	

Below the building foundations, the recent fill should be removed to natural soils, where encountered. The presence of high plastic soils and variable recent fill at the elevations presumed for the floor slab subgrade will necessitate over-excavation and replacement or placement of a low volume change material in order to reduce post construction heaving associated with volume changes in the high plastic soils. The recommendations for floor slab over-excavation are described in the **Floor Slab and Site Earthwork Recommendations** section of this report.

## 7.2 Athletic Track/Field Improvement Foundations

For the Track/Field Building Improvements, foundations for buildings and other structures may be proportioned for a maximum net allowable soil pressure of 2,000 P.S.F. (FS=3). The net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Spread footings should be a minimum of 30" in the least dimension, while continuous bearing wall footings should be at least 18 inches wide. A summary of the foundation recommendations is shown below:

Table 4b: Foundation Recommendation Summary – Athletic Track/Field Improvement Building Foundations

Description	Continuous Bearing Wall Footings	Isolated Column Footings
Net Allowable Soil Pressure	2,000 PSF	
Minimum Width, in.	18"	30"
Recommended Founding Depth	Nominal Depth Interior, 36" below Finished Exterior Grade	Nominal Depth Interior, 36" below Finished Exterior Grade
Coefficient of Sliding Friction	0.35	

Unsuitable (soft or unstable) soils and recent fill, if encountered, should be removed from the footing excavations, and consequently replaced with suitable material as recommended. The presence of high plastic soils in the floor slab subgrades will necessitate over-excavation and replacement or placement of a low volume change material in order to reduce post construction heaving associated with volume changes in the high plastic soils. The recommendations for floor slab over-excavation are described in the **Floor Slabs and Site Earthwork Recommendations** section of this report.

## 8.0 FLOOR SLAB AND SITE EARTHWORK RECOMMENDATIONS

### 8.1 Building Floor Slabs Recommendations

The presence of high plastic clay soils and variable recent fill near the anticipated floor slab elevations will necessitate the placement of at least 30 inches of low volume change (LVC) material below slabs on grade. The capillary break may be considered part of the low volume change material.

The LVC material may consist of on-site or off-site suitable materials such as lean clay (LL=45% or less and PI=25% or less) or granular material. Granular material, if used, should have a maximum size of approximately 1 inch and not more than approximately 15% non-plastic fines. Without removal of the high plastic clay soils below the building floor slab the risk of shrink/swell with fluctuations of moisture content is increased. Consideration may be given to slab elevation adjustment to optimize LVC recommendations due to high plastic clay, when applicable.

Topsoil should be removed from the subgrade and fill areas prior to the commencement of earthwork activities and stockpiled for possible use for finish grading, if desired. Once the limit of the overexcavation is reached, the exposed surface should be thoroughly compacted with suitable compaction equipment prior to backfilling. Construction debris and any foreign material should be removed, if encountered. During site grading it is recommended that the top 12 inches of the floor slab subgrades below new LVC or structural fill be proofrolled and/or compacted to at least 95% of the standard proctor maximum (ASTM D698) dry density at moisture contents of optimum to 5% above optimum. Soft and/or unstable areas revealed by the proofrolling/compacting process should be excavated, reworked, and then be recompacted or removed and replaced with suitable material as necessary. Additional effort may be required to rework and recompact the soils within the zone of seasonal moisture variation. Close attention should be given to the subgrade preparation to reduce instability associated with the natural high plastic soils; the subgrade should be brought to an adequately moistened condition prior to the placement of structural fill and/or backfill and should be subsequently protected from drying prior to construction. Limiting the amount of soil drying during construction is critical in limiting the potential for shrinking and swelling of the subgrade and structural fill soils during post construction periods. Consequently, placement of moisture conditioned fill material should begin immediately upon completion of the excavations and subgrade testing/verification to reduce the potential for drying and/or disturbance of the underlying subgrade.

Moderate to high plastic soils found in the upper 5 feet of the native soils and recent fill soils should not be used as structural fill within 30 inches of the bottom of floor slabs. Structural fill and/or backfill (below the LVC) and the LVC required for the building slabs should be compacted to a dry density of at least 95% of the standard proctor maximum dry density (ASTM D 698) and the moisture content should be controlled within a range of 2% below to 4% above optimum. Field density tests in the existing re-worked subgrade, new granular fill, structural fill and/or backfill are recommended at the rate of one per 5,000 square feet per lift for areal fills and at the rate of one test per 100 feet per lift of wall and/or trench backfill. A summary of the compaction recommendations follows:

Table 5: Compaction Recommendation Summary – Building Floor Slabs

Description	ASTM D 698	Moisture Content from Optimum
Building Subgrades (Top 12")	95%+	0% to +5%
Structural Fill/LVC	95%+	-2% to +4%
Footing Overexcavation Backfill	98%+	±2%

Floor slabs should be provided with adequate crack control joints and separated from the foundation system to accommodate vertical slab movements due to minor volume changes in the subgrade. The floor slab should be provided with a layer of free draining granular base such as crushed limestone and it should not contain more than 5% fines. We further recommend that a polyethylene moisture barrier be provided between the granular base or LVC and the floor slabs to reduce moisture transmission through the concrete floors and to reduce the potential for concrete curling.

The site grading plan should provide for positive surface water drainage away from the proposed structure(s) and roof drains should connect to watertight lines that extend away from the building(s). All drain or utility lines beneath floors should have tight joints to prevent leakage. Large trees and shrubs should not be planted adjacent to exterior footings, as these plants can cause drying and shrinkage of foundation soils. Surface drainage/runoff and gutter/roof drainage from the existing nearby building should be diverted away from the site construction area during construction activities.

## **8.2 Synthetic Field Turf Subgrade Recommendations**

Based on the field and laboratory data and our experience with similar soils, we estimate potential vertical rise (PVR) values at the boring locations to be up to approximately 1½ inches. If a reduction of the PVR value to 1 inch or below is required for the existing soils we recommend a low volume change (LVC) layer of at least 24 inches in thickness. The LVC material may consist of suitable materials such as lean clay (LL=40% or less and PI=20% or less), chemically modified soil, or granular material. Granular material, if used, should have a maximum size of approximately 1 inch and not more than approximately 15% non-plastic fines.

Topsoil should be removed from subgrades and areas to receive new structural fill prior to scarifying and re-working the existing subgrade. Care should be taken to remove all recent fill soils that contain organic material (if any are observed during grading). During site grading it is recommended that the subgrade below new structural fill or drainage material be proofrolled and compacted to at least 95% of the standard proctor maximum dry density but not more than the standard maximum dry density at moisture contents of optimum to 5% above optimum. Additional effort may be required to rework and recompact the soils within the zone of seasonal moisture variation. Foreign material found within the recent fill larger than 3 inches should be removed from the subgrade.

During seasonally wet weather periods, there will be some locations of the subgrade soils that are wet of optimum moisture and would require drying of the excess moisture to achieve the recommended degree of compaction. Conversely, dry weather periods will result in drier than optimum conditions that will necessitate adding moisture and reworking. Soft, unsuitable and/or unstable areas of the subgrade revealed during the proofrolling process should be removed and replaced with suitable material and compacted as previously recommended.

Close attention should be given to the subgrade preparation to reduce instability; the subgrade should be brought to an adequately moistened condition prior to the placement of structural fill and/or backfill and should be subsequently protected from drying prior to construction. Limiting the amount of soil drying during construction is critical in limiting the potential for shrinking and/or swelling of the subgrade and structural fill soils during post construction periods due to moisture changes. Consequently, placement of moisture conditioned fill material should begin immediately upon completion of the excavations and subgrade testing/verification to reduce the potential for drying and/or disturbance of the underlying subgrade.

Structural fill and/or backfill (below the LVC) and the LVC, if required, for the synthetic turf subgrade should be compacted to a dry density of at least 95% of the standard proctor maximum dry density (ASTM D 698) and the moisture content should be controlled within a range of 1% below to 4% above optimum. Field density tests in the existing re-worked subgrade, new granular fill or LVC, structural fill and/or backfill are recommended at the rate of one per 10,000 square feet per lift for areal fills.

For the field turf subgrade, if LVC is required to lower the PVR, consideration may be given to stabilization of the on-site or any imported clay soils not meeting the plasticity recommendations using quick lime, hydrated lime or the lime by-product, Code L (also known as lime kiln dust). Fill or subgrade soils to be stabilized with lime should be thoroughly pulverized by either rotary speed mixing or a discing method approved by the engineer so that all soil will pass a 2-inch sieve. Quick lime should be spread at a rate of at least 3 percent by dry weight of the soil (hydrated lime of 4 percent and at least 5 percent by dry weight if the lime by-product Code L is used). The lime should be spread evenly with a drag, by hand rakes, automated spreader, or other approved method before mixing. Spreading with a highlift or grader is not recommended. Mixing and pulverizing should continue until 100 percent of the mix passes a 1-inch sieve and 60 percent passes the #4 sieve. After pulverization, the fill and/or stabilized subgrade should be compacted to at least 95 percent of the standard proctor maximum dry density at moisture contents of 2% below to 5% above optimum moisture content. During this process, water may need to be added to the soil to raise the water content above the optimum value.

Lower ambient air temperatures will slow the hydration process and require longer curing periods. Experience has shown that curing times increase significantly below about 40°F. The lime or Code L should not be exposed to the air for extended periods. Excessive exposure can cause lime carbonation and cause the lime to become drastically less effective for the intended purpose. Lime should be used within two days of delivery to the site and adequately protected from the elements. Lime stabilization works well with moderately and high plastic clay soils such as those in the upper part of the soil profile at this site. Stabilization of silty low plasticity clays from on or off-site will not necessarily yield a favorable result, therefore, the material composition from off-site sources should be carefully screened before choosing a stabilization plan. If properly constructed, lime stabilized clay can significantly improve site surface conditions, allow for winter construction and reduce off-site mud problems from the site into nearby areas.

The subsurface drainage base layer should be provided with a layer of free draining granular base such as crushed limestone and it should not contain more than 5% fines. The site grading plan should provide for positive surface water drainage to prevent pooling and/or ponding of surface water. A summary of the compaction recommendations follows:

Table 6: Compaction Recommendations Summary – Synthetic Field Turf

Description	ASTM D 698	Moisture Content from Optimum
Turf Subgrade (Top 12")	95-100%	0% to +5%
Structural Fill/LVC	95%+	-1% to +4%
Chemically Modified Soils (i.e. Lime Stabilized)	95%+	-2% to +5%

### 8.3 Synthetic Athletic Track Subgrade Recommendations

The results of the geotechnical investigation, based on the in-situ field test results, indicate that the replacement track subgrade may be designed using a seasonally adjust CBR value of 2½%. In areas of track replacement overlying existing granular base, if encountered, we recommend the existing granular material remain in place and that the placement of a geogrid beneath new granular base be constructed in order to provide separation and reinforcement. Tensar® TX 140 or equivalent would be suitable for this application. Manufacturer’s guidelines suggest that at least 6 inches of aggregate base be used above the geogrid. Care should be taken to avoid damaging the existing aggregate base and subgrade during the placement of the geogrid and aggregate base. If damage occurs due to lack of aggregate base thickness in existing areas of the track or due to the presence of soft subgrade soils, reference the recommendations following for the track expansion.

In areas of the track expansion/re-location, topsoil should be removed from subgrades and areas to receive new structural fill prior to scarifying and re-working the subgrade. During site grading it is recommended that the subgrade below new structural fill or aggregate base be thoroughly proof-rolled and compacted to a depth of at least 12” and to a minimum of 97% of the standard proctor maximum dry density as established by ASTM D 698 and at moisture contents of 3% below to 3% above optimum. Additional effort may be required to re-work and re-compact the soils within the zone of seasonal moisture variation. Dry weather may result in drier than optimum conditions that will necessitate adding moisture and reworking, while wet weather will result in scarifying and drying then recompacting. Soft, unsuitable and/or unstable areas of the subgrade should be removed and replaced with suitable material and compacted as recommended or chemically modified following recommendations as previously recommended.

New structural fill (if any) should be compacted to at least 95% of the standard proctor maximum dry density at moisture contents within -2% to +4% of optimum moisture content. Field density tests in the subgrade and new structural fill and/or backfill are recommended at the rate of one test for every 250 linear feet per lift. The site grading plan should provide for positive surface water drainage away from the track surface and subgrade. Due to the high plastic clay in the natural soils, we recommend that at least 6” of granular base be placed under the areas of the expanded track surface overlying geogrid as recommended above. New aggregate base for the track expansion/replacement should be compacted to a minimum density of 98% of the maximum dry density (ASTM 698) at  $\pm 2\%$  of optimum. A summary of the compaction recommendations follows:

Table 7: Compaction Recommendations Summary – Synthetic Athletic Track Subgrade

Description	ASTM D 698	Moisture Content from Optimum
Track Subgrade (Top 12")	97%+	$\pm 3\%$
Structural Fill	95%+	-2% to +4%
Aggregate Base (Track)	98%+	$\pm 2\%$
Chemically Modified Soils (i.e. Lime Stabilized)	95%+	-2% to +5%

Equipment utilized for the placement of the aggregate base and track surface should be proportioned to minimize possible damage to the underlying subgrade during construction of the track pavement system. Damage caused during the placement of the aggregate base or new track surface for the track expansion should be repaired as recommended above prior to placement of material. The aggregate base course should conform to the gradation requirements of MoDOT Type 5 gradation subbase material. Proper slope of the track subgrade and surface to achieve adequate drainage is crucial for the track surface life span. Regular maintenance should be performed on the track surface to reduce the potential deterioration due to moisture infiltration through surface cracking.

## 9.0 ESTIMATED SITE SOIL PARAMETER RECOMMENDATIONS (ATHLETIC TRACK/FIELD AND IMPROVEMENTS)

Estimates of the pertinent soil parameters are recommendations for use as ultimate values and contain a factor of safety of 1.0. The borings revealed relative strata uniformity therefore we have estimated values based on averaged data from the borings. The soil layers are classified according to the primary material within the zone identified, as most apparent in the retrieved samples; please reference the boring logs. The estimated average soil parameter values follow:

Table 8: Average Soil Parameter Estimates Summary – Athletic Track/Field and Improvements

Depth (ft.)	Cohesion (PSF)	Total Unit Weight, P.C.F.	Ka	Ko	Kp	Soil Type
0-5	750	115	0.49	0.66	2.04	CL/CH
5-15	1,500	124	0.53	0.69	1.89	CH/CL

## 10.0 TEMPORARY EXCAVATIONS RECOMMENDATIONS

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Temporary excavations should be constructed in accordance with OSHA regulations. The soils at the site classify as OSHA Type B and excavations extending less than 20 feet in vertical height into these soils should be cut on a slope no steeper than 1H:1V. Flatter slopes may be required and all operations should be performed under the supervision of qualified site personnel in accordance with OSHA regulations. Excavations deeper than 20 feet must be designed by a registered professional engineer and, based on our understanding of the project are not anticipated. Excavation slopes left exposed should be protected from erosion and saturation by rainfall and runoff.

## 11.0 PAVEMENT SUBGRADE RECOMMENDATIONS

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We presume that the pavement section(s) will consist of either flexible (hot-mix asphalt) or portland cement concrete over a compacted aggregate base course and compacted soil subgrade. The subgrade in some areas to be paved may be comprised of recent fill, the soils should be observed for construction debris and other forms of foreign material during excavations and at the subgrade surface; removal of objectionable material is recommended. Structural fill required for the pavement areas should be compacted to a dry density of at least 95% of the standard proctor maximum dry density (ASTM D 698) and the moisture content should be controlled within a range of 2% below to 4% above optimum.

The subbase for all paved areas should be thoroughly proofrolled and compacted to a depth of at least 12" and to a minimum dry density of 98% of the maximum dry density as established by ASTM D 698 and within a moisture content range of  $\pm 2\%$  of optimum. We further recommend that the granular base under the pavement be compacted to a minimum density of 100% of the maximum dry density (ASTM 698) and the moisture content should be controlled within a range of  $\pm 2\%$  of optimum. Pavement subgrades should undergo the proofrolling process to help in identifying soft or unstable areas; remediation should follow our previous recommendations. We recommend a bearing ratio (CBR) of 3%, and a subgrade reaction modulus (k) of 100 P.S.I./in., may be used in design of pavement sections founded in natural, on-site soils prepared and compacted as recommended herein. A summary of the compaction recommendations follows:

Table 9: Compaction Recommendation Pavement Section Summary

Description	ASTM D 698	Moisture Content from Optimum
Structural Fill for Pavement	95%+	-2% to +4%
Pavement Subbase (Top 12")	98%+	±2%
Pavement Base (Aggregate)	100%+	±2%

During proofrolling, permanent rutting in excess of 1 inch should be considered failure. Elastic (rebound) movement or rutting in excess of 1 inch with substantial cracking or substantial lateral movement should be considered failure. Rutting and cracking greater than detailed above is considered “pronounced elasticity”. Elastic, rebound, or rolling movement is always associated with excess water in the subgrade system. Failing areas detected by proofrolling should be removed and replaced with suitable material as previously recommended. Areas of pavement subgrades that do not respond to proofrolling and recompaction may be amended by the use of chemical admixtures (i.e. lime product) and/or commercially available subgrade reinforcing geogrids such as Tensar® TX 160. The aggregate base course should conform to the gradation requirements of MoDOT Type 5 Base.

We recommend the use of a geogrid beneath the granular base in order to provide separation and reinforcement if utilizing a flexible pavement design. Tensar® TX 7 or equivalent would be suitable for this application and it will reduce the amount of overexcavation resulting from subgrade instability. Manufacturer’s guidelines suggest that at least 6 inches of aggregate base be used above the geogrid. If rigid pavement is selected we recommend the use of a geotextile fabric beneath the granular base in order to improve subgrade drainage and to provide separation and drainage from the underlying fine-grained soils. Mirafi 160N or equivalent would be suitable for this application. We recommend following the manufacturer’s guidelines for installation and overlap procedures. If chemical modification is utilized in the pavement subgrade to a depth of at least 12”, the recommendation for the geogrid does not apply.

For the pavement base, consideration may be given to stabilization of the on-site soils using quick lime or hydrated lime. Fill or subgrade soils to be stabilized with lime should be thoroughly pulverized by either rotary speed mixing or a discing method approved by the engineer so that all soil will pass a 2-inch sieve. Quick lime should be spread at a rate of at least 3 percent by dry weight of the soil (hydrated lime of 4 percent). The lime should be spread evenly with a drag, automated spreader, or other approved method before mixing. Spreading with a highlift or grader is not recommended. Mixing and pulverizing should continue until 100 percent of the mix passes a 1-inch sieve and 60 percent passes the #4 sieve. After pulverization, the fill and/or stabilized subgrade should be compacted to at least 95 percent of the modified proctor maximum dry density. During this process, water may need to be added to the soil to raise the water content above the optimum value.

Lower ambient air temperatures will slow the hydration process and require longer curing periods. Experience has shown that curing times increase significantly below about 40°F. The lime should not be exposed to the air for extended periods. Excessive exposure can cause lime carbonation and cause the lime to become drastically less effective for the intended purpose. Lime should be used within two days of delivery to the site and adequately protected from the elements. Lime stabilization works well with moderately and high plastic clay soils such as those in the upper part of the soil profile at this site. Stabilization of silty low plasticity clays from on or off-site will not necessarily yield a favorable result, therefore, the material composition from off-site sources should be carefully screened before choosing a stabilization plan. If properly constructed, lime stabilized clay can significantly improve site surface conditions, allow for winter construction, reduce off-site mud problems from the site into nearby areas and reduce the required pavement sections. If chemical stabilization is utilized we recommend a bearing ratio (CBR) of 15% may be used in design of pavement subgrade prepared and compacted as recommended.

It should be noted that some of the subgrade soils may be wet of optimum dependent upon the time of year during construction. Therefore, reworking and recompaction may be necessary and may require considerable effort. Consideration should be given to heavy-duty concrete pavement at entrances, near trash dumpsters, loading docks and/or areas of repeated truck traffic. We recommend drains be provided around catch basins and low parts of the roadway to minimize the accumulation of water in the subgrade soils. Proper slope of the pavement subgrades and pavement surfaces to achieve adequate drainage is crucial in pavement life span. Regular maintenance should be performed on the pavement surfaces to reduce the potential deterioration due to moisture infiltration through surface cracking.

## 12.0 SEISMICITY

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Based on the subsurface conditions encountered and our understanding of the areal geology, the site class is closest to C in accordance with IBC 2015. Seismic site classification is based on soil data in the top 100 feet below grade.

The calculated maximum considered earthquake spectral response accelerations for short periods value  $S_s = 0.160$  ( $MCE_R$  ground motion (period = 0.2s)) and for one second  $S_1 = 0.091$  ( $MCE_R$  ground motion (period = 1.0s)). The calculated site-modified spectral acceleration value  $S_{ms} = 0.192$  and the calculated site-modified spectral acceleration value  $S_{m1} = 0.155$ . The factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)  $S_{sUH} = 0.185$  and  $S_{1UH} = 0.109$ . Liquefaction potential for the site is low, although some vertical and horizontal displacement should be expected during a major earthquake. A summary of the seismicity value recommendations follows:

Table 10: Seismicity Value Estimates Summary

Description	Value Estimate
$S_{ms}$	0.192
$S_{m1}$	0.155
$S_s$	0.160
$S_1$	0.091
$S_sUH$	0.185
$S_1UH$	0.109

## 13.0 CONCLUSIONS

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The geotechnical investigation, including exploration, testing, and analyses has been completed for the proposed New Middle School Classroom, Athletic Track/Field and Improvements at the existing Hallsville School campus in Hallsville, Missouri. Foundation, slabs on grade, backfill, subgrade, pavement subgrade, soil parameter estimates, seismicity, and related site earthwork recommendations, based on the investigation, have been included in this report. The analyses, conclusions and recommendations contained in this report are based on the site conditions and project descriptions presented in this report, and the subsurface conditions disclosed by the exploratory borings.

The conclusions and recommendations presented are professional opinions based on the above conditions, professional judgment and experience. If during design and construction, changes occur, either in the proposed construction, due to natural causes or construction operations at the site, from a substantial lapse in time, or should subsurface conditions encountered during construction differ materially from those presented, we should be contacted to review any changes in circumstances and conditions to evaluate the effects on the analyses, conclusions and recommendations presented.

The borings were placed to obtain a reasonable picture of the subsurface conditions. However, variations in the subsurface conditions not indicated by the borings are always possible. These data are supplied for the benefit of the designers and owner and do not express or imply any warranty of the subsurface conditions. Completed foundation excavations, foundation construction, pavement subgrade and pavement construction and backfill construction should be observed and tested during the construction phase by a qualified professional to verify the subsurface conditions and the design assumptions.

The scope of our services does not include environmental assessment of investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater or surface water within the site studied. Any statements in this report regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our client.

**APPENDIX A**  
**TEST BORING LOCATION IMAGE**

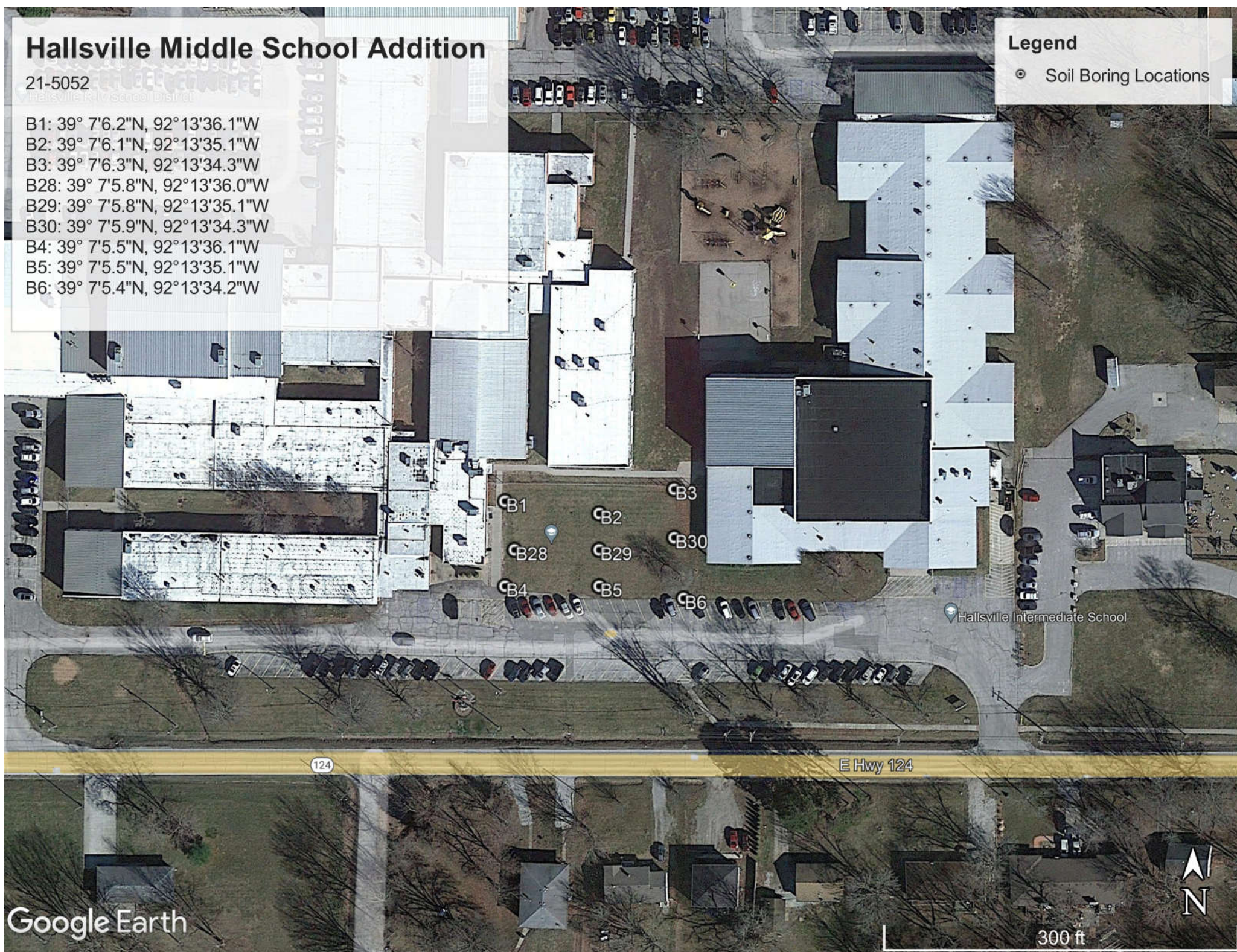
# Hallsville Middle School Addition

21-5052

- B1: 39° 7'6.2"N, 92°13'36.1"W
- B2: 39° 7'6.1"N, 92°13'35.1"W
- B3: 39° 7'6.3"N, 92°13'34.3"W
- B28: 39° 7'5.8"N, 92°13'36.0"W
- B29: 39° 7'5.8"N, 92°13'35.1"W
- B30: 39° 7'5.9"N, 92°13'34.3"W
- B4: 39° 7'5.5"N, 92°13'36.1"W
- B5: 39° 7'5.5"N, 92°13'35.1"W
- B6: 39° 7'5.4"N, 92°13'34.2"W

## Legend

- Soil Boring Locations



# Hallsville School

Athletic Track and Improvements  
21-5052

Continental Steel Erectors

## Legend

⊙ Soil Boring Locations

- B7: N39° 7' 16.5", W92° 14' 2.9"
- B8: N39° 7' 15.5", W92° 14' 2.9"
- B9: N39° 7' 14.8", W92° 14' 2.3"
- B10: N39° 7' 13.7", W92° 14' 2.9"
- B11: N39° 7' 12.8", W92° 14' 2.2"
- B12: N39° 7' 12.2", W92° 14' 2.9"
- B13: N39° 7' 16.9", W92° 14' 1.1"
- B14: N39° 7' 15.2", W92° 14' 0.8"
- B15: N39° 7' 14.2", W92° 14' 2.0"
- B16: N39° 7' 13.6", W92° 14' 0.7"
- B17: N39° 7' 13.0", W92° 14' 1.1"
- B18: N39° 7' 12.0", W92° 14' 1.6"
- B19: N39° 7' 17.0", W92° 13' 59.2"
- B20: N39° 7' 16.1", W92° 13' 56.8"
- B21: N39° 7' 14.1", W92° 13' 56.6"
- B22: N39° 7' 12.0", W92° 13' 56.9"
- B23: N39° 7' 11.4", W92° 13' 59.5"
- B24: N39° 7' 15.4", W92° 13' 59.5"
- B25: N39° 7' 14.5", W92° 13' 58.3"
- B26: N39° 7' 13.6", W92° 13' 59.5"
- B27: N39° 7' 12.8", W92° 13' 58.3"



**APPENDIX B**  
**FIELD AND LABORATORY**  
**INVESTIGATION GENERAL**  
**INFORMATION**

## **FIELD INVESTIGATION**

The field investigation consisted of site observation, subsurface exploration and sampling, as well as field testing and visual classification of the soils encountered in accordance with ASTM specifications. The site observation provided information concerning existing topography and recent manmade alterations, if any were observed. During the investigation the locations and ground elevations for each of the borings were determined, unless provided by others. Subsurface exploration and sampling was conducted in an effort to define the soil profile and to obtain disturbed and/or undisturbed representative samples of the various soils encountered for the purpose of the laboratory investigation.

Dependent upon the field conditions and project requirements, test borings were completed with a CME 75 truck mounted or CME 55 track mounted drill rig equipped with either 3¼ or 4¼ inch I.D. hollow stem augers in accordance with ASTM D6151, 5 inch solid stem augers in accordance with ASTM D1452, or rotary drilling equipment in accordance with ASTM D5783. The hollow stem augers permit convenient access to the undisturbed soil below the auger bit which allows the driller to obtain a soil sample at the desired depth. The boreholes upon completion were backfilled with auger cuttings (soil) and boring plug (if requested). Periodic observation and maintenance of the backfilled boreholes should be performed to monitor for subsidence at the ground surface as the borehole backfill could settle over time.

As the test borings were advanced, methods of sampling were employed to recover soils from the undisturbed strata below the auger bit. Representative disturbed samples were obtained from a standard Split Spoon and the samples were recovered by driving a 2 inch O.D. (1 3/8 inch I.D.) Split Spoon sampler in accordance with ASTM D1586. When subsurface conditions warranted, relatively undisturbed samples were obtained in cohesive soils by hydraulically pushing a thin walled seamless tube sampler into the soil in accordance with ASTM D1587. The Shelby Tubes were 2 or 3 inches in outside diameter depending upon the project requirements. One or both of these methods may have been utilized based on site conditions and/or job specific requirements. Additionally, disturbed samples collected from auger cuttings in accordance with ASTM D1452 may have been obtained as needed to further facilitate identification of the subsurface conditions.

The recovered samples were described in the field according to color, texture, grain size, plasticity and consistency, as recommended by ASTM D2488, "Description and Identification of Soils (Visual-Manual Procedure)". Split Spoon samples when obtained were sealed/preserved in glass jars and labeled while Shelby Tube samples, when obtained, were sealed/preserved within the tubes and also labeled prior to transporting to our laboratory. Auger cuttings, when obtained, were sealed in an air tight container to preserve the natural moisture content. The samples were all carefully stored, preserved, and transported for later use in the laboratory testing program in general accordance with ASTM D4220.

Field tests were conducted in an effort to estimate the shearing strength of the soil. Though the results of these tests were not used alone as a basis for shearing strength determination, they were helpful in predicting the behavior of the soil mass and should only be considered an approximate estimation. Where applicable, further laboratory testing and evaluation in conjunction with the field testing program was essential in determining the soil conditions.

The field testing program included the Standard Penetration Test conducted in accordance with ASTM D 1586. In this test, administered during the Split Spoon sampling procedure, a 2 inch O.D. (1 3/8 inch I.D.) 24 inch long standard Split Spoon was driven into the soil through a depth of 18 inches by a 140 pound weight dropped a distance of 30 inches. The penetration resistance, "N", was recorded as the number of blows, from the falling weight, required to drive the sampler through the final 12 inches. This penetration resistance provided a measure of the apparent relative density of cohesionless soils and an estimate of the consistency of cohesive materials.

Recovered cohesive samples were tested, when possible, by the use of a calibrated pocket penetrometer. The values from this test were considered an approximate measure of the consistency of the cohesive soils. The penetrometer values as well as the measures of penetration resistance were later correlated with the results of the laboratory tests conducted on cohesive soil samples obtained from the Split Spoon and/or Shelby Tube samples.

The results of the field tests on each soil sample, as well as the soil descriptions, were recorded on field boring logs in accordance with ASTM D 5434 as the subsurface exploration progressed. These field boring logs were later modified to reflect the more elaborate analysis provided by the laboratory testing program. These modified field boring logs are the final boring logs that are attached to this report.

## **LABORATORY INVESTIGATION**

The laboratory investigation involved the completion of classification tests on select undisturbed samples as well as select disturbed samples of the soils that were obtained from the various soil layers encountered beneath the site. Based on the field logs/records and our examination of the samples in the laboratory, a soil testing program was developed to acquire more precise estimations and detailed information about the soil conditions at the site.

Representative samples from the various soil strata were tested (site specific determination) in accordance with ASTM specifications. Dependent upon the sample availability and project requirements the laboratory testing on select representative samples included such soil index testing as natural moisture content (ASTM D2216), atterberg limits testing (ASTM D4318) and grain size analysis (ASTM D422). These parameters were used in identifying the soils through the Unified Soil Classification System in accordance with ASTM D 2487. This System, which is standardized and widely accepted, enables the Geotechnical Engineer to classify a soil using quantitative test results. A brief description of this classification system is contained in this report. Estimated predictions of the soil behavior during and after construction may readily be made through the use of this comparative type of classification.

Disturbed Split Spoon and/or relatively undisturbed Shelby Tube samples of cohesive soils were tested to determine unit weight and an approximation of the unconfined compressive strength. These tests were conducted with controlled strain by the use of a hand-operated compression apparatus with a double proving ring in accordance with ASTM D 2166. The results of some of the tests must be considered cautiously, recognizing that Split Spoon samples are disturbed and when tested, will generally provide slightly conservative values in relation to the probable conditions in the field. The relatively undisturbed Shelby Tube samples, however, should approach more closely the condition of the soils in-situ and the results of unconfined compression tests on these samples are typically considered to be fairly indicative of the in-situ soil conditions. When indicated, the undrained shear strength of saturated fine-grained soils was estimated utilizing the miniature vane shear test in accordance with ASTM D4648.

Additional laboratory testing in accordance with ASTM standards such as specific gravity, moisture-density relationship, relative density, hydraulic conductivity, consolidation, direct shear, triaxial compression, among others, are utilized when applicable for project specific requirements. Upon completion of the laboratory testing program the final boring logs were prepared utilizing the data obtained from the laboratory testing and the initial data/records contained on the field boring logs. The remaining soil samples after the project testing is completed will be held for a minimum period of one month. After one month, the samples are typically discarded unless prior notification is provided to us.

## **BORING LOGS**

### **GENERAL INFORMATION**

#### **I. DRILLING AND SAMPLING SYMBOLS:**

- HA - Hollow or Solid Stem Continuous Flight Auger Disturbed Samples
- SS - Split Spoon Sample (2" O.D. - 1 3/8" I.D.) Obtained Following the Standard Penetration Test
- 2ST - Shelby Tube Sample (2" O.D.)
- 3ST - Shelby Tube Sample (3" O.D.)

#### **II. SOIL IDENTIFICATION:**

The soils have been identified by Visual-Manual procedures in accordance with ASTM Standards (ASTM D 2488). Where specifically noted, the soils have been classified using the Unified Soil Classification System (ASTM D 2487). Classification estimates are in parentheses when applicable.

#### **RELATIVE PROPORTIONS OF SAND AND GRAVEL**

Descriptive Term(s) of Components Present in Sample by Percent of Dry Weight

Trace	<15
With	15-29
Modifier	>30

#### **RELATIVE PROPORTIONS OF FINES**

Descriptive Term(s) of Components Present in Sample by Percent of Dry Weight

Trace	<5
With	5-12
Modifier	>12

## GRAIN SIZE TERMINOLOGY

Major Component of Sample and Size Range

Boulders	Over 12 in.
Cobbles	12 in. to 3 in.
Gravel	3 in. to #4 sieve
Sand	#4 sieve to #200 sieve
Silt or Clay	Passing #200 sieve

## SOIL STRUCTURE TERMINOLOGY

Parting:	Paper Thin in Size
Seam:	1/8" to 3" in Thickness
Layer:	Greater than 3" in Thickness
Interbedded:	Alternating Soil Type Layers
Laminated:	Thin Layers of Varying Color and Texture, or Composition
Slickensided:	Having Inclined Planes of Weakness that are Slick and Glossy in Appearance
Fissured:	Containing Shrinkage Cracking, Frequently Filled with Fine Sand or Silt, Usually Vertical
Ferrous:	Containing Appreciable Iron
Desiccated:	Soil that has been Subjected to a Thorough Drying Process

### III. SOIL PROPERTY SYMBOLS:

MC - Natural Moisture Content in %.

DRY WT.- Unit Dry Weight in Pounds per Cubic Foot.

LL - Liquid Limit in %.

PL - Plastic Limit in %.

PI - Plasticity Index in %

Qp - Unconfined Compressive Strength in Tons per Square Foot Calibrated Penetrometer Value

Qu - Unconfined Compressive Strength in Tons per Square Foot Obtained in Laboratory at Controlled Rate of Strain

**BLOWS** - The "blows" are the recorded results of the Standard Penetration Test (SPT). In this field test, a standard Split Spoon Sampler (2" O.D.- 1 3/8" I.D.) is driven into the soil for a total penetration of 18 inches by a 140-pound hammer which is repeatedly dropped freely for a distance of 30 inches.

The number of blows are recorded (field logs) for each 6 inches of penetration, and the penetration resistance, "N", is considered as the number of blows required for the last 12 inches of penetration.

EXAMPLE: 3-8-6 "N" = 14 blows/foot

The SPT "N" value for split-spoon refusal conditions is typically estimated as greater than 100 blows per foot. When split-spoon refusal occurs, often little or no sample is recovered.

For our own in-house purposes, refusal is estimated at 50 blows per 6 inches. Where the sampler is observed not to penetrate after 50 blows, the "N" value is reported as 50/0". Otherwise, the depth of penetration after 50 blows is reported in inches (i.e. 50/5", 50/2"). Should the sampler not penetrate the full 18 inches, the results are recorded as follows:

EXAMPLE: 6-21-50/3"

This means that 6 blows were required for the first 6 inches of penetration, 21 blows were required for the second 6 inches of penetration, and 50 blows were required for the last 3 inches of penetration.

∇ - Groundwater Level During Drilling

▼ - Groundwater Level at Indicated Hours Following Boring Completion

**IV. APPROXIMATE RELATIVE DENSITY AND CONSISTENCY OF SOILS ON THE BASIS OF THE STANDARD PENETRATION TEST:**

<b>NONCOHESIVE SOILS</b>		<b>COHESIVE SOILS*</b>	
<b>BLOWS/FT.** RELATIVE DENSITY</b>		<b>BLOWS/FT ** CONSISTENCY</b>	
0 - 4	Very Loose	0 - 2	Very Soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium Dense	4 - 8	Medium
30 - 50	Dense	8 - 15	Stiff
50+	Very Dense	15 - 30	Very Stiff
		30+	Hard

\* Use with caution

\*\*Penetration Resistance "N"

**V. QUANTITATIVE EXPRESSIONS FOR THE CONSISTENCY OF CLAYS:**

**UNCONFINED  
COMPRESSIVE  
STRENGTH**

**CONSISTENCY T.S.F.**

**FIELD IDENTIFICATION**

Very Soft	0.0 - 0.25	Easily penetrated several inches by fist.
Soft	0.25 - 0.5	Easily penetrated several inches by thumb.
Medium	0.5 - 1.0	Penetrated by thumb with moderate effort.
Stiff	1.0 - 2.0	Readily indented by thumb but penetrated only with great effort.
Very Stiff	2.0 - 4.0	Readily indented by thumbnail.
Hard	4.0+	Indented with difficulty by thumbnail.

MAJOR DIVISIONS			GRAPH SYMBOL	GROUP SYMBOL	TYPICAL DESCRIPTIONS			
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (Little or No Fines)		GW	Well-Graded Gravel, Gravel-Sand Mixture, Little or No Fines			
				GP	Poorly-Graded Gravel, Gravel-Sand Mixtures, Little or No Fines			
		GRAVELS WITH FINES (Appreciable Amount of Fines)		GM	Silty Gravel, Gravel-Sand-Silt Mixtures			
				GC	Clayey Gravel, Gravel-Sand-Clay Mixtures			
	SAND AND SANDY SOILS	CLEAN SAND (Little or No Fines)		SW	Well-Graded Sand, Gravely Sands, Little or No Fines			
				SP	Poorly-Graded Sand, Gravely Sands, Little or No Fines			
		SANDS WITH FINES (Appreciable Amount of Fines)		SM	Silty Sand, Sand-Silt Mixtures			
				SC	Clayey Sand, Sand-Clay Mixtures			
			FINE GRAINED SOILS	SILTS AND CLAYS	Liquid Limit <u>LESS</u> than 50%		ML	Inorganic Silt and Very Fine Sand, Rock Flour, Silty or Clayey Fine Sand or Clayey Silt with Slight Plasticity
							CL	Inorganic Clay of Low to Medium Plasticity, Gravely Clay, Sandy Clay, Silty Clay, Lean Clay
	OL	Organic Silt and Organic Silty Clay of Low Plasticity						
SILTS AND CLAYS	Liquid Limit <u>GREATER</u> than 50%			MH	Inorganic Silt, Micaceous or Diatomaceous Fine Sand or Silty Soil, Elastic Silt			
				CH	Inorganic Clay of High Plasticity, Fat Clay			
				OH	Organic Clay of Medium to High Plasticity, Organic Silt			
HIGHLY ORGANIC SOILS				PT	Peat, Humus, Swamp Soils with High Organic Contents			

### SOIL CLASSIFICATION CHART

NOTES:

- 1) DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.
- 2) IN THE CASE OF COMBINATIONS, THE PREDOMINANT MATERIAL WILL BE IN HEAVY SYMBOL.

## GEOTECHNICS

Soil & Material Testing

□ 818 North 26th Street, Quincy, IL      Ph: (217) 223-9810 - Fax: (217) 223-9805  
 ■ 4510 Plain Grove Rd, Harwood, MD      Ph: (410) 321-0020 - Fax: (410) 321-0012  
 □ 810 N. Third Street, Suite 100, Burlington, IA      Ph: (515) 753-1939 - Fax: (515) 753-9806  
 Internet Address:      www.kinman.com

## UNIFIED SOIL CLASSIFICATION SYSTEM

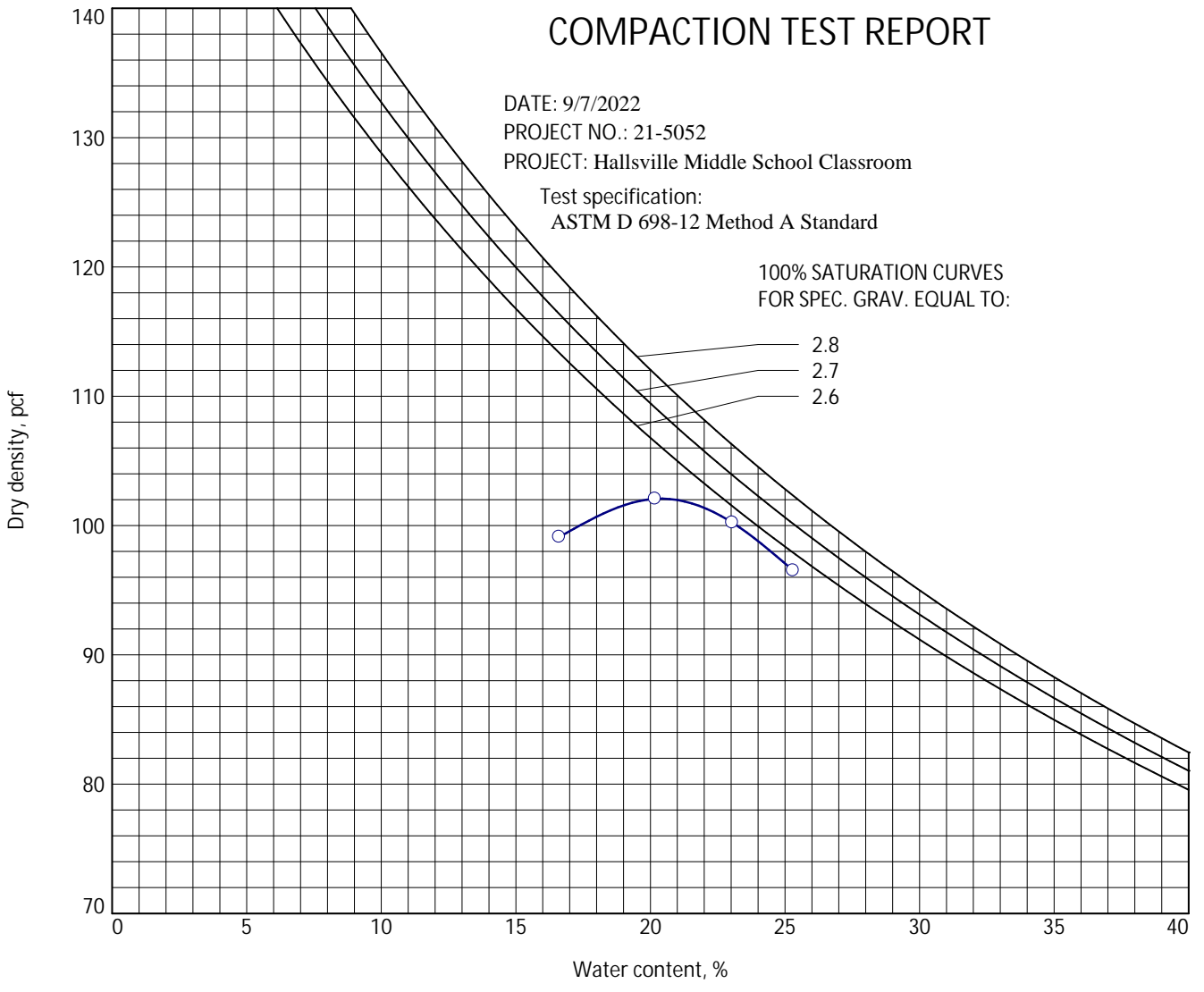
- ASTM D 2487 -

**APPENDIX C**  
**MOISTURE DENSITY RELATIONSHIP**

# COMPACTION TEST REPORT

DATE: 9/7/2022  
 PROJECT NO.: 21-5052  
 PROJECT: Hallsville Middle School Classroom

Test specification:  
 ASTM D 698-12 Method A Standard



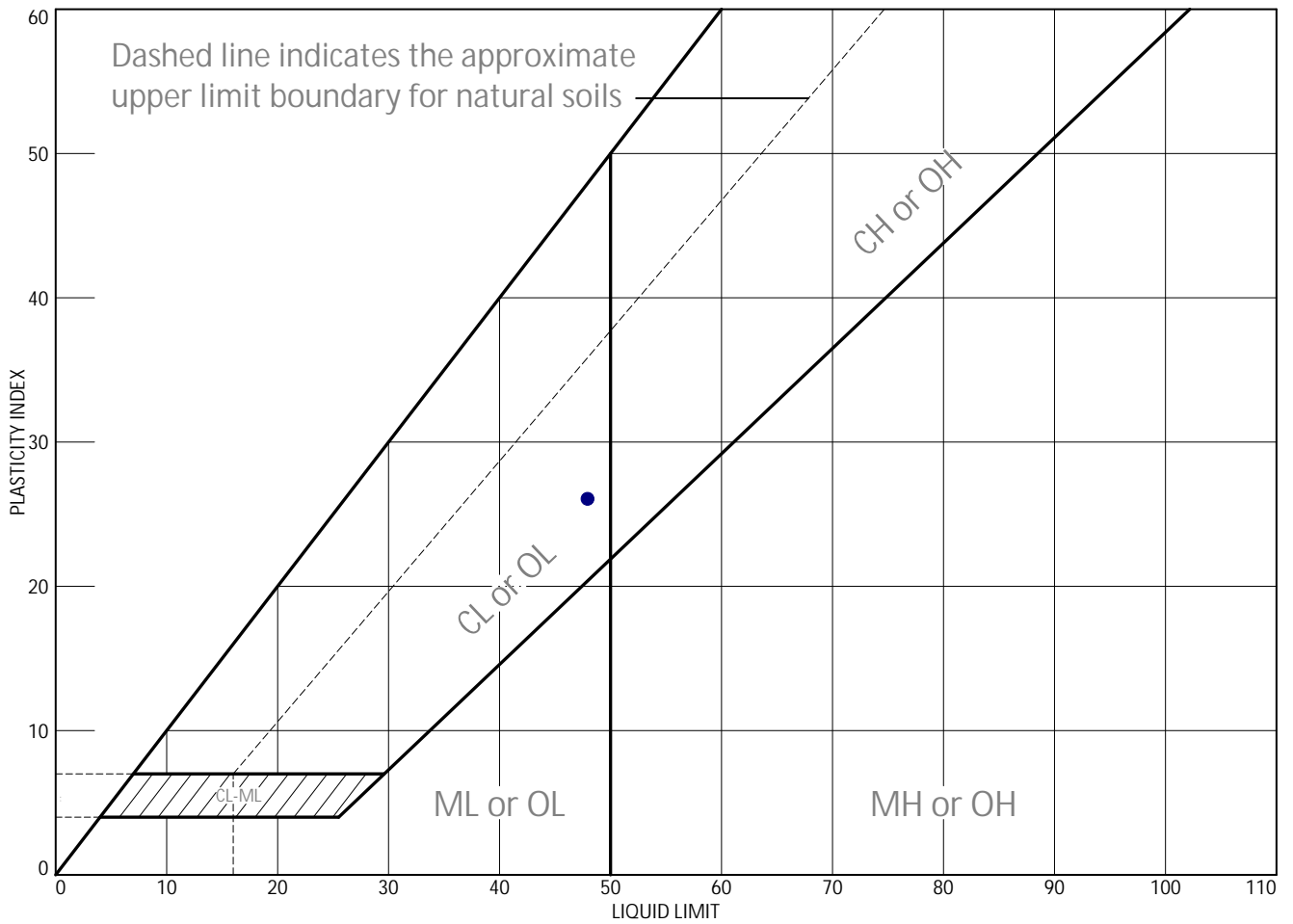
No.	LOCATION AND DESCRIPTION	REMARKS						
○ SP-1	Loc.: Bulk 24, 25, 26, 27    Depth: 0-5 ft.    Sample No.: Bulk Fat Clay (CH), Light Brown mottled Light Gray, Moist	Natural Moisture = 17.7%						
No.	USCS	LL	PI	NAT. MOIST.	OVERSIZE	%< No.200	MAX. DRY DEN.	OPT. MOIST.
○ SP-1	CH	55	34	17.7	%>#4=0.6	91.3 %	102.1	20.4 %

Figure SP-1

Tested By: DAW

**APPENDIX D**  
**ATTERBERG LIMIT**  
**DETERMINATIONS**

# LIQUID AND PLASTIC LIMITS TEST REPORT



MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
● Lean Clay (CL), Light Brown mottled Yellow Brown, Silty, Moist	48	22	26			CL

Project No. 21-5052      Client: Hallsville R-IV School District  
 Project: Hallsville Middle School Classroom  
 ● Location: Boring 6      Depth: 1-2½ ft.      Sample Number: 0

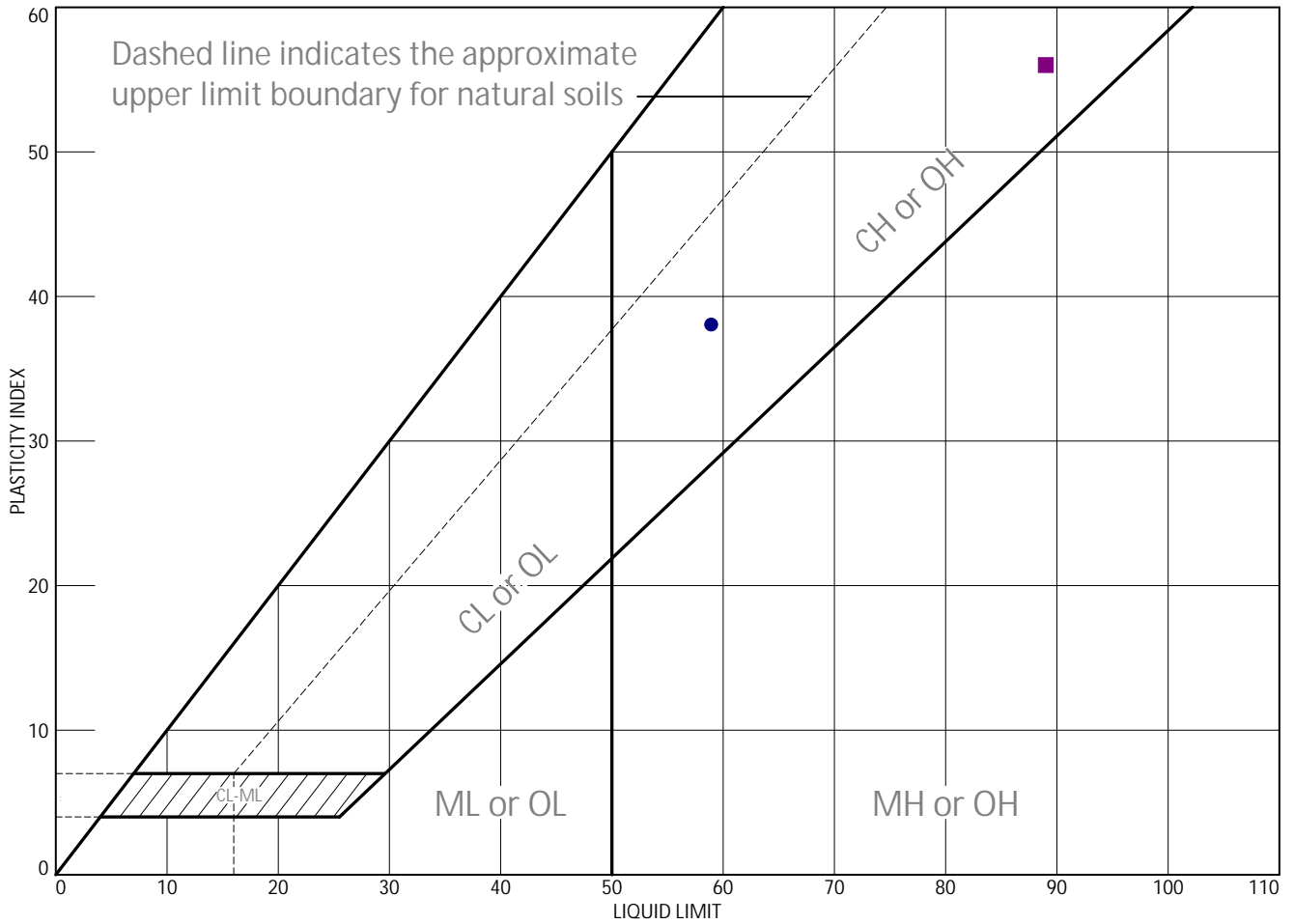
Remarks:  
 ● Natural Moisture = 10.9%



Figure 1

Tested By: NPP

# LIQUID AND PLASTIC LIMITS TEST REPORT



MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
● Fat Clay (CH), Brown mottled Light Brown, Silty, Moist	59	21	38			CH
■ Fat Clay (CH), Light Gray mottled Reddish Brown, Hard, Moist	89	33	56			CH

Project No. 21-5052      Client: Hallsville R-IV School District  
 Project: Hallsville Middle School Classroom

● Location: Boring 13      Depth: 1-2½ ft.      Sample Number: 0  
 ■ Location: Boring 18      Depth: 2½-4 ft.      Sample Number: 1

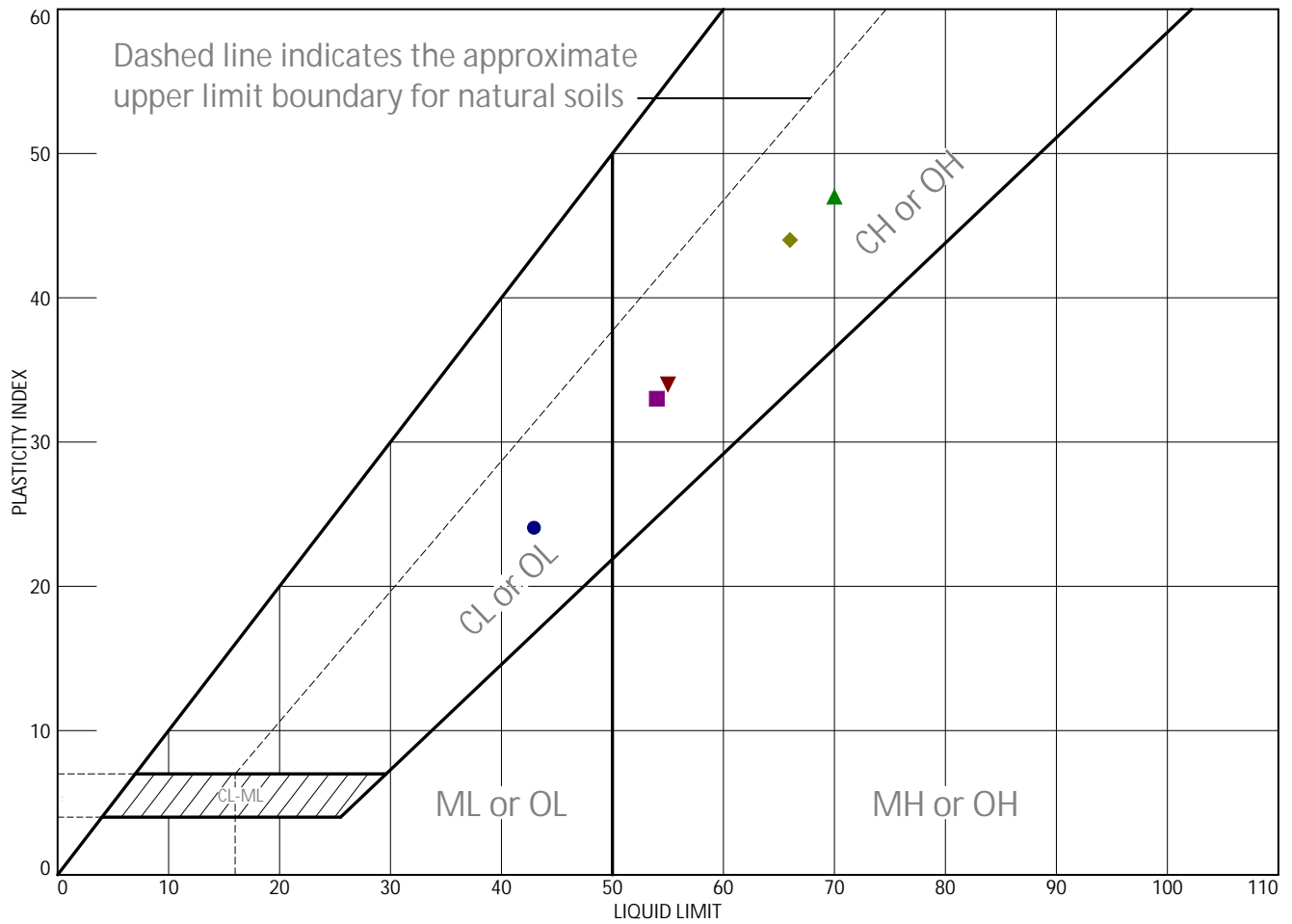
Remarks:  
 ● Natural Moisture = 23.6%  
 ■ Natural Moisture = 21.9%



Figure

Tested By:  NPP    DAW

# LIQUID AND PLASTIC LIMITS TEST REPORT



MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
● Lean Clay (CL), Light Gray mottled Yellow Brown, Black Oxidation, Trace Sand, Silty, Moist	43	19	24	96.7	92.6	CL
■ Fat Clay (CH), Light Gray mottled Yellow Brown, Silty, Trace Sand, Moist	54	21	33	97.1	93.3	CH
▲ Fat Clay (CH), Light Brown mottled Reddish Brown, Moist	70	23	47	99.7	99.4	CH
◆ Fat Clay (CH), Light Gray mottled Light Brown, Moist	66	22	44	98.7	97.8	CH
▼ Fat Clay (CH), Light Brown mottled Light Gray, Moist	55	21	34	96.3	91.3	CH

Project No. 21-5052      Client: Hallsville R-IV School District  
 Project: Hallsville Middle School Classroom

● Location: Boring 24      Depth: 6-48 in.      Sample Number: 2  
 ■ Location: Boring 24      Depth: 48-58 in.      Sample Number: 3  
 ▲ Location: Boring 25      Depth: 12-22 in.      Sample Number: 2  
 ◆ Location: Boring 26      Depth: 23-34 in.      Sample Number: 2  
 ▼ Location: Bulk 24, 25, 26, 27      Depth: 0-5 ft.      Sample Number: Bulk

Remarks:

● Natural Moisture = 19.7%  
 ■ Natural Moisture = 22.6%  
 ▲ Natural Moisture = 23.2%  
 ◆ Natural Moisture = 26.8%  
 ▼ Natural Moisture = 17.7%

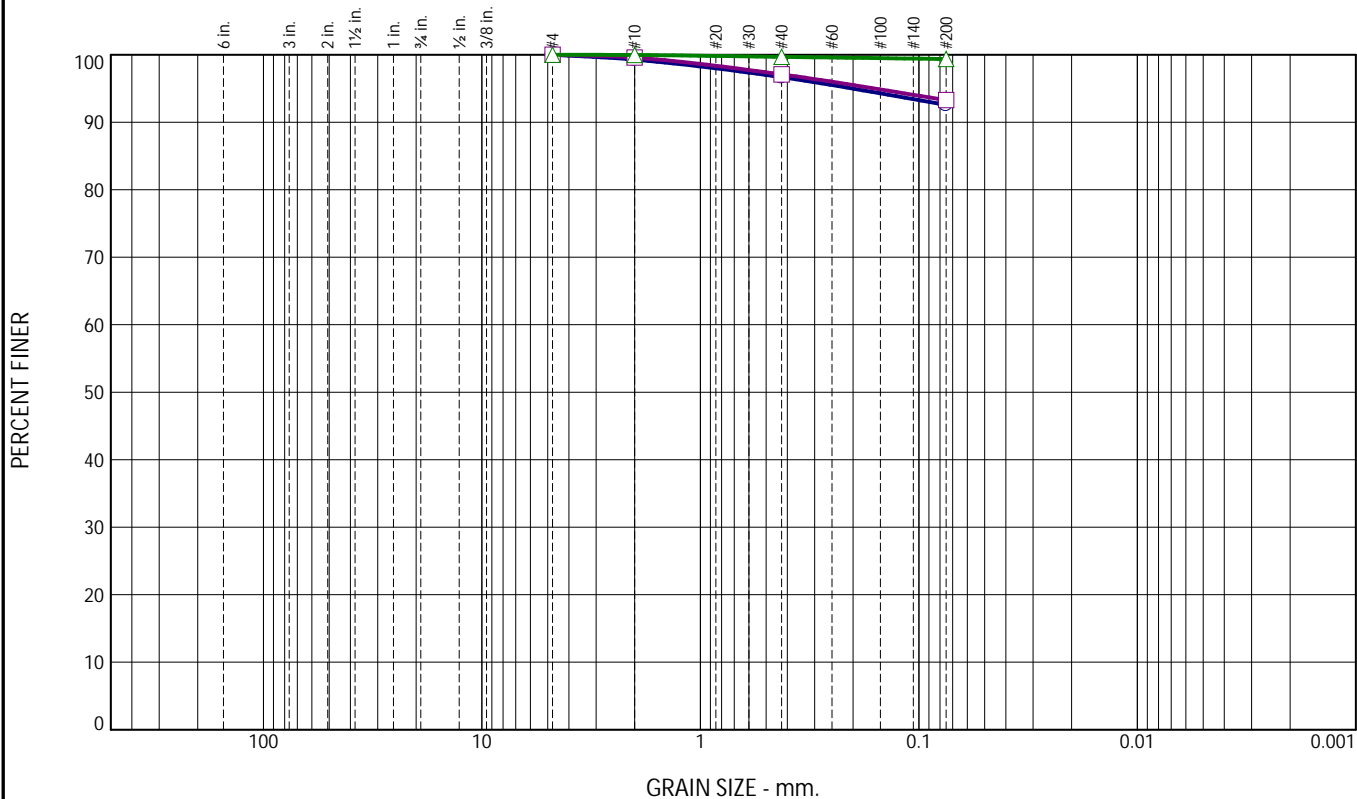


Figure 2

Tested By: ○ NPP    □ DAW    ▲ BRH    ◆ BRH    ▼ DJS

**APPENDIX E**  
**GRADATION ANALYSIS RESULTS**

# Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PL	PI
○	0.0	0.0	7.4	92.6		CL	43	19	24
□	0.0	0.0	6.7	93.3		CH	54	21	33
△	0.0	0.0	0.6	99.4		CH	70	23	47

SIEVE inches size	PERCENT FINER		
	○	□	△
<del>6 in.</del>			
<del>3 in.</del>			
<del>2 in.</del>			
<del>1 1/2 in.</del>			
<del>1 in.</del>			
<del>3/4 in.</del>			
<del>3/8 in.</del>			
<del>#4</del>			
<del>#10</del>			
<del>#20</del>			
<del>#40</del>			
<del>#200</del>			
<del>D<sub>60</sub></del>			
<del>D<sub>30</sub></del>			
<del>D<sub>10</sub></del>			
<del>C<sub>c</sub></del>			
<del>C<sub>u</sub></del>			

SIEVE number size	PERCENT FINER		
	○	□	△
#4	100.0	100.0	100.0
#10	99.3	99.6	100.0
#40	96.7	97.1	99.7
#200	92.6	93.3	99.4

**Material Description**

○ Lean Clay (CL), Light Gray mottled Yellow Brown, Black Oxidation, Trace Sand, Silty, Moist

□ Fat Clay (CH), Light Gray mottled Yellow Brown, Silty, Trace Sand, Moist

△ Fat Clay (CH), Light Brown mottled Reddish Brown, Moist

**REMARKS:**

○ Natural Moisture = 19.7%

□ Natural Moisture = 22.6%

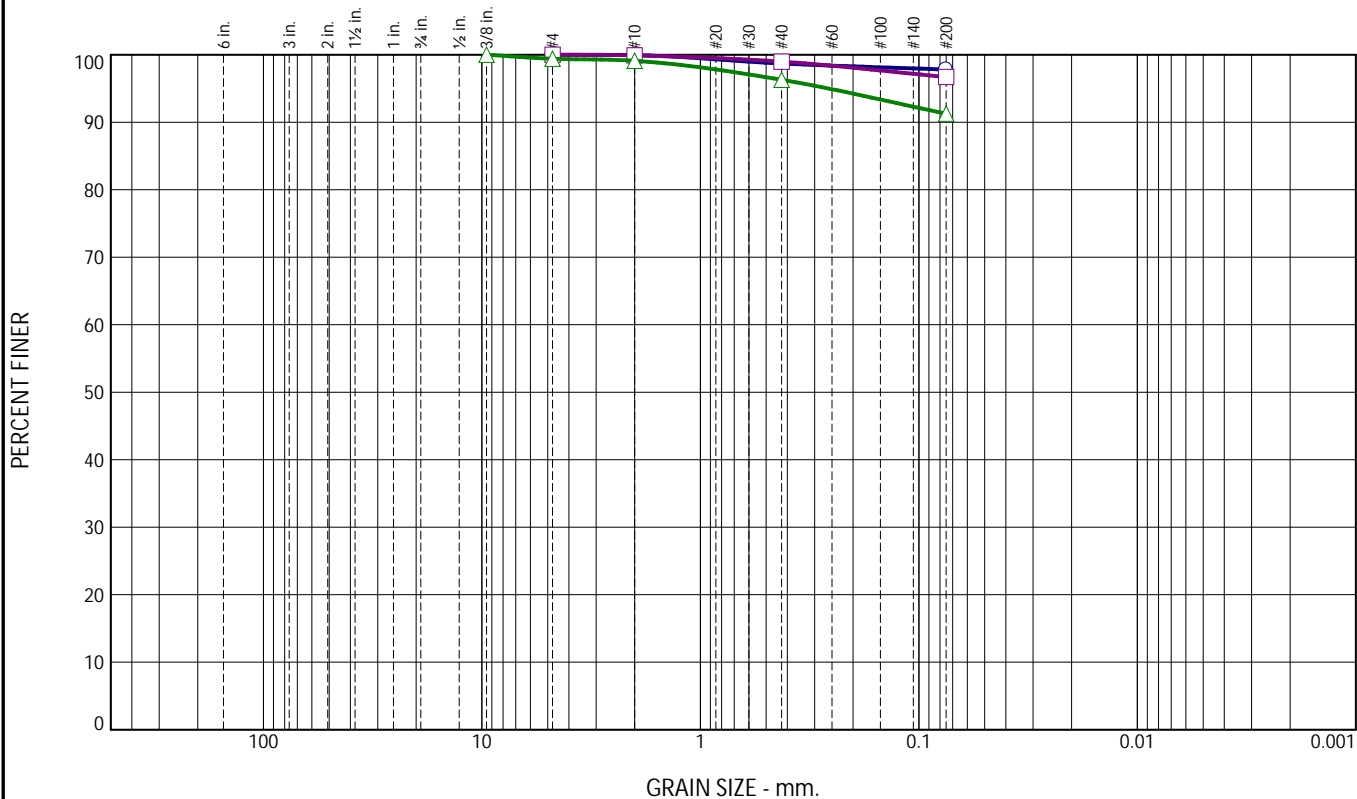
△ Natural Moisture = 23.2%

○ Location: Boring 24      Depth: 6-48 in.  
 □ Location: Boring 24      Depth: 48-58 in.  
 △ Location: Boring 25      Depth: 12-22 in.

Sample Number: 2  
 Sample Number: 3  
 Sample Number: 2

<b style="font-size: 1.2em;">GEOTECHNICS</b> <b style="font-size: 0.8em;">Soil &amp; Material Testing</b> 4510 Paris Gravel Road - Hannibal, MO	Client: Hallsville R-IV School District Project: Hallsville Middle School Classroom Project No.: 21-5052
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# Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PL	PI
○	0.0	0.0	2.2	97.8		CH	66	22	44
□	0.0	0.0	3.3	96.7		(CH)			
△	0.0	0.6	8.1	91.3		CH	55	21	34

SIEVE inches size	PERCENT FINER		
	○	□	△
3/8"			100.0
GRAIN SIZE			
D <sub>60</sub>			
D <sub>30</sub>			
D <sub>10</sub>			
COEFFICIENTS			
C <sub>c</sub>			
C <sub>u</sub>			

SIEVE number size	PERCENT FINER		
	○	□	△
#4	100.0	100.0	99.4
#10	99.9	99.9	99.1
#40	98.7	99.0	96.3
#200	97.8	96.7	91.3

**Material Description**

- Fat Clay (CH), Light Gray mottled Light Brown, Moist
- Fat Clay (CH), Light Gray mottled Yellow Brown, Wet
- △ Fat Clay (CH), Light Brown mottled Light Gray, Moist

**REMARKS:**

- Natural Moisture = 26.8%
- Natural Moisture = 35.0%
- △ Natural Moisture = 17.7%

○ Location: Boring 26                      Depth: 23-34 in.                      Sample Number: 2  
 □ Location: Boring 27                      Depth: 47-57 in.                      Sample Number: 4  
 △ Location: Bulk 24, 25, 26, 27                      Depth: 0-5 ft.                      Sample Number: Bulk

<b style="font-size: 1.2em;">GEOTECHNICS</b> <b style="font-size: 0.8em;">Soil &amp; Material Testing</b> 4510 Paris Gravel Road - Hannibal, MO	Client: Hallsville R-IV School District Project: Hallsville Middle School Classroom Project No.: 21-5052
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**APPENDIX F**  
**BORING LOGS-MIDDLE SCHOOL**  
**CLASSROOM**

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B1

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			898.9						
0		Topsoil (5")									
0		Fill: Lean Clay (CL), Light Brown, Trace Crushed Stone, Moist				0	HA				15.1
0		Fill: (CL), Light Brown/Yellow Brown mottled Light Gray, Silty, Soft, Moist				1	SS	3			28.1
5		Fill: (CL), Gray mottled Light Brown/Brown, Trace Crushed Stone, Soft, Moist				2	SS	2			28.1
10		Fat Clay (CH), Light Gray mottled Yellow Brown, Reddish Brown Oxidation, Stiff, Moist	1.50	101.1	891.4	3	SS	7	1.92		23.3
10		(CH), Stiff, Moist	2.00		7.5	4	SS	9			23.4
15		(CH), Very Stiff, Moist	2.00	104.1		5	ST		2.71		21.7
15		(CH), Stiff, Moist	2.25			6	SS	11			21.4
20		(CH), Trace Sand, Stiff, Moist	0.50			7	SS	10			20.7
25		Sandy Lean Clay (CL/CH), Yellow Brown mottled Light Gray, Black Oxidation, Silty, Trace Gravel, Very Stiff, Moist	3.00		873.9	8	SS	15			15.7
25					25.0						
25					872.4						
25					26.5						
30		End of Boring @ 26½ Ft.									

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/21/2022

Boring Completed: 7/21/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ 24 Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B2

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp — WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			898.5						
		Topsoil (3")									
		Fill: Crushed Lime Fines (SM), Light Brown, Moist				0	HA				4.3
		Fill: (SM), Light Gray, Medium Dense, Moist				1	SS	17			5.1
		Light Gravel (4½ to 5 ft.)			894.5						
		Fill: Lean Clay (CL), Gray mottled Brown/Light Brown, Trace Crushed Stone and Brick, Medium, Moist	0.75	101.1	892.5	2	SS	5	1.67		24.4
		Fat Clay (CH), Light Gray mottled Yellow Brown, Medium, Moist	1.25		892.5	3	SS	8			24.7
		(CH), Very Stiff, Moist	2.25	105.2	892.5	4	ST		2.81		22.2
		(CH), Black Oxidation, Stiff, Moist	2.00		892.5	5	SS	13			20.1
		(CH), Black Oxidation, Stiff, Moist	1.75		892.0	6	SS	10			24.3
		End of Boring @ 16½ Ft.			882.0						
					16.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/21/2022

Boring Completed: 7/21/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ 24 Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B3

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			899.1						
		Topsoil (6")			898.6						
		Fill: Lean Clay (CL), Light Brown, Trace Brick, Moist			0.5	0	HA				15.6
		Fill: Fat Clay (CH), Gray/Light Gray mottled Light Brown, Soft, Moist			896.6	1	SS	4			15.4
		Light To Medium Gravel (3 to 4½ ft.)			894.1						
5		Lean Clay (CL), Yellow Brown mottled Light Brown, Silty, Stiff, Moist	1.00	96.7	5.0	2	ST		1.29		24.4
		Fat Clay (CH), Light Gray mottled Yellow Brown, Black Oxidation, Stiff, Moist	1.25	101.9	7.5	3	SS	7	1.48		23.2
10		(CH), Stiff, Moist	1.50			4	SS	9			22.9
		(CH), Light Gray, Stiff, Moist	1.75			5	SS	9			21.6
15		(CH), Stiff, Moist	2.00			6	SS	8			23.3
20		(CH), Mottled Yellow Brown/Light Brown, Trace Sand, Stiff, Moist	2.00			7	SS	10			20.2
		End of Boring @ 21½ Ft.			877.6 21.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/21/2022

Boring Completed: 7/21/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B4

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			898.4						
	▨	Topsoil (5")									
	▨	Fill: Lean Clay (CL), Light Brown, Trace Crushed Stone, Moist			895.9	0	HA				13.6
	▨	Fat Clay (CH), Light Brown mottled Yellow Brown, Stiff, Moist	2.00	93.5	2.5	1	SS	7	1.94		28.1
5	▨	Fat Clay (CH), Light Gray mottled Yellow Brown, Silty, Medium, Moist	1.50	96.2		2	ST		0.97		23.3
	▨	(CH), Black Oxidation, Stiff, Moist	0.75			3	SS	7			24.0
10	▨	(CH), Mottled Yellow Brown/Reddish Brown, Medium, Moist	1.50			4	SS	7			25.4
	▨	(CH), Stiff, Moist	1.75			5	SS	12			20.1
15	▨	(CH), Stiff, Moist	2.25			6	SS	11			18.0
20	▨	(CH), Light Gray mottled Yellow Brown, Trace Sand, Very Stiff, Moist	2.75		876.9	7	SS	16			21.7
		End of Boring @ 21½ Ft.			21.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/22/2022

Boring Completed: 7/22/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ 3.25Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B5

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp —●— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			898.2						
		Topsoil (5")									
		Fill: Lean Clay (CL), Light Brown/ Yellow Brown mottled Light Gray, Trace Crushed Stone, Moist				0	HA				19.3
		Fill: (CL), Light Gray mottled Reddish Brown/Light Brown/Brown, Stiff, Moist	3.50			1	SS	12			21.9
5		Lean Clay (CL), Light Gray mottled Yellow Brown, Silty, Medium, Moist	0.75	96.6	893.2 5.0	2	SS	8	0.99		24.9
		Fat Clay (CH), Light Gray mottled Yellow Brown, Reddish Brown Oxidation, Stiff, Moist	1.50		890.7 7.5	3	SS	9			24.5
10		(CH), Stiff, Moist	0.75	102.8		4	ST		1.23		21.9
		(CH), Stiff, Moist	2.00			5	SS	11			21.3
15		(CH), Light Gray, Stiff, Moist	2.25			6	SS	11			22.3
		End of Boring @ 16½ Ft.			881.7 16.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/22/2022

Boring Completed: 7/22/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ 2.25Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B6

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp   WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			898.6						
		Topsoil (6")			898.1						
		Lean Clay (CL), Light Brown mottled Yellow Brown, Silty, Moist			0.5	0	HA				10.9
		(CL), Light Brown, Silty, With Fat Clay Seams, Medium, Moist	1.25			1	SS	7			26.7
5		(CL), Light Gray mottled Yellow Brown, Silty, Stiff, Moist	0.75	96.2		2	SS	7	1.02		28.0
		Fat Clay (CH), Light Gray mottled Yellow Brown, Very Stiff, Moist			891.1						
		(CH), Stiff, Moist	2.00	104.2	7.5	3	ST		2.16		20.7
		(CH), Trace Sand, Very Stiff, Moist	2.50			5	SS	15			19.5
		(CH), Black Oxidation, Trace Sand, Stiff, Moist	1.75			6	SS	10			22.8
20		Lean Clay (CL/CH), Yellow Brown mottled Light Gray, Trace Sand, Very Stiff, Moist	3.25		878.6						
		(CL/CH), Trace Sand, Stiff, Moist	2.75		20.0	7	SS	15			18.1
		End of Boring @ 26½ Ft.			872.1						
					26.5	8	SS	14			15.7

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/21/2022

Boring Completed: 7/21/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B28

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			899.0						
		Topsoil (6")			898.5						
		Fill: Lean Clay (CL), Light Brown, Trace Crushed Stone, Moist			0.5	0	HA				10.8
		Fill: (CL), Light Gray mottled Yellow Brown, Silty, Stiff, Moist	1.00			1	SS	9			25.7
5		Lean Clay (CL), Light Gray mottled Yellow Brown/Reddish Brown, Silty, Medium, Moist	0.25	94.6	894.0	2	SS	6	0.95		27.4
		Lean Clay (CL), Light Gray mottled Yellow Brown, Black Oxidation, Stiff, Moist	1.25		5.0	3	SS	8			21.6
10		Fat Clay (CH), Light Gray mottled Yellow Brown, Stiff, Moist	1.00		889.0	4	SS	9			26.5
		(CH), Stiff, Moist	2.75		10.0	5	SS	13			19.5
15		(CH), Mottled Yellow Brown/Reddish Brown, Black Oxidation, Stiff, Moist	2.50			6	SS	12			21.6
		End of Boring @ 16½ Ft.			882.5						
					16.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/22/2022

Boring Completed: 7/22/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ 1.5 Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B29

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp  -----  WI	
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.			
0		Ground Surface			898.9							
		Topsoil (6")			898.4							
		Fill: Lean Clay (CL), Light Brown, Trace Crushed Stone and Brick, Moist Light Gravel (1 to 2½ ft.)			896.4	0	HA					9.9
		Fill: Used Cuttings Crushed Stone and Concrete, Light Gray, Very Dense Heavy Drilling (2½ to 4 ft.)			894.9	1	SS	50/½"				50.1
5		Lean Clay (CL), Light Gray mottled Yellow Brown, Silty, Medium, Moist  (CL), Stiff, Moist	0.50	93.3	888.9	2	SS	6	0.78			29.1
			1.50			3	SS	9				24.0
10		Fat Clay (CH), Light Gray mottled Yellow Brown, Stiff, Moist  (CH), Black Oxidation, Stiff, Moist	1.25		882.4	4	SS	9				24.5
			2.75			5	SS	13				21.2
15		(CH), Stiff, Moist	2.00		16.5	6	SS	11				22.4
		End of Boring @ 16½ Ft.										

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/22/2022

Boring Completed: 7/22/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ 1 Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B30

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			898.9						
		Topsoil (6")			898.4						
		Lean Clay (CL), Light Brown, Moist			0.5	0	HA				14.0
		(CL), Mottled Reddish Brown, Stiff, Moist	1.50			1	SS	10			23.0
5		(CL), Light Gray mottled Yellow Brown, Silty, Medium, Moist	1.00			2	SS	8			24.0
		Fat Clay (CH), Light Gray mottled Yellow Brown, Stiff, Moist	1.00	100.8	891.4	3	SS	9	1.57		23.4
10		(CH), Medium, Moist	1.50		7.5	4	SS	7			23.6
		(CH), Mottled Reddish Brown, Stiff, Moist	2.25			5	SS	12			19.9
15		(CH), Stiff, Moist	2.00			6	SS	11			22.6
		End of Boring @ 16½ Ft.			882.4						
					16.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/22/2022

Boring Completed: 7/22/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling:  $\nabla$

Groundwater Elev. @ Comp.:  $\nabla$

Groundwater Elev. @ 0.5 Hrs.:  $\nabla$

Boring Location: See Location Sketch

**APPENDIX G**  
**BORING LOGS-ATHLETIC**  
**TRACK/FIELD AND IMPROVEMENTS**

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B7

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			889.9						
		Topsoil (±4")									
		Lean Clay (CL), Yellow Brown, Silty, Stiff, Moist	0.75	106.4		1	SS	6	1.67		20.0
		(CL), Mottled Light Gray, Stiff, Moist				2	SS	8			20.0
5		Fat Clay (CH), Light Gray mottled Yellow Brown, Medium, Moist	1.00		884.9 5.0	3	SS	7			26.2
		End of Boring @ 6½ Ft.			883.4 6.5						

Drill Method: 3 1/4" HSA with AW Rod  
 Boring Started: 7/19/2022  
 Boring Completed: 7/19/2022  
 Tested By: AJK/BRH/DJS/DAW/NPP  
 Logging By: BRH



Groundwater Elev. During Drilling:  $\nabla$   
 Groundwater Elev. @ Comp.:  $\nabla$   
 Groundwater Elev. @ Hrs.:  $\nabla$   
 Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B8

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp —●— WI	
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.			
0		Ground Surface			889.5							
		Crushed Stone (±8")			888.8							
		Lean Clay (CL), Light Gray mottled Yellow Brown, Silty, Stiff, Moist	1.25	103.3	0.7	1	SS	12	1.57		12	20.1
		(CL), Light Brown mottled Light Gray, Silty, Stiff, Moist	2.50			2	SS	12			12	18.5
5		Fat Clay (CH), Light Brown mottled Light Gray, Silty, Stiff, Moist	1.25		884.5	3	SS	10			10	24.6
		End of Boring @ 6½ Ft.			5.0							
					883.0							
					6.5							

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/19/2022

Boring Completed: 7/19/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ∇

Groundwater Elev. @ Comp.: ∇

Groundwater Elev. @ Hrs.: ∇

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom  
Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B9

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			889.8						
		Crushed Stone (±7")			889.2						
		Lean Clay (CL), Light Gray mottled Yellow Brown, Silty, Stiff, Moist	0.75	90.3	0.6	1	SS	7	1.45		26.8
		(CL), Silty, Stiff, Moist	1.25			2	SS	8			22.4
5		Fat Clay (CH), Light Gray mottled Yellow Brown, Silty, Stiff, Moist	2.00		884.8	3	SS	10			20.8
					5.0						
					883.3						
		End of Boring @ 6½ Ft.			6.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/19/2022

Boring Completed: 7/19/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B10

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			885.9						
		Topsoil (±5")									
		Lean Clay (CL), Light Gray mottled Yellow Brown, Silty, Medium, Moist	1.25	95.9		1	SS	7	0.73		21.5
		(CL), Silty, Stiff, Moist	1.00			2	SS	8			20.3
5		(CL), Light Gray mottled Yellow Brown, Black Oxidation, Silty, Medium, Moist	0.75			3	SS	7			22.7
		End of Boring @ 6½ Ft.			879.4 6.5						

Drill Method: 3 1/4" HSA with AW Rod  
 Boring Started: 7/19/2022  
 Boring Completed: 7/19/2022  
 Tested By: AJK/BRH/DJS/DAW/NPP  
 Logging By: BRH



Groundwater Elev. During Drilling: ∇  
 Groundwater Elev. @ Comp.: ∇  
 Groundwater Elev. @ Hrs.: ∇  
 Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B11

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp —●— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			885.7						
		Topsoil (±2")									
		Fat Clay (CH), Light Brown mottled Reddish Brown, Silty, Stiff, Moist	2.75			1	SS	9			20.5
		(CH), Light Gray mottled Yellow Brown, Silty, Stiff, Moist	2.00	94.2		2	SS	10	1.33		23.4
5		Lean Clay (CL), Light Gray mottled Yellow Brown, Silty, Stiff, Moist	1.00		880.7 5.0	3	SS	8			20.6
		End of Boring @ 6½ Ft.			879.2 6.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/19/2022

Boring Completed: 7/19/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ∇

Groundwater Elev. @ Comp.: ∇

Groundwater Elev. @ Hrs.: ∇

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B12

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			883.3						
		Topsoil (±7")			882.7						
		Lean Clay (CL), Light Brown mottled Reddish Brown, Stiff, Moist			0.6	1	SS	14			
		Fat Clay (CH), Light Gray mottled Yellow Brown, Black Oxidation, Stiff, Moist	2.00		880.8	2	SS	9			
5		(CH), Stiff, Moist			2.5						
			1.75		876.8	3	SS	8			
		End of Boring @ 6½ Ft.			6.5						

Drill Method: 3 1/4" HSA with AW Rod  
 Boring Started: 7/19/2022  
 Boring Completed: 7/19/2022  
 Tested By: AJK/BRH/DJS/DAW/NPP  
 Logging By: BRH



Groundwater Elev. During Drilling:  $\nabla$   
 Groundwater Elev. @ Comp.:  $\nabla$   
 Groundwater Elev. @ Hrs.:  $\nabla$   
 Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B13

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp  -----  WI	
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.			
0		Ground Surface			890.8							
		Crushed Stone (±8")			890.1							
		Fat Clay (CH), Brown mottled Light Brown, Silty, Moist			0.7	0	HA					23.6
		Lean Clay (CL), Light Gray mottled Yellow Brown, Silty, Stiff, Moist	1.00	105.9	888.3	1	SS	9	1.64			20.2
5		(CL), Black Oxidation, Silty, Stiff, Moist	1.75		2.5	2	SS	9				23.2
		Fat Clay (CH), Light Gray mottled Yellow Brown, Medium, Moist	2.00	104.6	883.3	3	ST		0.72			22.9
10		(CH), Stiff, Moist	2.25		7.5	4	SS	11				22.8
		(CH), Stiff, Moist	2.00			5	SS	12				22.5
15		(CH), Black Oxidation, Stiff, Moist	1.75			6	SS	10				23.4
		End of Boring @ 16½ Ft.			874.3							
					16.5							

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/21/2022

Boring Completed: 7/21/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B14

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp  -----  WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			890.0						
		Topsoil (±6")			889.5						
		Lean Clay (CL), Light Gray mottled Reddish Brown, Black Oxidation, Silty, Medium, Moist	0.75	89.4	0.5	1	SS	5	0.82	5	27.4
		(CL), Yellow Brown mottled Light Gray, Silty, Medium, Moist	0.50	92.3		2	SS	8	0.93	8	23.7
5		(CL), Silty, Very Stiff, Moist	1.50	105.7		3	ST		2.27		26.0
		Fat Clay (CH), Light Gray mottled Yellow Brown, Very Stiff, Moist	1.25	101.1	882.5	4	SS	9	2.10	9	23.9
10		(CH), Stiff, Moist	2.50		7.5	5	SS	11		11	20.5
		(CH), Stiff, Moist	2.00			6	SS	11		11	22.0
15		(CH), Stiff, Moist	2.25			7	SS	11		11	20.8
		End of Boring @ 16½ Ft.			873.5						
					16.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/21/2022

Boring Completed: 7/21/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B15

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp —●— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			889.2						
		Topsoil (±7")			888.6						
		Fat Clay (CH), Yellow Brown mottled Light Gray, Stiff, Moist	1.00		0.6	1	SS	8			29.1
		Lean Clay (CL), Light Gray mottled Yellow Brown, Silty, Stiff, Moist	1.00	94.0	2.5	2	SS	7	1.23		25.7
5		(CL), Silty, Very Stiff, Moist	1.75	107.9		3	ST		2.56		18.8
		Fat Clay (CH), Light Gray mottled Yellow Brown, Stiff, Moist	1.00		7.5	4	SS	8			26.9
10		(CH), Stiff, Moist	1.25			5	SS	8			22.2
		(CH), Stiff, Moist	2.00			6	SS	10			22.5
15		(CH), Trace Sand, Stiff, Moist	2.25			7	SS	11			22.8
		End of Boring @ 16½ Ft.			16.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/19/2022

Boring Completed: 7/19/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B16

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI	
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.			
0		Ground Surface			889.6							
		Crushed Stone (±8")			888.9							
		Fill: Lean Clay (CL), Light Gray mottled Brown, Silty, Moist			0.7	0	HA					22.6
		Fill: (CL), Light Greenish-Gray mottled Dark Gray, Medium, Moist	0.50	89.2		1	SS	3	0.59			30.8
5		Fill: (CL), Stiff, Moist				2	SS	8				25.7
		Lean Clay (CL), Light Gray mottled Yellow Brown, Silty, Very Stiff, Moist	1.25	105.0	882.1	3	SS	10	2.17			21.9
10		(CL), Silty, Very Stiff, Moist			7.5							
		Fat Clay (CH), Light Gray, Stiff, Moist	1.00		877.1	5	SS	10				22.1
15		(CH), Mottled Reddish Brown, Stiff, Moist			12.5							
		End of Boring @ 16½ Ft.	1.25		873.1	6	SS	11				23.6
					16.5							

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/21/2022

Boring Completed: 7/21/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B17

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			887.9						
		Topsoil (±7")			887.2						
		Lean Clay (CL), Light Brown, Silty, Moist			0.7	0	HA				15.6
		(CL), Light Gray mottled Yellow Brown, Silty, Medium, Moist	2.50			1	SS	7			22.2
5		(CL), mottled Light Brown/Reddish Brown, Stiff, Moist	1.75			2	SS	12			29.2
		(CL), Silty, Medium, Moist	0.75	99.8		3	SS	8	0.99		22.6
10		Fat Clay (CH), Light Gray mottled Reddish Brown, Stiff, Moist	2.00		877.9	4	ST	9			21.7
		(CH), Stiff, Moist	2.00		10.0	5	SS	12			20.4
15		(CH), Stiff, Moist	1.75			6	SS	10			21.7
		End of Boring @ 16½ Ft.			871.4						
					16.5						

Drill Method: 3 1/4" HSA with AW Rod  
 Boring Started: 7/19/2022  
 Boring Completed: 7/19/2022  
 Tested By: AJK/BRH/DJS/DAW/NPP  
 Logging By: BRH



Groundwater Elev. During Drilling: ▽  
 Groundwater Elev. @ Comp.: ▽  
 Groundwater Elev. @ 6 Hrs.: ▽  
 Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B18

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp   WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			885.5						
		Topsoil (±7")			884.9						
		Possible Fill: Fat Clay (CH), Light Brown, Silty, Moist			0.6	0	HA				
		Possible Fill: (CH), Light Gray mottled Reddish Brown, Hard, Moist	3.25	98.9		1	SS	14	6.02		
5		Possible Fill: (CH), Light Brown, Silty, Very Stiff, Moist				2	SS	17			
		Fat Clay (CH), Light Gray mottled Yellow Brown, Silty, Stiff, Moist	1.50	99.3		3	SS	9	1.69		
10		(CH), Stiff, Moist	2.00			4	SS	9			
		(CH), Stiff, Moist	2.25			5	SS	12			
15		(CH), Trace Sand, Stiff, Moist	3.00			6	SS	13			
		End of Boring @ 16½ Ft.			869.0 16.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/19/2022

Boring Completed: 7/19/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ 6.5 Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B19

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp —●— WI	
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.			
0		Ground Surface			887.8							
		Topsoil (±7")			887.2							
		Fill: Fat Clay (CH), Light Gray mottled Light Brown/Yellow Brown, Black Oxidation, Very Stiff, Moist	4.5+		0.6	1	SS	22				14.7
		Possible Fill: Fat Clay (CH), Light Gray mottled Yellow Brown, Hard, Moist	4.25	105.7	885.3	2	SS	11	5.25			18.7
5		Fat Clay (CH), Light Gray mottled Reddish Brown, Very Stiff, Moist	4.00			3	SS	15				19.9
		(CH), Mottled Yellow Brown, Stiff, Moist	3.00			4	SS	14				20.8
10		(CH), Stiff, Moist	2.25	102.4		5	SS	12	1.61			22.4
		(CH), Black Oxidation, Trace Sand, Stiff, Moist	1.75			6	SS	10				23.0
15		(CH), Trace Sand, Stiff, Moist	2.25			7	SS	12				19.5
		End of Boring @ 16½ Ft.			871.3							
					16.5							

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/21/2022

Boring Completed: 7/21/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B20

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp —●— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			889.7						
		Topsoil (±3")									
		Fat Clay (CH), Light Gray mottled Yellow Brown, Stiff, Moist	0.25			1	SS	11			20.3
		(CH), Medium, Moist	1.25			2	SS	6			21.0
5		(CH), Stiff, Moist	1.75	101.1		3	SS	9	1.87		24.3
		(CH), Reddish Brown Oxidation, Very Stiff, Moist	2.25	104.0		4	SS	13	2.66		21.7
10		(CH), Stiff, Moist	2.25			5	SS	13			22.2
		(CH), Stiff, Moist	2.25			6	SS	12			24.2
15		(CH), Light Gray, Black Oxidation, Stiff, Moist	1.50			7	SS	11			22.6
		End of Boring @ 16½ Ft.			873.2 16.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/21/2022

Boring Completed: 7/21/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B21

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp — WI	
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.			
0		Ground Surface			883.6							
		Topsoil (±7")			883.0							
		Fill: Lean Clay (CL), Light Brown mottled Yellow Brown, Silty, Very Stiff, Moist			0.6	1	SS	22				9.9
		Possible Fill: Fat Clay (CH), Light Gray mottled Yellow Brown, Hard, Moist	4.5+	110.3	881.1	2	SS	11	6.64			15.4
5		Fat Clay (CH), Light Gray, Stiff, Moist	3.50		2.5	3	SS	14				18.6
		(CH), Stiff, Moist	2.25	98.2		4	ST		1.99			27.8
10		(CH), Very Stiff, Moist	1.50	100.2		5	SS	8	2.10			25.5
		(CH), Mottled Yellow Brown, Stiff, Moist	1.75			6	SS	10				21.2
15		(CH), Light Gray, Trace Sand, Stiff, Moist	2.00			7	SS	9				20.2
		End of Boring @ 16½ Ft.			867.1							
					16.5							

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/19/2022

Boring Completed: 7/19/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ∇

Groundwater Elev. @ Comp.: ∇

Groundwater Elev. @ Hrs.: ∇

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B22

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp —●— WI	
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.			
0		Ground Surface			883.1							
		Topsoil (±7")			882.5							
		Lean Clay (CL), Light Brown mottled Reddish Brown, Stiff, Moist			0.6	1	SS	14				12.0
		Fat Clay (CH), Light Brown/Reddish Brown, Stiff, Moist	1.00	100.9	880.6	2	SS	7	1.64			22.3
		Lean Clay (CL), Light Gray mottled Yellow Brown, Silty, Stiff, Moist	0.75		879.1	3	SS	9				22.4
		Fat Clay (CH), Light Gray mottled Yellow Brown, Stiff, Moist	1.75	102.4	875.6	4	SS	10	1.73			23.1
		(CH), Trace Sand, Stiff, Moist	2.25		7.5	5	SS	11				20.9
		(CH), Trace Sand, Stiff, Moist	1.50			6	SS	10				24.3
		Lean Clay (CL), Yellow Brown mottled Light Gray, Trace Sand, Stiff, Moist			868.1	7	SS	9				18.5
		End of Boring @ 16½ Ft.			15.0							
					866.6							
					16.5							

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/19/2022

Boring Completed: 7/19/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: CME 55 (B-55)

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B23

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp   WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			885.8						
		Topsoil (±7")			885.2						
		Lean Clay (CL), Light Brown, Medium, Moist			0.6	1	SS	7			18.0
		(CL), Trace Sand, Medium, Moist				2	SS	4			30.6
5		Fat Clay (CH), Light Gray mottled Reddish Brown, Trace Sand, Stiff, Moist	0.50	96.5	880.8	3	SS	6	1.77		24.7
		(CH), Mottled Yellow Brown, Stiff, Moist	2.00		5.0	4	SS	10			22.7
10		(CH), Trace Sand, Medium, Moist	1.00	90.9		5	SS	7	0.78		32.2
		(CH), Trace Sand, Stiff, Moist	1.00			6	SS	8			21.8
15		Fat Clay with Sand (CH), Light Gray mottled Yellow Brown, Very Stiff, Moist	2.25		870.8	7	SS	15			16.3
					15.0						
		End of Boring @ 16½ Ft.			869.3						
					16.5						

Drill Method: 3 1/4" HSA with AW Rod

Boring Started: 7/19/2022

Boring Completed: 7/19/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: 3" Hand Auger

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B24

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp  -----  WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			888.8						
		Topsoil (±6")				1	HA				
		Lean Clay (CL), Light Brown, Silty, Moist (CL), Light Gray mottled Yellow Brown, Black Oxidation, Silty, Moist				2	HA				
2.5											19.7
		Fat Clay (CH), Light Gray mottled Yellow Brown, Trace Sand, Moist	1.25		884.8	3	ST				22.6
5		(CH), Moist			4.0	4	HA				25.3
		(CH), Moist				5	HA				22.7
7.5					880.8						
		End of Boring @ 8 Ft.			8.0						
10											
12.5											
15											

Drill Method: Hand Auger

Boring Started: 7/18/2022

Boring Completed: 7/18/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: 3" Hand Auger

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B25

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp  -----  WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0		Ground Surface			889.1						
		Topsoil (±4")				1	HA				24.7
		Fat Clay (CH), Brown, Silty, Moist				2	ST				23.2
		(CH), Light Brown mottled Reddish Brown, Moist	4.5+								70
2.5		(CH), Light Gray mottled Yellow Brown, Silty, Moist				3	HA				20.3
5		(CH), Moist				4	HA				22.6
7.5		End of Boring @ 8 Ft.			881.1 8.0						
10											
12.5											
15											

Drill Method: Hand Auger

Boring Started: 7/18/2022

Boring Completed: 7/18/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: ▽

Groundwater Elev. @ Comp.: ▽

Groundwater Elev. @ Hrs.: ▽

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: 3" Hand Auger

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B26

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI			
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.					
0		Ground Surface	0.50		888.8									
		Topsoil (±4") Possible Fill: Fat Clay (CH), Light Brown mottled Light Gray, Silty, Moist						1	HA				17.3	
2.5		Possible Fill: (CH), Light Gray mottled Light Brown, Moist						2	ST				26.8	66
		Fat Clay (CH), Light Brown mottled Yellow Brown, Silty, Moist						3	HA				21.3	
		(CH), Light Brown/Reddish Brown mottled Light Gray, Moist						4	HA				33.3	
5		Lean Clay (CL), Light Gray mottled Yellow Brown, Silty, Wet					883.6 5.2	5	HA				21.6	
7.5	(CL), Silty				6	HA				23.0				
8.3		End of Boring @ 8.3 Ft.			880.6 8.3									

Drill Method: Hand Auger

Boring Started: 7/18/2022

Boring Completed: 7/18/2022

Tested By: AJK/BRH/DJS/DAW/NPP

Logging By: BRH



Groundwater Elev. During Drilling: 881.8

Groundwater Elev. @ Comp.: 881.0

Groundwater Elev. @ Hrs.: 881.0

Boring Location: See Location Sketch

Project No.: 21-5052

# Boring Log

Rig: 3" Hand Auger

Project: Hallsville Middle School Classroom Athletic Track/Field and Improvements

Location: Hallsville, MO

Client: Hallsville R-IV School District

Driller: AJK

Boring No.: B27

SUBSURFACE PROFILE						SAMPLE				Standard Penetration Test blows/ft.	Water Content % Wp ——— WI
Depth (ft.)	Symbol	Description	Qp, t.s.f.	Dry Density, P.C.F.	Depth/Elev.	Number	Type	Blows/ft.	Qu, T.S.F.		
0	[Diagonal Hatching]	Ground Surface Topsoil (±4") Lean Clay (CL), Light Brown mottled Light Gray, Silty, Moist	0.75		889.1	1	HA				18.1
2.5		(CL), Black Oxidation, Moist			885.9 3.3	2	HA			23.3	
5	[Diagonal Hatching]	Fat Clay (CH), Light Gray mottled Yellow Brown, Silty, Moist (CH), Wet			883.8 5.3	3	HA			28.3	
5						4	ST			35.0	
7.5	[Diagonal Hatching]	Lean Clay (CL), Light Gray mottled Yellow Brown, Silty			880.9 8.2	5	HA			25.8	
8.2		End of Boring @ 8.2 Ft.									

Drill Method: **Hand Auger**  
 Boring Started: **7/18/2022**  
 Boring Completed: **7/18/2022**  
 Tested By: **AJK/BRH/DJS/DAW/NPP**  
 Logging By: **BRH**



Groundwater Elev. During Drilling: **▽ 884.9**  
 Groundwater Elev. @ Comp.: **▽**  
 Groundwater Elev. @ Hrs.: **▽**  
 Boring Location: **See Location Sketch**

**SECTION 031000**  
**CONCRETE FORMS AND ACCESSORIES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Formwork for cast-in place concrete.
  - 2. Shoring, bracing, and anchorage.
  - 3. Form accessories.
  - 4. Form stripping.
  
- B. Related Sections:
  - 1. Section 032000 - Concrete Reinforcing.
  - 2. Section 033000 - Cast-In-Place Concrete.

1.2 SYSTEM DESCRIPTION

- A. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 318 to conform to design and International Building Code requirements.
  
- B. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96.

1.3 REFERENCES

- A. American Concrete Institute:
  - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
  - 2. ACI 301 - Specifications for Structural Concrete.
  - 3. ACI 318 - Building Code Requirements for Structural Concrete.
  - 4. ACI 347 - Guide to Formwork for Concrete.
  
- B. American Forest and Paper Association:
  - 1. AF&PA - National Design Specifications for Wood Construction.
  
- C. The Engineered Wood Association:
  - 1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
  
- D. American Society of Mechanical Engineers:
  - 1. ASME A17.1 - Safety Code for Elevators and Escalators.
  
- E. ASTM International:

1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
2. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

F. West Coast Lumber Inspection Bureau:

1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.4 SUBMITTALS

- A. Manufacturer and type of void forms including compressive strengths.

1.5 QUALITY ASSURANCE

- A. Perform Work according to ACI 347, ACI 318 and ACI 301
- B. For wood products, comply with ANSI/AF&PA National Design Specification (NDS).

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver void forms and installation instructions in manufacturer's packaging.
- B. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.7 COORDINATION

- A. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

**PART 2 - PRODUCTS**

2.1 MATERIALS

- A. Forms for Surfaces Exposed to View:

1. Wood forms:

- a. New 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
- b. Built-in-place or prefabricated type panel.
- c. 4 x 8 FT sheets for built-in-place type except where smaller pieces will cover entire 40 area.
- d. When approved, plywood may be reused.

2. Metal forms:

- a. Metal forms excluding aluminum may be used.

3. Forms to be tight to prevent leakage, free of rust and straight without dents to provide 45 members of uniform thickness.

B. Forms for Surfaces Not Exposed to View:

1. Wood or metal sufficiently tight to prevent leakage.
2. Do not use aluminum forms.

C. Or as approved by Engineer.

## 2.2 PREFABRICATED FORMS

- A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
- C. Pan Type: Steel or Glass fiber and of size and profile required.
- D. Tubular Column Type: Round, spirally wound laminated fiber, wood, or glass fiber material, surface treated with release agent, non-reusable.
- E. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set.
- F. Steel Forms: Sheet steel, suitably reinforced, and designed for particular use indicated on Drawings.
- G. Framing, Studding and Bracing: Stud or No. 3 structural light framing grade.

## 2.3 FORMWORK ACCESSORIES

- A. Form Ties: Removable or Snap-off type, galvanized metal, fixed or adjustable length, free of defects capable of leaving holes larger than 1 inch in concrete surface.
- B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face. Wire ties, wood spreaders or through-bolts not permitted.
- C. Form Anchors and Hangers:
  1. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.
  2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
  3. Penetration of structural steel members is not permitted.
- D. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.
- E. Corners: Chamfer, rigid plastic or wood strip type; 3/4 x 3/4 inch size; maximum possible lengths.

- F. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, release tape sealed slots, anchors for securing to concrete formwork.
- G. Flashing Reglets: Galvanized steel or Rigid PVC, 22 gage thick, longest possible lengths, with alignment splines for joints, release tape sealed slots, anchors for securing to concrete formwork.
- H. Vapor Retarder: Where indicated on Drawings, 8 mil thick polyethylene sheet.
- I. Bituminous Joint Filler: ASTM D1751.
- J. Nails, Spikes, Lag Bolts, Through-bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.

## 2.4 COATINGS

- A. Coatings for Aluminum: Polyamide epoxy finish coat with paint manufacturer's recommended primer for aluminum substrate. Apply one coat primer and one coat finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- B. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.

### 3.2 INSTALLATION

#### A. Formwork - General:

1. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
2. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
3. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
4. Complete wedging and bracing before placing concrete.

#### B. Forms for Smooth Finish Concrete:

1. Use steel, plywood or lined board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.

7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

C. Framing, Studding and Bracing:

1. Space studs at 16 inches o.c. maximum for boards and 12 inches on center maximum for plywood.
2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Construct beam soffits of material minimum of 2 inches thick.
4. Distribute bracing loads over base area on which bracing is erected.
5. When placed on ground, protect against undermining, settlement or accidental impact.

D. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301 and ACI 318.

E. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

F. Obtain Engineer's approval before framing openings in structural members not indicated on Drawings.

G. Install chamfer strips on exposed corners.

H. Install void forms in accordance with manufacturer's recommendations.

I. Do not patch formwork.

### 3.3 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish." Apply form coatings before placing reinforcing steel.

### 3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Install formed openings for items to be embedded in or passing through concrete Work.

B. Locate and set in place items required to be cast directly into concrete.

C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

- D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- G. Form Ties:
  - 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
  - 2. Place ties at least 1 inch away from finished surface of concrete.
  - 3. Leave inner rods in concrete when forms are stripped.
  - 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- H. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- I. Construction Joints:
  - 1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
  - 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
  - 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
  - 4. Arrange joints in continuous line straight, true and sharp.
- J. Embedded Items:
  - 1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
  - 2. Do not embed wood or uncoated aluminum in concrete.
  - 3. Obtain installation and setting information for embedded items furnished under other Specification sections.
  - 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
  - 5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.
- K. Openings for Items Passing Through Concrete:
  - 1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
  - 2. Coordinate work to avoid cutting and patching of concrete after placement.
  - 3. Perform cutting and repairing of concrete required as result of failure to provide required openings.
- L. Screeds:
  - 1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
  - 2. Slope slabs to drain where required or as indicated on Drawings.

3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

M. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not permitted.

N. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

### 3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

### 3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Architect/Engineer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Leave forms in place for minimum number of days as specified in ACI 347.

### 3.7 FORMWORK

A. Cleaning:

1. Clean forms as erection proceeds.
2. Clean formed cavities of debris.
3. Flush with water or use compressed air.
4. During cold weather:

- a. Remove ice and snow from within forms.
- b. Do not use de-icing salts.
- c. Do not use water
- d. Use compressed air to remove foreign matter.

B. Removal:

1. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
2. Loosen forms carefully. Do not wedge tools against finish concrete surfaces.
3. Leave forms in place for minimum number of days according to ACI 347.

### 3.8 ERECTION TOLERANCES

- A. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances according to ACI 117.
- B. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 301.

### 3.9 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing and inspecting agency to perform field special structural inspections and testing in accordance with the applicable International Building Code and to submit reports.
- B. Inspect erected formwork, shoring, and bracing to ensure that Work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- C. Notify Engineer after placement of reinforcing steel in forms, but prior to placing concrete.
- D. Schedule concrete placement to permit formwork inspection before placing concrete.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or corrective work.

END OF SECTION 031000

## SECTION 032000 CONCRETE REINFORCING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Work includes

1. Provide complete, in place, all concrete reinforcement required for all cast-in-place concrete work for the project, as shown or noted on the drawings and as specified herein.

##### B. Related work

1. Specified elsewhere
  - a. Concrete forming specified in Section 031100.
  - b. Concrete accessories specified in Section 031500.
  - c. Cast-in-place concrete specified in Section 033000.

#### 1.2 SUBMITTALS

##### A. Shop drawings

1. Submit for Architect's approval:
  - a. Complete fabrication and layout drawings covering all details of concrete reinforcement, including bar schedules, stirrup spacing, diagrams of bent bars, and arrangements and assemblies.
2. Detail shop drawings in accordance with ACI 315.

#### 1.3 QUALITY ASSURANCE

##### A. Standards

1. Any procedure, material, or operation specified by reference to the following standards, specifications, or codes shall comply with the current or most recent issue.
2. Work of this section shall comply with all pertinent provisions of the following:
  - a. American Society for Testing and Materials (ASTM) Specifications as listed elsewhere for various materials required.
  - b. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice".
  - c. American Concrete Institute (ACI) ACI 318.

#### 1.4 PRODUCT HANDLING

- A. Deliver reinforcement to job site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on shop drawings.

- B. Store reinforcement at job site in a manner to prevent damage and accumulation of dirt and excessive rust.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Bar Reinforcing - ASTM A 615, Grade 60, sizes as detailed or noted on the drawings.
  - 1. Mat fabrication - ASTM A 184.
- B. Steel Wire - ASTM A 82.
- C. Mesh reinforcing - ASTM A 185, Welded Steel Wire Fabric, sizes and weights as detailed or noted on the drawings.
- D. Supports for Reinforcement - Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place:
  - 1. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated on the drawings.
  - 2. Do not use wood, brick, or other unacceptable materials.
  - 3. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
  - 4. For exposed to view concrete surfaces, where legs of supports are in contact with forms, provide supports with either hot-dipped galvanized or plastic protected legs.

### **2.2 FABRICATION**

- A. General - Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI Manual. In case of fabrication errors, do not straighten bars in a manner that will injure or weaken the material.
- B. Bars shall be bent cold. Bend & hooks shall conform to ACI 318.
- C. Unacceptable materials - reinforcement with any of the following defects will not be permitted in the work:
  - 1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
  - 2. Bends or kinks not indicated on drawings or final shop drawings.
  - 3. Bars with reduced cross-section due to excessive rusting or other cause.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed. Do not proceed with the work until all unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General - Comply with the specified standards for details and methods of reinforcement placement and supports, and as herein specified.
- B. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
  - 1. At time concrete is placed, metal reinforcement shall be free from rust, scale, oil, grease, dirt or other foreign material.
- C. Reinforcement shall be accurately positioned and firmly secured against displacement.
  - 1. Arrange, space, and securely tie bars and bar supports together to hold accurately in position during concrete operation.
    - a. Wire tie or clip at all intersections.
  - 2. Provide spacers, support bars, chairs and bolsters in accordance with CRSI-75. All such items in areas of exposed concrete shall be galvanized or plastic covered.
- D. During placement of concrete the position and condition of all reinforcement shall be constantly monitored by qualified workmen to assure compliance with specified clearances.
- E. Clearances (face of concrete to near edge of rebar):
  - 1. Footings: 3 inches.
  - 2. Walls: 1-1/2 inches.
  - 3. Beams & Columns: 1-1/2 inches.
  - 4. Slabs on Grade: Center of slab unless noted otherwise on drawings.
  - 5. Backfill surfaces: 2 inches.

END OF SECTION 032000

**SECTION 033000**  
**CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes cast-in-place concrete for the following:
1. Foundations.
  2. Slabs on grade.
  3. Control, expansion and contraction joint devices.
  4. Other items as indicated on drawings.
- B. Related Sections:
1. Section 031000 - Concrete Forming and Accessories
  2. Section 032000 - Concrete Reinforcing.

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 305 - Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 308.1 - Standard Specification for Curing Concrete.
5. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
6. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
7. ASTM C150 - Standard Specification for Portland Cement.
8. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
9. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
10. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
11. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
12. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
13. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
14. ASTM C595 - Standard Specification for Blended Hydraulic Cements.

15. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
16. ASTM C685 - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
17. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
18. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
19. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
20. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
21. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
22. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
23. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
24. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
25. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
26. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
27. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
28. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
29. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
30. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
31. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
32. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
33. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

### 1.3 SUBMITTALS

- A. Product Data: Submit data on joint devices, attachment accessories and admixtures.
- B. Design Data:
  1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
    - a. Hot and cold weather concrete work.
    - b. Air entrained concrete work.
  2. Identify mix ingredients and proportions, including admixtures.
  3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.
- C. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

1.4 QUALITY ASSURANCE.

- A. Perform Work in accordance with ACI 301 and ACI 318.
- B. Conform to ACI 305 when concreting during hot weather.
- C. Conform to ACI 306.1 when concreting during cold weather.
- D. Acquire cement and aggregate from one source for Work.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.
- B. Maintain high early strength concrete temperature after installation at minimum 50 degrees F for minimum 3 days.

1.6 COORDINATION

- A. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

**PART 2 - PRODUCTS**

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C150; Portland Type: **Type I - Normal, Type IA - Air Entraining**
- B. Normal Weight Aggregates: ASTM C33.
  - 1. Coarse Aggregate Maximum Size: 3/4 inches, In accordance with ACI 318.
- C. Water: ACI 318; potable, without deleterious amounts of chloride ions.

2.2 ADMIXTURES

- A. Air Entrainment: ASTM C260.
- B. Chemical: ASTM C494.
  - 1. Type A - Water Reducing.
  - 2. Type B - Retarding.
  - 3. Type C - Accelerating.
  - 4. Type D - Water Reducing and Retarding.
  - 5. Type E - Water Reducing and Accelerating.
  - 6. Type F - Water Reducing, High Range.
  - 7. Type G - Water Reducing, High Range and Retarding.
- C. Fly Ash: ASTM C618 Class C or F.

- D. Silica Fume: ASTM C1240
- E. Slag: ASTM C989; ground granulated blast furnace slag
- F. Plasticizing: ASTM C1017/C1017M.
  - 1. Type I, plasticizing.
  - 2. Type II, plasticizing and retarding.

2.3 ACCESSORIES

- A. Bonding Agent:
  - 1. Manufactures:
    - a. Sika – Sikadur 32 High-Mod.
    - b. Euclid – Duralbond.
    - c. Substitutions: Permitted upon approval of Engineer
- B. Vapor Retarder: ASTM E1745 Class A 15 vapor barrier; type recommended for below grade application. Furnish joint tape recommended by manufacturer.
  - 1. Manufactures:
    - a. Stego Industries, LLC, Stego Wrap Vapor Barrier.
    - b. Substitutions: Permitted upon approval of Engineer
    - c. W.R. Meadows Perminator – 15 mil.
    - d. Poly-America Husky Yellow Guard – 15 mil.
- C. Non-Shrink Grout: ASTM C1107/C1107M; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.4 JOINT DEVICES AND FILLER MATERIALS

- A. Joint Filler Type A: ASTM D1751 or ASTM D994; Asphalt impregnated fiberboard or felt, 1/4 inch thick; tongue and groove profile.
- B. Joint Filler Type B: ASTM D1752; recycled PVC.
- C. Joint Filler Type C: ASTM D1752; Premolded sponge rubber.

2.5 CONCRETE MIX

- A. Provide concrete to the following criteria for interior concrete:

Material and Property	Measurement
Compressive Strength (7 day)	3000 psi
Compressive Strength (28 day)	4000 psi

Cement Type	<b>ASTM C150</b>
Aggregate Type	<b>Normal weight</b>
Min. Cementitious Content	564 lb/cu yd
Water-Cement Ratio (maximum)	0.45 by weight
Aggregate Size (maximum)	3/4 inch
Aggregate Size (minimum)	1/2 inch
Air Content	0 to 3 percent entrapped
Fly Ash Content:	20 percent of cementitious materials by weight, maximum
Slump	<b>4 inches plus or minus 1 inch</b>

B. Provide concrete to the following criteria for concrete exposed to weather:

Material and Property	Measurement
Compressive Strength (7 day)	3000 psi
Compressive Strength (28 day)	4000 psi
Cement Type	<b>ASTM C150</b>
Aggregate Type	<b>Normal weight</b>
Min. Cementitious Content	564 lb/cu yd
Water-Cement Ratio (maximum)	0.45 by weight
Aggregate Size (maximum)	3/4 inch
Aggregate Size (minimum)	1/2 inch
Air Content	6 percent plus or minus 1.5 percent
Fly Ash Content:	20 percent of cementitious materials by weight, maximum
Slump	<b>4 inches plus or minus 1 inch</b>

C. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer.

1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
2. Do not use calcium chloride nor admixtures containing calcium chloride.
3. Use set retarding admixtures during hot weather.
4. Add air entrainment admixture to concrete mix for work exposed to freezing and thawing or deicing chemicals

D. Average Compressive Strength Reduction: Not permitted.

- E. Ready Mixed Concrete: Mix and deliver concrete in accordance with ASTM C94 and ASTM C685.
- F. Site Mixed Concrete: Mix concrete in accordance with ACI 318.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify requirements for concrete cover over reinforcement.
- B. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

#### **3.2 PREPARATION**

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.
- E. Concrete can be place under water using tremie as approved by engineer.

#### **3.3 PLACING CONCRETE**

- A. Place concrete in accordance with ACI 301 and ACI 318.
- B. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and are not disturbed during concrete placement.
- D. Install vapor retarder under interior slabs on grade in accordance with ASTM E1643; place sheets in position with longest dimension parallel with direction of pour.
  - 1. Level and compact base material.
  - 2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments (such as dowels, water-stops, or any other site condition requiring early termination of the vapor barrier). At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.
  - 3. Lap joints minimum 6 inches and seal watertight by taping edges and ends.
  - 4. Apply seam tape to a clean and dry vapor barrier.
  - 5. Seal all penetrations (including pipes) per manufacturer's instructions.
  - 6. Avoid the use of non-permanent stakes driven through vapor retarder.

7. If non-permanent stakes are driven through vapor retarder, repair as recommended by vapor retarder manufacturer.
  8. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material of similar (or better) permeance, puncture, and tensile; lap over damaged areas minimum 6 inches and seal watertight.
- E. Separate slabs on grade from vertical surfaces with 1/2 inch thick joint filler unless otherwise shown on drawings.
  - F. Deposit concrete at final position. Prevent segregation of mix.
  - G. Place concrete in continuous operation for each panel or section determined by predetermined joints.
  - H. Consolidate concrete.
  - I. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
  - J. Place concrete continuously between predetermined expansion, control, and construction joints.
  - K. Do not interrupt successive placement; do not permit cold joints to occur.
  - L. Place floor slabs in saw cut pattern indicated.
  - M. Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.
  - N. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/8 inch in 10 ft.
  - O. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/8 inch per foot nominal unless otherwise indicated on drawings. Areas that have floor drains shall not be required to meet the levelness tests.
- 3.4 SEPARATE FLOOR TOPPINGS
- A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.
  - B. Place required reinforcing and other items to be cast in.
  - C. Apply bonding agent to substrate.
  - D. Place concrete floor toppings to required lines and levels.
  - E. Screed toppings level, maintaining surface flatness maximum 1/8 inch in 10 ft.
- 3.5 CONCRETE FINISHING
- A. Provide formed concrete surfaces as follows:

1. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
    - a. Apply to concrete surfaces not exposed to public view.
  2. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
    - a. Apply to concrete surfaces exposed to public view.
  3. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- B. Finish concrete floor surfaces in accordance with ACI 301 and ACI 311].
- C. Wood float surfaces receiving quarry tile, ceramic tile or terrazzo with full bed setting system.
- D. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set quarry tile or thin set ceramic tile.
- E. Steel trowel surfaces which are indicated to be exposed.

### 3.6 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Protect concrete footings from freezing for minimum 5 days.
- C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- D. Cure concrete in accordance with ACI 308.1.
- E. Cure floor surfaces in accordance with ACI 301 and ACI 318.

### 3.7 FIELD QUALITY CONTROL

- A. **Owner** shall engage a qualified testing and inspecting agency to perform field special structural inspections and testing in accordance with the applicable International Building Code and to submit reports.
- B. The contractor shall be responsible for scheduling the tests. The contractor shall be required to notify the owner's representative a minimum of 48 hours prior to all placement of concrete.
- C. Provide free access to Work and cooperate with appointed firm.
- D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.

E. Concrete Inspections:

1. Periodic Placement Inspection: Inspect for proper installation procedures.
2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.

F. Strength Test Samples:

1. Sampling Procedures: ASTM C172.
2. Cylinder Molding and Curing Procedures: ASTM C31, cylinder specimens, standard cured.
3. Sample concrete and make one set of four cylinders for every 50 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area for slabs and walls.
4. When volume of concrete for any class of concrete would provide less than 5 sets of cylinders, take samples from five randomly selected batches, or from every batch when less than 5 batches are used.
5. Make one additional cylinder during cold weather concreting, and field cure.

G. Field Testing:

1. Slump Test Method: ASTM C143.
2. Air Content Test Method: ASTM C173 for normal weight concrete, ASTM C231 for lightweight concrete.
3. Temperature Test Method: ASTM C1064.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

H. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39.
2. Test Acceptance: In accordance with ACI 318.
3. Test one cylinder at 7 days.
4. Test two cylinders at 28 days.
5. Retain one cylinder for 56 days for testing when requested by Engineer.
6. Dispose remaining cylinders when testing is not required.

I. Core Compressive Strength Testing:

1. Sampling and Testing Procedures: ASTM C42.
2. Test Acceptance: In accordance with ACI 318.
3. Drill three cores for each failed strength test from concrete represented by failed strength test.

J. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

### 3.8 PATCHING

- A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

- C. Patch imperfections as directed by Engineer and in accordance with ACI 301 and ACI 318.

### 3.9 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or corrective work.

END OF SECTION 033000

## SECTION 079200 JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
  - 1. Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 2. Exterior joints in horizontal traffic surfaces.
  - 3. Interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 4. Interior joints in horizontal traffic surfaces.
- B. See Division 32 Section "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.
- C. See Division 08 Section "Glazing" for glazing sealants.

#### 1.2 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Preconstruction field test reports.
- D. Compatibility and adhesion test reports.
- E. Product test reports.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

#### 1.4 QUALITY ASSURANCE

- A. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

- B. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 and in accordance with manufacturer's field adhesion test procedure (see Section 1.5.B); each that is appropriate for the types of Project joints.
- C. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
  - 1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

## 1.5 WARRANTY

- A. Special installer's warranty for sealant installed at exterior side of precast concrete wall panel joints: 5 years period from date of Substantial Completion.
- B. Special manufacturer's warranty for sealant installed exterior side of precast concrete wall panel joints: 20 years from date of Substantial Completion (upon documentation of field adhesion tests as per the manufacturers field adhesion test procedure).
- C. Special Installer's Warranty for other sealants: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 2 years from date of Substantial Completion.
- D. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

### 2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

## 2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- D. Single-Component Neutral and Basic-Curing Silicone Sealant:
  1. Products:
    - a. Dow Corning Corporation; 790.
    - b. Tremco; Spectrem 1.
    - c. Pecora Corporation; 890.
    - d. GE Silicones; SilPruf NB SCS9000 NB.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 100/50.
  4. Use Related to Exposure: NT (nontraffic).
  5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
  6. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.
- E. Single-Component Neutral-Curing Silicone Sealant:
  1. Products:
    - a. Dow Corning Corporation; 799.
    - b. GE Silicones; UltraGlaze SSG4000.
    - c. GE Silicones; UltraGlaze SSG4000AC.
    - d. Tremco; Proglaze SG.
    - e. Tremco; Spectrem 2.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 25.
  4. Use Related to Exposure: NT (nontraffic).
  5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
- F. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:
  1. Products:

- a. Pecora Corporation; 898.
    - b. Tremco; Tremsil 600 White.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 25.
  4. Use Related to Exposure: NT (nontraffic).
  5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
- G. Single-Component Nonsag Urethane Sealant:
  1. Products:
    - a. Sika Corporation, Inc.; Sikaflex - 1a.
    - b. Sonneborn, Division of ChemRex Inc.; Ultra.
    - c. Sonneborn, Division of ChemRex Inc.; NP 1.
    - d. Tremco; Vulkem 116.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 25.
  4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
  5. Uses Related to Joint Substrates: M, [G,] A, and, as applicable to joint substrates indicated, O.
- H. Single-Component Pourable Urethane Sealant:
  1. Products:
    - a. Sika Corporation, Inc.; Sikaflex - 1CSL.
    - b. Sonneborn, Division of ChemRex Inc.; SL 1.
    - c. Tremco; Vulkem Nova 300 SSL.
  2. Type and Grade: S (single component) and P (pourable).
  3. Class: 50.
  4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
  5. Uses Related to Joint Substrates: M, [G,] A, and, as applicable to joint substrates indicated, O.
- I. Single-Component Pourable Urethane Sealant:
  1. Products:
    - a. Bostik Findley; Chem-Calk 950.
    - b. Pecora Corporation; Urexpan NR-201.
    - c. Polymeric Systems Inc.; Flexiprene 952.
    - d. Schnee-Morehead, Inc.; Permathane SM7101.
    - e. Tremco; Tremflex S/L.
    - f. Tremco; Vulkem 45.
  2. Type and Grade: S (single component) and P (pourable).
  3. Class: 25.
  4. Use Related to Exposure: T (traffic).
  5. Uses Related to Joint Substrates: M, [G,] A, and, as applicable to joint substrates indicated, O.

## 2.4 LATEX JOINT SEALANTS

- A. Latex Sealant: Comply with ASTM C 834, Type O P, Grade NF.
- B. Products:
  - 1. Pecora Corporation; AC-20+.
  - 2. Schnee-Morehead, Inc.; SM 8200.
  - 3. Sonneborn, Division of ChemRex Inc.; Sonolac.
  - 4. Tremco; Tremflex 834.

## 2.5 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. Products:
    - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
    - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
    - c. Tremco; Tremco Acoustical Sealant
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
  - 1. Available Products:
    - a. Pecora Corporation; BA-98.
    - b. Tremco; Tremco Acoustical Sealant.

## 2.6 PREFORMED JOINT SEALANTS

- A. Preformed Silicone-Sealant System: Manufacturer's standard system consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.
  - 1. Products:
    - a. Dow Corning Corporation; 123 Silicone Seal.
    - b. GE Silicones; UltraSpan US1100.
    - c. Pecora Corporation; Sil-Span.
    - d. Tremco; Spectrem Ez Seal.
- B. Pre-Compressed Foam Sealants: Manufacturer's standard mildew-resistant, non-migratory, preformed, pre-compressed, open-cell foam sealant that is manufactured from high-density urethane foam impregnated with a nondrying, water-repellent agent. Custom size  $\frac{3}{4}$ " x 2" for precast concrete wall panel joints.
  - 1. Provide following product or equal product that meets specified performance criteria in this section:

a. EMSEAL Joint Systems, Ltd.; Backerseal

2. Pre-compressed sealant shall be pre-formed, pre-compressed, self-expanding, sealant system. Expanding foam to be cellular foam impregnated with a water-based, non-drying, polymer-modified 100% acrylic dispersion.
3. Material shall be capable of movements of +25%, -25% (50% total) of nominal material size.
4. At precast concrete joints, pre-compressed sealant to be installed in two layers as shown on drawings at depth sufficient to allow installation of properly sized backer rod and liquid sealant in front of material.
5. Pre-Compressed foam sealant must be supplied pre-compressed to less than the joint size, packaged in reels or shrink-wrapped lengths (sticks) with a mounting adhesive on one face, for ease of installation.

2.7 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C closed-cell material with a surface skin and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26°F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
    - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
  - 2. Remove laitance and form-release agents from concrete.
    - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### **3.2 INSTALLATION**

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
  
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
  
- G. Installation of Preformed Silicone-Sealant System: Comply with manufacturer's written instructions.
  
- H. Installation of Pre-Compressed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. Install in complete accordance with sealant manufacturer's written instructions. No drilling, or screwing, or fasteners of any type are permitted to anchor the system into the substrate.
  
- I. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior vertical and horizontal non-traffic construction joints in cast-in-place concrete.
  - 1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant.
  - 2. Joint-Sealant Color: Custom color as selected by Architect.
  
- B. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry.
  - 1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant.
  - 2. Joint-Sealant Color: Custom color as selected by Architect.
  
- C. Joint-Sealant Application: Exterior vertical joints between different materials listed above.
  - 1. Joint Sealant: Single-component neutral-curing silicone sealant] [Single-component neutral-curing silicone sealant.
  - 2. Joint-Sealant Color: Custom color as selected by Architect.
  
- D. Joint-Sealant Application: Exterior perimeter joints at frames of doors, windows and louvers.
  - 1. Joint Sealant: Single-component neutral-curing silicone sealant.

2. Joint-Sealant Color: Custom color as selected by Architect.
- E. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.
1. Joint Sealant: Single-component non-sag urethane sealant
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- F. Joint-Sealant Application: Interior perimeter joints of exterior openings.
1. Joint Sealant: Single-component non-sag urethane sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- G. Joint-Sealant Application: Interior ceramic tile expansion, control, contraction, and isolation joints in horizontal traffic surfaces.
1. Joint Sealant: Multicomponent non-sag urethane sealant, Multicomponent pourable urethane sealant or Single-component pourable urethane sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- H. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
1. Joint Sealant: Single-component mildew-resistant neutral-curing silicone sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- I. Joint-Sealant Application: Vertical joints on exposed surfaces of interior walls and partitions.
1. Joint Sealant: Multicomponent non-sag urethane sealant, Single-component non-sag urethane sealant or Latex sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- J. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors and windows.
1. Joint Sealant: Latex sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.
- K. Joint-Sealant Application: Interior control, expansion, and isolation joints in horizontal traffic surfaces.
1. Joint Sealant: Multicomponent non-sag urethane sealant, Multicomponent pourable urethane sealant or Single-component pourable urethane sealant.
  2. Joint-Sealant Color: From manufacturer's standard color chart.

END OF SECTION 079200

## SECTION 116600

### ATHLETIC EQUIPMENT/INFRASTRUCTURE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Design, Engineering and Construction required for all proposed equipment/infrastructure.
- B. Long Jump & Triple Jump Equipment/Infrastructure.
- C. Pole Vault Equipment/Infrastructure.
- D. High Jump Equipment/Infrastructure.
- E. Football field goal posts

##### 1.2 SUBMITTALS

- A. Submit manufacturer's product illustrations, data and literature that fully describes the equipment and accessories proposed for installation.
- B. Submit drawings illustrating the design and location of proposed improvements.

#### PART 2 - PRODUCTS

##### 2.1 QUALITY ASSURANCE

- A. In order to establish minimum quality requirements, products of certain manufacturers are listed. Products of other reputable manufacturers, which are equal in all respects to those listed, will be considered, subject to Owner's approval.
- B. Contractor shall employ only skilled workmen who are fully qualified and experienced in the required assembly and installation of each specific item or items.
  - 1. Where specified, installation of certain items shall be by an authorized distributor or representative of the manufacturer.

##### 2.2 GENERAL INSTALLATION REQUIREMENTS

- A. Refer to all drawings and drawing details applicable to each item. All items shall be installed in accordance with the applicable drawing details, approved shop drawings, and manufacturer's recommended installation or erection procedures.

##### 2.3 GOAL POSTS

- A. Goal Post to be Base Plate Mount High School Football Goal Posts with Accessories.

1. Acceptable Manufacturers:

Sportsfield Specialties, Inc.  
P.O. Box 231  
41155 State Highway 10  
Delhi, NY 13753  
p. 888-975-3343  
f. 607-746-8481  
[www.sportsfieldspecialties.com](http://www.sportsfieldspecialties.com)

2. Aluminum Athletic Equipment

1000 Enterprise Drive  
Royersford, PA 19468  
p. 800-523-5471  
[www.AAEsports.com](http://www.AAEsports.com)

3. Approved Equal

B. COMPONENTS:

1. Single Base Plate Mount Gooseneck Support: Fabricated of 6" Schedule 40 Aluminum Pipe (6.625" O.D.), 5' Radius, 8' Offset, Custom Offsets Available

2. Base Plate Mounting Kit

3. Crossbar: Fabricated of 6" Schedule 40 Aluminum Pipe (6.625" O.D.)

a. Length: 23'-4" – High School

b. Includes Patented AdjustRight® feature allowing for easy installation through the adjustment of an internal locking rotating sleeve at both the gooseneck/crossbar and upright/crossbar connections. This adjustment can easily be repeated throughout the life of the football goal post ensuring proper alignment of all components for years of competition and all with the added benefit of no exposed hardware on the face of the goal. Thermal arc sprayed internal textured mating surface and anti-vibration enhancements such as serrated washers and nyloc coated bolt ends ensure the AdjustRight® Football Goal Posts remain in position.

4. Uprights: Fabricated of Extruded 6061-T6 Aluminum Tube (4" O.D.) with Rigid Wire Loop Welded to Upper End

a. Length: 30'

5. Powder Coated Finish: Yellow or White- Owner to select color from manufacturer standard colors.

6. Installation Package Consisting of the Following Components:

a. Base Plate Mounting Kit

b. Access Frame Kit: 1/8" (0.125") Aluminum Construction with 1" PVC Drain Stub, Includes Two (2) Half Moon Filler Plugs, Optional Full Size Filler Plug and SG2S® Patented Soccer Goal Rear Bottom Ground Bar Retractable Safety Clamp System Available, Use GFAFIT for Synthetic Turf Installation Applications and GPAFNG for Natural Grass Installation Applications

7. Included Accessories:

a. Directional Wind Flags

b. Touch-up Paint (Powder Coat Finish Specific)

c. Model Specific Hardware Kit and Installation Instructions

- d. Football Goal Post Pads: 18 oz. Vinyl with Polyester Scrim and Vertically Sewn in Hook and Loop Securement, Standard 6' in Height, Various Standard Vinyl Colors Available, Custom Digitally Printed Lettering and/or Graphics per Owner direction.
  - 1. GPPR – Round, Fully Encased Vinyl 18" O.D. and 7" I.D. Polyurethane Foam Core
  - 2. GPPRDG – Custom Digitally Printed Graphics
  
- e. Football End Zone Pylons: Set of Four (4) Orange Vinyl Covered Foam Football End Zone Pylons with Self-Standing Weighted Bases, 18"H x 4"L x 4"W

### **PART 3 - EXECUTION**

#### **3.1 LONG JUMP/TRIPLE JUMP**

- A. Reinforced concrete curb jump pit perimeter with compacted aggregate base.
- B. Jump pit minimum inside dimensions meeting required MSHSAA standards.
- C. Concrete runway. Track surfacing shall extend for full length of runway on a concrete base.
- D. Provide required takeoff boards.

#### **3.3 POLE VAULT**

- A. Concrete runway. Track surfacing shall extend for full length of runway on a concrete base.
- B. Provide plant box each end, typical.
- C. Square concrete pole vault pit pads with track surfacing each end.

#### **3.4 HIGH JUMP**

- A. High jump area to be paved and surfaced to match the track and shall be located at the south end of the football field.

END OF SECTION 116600

**SECTION 133419**  
**PRE-ENGINEERED STEEL BUILDING SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Work includes:

1. Provide complete, in place, all pre-engineered steel structure, preformed metal wall panels, standing seam metal roofing system, sheet metal flashing and trim, exterior doors and windows required for the project, as shown, detailed, scheduled, or noted on the drawings and as specified herein.
2. All materials, accessories, tools, equipment, transportation, labor, services and all operations required to complete the pre-engineered metal structure and metal roofing system work for the project.
3. Provide all engineering, labor, material and equipment for complete pre-engineered metal building work as shown on the drawings and specified herein. Work includes, but is not limited to, the following:
  - a. Clear span rigid frame and X-bracing rods or modular rigid frame supported with intermediate columns.
  - b. Clearances and heights as shown on Drawings.
  - c. Bay spacing as shown on drawings.
  - d. Roof Slope: 2 in 12.
  - e. Primary Framing: Rigid frame of rafter beams and columns, braced end frames, mezzanine framing beams, and end wall columns.
  - f. Secondary Framing: Purlin, eave struts, flange bracing, and other items detailed. Lateral Bracing: Horizontal loads not resisted by main frame action shall be resisted by rod, diaphragm, portal frames and/or fixed base columns in the sidewall; Diaphragm, rod, portal frame and/or fixed base columns in the endwall; Rod and/or diaphragm in the roof, Cables are not allowed.
  - g. Wall and Roof System: Standing seam metal roof, girts and purlins, overhang framing, and preformed metal wall panels, and accessory components.
4. Structural design of the foundations, concrete grade beams and pedestals and rigid frame ties have been accomplished based on estimated loads and sizes. The Engineer will review the calculations and shop drawing submittals and make any changes in the foundation design which are required.

B. Related Work Specified Elsewhere:

1. Section 033000 - Cast-In-Place Concrete
2. Section 079200 - Joint Sealants.
3. Section 081113 - Hollow Metal Doors & Frames
4. Section 084113 - Aluminum Storefronts
5. Section 085113 - Aluminum Windows
6. Section 099100 - Painting.

## 1.2 REFERENCES

1. AISI - Specification for the Design of Cold-Formed Steel Structural, Members - 1996 Edition with 1999 Addendum.
2. AISC - Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design, 1989.
3. AISC - Steel Design Guide Series 3 - Serviceability Design Considerations for Low-Rise Buildings, 1990.
4. ASTM A36 - Specification for Carbon Structural Steel, 2000.
5. ASTM A123 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products, 2000.
6. ASTM A153 - Specification for Zinc Coating (Hot Dip) on Iron and steel Hardware, 2000.
7. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength, 2000.
8. ASTM A325 - Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength, 2000.
9. ASTM A463 - Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process, 2000.
10. ASTM A475 - Specification for Zinc-Coated Steel Wire Strand.
11. ASTM A490 - Specification for Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength, 2000.
12. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, 1999.
13. ASTM A501 - Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing, 1999.
14. ASTM A529 - Specification for High-Strength Carbon-Manganese Steel of Structural Quality, 2000.
15. ASTM A572 - Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel, 2000.
16. ASTM A653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process, 2000.
17. ASTM A792 - Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, 1999.
18. ASTM A1011 - Specification for Steel Sheet and Strip Hot Rolled Carbon, Structural High Strength Low-Alloy and High Strength Low-Alloy with Improved Formability, 2000.
19. ASTM C665 - Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing, 1998.
20. ASTM D1494 - Test Method for Diffused Light Transmission Factor of Reinforced Plastic panels, 1997.
21. ASTM E1514 - Specification for Structural Standing Seam Steel Roof panel Systems, 1998.
22. ASTM E1592 - Test method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference, 1998.
23. ASTM E1646 - Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference, 1995.
24. ASTM E1680 - Test Method of Rate of Air Leakage through Exterior metal Roof Panel Systems, 1995.
25. AWS A2.4 - Standard Welding Symbols, 1998.
26. AWS D1.1 - Structural Welding Code – Steel, 2000. AA. AWS D1.3 - Structural Welding Code - Sheet Steel, 1998. BB. MBMA Metal Building Systems Manual, 2002. CC. NAIMA 202 - Standard for Flexible Fiberglass Insulation Systems in Metal Buildings, 2000. DD. SJI (Steel Joist Institute) - Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders, 40th Edition, 1994.
27. SSPC (Society for Protective Coatings) - SP-2 - Specification for Hand Tool Cleaning, 1995 (Part of Steel Structures Painting Manual, Vol. Two)

28. SSPC - Paint 15 – Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Part of Steel Structures Painting Manual, Vol. Two).
29. SSPC – Paint 20 – Zinc-Rich Primers (Type I, “Inorganic”, and Type II, “Organic”); Society for Protective Coatings; 1991 (Part of Steel Structures Painting Manual, Vol. Two).
30. UL 580 - Tests for Uplift Resistance of Roof Assemblies, 1994.

### 1.3 SUBMITTALS

- A. Product Data: For each type of metal building system component indicated.
- B. Submit anchor bolt placement plan and column reactions in advance of erection drawings. Include location, diameter, and projection of anchor bolts required to attach metal building.
- C. Shop or Erection Drawings: Include plans, elevations, sections, details, and attachments to other work.
  1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  2. Anchor-Bolt Plans: Submit anchor-bolt plans before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.
  3. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
  4. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
- D. Samples: For each type of building component and for each color and texture required.
- E. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
  1. Name and location of Project.
  2. Order number.
  3. Name of manufacturer.
  4. Name of Contractor.
  5. Building dimensions including width, length, height, and roof slope.
  6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
  7. Governing building code and year of edition.
  8. Design loads and load combinations.
  9. Building-use category.
  10. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer or submit all the reports required by AISC Quality Control Quality Assurance Requirements of Chapter N.
- F. Welding certificates.
- G. Erector Certificate: Signed by manufacturer certifying that erector complies with requirements.

H. Manufacturer certificate.

#### 1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Design Loads: As indicated on Drawings.
2. Design Loads: As required by International Building Code (IBC) 2015 edition and ASCE7-10.
3. Design Loads: Refer to mechanical plans for equipment suspended from building framing. Roof purlins and rafters shall be designed for maximum L/180 deflection.

B. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

C. Thermal Performance: Provide insulated metal panel assemblies meeting the 2018 International Energy Conservation Code with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C 1363 or ASTM C 518:

1. Metal Roof Panel Assemblies:
  - a. U-Factor: 0.035
2. Metal Wall Panel Assemblies:
  - a. U-Factor: 0.052

D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 90.

E. The building framing shall be sized by the Manufacturer to support the loads placed on the building frame from the Maximum Reactions labeled in the Drawings that are from the basketball goal supports, volleyball net supports, batting cage supports and divider curtain supports.

F. Mechanical Equipment and Louver supports: Framed wall openings shall be made in such a way as to allow for no exposed insulation and adequately support the mechanical louver or wall mounted equipment for loads labeled in the Mechanical Drawings.

G. All manufacturer drawings and design calculations shall bear the professional seal and signature of a Licensed Professional Engineer registered in the State of Missouri.

#### 1.5 QUALITY ASSURANCE

A. Erector Qualifications: An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

B. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.

1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility or can submit all the reports required by AISC Quality Control Quality Assurance Requirements of Chapter N.
  2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- D. Structural Steel: Comply with AISC's "Specification for Structural Steel Buildings--Allowable Stress Design, Plastic Design," or AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings," for design requirements and allowable stresses.
- E. Cold-Formed Steel: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members," or AISI's "Load and Resistance Factor Design Specification for Steel Structural Members," for design requirements and allowable stresses.
- F. Pre-Erection Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to metal building systems including, but not limited to, the following:
1. Inspect and discuss condition of foundations and other preparatory work performed by other trades.
  2. Review structural load limitations.
  3. Review required testing, inspecting, and certifying procedures.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness and with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- 1.7 PROJECT CONDITIONS
- A. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
- 1.8 COORDINATION
- A. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

## 1.9 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Provide manufacturer's standard 20-year weathertight warranty on galvalume roof panels.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Varco Pruden, Roof Panels: SSR Panel, Wall Panels: RPR Panel
  - 2. Substitutions: Permitted with approval by Engineer/Architect

### 2.2 STRUCTURAL-FRAMING MATERIALS

- A. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
- B. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
- C. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
- D. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.
- F. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70; or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80, or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70.
- G. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G60 coating designation; mill phosphatized.

- H. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G90 coating designation.
    - 2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 50 or 80; with Class AZ50 coating.
  - I. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
    - 1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
  - J. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
    - 1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
    - 2. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with splined ends.
      - a. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50.
  - K. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.
  - L. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
    - 1. Configuration: Straight.
    - 2. Nuts: ASTM A 563 heavy hex carbon steel.
    - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
    - 4. Washers: ASTM F 436 hardened carbon steel.
    - 5. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
  - M. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
    - 1. Nuts: ASTM A 563 heavy hex carbon steel.
    - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
    - 3. Washers: ASTM F 436 hardened carbon steel.
    - 4. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
  - N. Threaded Rods: ASTM A 193/A 193M.
    - 1. Nuts: ASTM A 563 heavy hex carbon steel.
    - 2. Washers: ASTM F 436 hardened carbon steel.
    - 3. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
  - O. Primer: SSPC-Paint 15, Type I, red oxide.
- 2.3 MATERIALS FOR FIELD-ASSEMBLED METAL PANELS
- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80, with G90 coating designation.
2. Surface: Smooth, flat finish.
3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings:
  - a. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturers' written instructions, except as modified below:
    - 1) Humidity Resistance: 2000 hours.
    - 2) Salt-Spray Resistance: 1000 hours.
  - b. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored backer finish, consisting of prime coat and wash coat with a total minimum dry film thickness of 0.5 mil.

#### 2.4 PRE-ENGINEERED BUILDING LINER SYSTEM INSULATION FOR WALLS AND ROOFS

- A. Pre-engineered Building Liner System Insulation: ASTM C 991, Type I, or NAIMA 202, preformed formaldehyde-free glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch- wide, continuous, vapor-tight edge tabs; and with a flame-spread index of 25 or less.
  1. Thermal Resistance of Installed System: Roof – U-0.035; Walls – U-0.052
- B. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm when tested according to ASTM E 96, Desiccant Method meeting UL 723/ASTM E84 Flame Spread and Smoke Contribution. System shall provide a continuous vapor barrier inside of building purlins, girts, and insulation to provide complete isolation from inside conditioned air.
  1. Composition: woven, HPDE Scrim facing, bright white, LRV – 84.
- C. Retainer Strips: 0.019-inch- thick, formed, galvanized steel or PVC retainer clips colored to match insulation facing.
- D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- E. Thermal Blocks: 1"x3" extruded polystyrene
- F. Approved Manufacturer's: Skyliner Insulation Systems by Bay Industries; Simple Saver System by Thermal Design, Inc., CGI Silvercote Energy Saver System.

#### 2.5 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

1. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.
  2. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with nylon or polypropylene washer.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- C. Metal Panel Sealants:
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing.
  2. Joint Sealant: ASTM C 920; one-part elastomeric polyurethane, polysulfide, or silicone-rubber sealant.
- 2.6 FABRICATION, GENERAL
- A. Tolerances: Comply with MBMA's "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."
- B. Metal Panels: Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.
- 2.7 STRUCTURAL FRAMING
- A. General:
1. Primary Framing: Shop fabricate framing components to indicated size and section with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
    - a. Make shop connections by welding or by using high-strength bolts.
    - b. Join flanges to webs of built-up members by a continuous submerged arc-welding process.
    - c. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
    - d. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary structural members with specified primer after fabrication.
  2. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
    - a. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary structural members with specified primer after fabrication.
- B. Primary Framing: Manufacturer's standard structural primary framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and

lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing. Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.

1. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
  2. Frame Configuration: Single gable.
  3. Exterior Column Type: Tapered.
  4. Rafter Type: Tapered.
- C. End-Wall Framing: West end wall framing shall be expansion main frame. East end wall framing shall be Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 inch.
  2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 inch; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
- D. Secondary Framing: Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet prepainted with coil coating, unless otherwise indicated, to comply with the following:
1. Purlins: C- or Z-shaped sections; fabricated from minimum 0.0598-inch- thick steel sheet, built-up steel plates, or structural-steel shapes; minimum 2-1/2-inch- wide flanges.
    - a. Depth: Nominal 8"
  2. Girts: C- or Z-shaped sections; fabricated from minimum 0.0598-inch- thick steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange and with minimum 2-1/2-inch- wide flanges.
    - a. Depth: Nominal 8"
  3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from 0.0598-inch- thick steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.
  4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary frame flanges.
  5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
  6. Base or Sill Angles: Minimum 3-by-2-by-0.0598-inch zinc-coated (galvanized) steel sheet.
  7. Purlin and Girt Clips: Minimum 0.0598-inch- thick, steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
  8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from minimum 0.0598-inch- thick, zinc-coated (galvanized) steel sheet.
  9. Framing for Openings: Channel shapes; fabricated from minimum 0.0598-inch- thick, cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.

10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- E. Bracing: Provide adjustable wind bracing as follows:
1. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
- F. Bolts: Provide plain finish bolts for structural-framing components that are primed or finish painted. Provide **[zinc-plated]** **[or]** **[hot-dipped galvanized]** bolts for structural-framing components that are galvanized.
- G. Factory-Primed Finish: Apply specified primer immediately after cleaning and pretreating.
1. Prime primary, secondary, and end-wall structural-framing members to a minimum dry film thickness of 1 mil.
    - a. Prime secondary steel framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.
  2. Prime galvanized members with specified primer, after phosphoric acid pretreatment.
- 2.8 METAL ROOF PANELS
- A. Vertical-Rib, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
- B. Approved roof system:
1. Varco Pruden SSR Panel.
- C. Roof shall have 2:12 slope.
- D. Panels are rated for UL90® uplift rating UL580 when installed to roof support members spaced as listed in UL Construction Listing #552, supported at a maximum of 5'-0" on center by either joists or purlins.
- E. Roof Panel:
1. Panel profile shall be precision roll-formed from 24 gage steel. Galvalume steel sheeting is aluminum-zinc coated steel alloy coated steel sheet with a minimum yield strength of 50 ksi in accordance with ASTM A-792, Grade 50. It has a coating thickness of .55 oz. per square foot.
  2. Roof panels provided by Building Systems for exterior use are precision roll-formed from pre-painted Galvalume coils. Coils to receive finish paints are subjected to a strenuous cleaning process prior to coating. Next, the coils are prime coated and oven cured. The finish coat is then applied and monitored for proper oven-cure temperature and color uniformity. Finished material is subjected to stringent quality control tests including: physical bend and impact resistance, film thickness, hardness, gloss and color. CFR roof accessories (end dams, cinch straps, gutter brackets) are provided as unpainted.
  3. Exterior Finish Color: As selected by the Owner from manufacturer's full range.

4. Panel shall be factory-punched and notched at ridge, high side, and lap locations.
5. Panel sidelaps shall have factory-applied non-skinning Butyl mastic.

F. Panel Configuration:

1. Panels shall have 2" to 3" deep vertical ribs spaced 24" on center. Minor ribs are spaced in the flat of the panel between the major ribs.

G. Panel Clip and Fasteners:

1. Fixed panel clips shall only be used with panel runs of less than 120'. Floating panel clips shall be used up to a 250' panel run and shall be self-centering and allow for up to 1-1/2" expansion and/or contraction of total movement from the centered position. The clip design shall insure that movement does not occur between the panel and clip.
2. The panel clips shall have factory-applied mastic to insure a weather-tight installation.
3. Each clip shall be attached to the joist or purlin with two fasteners. Size and type will be recommended by MBM for the specific application.
4. Panel endlap fasteners shall be a No. 17 self-tapping carbon steel screw, hex washer head, 1-1/2" long. Fastener shall have a 20-year corrosion resistant coating.

H. Trim and Flashing:

1. Color-coated trim and flashing shall be 26 gage. Trim shall be provided at eave, ridge, rake, and where necessary to ensure a properly constructed building.
2. High eave flashing and flashing parallel to the roof panels shall accommodate the thermal expansion and contraction of the roof without damage to the roof panels or flashing.
3. All exposed trim and flashing material shall be manufactured from galvanized or Galvalume® steel strip.
4. Exterior gutters and gable flash shall typically be manufactured in 20' lengths wherever possible.

I. Installation:

1. Storage and installation of the roofing system shall be in accordance with MBM printed instructions.
2. The panel splice shall have a 0.060" galvanized steel back-up plate and an 0.090" aluminum cinch strap.
3. The back-up plate and cinch strap shall be factory-punched to ensure proper fit.
4. Panel splice shall be sealed with precut tape mastic.
5. Standard maximum panel length shall be 55'-0".
6. The use of cutting tools that damage the panel finish shall not be allowed.
7. Panels shall not be marked with any graphite or lead markers.

J. Clean-up:

1. Roof surface should be cleaned daily during construction of all filings, cuttings, screws, pencil markings, and debris to prevent damage due to oxidation of foreign materials.
2. Contractor shall thoroughly clean all panels, trim, and gutters of all foreign material upon completion of construction.

K. Field-Cutting of Panels:

1. When field-cutting or mitering roof panels, non-abrasive cutting tools such as nibblers or tin-snips shall be used. Abrasive cutting tools such as mechanical grinders, saws, shears, or scissors can damage the Galvalume® or painted finish and create excess

metal shavings that can corrode the panels. The use of non-approved cutting devices may void manufacturer's warranty.

## 2.9 FIELD-ASSEMBLED METAL WALL PANELS

- A. Reverse-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with recessed, trapezoidal major valleys and intermediate stiffening valleys symmetrically spaced between major valleys; designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
1. Material: Zinc-coated (galvanized) steel sheet, 26 gauge.
    - a. Exterior Finish: Fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.
  2. Major-Rib Spacing: 12 inches o.c.
  3. Panel Coverage: 36 inches.
  4. Panel Height: 1.5 inches.

## 2.10 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including rake trim, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated. Rake trim finish and color to match wall panels.
1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
  2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
  3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
  4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Soffit Panel: Varco Pruden FP-12 with two stiffening beads, 24 ga., Provide in white color to match existing.
- D. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.

2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
  - E. Flashing and Trim: Formed from minimum 0.0159-inch- thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels, except flashing above panelized stone veneer to be contrasting color trim.
    1. Opening Trim: Minimum 0.0159-inch- thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings. Color to match adjacent wall panels.
  - F. Gutters: Formed from minimum 0.0159-inch- thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match wall panels and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
    1. Gutter Supports: Fabricated from same material and finish as gutters; spaced 36 inches o.c.
  - G. Downspouts: Formed from 0.0159-inch- thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- long sections, complete with formed elbows and offsets.
    1. Mounting Straps: Fabricated from same material and finish as gutters; spaced 10 feet o.c.
  - H. Snow Bars: Snow Bars: Provide snow bars where indicated on drawings equal to Snoblox-Snojax "ColorRail", 6061-T6 aluminum bar powder coated to match the roof panels. 12 ga. one-piece stainless steel clamps with two "cup tipped" stainless steel set screws are provided at each roof seam.
  - I. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- 2.11 SOURCE QUALITY CONTROL
- A. Special Inspector: Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports. Special Inspector will verify that manufacturer maintains detailed fabrication and quality-control procedures and will review the completeness and adequacy of those procedures to perform the Work.
    1. Special inspections will not be required if fabrication is performed by a manufacturer registered and approved by authorities having jurisdiction to perform such Work without special inspection.
      - a. After fabrication, submit certificate of compliance with copy to authorities having jurisdiction certifying that Work was performed according to Contract requirements.
  - B. Tests and Inspections:

1. Bolted Connections: Shop-bolted connections shall be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
2. Welded Connections: In addition to visual inspection, shop-welded connections shall be tested and inspected according to AWS D1.1.

## **PART 3 - EXECUTION**

### **3.1 ERECTION**

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.
- B. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- C. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- D. Set structural framing accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- E. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  1. Set plates for structural members on wedges, shims, or setting nuts as required.
  2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- F. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure.
- G. Primary Framing and End Walls: Erect framing true to line, level, plumb, rigid, and secure. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist cure grout for not less than seven days after placement.
  1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and snug-tightened or pretensioned joints.
- H. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips with field connections using non-high-strength bolts.
  1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.

2. Locate and space wall girts to suit openings such as doors and windows.
  3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
1. Tighten rod and cable bracing to avoid sag.
  2. Locate interior end-bay bracing only where indicated.
- J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

### 3.2 METAL PANEL INSTALLATION, GENERAL

- A. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
  2. Install metal panels perpendicular to structural supports, unless otherwise indicated.
  3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
  4. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  5. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- B. Lap-Seam Metal Panels: Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or metal panels. Install screws in predrilled holes. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal panel manufacturer.

### 3.3 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Install ridge caps as metal roof panel work proceeds.

- B. Field-Assembled, Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
1. Install clips to supports with self-tapping fasteners.
  2. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels for fasteners.
  5. Provide metal closures at rake edges and each side of ridge caps.

### 3.4 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. When two rows of metal panels are required, lap panels 4 inches minimum.
  2. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
  3. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Pre-drill panels.
  4. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
  5. Install screw fasteners in pre-drilled holes.
  6. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated, or if not indicated, as necessary for waterproofing.
  7. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws.
  8. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Field-Assembled, Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

### 3.5 THERMAL INSULATION INSTALLATION FOR FIELD-ASSEMBLED METAL PANELS

- A. General: Install Pre-engineered building insulation liner system in accordance with manufacturer's installation instructions and approved shop drawings. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Install in exterior spaces without gaps or voids. Do not compress insulation. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids. Fit insulation in tight spaces and tight to exterior side of the sealed liner fabric and around mechanical and electrical services within the plan of insulation.
1. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
  2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
  3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths with both sets of facing tabs sealed to provide a complete vapor retarder.

4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation with both sets of facing tabs sealed to provide a complete vapor retarder.

B. Roof Insulation: Comply with the following installation method:

1. Straps: Cut straps to length and install in the pattern and spacings indicated on shop drawings. Tension straps to required value.
2. Vapor Barrier Fabric: Install vapor barrier fabric in large one-piece custom fabricated pieces to substantially fit defined building areas with minimum practicable job site sealing. Position pre-folded fabric on the strap platform along one eave purlin. Clamp the two bottom corners at the eave and also centered on the bar. Pull the other end of the pleat-folded fabric across the building width on the strap platform, pausing only at the ridge to fasten the straps and fabric in position where plane of roof changes and to release temporary fasteners on the opposite ridge purlins. Once positioned, install fasteners from the bottom side at each strap purlins intersection. Trim edges and seal along the rafters. All seams must be completely sealed and stapled seams not acceptable.
3. Insulation: Unpack, and shake to a thickness exceeding the specified thickness. Ensure that cavities are filled completely with insulation. Place on the vapor barrier liner fabric without voids or gaps. Place top layer of insulation over and perpendicular to the purlins without voids or gaps, as roof sheathing is applied. Place thermal block on top of purlins. Place new insulation between purlins at the required thickness for the thermal performance specified. Seal vapor barrier to the wall fabric and elsewhere as required to provide a continuous vapor barrier.

C. Blanket Wall Insulation: Comply with the following installation method:

1. Insulation: Install thermal break to exterior surface of girts as wall sheathing is applied. Install self-sticking foam thermal break to interior surface of girts prior to installation of insulation. Position and secure hangers to girts on the inside face of the wall sheathing. Cut insulation to required lengths to fit vertically between girts. Fluff the insulation to the full-specified thickness. Neatly position in place and secure to hangers. Ensure that cavities are filled completely with insulation.
2. Vapor Barrier Fabric: Install vapor barrier fabric in large one-piece custom fabricated pieces to substantially fit defined building areas with minimum practicable job site sealing. Apply the vapor barrier fabric by clamping it in position over the eave strap and installing fasteners through the eave strap into each roof strap, permanently clamping the wall fabric between them. Once in position, draw the vapor barrier fabric down over the column flanges to the base angle and install vertical straps along each column and 5'-0" o.c., maximum, fastening to each girt to retain system permanently in place. All seams must be completely sealed and stapled seams not acceptable. Seal wall fabric to the roof fabric, to the base angle and up the columns to provide a continuous vapor barrier.

### 3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Install components for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection.
- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
  - 1. Provide elbows at base of downspouts to direct water away from building.
  - 2. Tie downspouts to underground drainage system indicated.
- E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

### 3.7 FIELD QUALITY CONTROL

- A. Special Inspector: Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports.
- B. Tests and Inspections:
  - 1. High-Strength, Field-Bolted Connections: Connections shall be tested and inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
  - 2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1.

### 3.8 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
  - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
  - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION 133419

**SECTION 260500**  
**COMMON WORK RESULTS FOR ELECTRICAL**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
1. Electrical equipment coordination and installation.
  2. Common electrical installation requirements.

1.2 COORDINATION

- A. Contractor must read the entire Specifications covering other branches of Work. Contractor is responsible for coordination of his (her) work with work performed by other trades.
- B. Consult all Contract Documents which may affect the location of any equipment or apparatus furnished under this Work and make minor adjustments in location as necessary to secure coordination.
- C. System layout is schematic and exact locations shall be determined by structural and other conditions. This shall not be construed to mean that the design of the system may be arbitrarily changed. The equipment layout is to fit into the building as constructed and to coordinate with equipment included under other Divisions of Work.
- D. Contractor shall contact the Owner's Representative immediately if he (she) notices any discrepancies or omissions in either the Drawings or Specifications, or if there are any questions regarding the meaning or intent thereof.
- E. Submit all changes, other than minor adjustments, to the Engineer/Architect for approval before proceeding with the work.
- F. The Contractor is required to visit the site and fully familiarize himself or herself concerning all conditions affecting the scope of work. Failure to visit the site shall not relieve the Contractor from any responsibility in the performance of his or her Work.
- G. All workmanship to be of the highest quality in accordance with the best practices of the trade by craftsmen/craftswomen skilled in this particular work.
- H. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  3. To allow right of way for piping and conduit installed at required slope.
  4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

- I. All buried conduits passing from below the proposed building to the exterior shall pass below the proposed structural footing.
  - J. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
  - K. Coordinate sleeve selection and application with selection and application of firestopping.
  - L. Where thermostat locations are shown, the electrical contractor shall provide a recessed wall box with conduit to an accessible location. In areas where surface mounted boxes are required, a surface mounted box and conduit to 10' AFF shall be provided (or to the equipment location, whichever is closer). Thermostat installation and the corresponding low voltage thermostat wiring shall be by the mechanical contractor.
- 1.3 PERMITS, INSPECTIONS AND CODES
- A. File all drawings, pay all fees, and obtain permits and certificate of inspection relative to this Work.
  - B. Complete installation shall conform with all applicable Federal, State and Local laws, Codes and Ordinances including, but not limited to the latest approved editions of the following:
    - 1. State Building Codes.
    - 2. Specific Construction Safety Requirements, State Industrial Commission.
    - 3. National Electrical Code (NFPA-70).
    - 4. Life Safety Code, NFPA-101.
    - 5. Occupational Safety and Health Act (OSHA) of 1971 and all amendments thereto.
  - C. Nothing contained in the drawings and specifications shall be construed to conflict with these laws, codes, and ordinances and they are hereby included in these specifications.
- 1.4 RECORD DRAWINGS
- A. Record all deviations from the Drawings, on a set of prints and deliver them to the Owner and Owner's Representative upon completion of the work. Special attention to record the location of concealed boxes, service runs shall be made at the point of installation to maintain accuracy.
    - 1. Sufficient dimensional tie points to permanent building features shall be provided for all buried conduits to facilitate future location.
- 1.5 INSPECTION
- A. Contractor shall arrange for and include in his (her) bid, inspection of this work by the appropriate stator or local code authority having jurisdiction.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Furnish new, undeteriorated materials of a quality not less than what is specified.
- B. Contractor to furnish and install only those brands of equipment mentioned specifically or accepted as substitutes.

## **PART 3 - EXECUTION**

### **3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

- A. Furnish all materials, labor, tools, transportation, incidentals, and appurtenances to complete in every detail and leave in working order all items of work called for herein or shown on the accompanying Drawings.
- B. Include any minor items of work necessary to provide a complete and fully operative electrical system which meets all required codes.
- C. Comply with NECA 1.
- D. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- E. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- G. Right of Way: Give to piping systems installed at a required slope.

### **3.2 PROTECTION AND CLEANING**

- A. Protect all fixtures and equipment against damage from leaks or abuse and pay the cost of repair or replacement of fixtures or equipment made necessary by failure to provide suitable safeguards or protection.
- B. After all fixtures and equipment have been set, thoroughly clean all fixtures and equipment with manufacturers recommended cleaning agents, removing stickers and other foreign matter and leave every part in acceptable condition, clean and ready for use.
- C. Repair all dents and scratches in factory prime or finish coats on all electrical equipment. If damage is excessive, replacement may be required.

END OF SECTION 260500

**SECTION 260519**  
**LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

**PART 2 - PRODUCTS**

2.1 STANDARDS

- A. Insulation types, ratings and usage shall be in accordance with the National Electrical Code requirements.
- B. All conductors shall be copper
- C. Unless otherwise noted , minimum wire size for lighting and power branch circuits shall be No. 12 AWG. For control and auxiliary systems the minimum size shall be No. 14 AWG.

2.2 CONDUCTORS AND CABLES

- A. All wire and cable shall be UL listed.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW, and SO.
  - 1. THHN-THWN and XHHW: 90 degree C temperature rating in dry or wet locations.

- D. Multiconductor Cable: Comply with NEMA WC 70 for metal clad cable, Type MC and Type SO with ground wire.

### 2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- B. All components used at wiring terminations, connections and splices shall be UL listed.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway or Type XHHW, single conductors in raceway.
- B. Feeders and Branch Circuits: Type THHN-THWN, single conductors in raceway.
- C. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- D. Concealed light fixture whips: Metal clad cable (Type MC) limited to six feet in length.
- E. Existing walls and ceilings requiring fishing of cable between access points: Metal clad cable (Type MC).
- F. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- G. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

END OF SECTION 260519

**SECTION 260526**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.
- B. Grounding system shall be in compliance with all requirements of the National Electrical Code.

1.2 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

**PART 2 - PRODUCTS**

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.

- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

### 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 5/8 inch in diameter by 10 feet or as noted on the Drawings.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 EQUIPMENT GROUNDING

- A. A separate equipment grounding conductor, minimum size per NEC, shall be installed in each feeder, branch circuit, and control circuit conduit. Conductor insulation shall be green. DO NOT use conduit as a means for grounding of receptacles or any other such devices.
- B. Conduit system shall be electrically continuous. All enclosures and non-current carrying metals to be grounded. All locknuts must cut through enameled or painted surfaces on enclosures. Where enclosures and non-current carrying metals are isolated from the conduit system, use bonding jumpers with approved clamps.
- C. All new receptacles shall be bonded to a ground conductor using a #12 AEG min. bonding jumper between receptacle terminal and ground conductor. Metal-to-metal contact between the device yoke and the outlet box is not acceptable for either surface mounted boxes or flush type boxes.
- D. Junction boxes and pull boxes shall be bonded by the use of UL listed ground screws or lugs.
- E. Lighting fixtures shall be grounded by the use of a pigtail fastened on bare metal that is free of paint.
- F. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

- G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

### 3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- C. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

END OF SECTION 260526

**SECTION 260529  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes:
  - 1. Hangers and supports for electrical equipment and systems.

1.2 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.

**PART 2 - PRODUCTS**

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
    - g. Wesanco, Inc.
  - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 2. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
  - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  - 5. Toggle Bolts: All-steel springhead type.
  - 6. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

**SECTION 260533**  
**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

**PART 2 - PRODUCTS**

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. EMT: ANSI C80.3.
- C. FMC: Zinc-coated steel.
- D. LFMC: Flexible steel conduit with PVC jacket.
- E. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Fittings for EMT: Steel, compression type. Die cast fittings are not acceptable.
- F. LFMC: Flexible steel conduit with PVC jacket. Made from a continuous length of galvanized cold rolled steel strip, spirally wound. Adjacent strips shall have locked typed construction with all the edges turned in. With an extruded PVC jacket.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. PVC conduit shall be heavy wall, Schedule 40 ultra-violet resistant, UL listed under Standard 651. Conduit shall be suitable for use with 90 degree C insulated wire. Conduit fittings and cement shall be of the same manufacturer.
- B. Fittings for Schedule 40 PVC: Match to conduit or tubing type and material.

## 2.3 BOXES AND ENCLOSURES

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1,
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

## 2.4 SLEEVES FOR RACEWAYS

- A. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
  - 1. Exposed Conduit: Rigid Steel Conduit.
  - 2. Concealed Conduit: EMT.
  - 3. Underground Conduit: Schedule 40 PVC, direct buried.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. All other exposed areas: RMC.
  - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC
  - 5. Damp or Wet Locations: RMC.
  - 6. Raceways for Optical Fiber or Communications Cable: EMT.
  - 7. Boxes and Enclosures: NEMA 250, Type 1, or as required for environmental conditions expected.
- C. Minimum Raceway Size: 3/4-inch trade size Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

### 3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. In finished areas, conduit must be concealed above accessible ceilings, within the building structure, or within chases. Exposed conduits to be run tight to wall or ceiling and installed in a neat workmanlike manner, ready for painting.
- C. Install conduit parallel or perpendicular to building lines (except where run in or below floor slabs). Keep conduit runs as closed to underside of structure as possible.
- D. Exercise necessary precautions to prevent accumulation of water, dirt, or concrete in conduits during execution of electrical work. Conduit in which water or foreign material has been permitted to accumulate shall be thoroughly cleaned, or replaced where such accumulations cannot be removed.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- H. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- I. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- J. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- K. Raceways below slabs:
  1. Minimum conduit size shall be 1".
  2. Change from PVC conduit to rigid steel conduit before rising above floor.
- L. Raceway below grade: Install warning tape a minimum of six (6) inches below grade and not less than twelve (12) inches above the raceway.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 240-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- O. Raceways for Optical Fiber and Communications Cable: Install as follows:
  1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
  2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.

3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- P. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where otherwise required by NFPA 70.
- Q. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
- R. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
1. Wall boxes in tile, marble, brick or other finished masonry wall shall be of welded construction and designed for installation within masonry.
- S. Set metal floor boxes level and flush with finished floor surface.
- T. Metal boxes cast in concrete shall be designed for concrete installation.
- U. Weather-proof boxes shall be die cast aluminum.
- V. Boxes for exposed work in finished area to be Type FS with threaded hubs and rigid conduit risers.
- W. Install expansion fittings at all locations where conduits cross building expansion joints.
- X. Secure rigid conduit at cabinets and boxes using insulated throat type grounding and bonding bushings. Locknuts shall be tightened to cut through painted surfaces.
- Y. Where a number of conduits are to be run exposed and parallel, one with another, they shall be grouped and supported by trapeze hangers or unistrut racks tight to the building structure.
- Z. Mount junction and pull boxes securely to building structure in a location that meets the requirements of the National Electrical Code for accessibility and work space clearance. Coordinate exact locations of work with other trades. Unless noted otherwise, mounting heights shall be (all measurements are to the top of the box):

Switches, receptacles, or telephone/data shown above a countertop	12" above countertop
Dedicated receptacles (i.e. refrigerator, microwave, etc.)	To suit equipment (see equipment/cabinetry elevation drawings where applicable)
Other interior receptacles	16" AFF
Exterior receptacles	20" above finished grade

Other switches	48" AFF
Telephone/data shown next to a doorway	56" AFF
Other telephone/data	16" AFF

### 3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials.
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION 260533

**SECTION 260553**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Identification for conductors and communication and control cable.
  - 2. Data/Telephone outlet labels
  - 3. Receptacle labels
  - 4. Warning labels and signs.
  - 5. Instruction signs.
  - 6. Equipment identification labels.
  - 7. Miscellaneous identification products.

1.2 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.145.

1.3 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

**PART 2 - PRODUCTS**

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 DATA/TELEPHONE OUTLET LABELS

- A. Machine printed paper insert with black filled lettering located under clear label cover on face of plate and durable wire markers on inside of outlet box.

## 2.3 RECEPTACLE LABELS

- A. Hot stamped machine printing with black filled lettering on clear background on face of plate and durable wire markers on inside of outlet box.

## 2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Color Scheme
  - 1. Emergency Warning labels: White background with red letters
  - 2. All other warning labels: Yellow background with black letters
- D. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
  - 3. Junction boxes containing emergency circuits: "EMERGENCY CIRCUITS- PANEL *insert name*"
  - 4. As noted on drawings.

## 2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face. (White letters on red background for emergency information)
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for fasteners, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Fasteners for Labels: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## 2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

- B. Covers for all junction boxes containing emergency circuits shall be red.

### **PART 3 - EXECUTION**

#### **3.1 APPLICATION**

- A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.
  - 2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
- B. Data/Telephone Outlet Identification: Use outlet labels to identify each outlet connection. Use system of designation that is uniform and consistent with cable identification. Label face of plate and wire markers inside of box,
- C. Receptacle Identification: Use labels to identify panelboard and circuit number from which served. Label face of plate and wire markers inside of box,
- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
  - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
  - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- E. Instruction Signs:
  - 1. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters.
- F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
  - 1. Labeling Instructions:
    - a. Indoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment. Unless otherwise indicated, provide a single line of text with

1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.

- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
- c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

- a. New panelboards, electrical cabinets, and enclosures.
- b. Inverters
- c. Disconnect switches.
- d. Contactors.
- e. Timeclocks
- f. Fire alarm control panel and annunciators
- g. Motor control switches including Hand/Off/Auto switches

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded feeder, and branch-circuit conductors.
  - 1. Color shall be factory applied or for sizes larger than No. 10 AWG field applied
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 3. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
  - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION 260553

## SECTION 262416 PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
1. Distribution panelboards.
  2. Lighting and appliance branch-circuit panelboards.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  3. Detail bus configuration, current, and voltage ratings.
  4. Short-circuit current rating of panelboards and overcurrent protective devices.
  5. Include evidence of NRTL listing for series rating of installed devices.
  6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  7. Include wiring diagrams for power, signal, and control wiring.
  8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

#### 1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

## 1.4 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  - 4. Finishes:
    - a. Panels and Trim: Steel and galvanized steel factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
  - 5. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
  - 1. Hard-drawn copper, 98 percent conductivity.
  - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Main and Neutral Lugs: Mechanical type.
  - 3. Ground Lugs and Bus Configured Terminators: Mechanical type.
  - 4. Feed-Through Lugs (When required): Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - 5. Subfeed (Double) Lugs (When required): Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

- E. Service Equipment Label (When applicable): NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Square D; a brand of Schneider Electric.
  - 4. Siemens
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Mains: Circuit breaker or main lugs only as noted on Drawings.
- E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Square D; a brand of Schneider Electric.
  - 4. Siemens
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  - 3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.

- b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
- c. Shunt Trip (When indicated or required): 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
- d. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
- e. Handle Padlocking Device (When indicated or required): Fixed attachment, for locking circuit-breaker handle in on or off position.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 90 inches Insert height above finished floor unless otherwise required keep the distance from the floor to top most circuit breaker within the height limitation contained in the NEC.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Recessed panels: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- H. Comply with NECA 1.

#### **3.2 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

END OF SECTION 262416

**SECTION 262816**  
**ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
1. Fusible switches.
  2. Nonfusible switches.
  3. Enclosures.

1.2 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
1. Enclosure types and details for types other than NEMA 250, Type 1.
  2. Current and voltage ratings.
  3. Short-circuit current rating.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.4 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 FUSIBLE AND NONFUSIBLE SWITCHES

### A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Square D/Group Schneider.
4. Siemens

### B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type Heavy Duty, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

### C. Non-fusible Switch, 600 A and Smaller: NEMA KS 1, Type Heavy Duty Duty, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

### D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors. ( If required)

## 2.3 ENCLOSURES

### A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. As noted in the drawings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

### 3.3 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816

## SECTION 265600 EXTERIOR LIGHTING

### 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. This Section includes the following:

- 1. Exterior luminaires.
- 2. Poles and accessories.

#### 1.3 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
  - 2. Details of installation and construction.
  - 3. Luminaire materials.
  - 4. Lamps, including life, output, and energy-efficiency data.
  - 5. Materials, dimensions, and finishes of poles.
  - 6. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
  - 7. Anchor bolts for poles.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. See lighting schedule on Drawings.

### **2.2 LUMINAIRES, GENERAL REQUIREMENTS**

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Exposed Hardware Material: Stainless steel.
- G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- H. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- I. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

### **2.3 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS**

- A. Structural Characteristics: Comply with AASHTO LTS-4.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
  - 1. Materials: Shall not cause galvanic action at contact points.
  - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
  - 3. Anchor-Bolt Template: Plywood or steel.

- D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

### **PART 3 - EXECUTION**

#### **3.1 LUMINAIRE INSTALLATION**

- A. Fasten luminaire to indicated structural supports.
- B. Adjust luminaires that require field adjustment or aiming.

#### **3.2 POLE INSTALLATION**

- A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
  - 1. Fire Hydrants and Storm Drainage Piping: 60 inches.
  - 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet .
  - 3. Trees: 15 feet.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
  - 1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
  - 2. Install base covers, unless otherwise indicated.
  - 3. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

- E. Raise and set poles using web fabric slings (not chain or cable).

#### **3.3 BOLLARD LUMINAIRE INSTALLATION**

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

### 3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### 3.5 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole, unless otherwise indicated.
  - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

### 3.6 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

END OF SECTION 265600

## SECTION 311000 SITE CLEARING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
1. Protecting existing trees, shrubs, groundcovers, plants and grass to remain.
  2. Removing existing trees, shrubs, groundcovers, plants and grass.
  3. Clearing and grubbing.
  4. Stripping and stockpiling topsoil.
  5. Removing above- and below-grade site improvements.
  6. Disconnecting and capping or sealing site utilities.
  7. Temporary erosion and sedimentation control measures.

#### 1.2 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

#### 1.3 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

### PART 2 - PRODUCTS

#### 2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in 312300 Excavation and Fill.

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
  1. Restore damaged improvements to their original condition, as acceptable to Owner.

#### **3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

#### **3.3 TREE PROTECTION**

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect/Engineer.

#### **3.4 UTILITIES**

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
  1. Arrange with utility companies to shut off indicated utilities.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect/Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect/Engineer's written permission.

### 3.5 CLEARING AND GRUBBING

- A. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

### 3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

### 3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

### 3.8 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 311000

## MSECTION 312300

### EXCAVATION AND FILL

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Excavate, fill, compact, and grade the site to the elevations shown on the Drawings, as specified herein, and as needed to meet the requirements of the construction shown in the Contract Documents.
- B. Related work:
  - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
  - 2. Information Available to Bidders: Geotechnical Investigation report; bore hole locations and findings of subsurface materials, is attached for reference only.

##### 1.2 QUALITY ASSURANCE

- A. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.
- B. Perform excavation and embankment work in compliance with applicable rules and regulations of IEPA and OSHA.
- C. Perform Field Quality Controls Testing as specified herein.

#### PART 2 - PRODUCTS

##### 2.1 TOPSOIL

- A. Topsoil shall consist of friable, fertile soil of a loamy character. Use suitable topsoil of uniform quality, free from hard clods, roots, sod, stiff clay, hard pan, stones larger than 1 inch (1/2 inch for turfgrass seeding), lime cement, ash, slag, concrete, tar residue, tarred paper, boards, chips, sticks, or any undesirable material.
- B. Use on-site topsoil from sources within the project limits, unless compost-amended or off-site topsoil is specified.
  - 1. **On-site Topsoil:** On-site topsoil material is material excavated from the top 12 inches of the site. Use of on-site topsoil material is subject to the Engineer's approval.
  - 2. **Compost-amended On-site Topsoil:** Amend low-quality on-site topsoil, not meeting the requirements specified for off-site topsoil, with a minimum of 1 inch of compost for every 3 inches of topsoil. Use compost meeting the requirements of mulch for pneumatic seeding in Section 329219 "Seeding".

2.2 **Off-site Topsoil:** Contains at least 3% organic matter, according to ASTM D 2974, has a high degree of fertility, is free of herbicides that prohibit plant growth, has a pH level between 5.5 and 7.5, and meets the following mechanical analysis of at least 90 percent must pass the No. 10 sieve. The Engineer will approve the source of off-site topsoil. Surface soils from ditch bottoms, drained ponds, and eroded areas, or soils that are supporting growth of noxious weeds or other undesirable vegetation, will not be accepted. The Engineer will determine if testing is necessary. The Contractor will be responsible for payment of the testing if the off-site topsoil does not meet the above requirements. If the testing verifies the off-site topsoil does meet the above requirements, payment for the testing will be the responsibility of the Jurisdiction.

## 2.3 SOIL MATERIALS

### A. General embankment and fill materials:

1. Predominately granular or non-expansive soils, free from organic matter and deleterious substances, containing no rocks over 3" in greatest dimension and having a minimum Standard Proctor Density of not less than 100 lbs/cu ft.
2. Material is subject to the approval of the A/E, and may be removed from onsite excavations or imported from off-site borrow areas.
3. The upper 12" of fill or embankment shall not have rocks greater than 1" in dimension.
4. For soils to be placed below water, use clean granular material.

### B. Structure embankment and fill materials:

1. In addition to the General embankment requirements, soils placed beneath and within 10 feet structures or pavements shall have the following the requirements:
  - a. Cohesive soils must meet all of the following:
    - 1) Liquid limit of less than 40% and a plasticity index greater than 10 and less than or equal to 20%.
    - 2) Density of 110 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density).
  - b. Granular soils must meet all of the following:
    - 1) Density of 110 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density).
    - 2) no more than 20% or less of fines passing the 200 sieve
    - 3) Plasticity index of 3 or less
  - c. Drainage Layers:
    - 1) ¾ inch clean aggregate for drainage.
  - d. Crushed stone, crushed PCC, crushed composite pavement, or RAP; mixtures of gravel, sand, and soil; or uniformly-blended combinations of the above; as approved by the Engineer.
2. Subgrade Treatment (if necessary):
  - a. Cement: Meet the requirements of AASHTO M 85 for portland cement.

- b. Fly ash: Provide Class C meeting the requirements of ASTM C 618 with a minimum of 22% CaO; the Loss of Ignition requirements in Table 1 will not apply. Approval of source required.
- c. Lime: Hydrated lime should meet requirements of ASTM C 207, Type N or AASHTO M 216, and others.

C. Geotextile Materials:

- 1. Geotextile Fabric: Consisting of woven or non-woven filaments of polypropylene, polyester or polyethylene meeting the following minimums:
  - a. Weight (oz/sy): 4.
  - b. Grab tensile Strength (lbs): 200 ASTM D 4632.
  - c. Elongation (%): 15 ASTM D 4632.
  - d. Trapezoidal Tear Strength (lbs): 75 ASTM D 4533.
- 2. Geogrid, Rectangular: Consisting of integrally-formed grid structure manufactured of a stress-resistant polypropylene material meeting the following minimums:
  - a. Minimum true initial modulus in use (lb/ft): 20,000 ASTM D 6637
  - b. Tensile strength, 2% strain (lb/ft): 380 ASTM D 6637
  - c. Flexural rigidity (mg-cm): 250,000 ASTM D 1388
  - d. Aperture Size (in): 0.5 minimum, 2.0 maximum
- 3. Geogrid, Triangular: punched and drawn polypropylene that is oriented in three substantially equilateral directions meeting the following minimums:
  - a. Tensar TX 140 and/or TX160TX or approved equal.

**PART 3 - EXECUTION**

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 FINISH ELEVATIONS AND LINES

- A. Finish grading shall be worked to contours or elevations indicated on the drawings. Rocks and other debris unearthed during finish grading operations shall be removed from immediate construction area and disposed of elsewhere on site as approved by Owner and Engineer/Architect.
- B. Final disking, harrowing, raking etc. and other preparations for seeding, sod or landscaping will covered in subsequent specification sections.
- C. The Contractor shall provide field engineering services as required but not limited to:
  - 1. Establish and maintain lines and levels.

2. Structural design of shores, forms, and similar items as part of his/her means and methods of construction.

### 3.3 PROCEDURES

#### A. Utilities:

1. Unless shown to be removed, protect active utility lines shown on the Drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.
2. If active lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
4. Where existing underground utilities are in actual contact with the new work, so that such utilities cannot be replaced as originally found prior to excavation, and where relocation and changes are required, then the work shall be replaced or relocated by "others" at no cost to the Contractor. The Contractor shall so coordinate his work as to allow a reasonable time for such replacement or relocation and in no event shall extra compensation be allowed for such coordination or any reasonable delay occasioned there from. Should it be found necessary or desirable by the Owner for the Contractor to perform the work of replacement or relocation, the Engineer/Architect will issue in writing a field order defining the extent of the additional work and instructing the Contractor to proceed with such construction. Compensation for such work shall be determined as set forth in paragraphs 14 and 17 of the General Conditions.

#### B. Protection of persons and property:

1. Furnish, install and maintain barricades, warning lights, and/or warning tape at open holes and depressions or other potential hazards occurring as part of this Work.
2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section.
4. Provide traffic control items in accordance with the Manual of Uniform Traffic Control Devices (MUTCD), and the requirements of the governmental agency having jurisdiction, when work is being complete on or adjacent to public streets and/or Right-of-ways.

#### C. Dewatering:

1. Remove all water, including rainwater, encountered during trench and substructure work to an approved location by pumps, drains, and other approved methods.
2. Keep excavations and site construction area free from water.

#### D. MDNR Land Disturbance Permit:

1. The project will result in disturbance of one (1) or more acres of land and will require compliance with the National Pollutant Discharge Elimination System (NPDES) Storm Water Permit.
  - a. The Contractor and will be required to certify that he/she understands and will comply with all requirements of the permit.

- b. The Contractor shall be responsible for developing and implementing a storm water pollution prevention plan in accordance with good engineering practice.
- c. The plan shall identify potential sources of pollution, which may be expected to affect the quality of storm water discharges. In addition, the plan shall describe and ensure the implementation of practices which will be used to reduce the pollutants in the storm water discharges associated with the project. A copy of the permit form and a sample plan if not a part of these specifications can be obtained at the A/E's office.

### 3.4 TOPSOIL STRIPPING

#### A. Stripping and Salvaging Topsoil:

1. Mow all weeds, grass, and growing crops or other herbaceous vegetation close to the ground and remove from the site. Shred sod by shallow plowing or blading and thorough disking. Thoroughly shred to allow the soil to be easily spread in a thin layer over areas to be covered. If allowed by the Engineer, herbicides may be applied, and vegetation may be incorporated into the topsoil.
2. Remove an adequate amount of topsoil from the upper 8 inches of existing on-site topsoil to allow finish grading with a finished grade of 8 inches of salvaged or amended topsoil. The topsoil may be moved directly to an area where it is to be used, or may be stockpiled for future use.

#### B. Preparation for Topsoil Placement:

1. Finish excavation and embankment work according to the specified grades and cross sections; grade and slope all surfaces to drain away from buildings and prevent ponding. Conform to the grading plan within  $\pm 2$  inches.
2. Loosen surface to a minimum depth of 4 inches to reduce compaction.

#### C. Topsoil Spreading and Finish Grading:

1. Place the topsoil after all grading and trenching activities in the area have been completed.
2. Place topsoil at least 8 inches deep; smooth and finished grade according to the contract documents. If topsoil is being amended with compost, thoroughly blend compost with on site topsoil at the rate specified
3. After finish grading the topsoil, remove clods, lumps, roots, litter, other undesirable material, or stones larger than 1 inch (1/2 inch for turfgrass).
4. Excess topsoil shall be removed offsite or incorporated into the embankment, if acceptable, in areas not requiring structural fill.

### 3.5 EXCAVATING

#### A. Perform excavation within the project limits to the lines, grades, and elevations indicated and specified herein.

#### B. Excavated Materials:

1. Satisfactory materials shall be used for fill or embankments within the project limits.
2. Unsatisfactory materials shall be excavated to a depth below grade sufficient to provide a suitable subgrade support, and fill and compact with satisfactory materials.

C. Surplus materials:

1. Dispose of unsatisfactory excavated materials, and surplus excavated material, offsite at disposal areas arranged and paid for by the Contractor.

D. Drainage:

1. Provide temporary drainage facilities to prevent damage to public or private interests when necessary to interrupt natural drainage or flow of artificial drains.
2. Excavate and fill in a manner and sequence that will provide proper drainage at all times.
3. Restore original drainage as soon as work allows.

E. Off-site Borrow:

1. Obtain material required for fill or embankment in excess of that produced within the grading limits of the project from borrow areas selected and paid for by the Contractor and approved by the Owner or his/her representative. The Contractor shall obtain written agreements from the property owners for the removal of the materials.

F. Stability of Excavations:

1. Perform excavations in accordance with OSHA excavating rules and regulations.
2. Slope sides or shore and brace where sloping is not possible because of space restrictions of stability of the materials being excavated.
3. Maintain sides and slopes of excavations in a safe condition until completion of filling.

G. Excavating for Structures:

1. Excavate to elevations and dimensions shown for building pad within a tolerance of 0.05ft., and extending a sufficient distance from footings and foundations to permit placing and removing concrete formwork, installation of services and for inspection.
2. Excavation for footings and foundations shall not disturb the bottom of the excavation:
  - a. Excavate and trim with hand tools as necessary to final grade just before concrete is placed.

H. Excavating for pavements:

1. Excavate subgrade under pavements to within 0.05 ft of the proposed subgrade.
2. Prepare subgrade as specified herein.

I. Cold weather protection:

1. Protect excavation surfaces from freezing when an atmospheric temperature is less than 35 degrees F.

3.6 EMBANKMENT

A. Fill excavations as promptly as progress of the Work permits, but not until:

1. Acceptance of construction below finish grade.
2. Concrete formwork is removed.
3. Shoring and bracing are removed, and voids have been backfilled with satisfactory materials.

4. Trash and debris have been removed.

B. Subgrade Preparation:

1. Remove vegetation, topsoil, obstructions, and deleterious materials from the ground surface prior to placement of embankment per Section 3.4 of this specification.
2. Disk excavated area to a depth of 8", unless sand or aggregate. Proof roll and prepare the surface per Section 3.8-D of this specification. Unsuitable material or material not achieving the specified stability, density and moisture requirements after three consecutive good drying days of moisture conditioning and compaction, consisting of at least two processing's utilizing discs or tillers, shall be removed and/or replaced, or shall be further treated per instructions of the soils engineer. Additional work or materials required after the three day conditioning period to stabilize the material, when approved in writing by the Owner or his/her representative, shall be performed and paid for in accordance with the General Conditions.

C. Subgrade Treatment:

1. Lime, Cement, or Fly Ash:
  - a. Incorporate the subgrade treatment material uniformly during subgrade preparation to the depth and rate specified in the contract documents.
  - b. Place subgrade treatment in the areas as specified or as directed by the Engineer.
2. Geogrid or Geotextiles:
  - a. Install according to manufacturer's recommendations, on top of the prepared subgrade.
  - b. Geogrid shall only be utilized when the aggregate base thickness will have a minimum of six (6) inches thick in order to prevent it from popping through the aggregate base. Minimum lap shall be 12" and minimum sewn lap shall be 4" or as specified by the manufacturer.
  - c. Place subgrade treatment in the areas as specified or as directed by the Engineer.

D. Placing and compacting:

1. Place fill materials in layers not more than 8" in loose depth, unless otherwise approved by the A/E.
2. Before compacting, moisten or aerate each layer as necessary to provide the specified moisture content.
3. Compact each layer to required percentage of maximum density for the area.
4. Do not place backfill or fill material on surfaces that are muddy, frozen, or containing frost or ice.
5. Place backfill and fill materials evenly adjacent to structures, to required elevations.
6. Prevent wedging action of backfill against structures by carrying the material uniformly around the structures to approximately the same elevation in each lift.
7. The building embankment shall be constructed at minimum 5 feet beyond the proposed building line and pending approval of the compacted fill, shall be cut back at a 1:1 slope extending from the top of the proposed footing to 4 feet inside the building wall.
8. Placement of granular drainage material beneath the floor slab will be completed by the Building Contractor.

3.7 GRADING

A. General:

1. Uniformly grade the areas within project limits under this Section, including adjacent transition areas.
2. Finished surfaces within specified tolerance.
3. Compact with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades.
4. Where a change of slope is indicated on the Drawings, construct a rolled transition section having a minimum radius of approximately 8'-0", unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage.

B. Grading inside building lines:

1. Provide drainage away from structures during construction of the embankments to prevent ponding.
2. Finish surface within 0.05 foot of the proposed subbase elevation.

C. Grading outside building lines:

1. Provide drainage in areas adjacent to buildings away from the structures, and to prevent ponding.
2. Finish areas under walks and pavements to within 0.05 ft above or below the required subgrade elevation.

3.8 COMPACTING

A. Control material compaction during construction to provide the minimum Standard Proctor Density (SPD) specified, within moisture requirements, for each area as determined according to (ASTM D 698).

B. Provide not less than the following minimum densities for layer or lift of material placed:

Compaction Recommendation Summary – Building Floor Slabs

Description	ASTM D 698	Moisture Content from Optimum
Building Subgrades (Top 12")	95%+	0% to +5%
Structural Fill/LVC	95%+	-2% to +4%
Footing Overexcavation Backfill	98%+	±2%

Compaction Recommendations Summary – Synthetic Field Turf

Description	ASTM D 698	Moisture Content from Optimum
Turf Subgrade (Top 12")	95-100%	0% to +5%
Structural Fill/LVC	95%+	-1% to +4%
Chemically Modified Soils (i.e. Lime Stabilized)	95%+	-2% to +5%

Compaction Recommendations Summary – Synthetic Athletic Track Subgrade

Description	ASTM D 698	Moisture Content from Optimum
Track Subgrade (Top 12")	97%+	±3%
Structural Fill	95%+	-2% to +4%
Aggregate Base (Track)	98%+	±2%
Chemically Modified Soils (i.e. Lime Stabilized)	95%+	-2% to +5%

C. Moisture control:

1. Moisture content for compaction purposes shall be within the ranges noted above as established by ASTM D 698.
2. Existing ground surface or embankment layer of material if necessary shall be moisture-conditioned before compacting by:
  - a. For material below specified moisture parameters, uniformly apply water to surface of the material and incorporate with a disk or tiller.
  - b. For material above the specified moisture parameters, air dry with disks and tillers or replaced with acceptable onsite soils at the Contractors expense. If moisture reduction is unable to be achieved after multiple attempts, due to temperature or excessive weather conditions the A/E may approve another method.
3. Process material to provide uniform moisture and clod reduction throughout.
4. Unsuitable material removed due to high moisture may be spread and allowed to dry until suitable.

D. Proof roll:

1. Prior to placement of granular subbase material on building and pavement areas, the subgrade shall be "proof rolled" with a minimum 25 ton gross vehicle weight (G.V.W.) truck to identify areas of soft or unstable subgrade. Permanent rutting in excess of 1" should be considered failure. Elastic (rebound) movement or rutting in excess of 1" with substantial cracking or substantial lateral movement should be considered failure. Rutting and cracking greater than detailed above is considered "pronounced elasticity." Elastic, rebound, or rolling movement is always associated with excess water in the subgrade system. Failing areas detected by proofrolling should be immediately repaired and retested or removed and replaced with suitable material.

3.9 FIELD QUALITY CONTROL

- A. The Owner shall provide testing services of a soils engineer and/or independent laboratory approved by the Owner.
- B. Upon completion of each test and/or inspection, promptly distribute copies of test or inspection reports to the A/E.
- C. Testing Requirements:
  1. Pentrometer Tests:
    - a. 1 per each spread footing.

- b. 1 per 25' of lineal footing.
- 2. Standard Proctor Density/Moisture (ASTM D 698):
  - a. 1 per the insitu fill material.
  - b. 1 per each source of offsite fill material.
- 3. Field density/moisture tests ASTM D 2922 and ASTM D 3017 (nuclear) or ASTM D 1556 (sand cone) and ASTM D 2216 (moisture content):
  - a. Paved Areas: 1 per 5000 sq ft per 8" lift.
  - b. Building Area: 1 per 2500 sq ft per 8" lift.
- 4. Liquid Limit and Plasticity Index
  - a. Building Area: 1 per each source of offsite fill material.

### 3.10 MAINTENANCE

- A. Protection of newly graded areas:
  - 1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds;
  - 2. Repair and reestablish grades in settled, eroded, and rutted areas to the specified tolerances.
- B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

### 3.11 CERTIFICATION

- A. Upon completion of this portion of the work, and as a condition of its acceptance, deliver to the Owner or his/her site representative a written report from the independent soils engineer or testing laboratory certifying that the compaction requirements have been obtained. Include in the report the soil classification, standard proctor density, optimum moisture content and plasticity index of the onsite and borrow materials used in the areas of embankment,

END OF SECTION 312300

**SECTION 312379  
TRENCHING, BACKFILLING, AND COMPACTING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Trench, backfill, and compact as specified herein and as needed for installation of underground pipelines and utilities associated with the Work.
- B. Related work:
  - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Division 01 - General Requirements of these Specifications.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.
- C. Comply with requirements of governmental agencies having jurisdiction.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Comply with pertinent provisions of Section 016600.

**PART 2 - PRODUCTS**

2.1 GRANULAR PIPE BEDDING AND COVERING MATERIALS

- A. Provide well graded, washed, mixture of gravel or crushed stone aggregate free of clay, loam, dirt, calcareous or other foreign matter conforming to the MoDOT "Standard Specifications" Type 5, or the Standard Specifications for Water and Sewer Construction in Illinois, with the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
1-inch	100%
3/4-inch	84 - 100%
1/2-inch	30 - 60%
No. 4	0 - 12%
No. 16	0 - 6%

- 1. For flexible thermoplastic pipes including sewer pipes, sewage force mains, and water mains: Comply with ASTM D2321, Class I or II as modified below.

- a. Exclude sharp angular granular materials.
  - b. Limit maximum particle size to 1/2-inch.
  - c. Do not use Class II materials in wet conditions.
2. For rigid pipes comply with ASTM C12, Bedding Class B.

## 2.2 EXCAVATED BACKFILL MATERIALS

- A. Provide soil materials free from organic matter, rubble, or frozen material, containing no rocks or lumps over 6 inches, and with not more than 15 percent of the rocks or lumps larger than 2-3/8 inches.

## 2.3 GRANULAR BACKFILL

- A. Provide either pit run gravel or granular material:
1. Pit run gravel: Free from organic matter, cohesionless granular material obtained from natural deposits of sand and gravel, passing 3/4-inch sieve, and not more than 15 percent passing the No. 200 sieve.
  2. Granular material: Use 100 percent crushed stone or gravel complying with the MoDOT "Standard Specifications" Type 5.

## 2.4 FLOWABLE FILL TRENCH BACKFILL MATERIALS

- A. Provide controlled low-strength material (CLSM) where shown on the Drawings.
1. Provide a portioned cement, fly ash, fine aggregate and water mix.
  2. Comply with MoDOT Standard Specification for material mix design criteria, and testing.
    - a. Acceptable products: Geofill by MixOnSite.
    - b. Or equal.

## 2.5 TEMPORARY PAVEMENT MATERIAL

- A. Provide well graded, 100 percent crushed gravel or crushed stone aggregate free of clay, loam, dirt, calcareous or other foreign matter conforming to the MoDOT "Standard Specifications" Type 5

## 2.6 GEOTECHNICAL FABRIC

- A. Provide geotechnical fabric for separation of granular material and native soil in areas where trench is over-excavated to remove unsuitable materials.
1. Acceptable manufacturers:
    - a. Mirafi: 160N.
    - b. Synthetic Industries: 601.
    - c. Amaco: 4551.

## 2.7 WATER MAIN REPAIR

- A. Repair water main or water services damaged during construction utilizing products of type and manufacturers as approved by the Owner.
- B. Pipe couplings for joining of sections of cut water main where a section of new pipe is used to replace a broken pipe.
  - 1. Acceptable manufacturers:
    - a. Dresser Style 38.
    - b. Smith-Blair CC-441.
    - c. Or equal.
- C. Repair clamps for broken or cracked pipe and sealing of existing corporation stop opening.
  - 1. Use full-circle single band all stainless steel clamps.
  - 2. Acceptable manufacturers:
    - a. Dresser Style 360.
    - b. Smith-Blair 200 Series.
    - c. Or equal.
  - 3. Replace damaged service corporation stops by installation of full-circle single band all stainless steel clamps, with service outlet, matching manufacturer's and styles used for repair of a cracked pipe.

## 2.8 DRAIN TILE REPLACEMENT

- A. Replacement pipe: New pipe of the same size. Match material or use new PVC SDR-26 pipe per ASTM D3034.
- B. Utilize flexible couplings with stainless steel bands for connecting new pipe to old pipe.
- C. Provide Type 5 aggregate for backfill material.

## PART 3 - EXECUTION

### 3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

### 3.2 GENERAL CONSTRUCTION REQUIREMENTS

- A. Protection of existing facilities:
  - 1. Unless shown to be removed, protect existing structures, conduits, active utility lines and all other facilities shown on the Drawings or otherwise made known to the Contractor. If

- damaged, repair, replace, or restore to a condition equal to or better than the original condition at no additional cost to the Owner.
2. Notify all persons, firms, corporations, or agencies owning or using any existing structures, conduits, or utilities which may be affected by the Work prior to the start of construction.
  3. Make arrangements to locate, maintain, protect, and/or relocate facilities in order to complete the Work.
  4. Make such exploration as is necessary to determine the exact location of underground utilities.
  5. Exercise care during the progress of work in the area to prevent damage to the utilities.
  6. Whenever it becomes necessary to relocate underground gas mains, telephone conduit, or electrical lines or support or relocate utility poles, the utility company involved will make such relocation or provide pole support. Notify the utility company promptly.
  7. Whenever it becomes necessary to relocate water or other pipes or conduits in direct conflict with the proposed pipe (exclusive of culverts) which are not shown on the Drawings, obtain the direction from the Engineer for the relocation. Compensation will be allowed only for such quantities as directed by the Engineer.
  8. Do not block or obstruct sidewalks, streets, and pavements.
  9. Whenever during construction operations any loose material is deposited in the flow line of gutters, drainage structures, or ditches such that the natural flow line of water is obstructed, remove this loose material at the close of each working day. At the conclusion of construction operations, keep all drainage structures and flow lines free from dirt and debris.
  10. Do not obstruct accessibility of fire hydrants.
  11. Maintain access to adjacent areas at all times.

B. Protection of Trees and Shrubs:

1. Protect trees and shrubs from damage.
2. Do not remove trees or shrubs unless indicated on the Drawings or authorized in the field by the Engineer.
3. Where trees which are to remain interfere with normal excavation operations, use the following procedures:
  - a. Prior to excavation, carefully remove trees with trunk diameters of less than 4 inches, shrubs, and other plantings in the way of construction.
  - b. Do not machine excavate within a distance of three trunk diameters or 12 inches (whichever is greater) of any tree, and do not cut roots over 2-inch diameter unless approved by the Engineer.
  - c. Excavate by hand when closer than three tree trunk diameters or 12 inches (whichever is greater).
  - d. Tree tunneling where necessary to be determined by the Engineer.
  - e. Tie back shrubs and tree limbs to prevent loss or damage.
  - f. Prune and seal damaged limbs and branches.
  - g. Provide plank wrappers wired in place to protect tree trunks from being damaged by trench machinery, tractors, or trucks; remove protective planking as soon as practical after work in vicinity has been completed.
  - h. Remove spoil banks from around trees by hand to prevent damage to trunks by construction machinery.
4. Replace trees and shrubs which cannot be protected or are damaged during construction:
  - a. Replant or replace with stock of like character, quality, variety, size, shape, color and condition upon completion of the construction.

- b. Replace 4-inch diameter and larger trees with one 4-inch diameter size tree for each 6" of original tree diameter or fraction thereof.
  - c. Replace trees smaller than 4-inch diameter and shrubs with same kind and type.
  - d. As an option, replant trees smaller than 2-inch diameter or shrubs which are not damaged.
5. Remove and replace trees and shrubs which do not survive in good condition for a period of 18 months after time of planting.

C. Work on private property:

1. Construct work on private property within easements obtained by the Owner as shown on the Drawings.
  - a. The Contractor will be permitted construction privileges within construction easement lines as shown on the Drawings.
  - b. Perform the work in a manner such as to minimize damage to lawns, shrubs, trees and other plantings, driveways, sidewalks, fences, outbuildings, and any other miscellaneous improvements, using proper size and type of equipment.
  - c. The Engineer has the authority to prohibit the use of any equipment which in his judgment is too large or otherwise unsuitable for the conditions of the work on private property.
2. Remove and replace fences, outbuildings and other miscellaneous improvements in the way of construction to the satisfaction of the property owner.
3. When working in cultivated fields or gardens remove original topsoil to a depth of 12 inches prior to excavation, and replace the topsoil to its original depth and grade upon completion of trench backfill.
4. Restore the private property to its original condition or better, free of debris, stones and excess materials.

### 3.3 TRENCHING

- A. Do not advance trench excavation more than 50 feet ahead of completed pipe installation except as approved by the Engineer.
- B. Provide and maintain sheeting, shoring, and bracing necessary for protection of the Work, adjacent property, and for the safety of personnel.
  1. Remove temporary sheeting and bracing after backfilling to an elevation which will prohibit caving of exposed sidebanks.
  2. Fill voids left by the withdrawal of sheeting with compacted sand.
  3. The Engineer may direct that supports in trenches be cut off at any specific elevation to protect adjacent facilities or property. Compensation for support left in place will be negotiated.
  4. No extra payment will be made for the supports left in place without the direction of the Engineer.
  5. Do not leave supports within 4 feet of the ground or pavement surface in place without the permission of the Engineer.
- C. Provide pumping, bailing, wellpointing, and construct ditches and dikes required to dewater and drain ground water, sewage, or storm water to keep the excavation and site dry for the completion of the Work.

D. Excavation:

1. Excavate by open cut unless otherwise indicated on the Drawings.
2. Excavate trenches to the depths and grades necessary for the pipelines with allowances for bedding material.
  - a. Comply with the following minimum depth of cover unless otherwise noted on the Drawings.
  - b. Water pipelines: 4'-6" feet.
  - c. Sewage and sludge pressure piping: 4 feet.
  - d. Air and gas piping: 3 feet.
  - e. Electrical or wiring conduits and cables: 30 inches.
3. Over-excavate organic, soft, spongy, or otherwise unsuitable soils found at or below the bottom of the trench to meet firm subsoil or as directed by the Engineer.
4. Comply with the following maximum trench widths at the top of pipelines:

<u>Nominal Pipe Sizes (inches)</u>	<u>Trench Widths (inches)</u>
12 or smaller	30
14 - 18	36
20 - 24	42
27 - 30	48
33 and larger	1-1/3 times pipe OD

5. Where the trench width exceeds the maximum limitations, provide higher strength pipe, or embed or cradle the pipe in concrete to achieve the necessary load factor as determined by the Engineer at no additional cost to the Owner.

3.4 EXCAVATION FOR APPURTENANCES

- A. Excavate for manholes and similar structures to the depths as shown on the Drawings and to a distance sufficient to leave at least 12 inches clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.
- B. Over-depth excavation beyond depths indicated on the Drawings that has not been directed will be considered unauthorized. Fill with sand, gravel, or lean concrete as directed by the Engineer, and at no additional cost to the Owner.

3.5 BEDDING AND COVERING OF PIPE

A. General:

1. Bedding is defined as the shaped and tamped material which supports the pipes. Covering is defined as the compacted material which protects and covers the pipes.
2. Provide continuous bedding and covering for underground pipelines, except where concrete encasement, concrete cradles, boring or jacking are indicated.

B. Pipe bedding:

1. Provide compacted granular pipe bedding and covering material with a minimum thickness of 4 inches under pipe barrels and 2 inches under bells.

2. Wherever the trench is over-excavated due to the removal of unsuitable material, refill the excavated area to the bottom of the pipe bedding with material conforming to the MoDOT "Standard Specifications" gradation.
3. Wherever the trench is over-excavated to remove unsuitable material, install geotechnical fabric between native soil and granular material:
  - a. Install fabric to cover bottom and sides of trench to heights as follows:
    - 1) For all flexible pipe and rigid pipe 24-inch and smaller: to envelop entire bedding and covering material and overlap 1-foot at the top.
    - 2) For rigid pipe 27-inch and larger to cover bedding material and from sides of trench to edge of pipe.
    - 3) Where undercut is of a depth that requires more than one piece of fabric to provide envelope, provide sewn seams between sections of fabric.
4. Wherever two or more pipes or conduits are placed in the same trench or excavated area, backfill the trench with granular pipe bedding and covering material to support the uppermost pipe or conduit.
5. Provide sand bedding with a minimum thickness of 3 inches under electrical and wiring conduits and cables.

C. Pipe covering:

1. Following placement of pipe and inspection of joints, provide compacted granular pipe bedding and covering material for the full width of the trench to the following levels unless otherwise shown on the Drawings:
  - a. For pipes sizes 24-inch and smaller, except flexible thermoplastic pipe: To 4 inches above the top of the pipe.
  - b. For pipes sizes 27-inch and larger, except flexible thermoplastic pipe: To the horizontal centerline of the pipe.
  - c. For flexible thermoplastic pipes, including ABS and PVC composite pipe, PVC plastic pipe, and other flexible type pipe: To 12 inches above the top of the pipe.
  - d. If compacted excavated materials are used for backfilling under the pavement as indicated on the Drawings: To 12 inches above the top of the pipe for all pipe sizes.
2. Place granular pipe bedding and covering material in uniform loose layers not exceeding 8 inches thick.
  - a. Compact each layer firmly by ramming or tamping with tools approved by the Engineer in such a manner as not to disturb or injure the pipe to yield a minimum density of 95 percent of maximum dry density as determined according to ASTM D1557 or AASHTO-T180.
3. Where trench is widened by installation of structures or jacking pits, extend bedding and covering materials to total width of excavations.

### 3.6 TRENCH BACKFILLING AND COMPACTING

A. General:

1. Backfill trench from the top of pipe cover to topsoil, paving subgrade, or foundation level.

2. If trenches settle during the period of construction and within the guarantee period of the work, fill trench back to the surrounding grade, and restore the surfaces.
- B. For trench in lawns, parkways, and other improved areas not subject to vehicular traffic:
1. Backfill with excavated materials in uniform loose layer not exceeding 12 inches thick.
  2. Compact each layer of trench backfill materials to yield a minimum of 85 percent of maximum dry density as determined according to ASTM D1557 or AASHTO-T180.
- C. For trench in unimproved areas and cultivated fields:
1. Backfill with excavated materials.
  2. Provide crowned surface to compensate for settlement.
- D. For trench in streets, parking areas, driveways, sidewalks, curb and gutter, or within 2 feet of any proposed curb and gutter, sidewalk, or other paved areas:
1. Backfilling with granular backfill materials:
    - a. Place in uniform loose layer not exceeding 12 inches thick and compact with vibrating roller or equivalent.
    - b. Water jetting may be used in lieu of vibratory compaction when approved by the Engineer.
      - 1) Demonstrate jetting procedures before beginning operation.
      - 2) Place and jet in maximum lift of 6 to 8 feet.
      - 3) Do not place paving until surface settlement has occurred or a minimum of 30 days after jetting.
    - c. Fill the top 12 inches of trenches with temporary pavement material.
  2. Compacting requirements:
    - a. Compact each layer of trench backfill materials to yield a minimum density of 90 percent of maximum dry density as determined according to ASTM D1557 or AASHTO T-180.
    - b. Determine the density of compacted backfill at intervals of not more than 500 feet at locations selected by the Engineer.
    - c. Provide the services of an independent testing laboratory for the density tests complying with the pertinent provisions of Section 014529.
  3. Maintain temporary pavement level with adjoining pavement surfaces until the permanent pavement is placed.
- 3.7 BACKFILL AND BEDDING FOR APPURTENANCES
- A. Provide 3 inches of sand or granular bedding material unless otherwise shown on the Drawings.
  - B. Do not backfill until new concrete has properly cured, and any required tests have been accepted.
  - C. Backfill in lawns and landscaped areas with excavated materials.

- D. Backfill in pavement around manholes, catch basins, inlets, valve vaults, and other structures as directed by the Engineer with special granular backfill materials.

### 3.8 FINISH GRADING

#### A. General:

1. Provide finish grading and filling to achieve the lines and grades.
2. Slope grades to drain away from structures.
3. Replace culverts damaged during the construction with new culverts as specified in Section 334213 of the Specifications.

#### B. Finish grading:

1. Except where mounding over trenches is specified, grade smooth areas of the Work including previously grassed areas that have been disturbed, and adjacent transition areas.
2. Fill and compact depressions from settlement and round tops of embankments and breaks in grade.
3. Protect newly graded areas from traffic and erosion. Repair settlement or washing away that may occur prior to surface restoration and re-establish grades to the required elevations at no additional cost to the Owner.

#### C. Disposal of waste excavated material:

1. Remove unsuitable and surplus excavated materials not used for backfilling from the project site.
2. Do not deposit on public or private property without written permission from property owner or authorized representative of appropriate public agency.

### 3.9 WATER MAIN REPAIR

- A. Whenever existing water mains and water service pipes are damaged during construction, stop the pipe installation work and immediately repair the damaged portion of the existing piping.
- B. Contact the Engineer and Owner immediately to report the location and extent of the damage.
- C. Repair the water main with methods complying with Missouri DNR standards, and any additional requirements required by the Owner.
- D. Utilize only materials of repair as noted in the products section of this specification or as dictated by the Owner.
- E. Where water services have been stripped or pulled from the water main, replace the corporation stop as instructed by the Engineer and Owner, and replace the water service pipe to a point as directed by the Owner.
- F. Comply with disinfection requirements as dictated by the Owner.
- G. Do not cover the repair until work is inspected and approved by Owner.

### 3.10 ROCK EXCAVATION

- A. Rock excavation is classified as excavation requiring blasting or jack hammering to remove solid rock formations such as boulders, concrete, or solid masonry exceeding one cubic yard in volume.
- B. Allowable trench width for open trench excavation:
  - 1. For pipes up to 18 inches ID: 30 inches.
  - 2. For larger pipes: The outside diameter of the pipe plus 8 inches.
  - 3. Pipe bedding: 6 inches below the bottom of the pipe.
  - 4. Manholes and similar structures not requiring formwork: 1-foot outside such structures.
- C. Lay pipelines constructed in trenches in rock to the grades shown on the Drawings on a continuous bed of compacted gravel or crushed stone.
  - 1. Dispose of excavated rock; do not use as backfill.
- D. Blasting:
  - 1. Comply with rules and regulations of authorities having jurisdiction.
    - a. Issue signals of danger before firing a blast.
    - b. Do not blast adjacent to any portion of the completed work unless proper precautions are taken to protect the work.
    - c. Use only persons who are licensed as required by state or local regulations, and who are experienced in the techniques of blasting, to perform blasting operations.
  - 2. Repair or reconstruct structures, pipelines, or other property damaged by blasting operations.

### 3.11 DRAIN TILE REPLACEMENT

- A. Replace all drain tile disturbed or damaged with new pipe of the same size, at same grade and slope, and utilizing flexible couplings for connection to existing pipe.
- B. Indicate location, depth, and size of drain tile on Job Set of plans.
- C. Provide aggregate backfill from bottom of trench to a minimum of 12 inches above new drain pipe.
- D. Inform Engineer immediately when drain tiles are encountered as a part of the trenching operation.
  - 1. Drain tile repair conducted without the observance of the Engineer will not be paid for.

END OF SECTION 312379

## SECTION 313700 ROCK DITCH LINER

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The work covered by this section consists of furnishing all plant, labor, equipment, and materials, and performing all operations in connection with the construction of stone protection for the areas shown on the Drawings and in accordance with these specifications.

### PART 2 - PRODUCTS

#### 2.1 ROCK DITCH LINER

- A. The rock ditch liner shall meet the following requirements for the MoDOT Standard Specifications, current edition or 2022:
  - 1. Section 609.60.2.1 Type 1 Rock Ditch Liner shall consist of material with a predominant rock size of 3 inches, a maximum rock size of 6 inches and a gradation such that no more than 15 percent will be less than one inch.
  - 2.
  - 3. Section 609.60.2.2 Type 2 Rock Ditch Liner shall consist of material with a predominant rock size of 6 inches, a maximum rock size of 10 inches and a gradation such that no more than 15 percent will be less than 3 inches.
  - 4.
  - 5. Section 609.60.2.3 Type 3 Rock Ditch Liner shall consist of material with a predominant rock size of 12 inches, a maximum rock size of 20 inches and a gradation such that no more than 15 percent will be less than 4 inches.
  - 6.
  - 7. Section 609.60.2.4 Type 4 Rock Ditch Liner shall consist of material with a predominant rock size of 19 inches, a maximum rock size of 28 inches and a gradation such that no more than 15 percent will be less than 6 inches.
- B. All stone for the protection work shall be of a hard, durable quality such as will not disintegrate under the elements or be easily broken in handling. It shall be clean and free from earth, dust, or other refuse. The faces of individual pieces of stone shall be roughly angular, not rounded in shape. Field stone will not be accepted. The stone meeting the requirements herein shall be as designated by the Missouri Department of Transportation. Standard specifications, 2022. Broken concrete is not acceptable material.

### PART 3 - EXECUTION

#### 3.1 ROCK DITCH LINER PLACEMENT

- A. Subgrade shall be graded to elevations shown on the drawings.
- B. Keys shall be excavated to elevations shown on the drawings.

- C. All excavated spoil shall be placed in an area designated by the Owner. Spoil materials shall be graded to provide a smooth transition and shall be suitable for seeding.
- D. The rock ditch liner shall be placed to the lines and grades shown on the drawings.
- E. The rock ditch liner shall be placed to achieve the depth shown on the drawings.
- F. The final surface shall be free of mounds and windrows using hand or machine leveling as required to achieve a uniform, reasonably even surface.
- G. The rock ditch liner shall be placed beginning at the bottom of the slope working upward using a method to minimize segregation of the various sized rock ditch liner components.
- H. Excess handling or the passage of heavy equipment over the rock ditch liner which cause breakage of the stones shall be avoided.
- I. Compaction of the rock ditch liner is not required.
- J. Fill slopes above rock ditch liner as required to produce the grades indicated on the Drawings.

END OF SECTION 313700

**SECTION 321123  
AGGREGATE BASE COURSES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Provide aggregate base courses on a prepared subbase where shown on the Drawings, and as specified herein.

1.2 SUBMITTALS

- A. Comply with pertinent provisions of other Sections
- B. If requested by the Engineer/Architect (A/E), within 15 calendar days after the Contractor has received the Owner's Notice Award, submit:
  - 1. Certifications of material compliance for:
    - a. Aggregate base course
    - b. Geotextile fabric
    - c. Geogrid materials

1.3 REFERENCES

- A. Standard Specifications for Highway Construction, Current Edition, Missouri Department of Transportation (MoDOT) herein noted as the Standard Specifications.

**PART 2 - PRODUCTS**

2.1 MATERIALS

- A. Geotextile Fabric: As specified in Section 312300 Excavation and Fill.
- B. Geogrid Material: As specified in Section 312300 Excavation and Fill.
- C. Aggregate Base Course:
  - 1. MODOT TYPE 5.

**PART 3 - EXECUTION**

3.1 SUBGRADE PREPARATION

- A. Subgrade preparation shall be in accordance with Section 3.6 of 312300 Excavation and Fill of these specifications.

### 3.2 GEOTEXTILE FABRIC

- A. Geotextile fabric when specified shall be placed on the prepared subbase prior to placement of the aggregate base course. Fabric of insufficient width or length to fully cover the specified area shall be lapped or sown. Minimum lap shall be 12" and minimum sewn lap shall be 4".
- B. Placement of the base course on the fabric shall be accomplished in a manner as to prevent tearing or shoving of the material. Fabric damaged shall be repaired or replaced prior to placement of the base course.

### 3.3 GEOGRID

- A. Geogrid when specified shall be placed on the prepared subbase prior to placement of the aggregate base course. When geogrid is used for stabilization, the aggregate base thickness shall be a minimum of six (6) inches thick in order to prevent it from popping through the aggregate base. Minimum lap shall be 12" or as specified by the manufacturer.

### 3.4 AGGREGATE PLACEMENT

- A. General: The aggregate shall be uniform in gradation. The base course shall be constructed in layers not more than four (4) inches thick when compacted, except that if tests indicate that the desired results are being obtained, the compacted thickness of any layer may be increased to a maximum of six (6) inches. When placed, it shall be free from segregation and shall require minimum blading or manipulation. Immediately after the material has been placed, it shall be compacted with a tamping roller, a vibratory machine or combination of the two.
- B. Compaction: Before the aggregate is deposited on the subgrade, the aggregate shall contain the amount of moisture required for compaction. The granular material shall be compacted to not less than 98 percent of the Standard Laboratory Density, determined in accordance with ASTM D 698. If test indicate that the base course does not comply with the density requirements, additional wetting, if necessary, and rolling will be required until the density is obtained. Moisture shall be added to the material during compaction only when it is necessary to increase the percentage of moisture to obtain the required density.
- C. Staging: The aggregate base shall initially be placed and compacted to 90% of the design thickness shown on the Drawings. The remaining 10% of the aggregate base and final finishing shall be completed after the curbs and driveways are installed. The final surface shall be within + or - 0.5".
- D. Flatness: Maximum variation of 1/2 inch measured with 10-foot straight edge.

### 3.5 FIELD QUALITY CONTROL

- A. The Owner will provide testing services of a soils engineer and/or independent laboratory for this project.
- B. Upon completion of each test and/or inspection, promptly distribute copies of test or inspection reports to the A/E.
- C. Testing Requirements:

1. Determine moisture-density relationships by ASTM D 698 (Standard Proctor). Perform at least one test for each type of material used.
2. Provide not less 98% of maximum density of material compacted at optimum moisture content for the actual density of each layer of material in place.
3. Field density/moisture tests (ASTM D 6938):
  - a. Aggregate Base: 1 per 5000 sq ft.

END OF SECTION 321123

**SECTION 321216**  
**ASPHALT PAVING**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Section Includes:

1. Cold milling of existing hot-mix asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt paving overlay.
5. Pavement-marking paint.

B. Related Sections:

1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
2. Job-Mix Designs: For each job mix proposed for the Work.

B. Material Certificates: For each paving material, from manufacturer.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer certified with and approved by MoDOT.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Missouri Standard Specifications for Highway Construction, Current Edition, as published by the Missouri Department of Transportation for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

C. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
  - 1. Tack Coat: Minimum surface temperature of 60 deg F.
  - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
  - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials 55 deg F for water-based materials, and not exceeding 95 deg F.

### PART 2 - PRODUCTS

#### 2.1 AGGREGATES

- A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- B. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
- C. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

#### 2.2 ASPHALT MATERIALS

- A. Asphalt Binder: BP-1, PG 64-22.
- B. Asphalt Surface: BP-2, PG 64-22.
- C. Tack Coat: ASTM D 977 emulsified asphalt or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

#### 2.3 AUXILIARY MATERIALS

- A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.
- B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.
  - 1. Color: White.
- C. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
  - 1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

## 2.4 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:
  - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  - 2. Base Course: BP-1.
  - 3. Surface Course: BP-2.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- B. Proceed with paving only after unsatisfactory conditions have been corrected.

### 3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
  - 1. Mill to a depth of 2 inches.

### 3.3 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
  - 1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

- D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

### 3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.5 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
  - 1. Spread mix at minimum temperature of 250 deg F.
  - 2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
  - 1. Clean contact surfaces and apply tack coat to joints.
  - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
  - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
  - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

### 3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
  - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
  - 1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.8 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  - 1. Base Course: Plus or minus 1/2 inch.
  - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: 1/4 inch.
  - 2. Surface Course: 1/8 inch.
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

### 3.9 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

- B. Allow paving to age for 30 & 90 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
  - 1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

### 3.10 WHEEL STOPS

- A. Install wheel stops in bed of adhesive as recommended by manufacturer.
- B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Replace and compact hot-mix asphalt where core tests were taken.
- C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### 3.12 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 321216

## SECTION 321217 AGGREGATE SURFACE COURSE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Provide aggregate surface course where shown on the Drawings, and as specified herein.
- B. Work shall consist of preparing the completed subgrade. It shall include shaping and final compaction of the subgrade material for the construction of the surface course.

#### 1.2 REFERENCES

- A. *Standard Specifications for Highway Construction, 2022*, Missouri Department of Transportation (MODOT) herein noted as the Standard Specifications.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Provide materials in accord with referenced Articles in the Standard Specifications.
- B. Aggregate:
  - 1. Section 1007-Type 5

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. The entire subgrade shall be prepared by removing all vegetation, filling all depressions, and bringing the surface to grade. Soft and unsuitable material that will not compact when rolled or tamped shall be processed as described below or removed, disposed and replaced with suitable material.
- B. The subgrade shall be compacted to 95 percent of standard proctor density.
- C. In cut sections the Contractor shall take the following steps to obtain not less than 95% of the standard proctor density in the subgrade.
  - 1. Step 1 - Cut plan ditches which are to drain the area at least two weeks prior to Step 2
  - 2. Step 2 - Air dry the top 8" of the subgrade. This procedure shall include at least two 8" depth processings utilizing discs or tillers each day for three consecutive days.
  - 3. Step 3 - Recompact the layer processed in Step 2 to achieve the required density or until a roller which has the ability to obtain the density has made at least 9 passes over the area.

- D. If the subgrade does not meet the density requirements after processing, the Engineer shall be notified to determine how the density shall be obtained. Work completed after processing to obtain a satisfactory subgrade density in an area shall be paid for as Extra Work.

### 3.2 AGGREGATE SURFACE

- A. General: The subgrade shall be constructed so that after being compacted, it will conform to the alignment, grade and cross section shown on the plans prior to placement of the Aggregate Surface Course.
- B. The aggregate surface shall be constructed to the thickness shown on the plans. The aggregate shall be placed such that the required amount of material will be deposited uniformly along the central portion of the roadbed and spread to the proposed cross section. When the constructed thickness is less than 90% of the thickness shown on the plans, aggregate shall be added to obtain the required thickness.
- C. The aggregate shall be compacted to 95% standard proctor density.

END OF SECTION 321217

## SECTION 321313 CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes exterior Portland cement concrete (PCC) pavement and appurtenances for the following:
  - 1. Driveways and Roadways
  - 2. Parking lots
  - 3. Curbs and Gutters.
  - 4. Sidewalks
  - 5. Site Lighting, Bollard and misc. foundations

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete pavement mixture.
- C. Pavement Jointing Plan

#### 1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

#### 1.4 REFERENCES

- A. *Standard Specifications for Highway Construction, 2022*, Missouri Department of Transportation (MoDOT) herein noted as the Standard Specifications.

### PART 2 - PRODUCTS

#### 2.1 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

- C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed, epoxy coated.
- D. Plain Steel Wire: ASTM A 82, as drawn.
- E. Deformed-Steel Wire: ASTM A 496.
- F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice."

## 2.2 CONCRETE MATERIALS

- A. Comply with the following as minimums:
  - 1. Portland cement: ASTM C150, Type I.
  - 2. Aggregate: ASTM C33, uniformly graded and clean.
  - 3. Aggregate, coarse: Crushed rock or washed gravel. (Max. Size 3/4" to 1 1/2", w/ 0 - 12% passing #4)
  - 4. Aggregate, fine: Natural washed sand. (Max. Size 3/8" with 3 - 30% passing #50)
  - 5. Water: Clean and potable.
  - 6. Admixtures: Air entraining and/or water reducing agents of standard brand as approved.
  - 7. Fly Ash: ASTM C618, Class C or F.
- B. At least six test cylinders shall be made from trial batches of the design proposed. Two of these shall be broken at 7 days, two at 14 days, and two at 28 days. In lieu of test cylinders the Contractor may furnish a certificate from the concrete supplier that the proposed mix design has been satisfactorily used on other work and that it will meet the requirements of the specifications.
- C. Classes of concrete:
  - 1. Concrete shall be Class B-1 concrete in accordance with the standard specifications.
- D. Consistency shall be such that the mixture can be worked into all parts of the forms and around the reinforcing steel of the structure, without segregation of the materials or the appearance of free water on the surface of the concrete. Unless otherwise stated, the slump measured in accordance with ASTM C143 shall be within the following limits.
  - 1. Floors, walks, and slabs 2" to 4"
  - 2. Forms 9" wide or over 2" to 4"
  - 3. Forms less than 9" wide 3" to 5"
- E. All concrete be air entrained, containing between 4% and 7% entrained air, after mixing is complete and just prior to placement.
- F. Pumped concrete shall comply with ACI 304 and these specifications.

## 2.3 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

## 2.4 CONCRETE PROTECTION

- A. All concrete pavements, sidewalk and curb and gutters shall be treated with a penetrating permanent concrete protection treatment at its time of placement. The treatment shall be a clear penetrating siloxane or silane based sealer for use as shown on exterior concrete. Provide and install in accordance with Section 1059.30 of the Standard Specifications.

## 2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than 45 minutes. The Architect/Engineer shall approve the paint manufacturer.
  - 1. Color: Blue for Accessibility Parking stripes and hatching. White for all other stripes, symbols, words, and hatching.

## 2.6 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

# PART 3 - EXECUTION

## 3.1 SUBGRADE PREPARATION

- A. Subgrade preparation shall be in accordance with Section 31 23 00 Excavation and Fill of these specifications.
- B. Geotextile Fabric, Geogrid and Aggregate Base shall be in accordance with Section 32 11 23 Aggregate Base Courses of these specifications.

## 3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Epoxy coated bars will not be required.

### 3.4 JOINTS

- A. General: Joints in sidewalks and driveways shall be by tooling while the concrete is plastic. Sawed joint may be allowed in pavements and curbs. All sidewalks, driveways and pavements shall be edged. Deformed steel tie bars in Longitudinal Construction Joints shall be placed by drilling and epoxy setting when adjacent slabs are to be constructed separately. Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Sawed contraction joints for a depth equal to at least one-fourth of the concrete thickness. Sidewalk joints shall be tooled and not sawed.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces. Tool joints on all sidewalks and in locations indicated on the Drawings.
- F. Contractor shall submit a jointing plan for approval by owner's representative prior to placing any concrete pavement.

### 3.5 CONCRETE PLACEMENT AND FINISHING

- A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- D. Strike Off, Consolidation and Finishing: The pavement may be placed utilizing an approved vibrating screed or other approved strike-off and consolidating machine that provides a surface that is uniform texture, true to grade and cross section and free from porous areas. Additional

consolidation with handheld or machine vibrators in front of strike off may be necessary if adequate consolidation is not being achieved. Longitudinal hand bull floating with a float having a min. width of 5 ft for non-vehicular slabs and a min. width of 10 ft for vehicular use slabs will be required. Floats or darbies shall be used at all edges as necessary to provide a uniform surface plane.

- E. General: Do not add water to concrete surfaces during finishing operations.
- F. Exterior Finish:
  - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
  - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
  - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
- G. Interior (smooth) Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish floating to a trowel smooth surface.
- H. Apply surface treatments, if any, per manufacturer's recommendations.

### 3.6 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these methods.

### 3.7 CONCRETE PROTECTION

- A. Apply penetrating permanent concrete protection treatment to all concrete pavements, sidewalk and curb and gutters at its time of concrete placement at rates as required by the manufacturer.

### 3.8 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
  - 1. Elevation: 1/4 inch.
  - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  - 3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 3/16 inch.
  - 4. Joint Spacing: Max 2 times slab thickness (inches) times 24.

5. Contraction Joint Depth: 1/3 slab thickness, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

B. Curb tolerances:

1. Finished curb surfaces including curb top, face and gutter line shall not vary more than a 1/4" from the testing edge of a 10 foot straightedge. Permissible deficiencies in section thickness will be up to a 1/4".

3.9 PAVEMENT MARKING

- A. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.
- B. Sweep and clean surface to eliminate loose material and dust. Remove any oil or grease.
- C. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 16 mils.
- D. Paint shall not be applied at air temperatures below 40 degrees F.

3.10 WHEEL STOPS

- A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded in holes drilled or cast into wheel stops at one-quarter to one-third points. Firmly bond each dowel to wheel stop and to pavement. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 SEALANT

- A. The top 1/4 inch of all sidewalk expansion joints (excluding tooled joints) shall be sealed with a self-leveling polyurethane horizontal sealant complying with ASTM C920, Type M, Grade P, Class 25.
- B. Pavement joints shall be sealed with hot-poured joint sealer in compliance with Article 420.12 and Article 1050.02.
  1. The hot poured sealer shall be placed utilizing a "V" shaped wand tip, to allow penetration of the materials into the joints while providing neat completely filled joints.
  2. Joints shall be completely filled or over banded not to exceed 1 1/2". Excessive over banding shall be removed as directed by the A/E.

3.12 FIELD QUALITY CONTROL

- A. The Owner will provide testing services of a soils engineer and/or independent laboratory for this project.
- B. Upon completion of each test and/or inspection, promptly distribute copies of test or inspection reports to A/E.

- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for the first 10 cu. yd. placed each day, plus one set for each additional 50 cu. yd. placed.
  2. Slump: Required 2"-4" - ASTM C 143/C 143M; one test at point of placement for each composite sample of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: Required 6% (-2%, +1%) - ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample of each concrete mixture.
  4. Concrete Temperature: ASTM C 1064/C 1064M; one test per truck when air temperature is 35 deg F and below and when 85 deg F and above.
  5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample of each concrete mixture.
  6. Compression Test Specimens: ASTM C 31/C 31M.
    - a. Cast and laboratory cure one set of four (4) standard 6" x 12" or 4" x 8" cylinder specimens for each composite sample.
    - b. Cast and field cure one additional standard cylinder specimen for each composite sample for cold or hot weather concrete.
  7. Compressive-Strength Tests: ASTM C 39/C 39M;
    - a. If 6" x 12" cylinders are taken: test one of four laboratory-cured specimens at 7 days and one set of two specimens at 28 days. The fourth specimen will be a hold to serve as a spare if specimens do not reach their design strengths.
    - b. If 4" x 8" cylinders are taken: test one of five laboratory-cured specimens at 7 days and one set of three specimens at 28 days. The fifth specimen will be a hold to serve as a spare if specimens do not reach their design strengths.
    - c. A compressive-strength test shall be the average compressive strength from a set of two or three specimens obtained from same composite sample and tested at age indicated.

### 3.13 REPAIRS AND PROTECTION

- D. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- E. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.
- F. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

## **SECTION 321813 SYNTHETIC GRASS SURFACING**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Synthetic grass surfacing and infill.
- B. Edge anchoring and borders.
- C. Shock absorbing course.
- D. Correction of grades and subgrade.
- E. Drainage layer.
- F. Field graphics.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 312300 – Excavation and Fill.
- B. Section 321216 – Asphalt Paving.
- C. Section 321123 – Aggregate Base Courses.
- D. Section 321313 – Concrete Paving.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- B. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2022a.
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates 2019.
- D. ASTM C476 - Standard Specification for Grout for Masonry 2022.
- E. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)) 2012 (Reapproved 2021).
- F. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber 2020.
- G. ASTM D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings 2021.

- H. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)) 2012 (Reapproved 2021).
- I. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials 2016 (Reapproved 2021).
- J. ASTM D5823 - Standard Test Method for Tuft Height of Pile Floor Coverings 2019.
- K. ASTM D6662 - Standard Specification for Polyolefin-Based Plastic Lumber Decking Boards 2022.
- L. ASTM F1632 - Standard Test Method for Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes 2003 (Reapproved 2018).
- M. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples 2021.
- N. ASTM F1936 - Standard Specification for Impact Attenuation of Turf Playing Systems as Measured in the Field 2010 (Reapproved 2015).
- O. ASTM F2765 - Standard Specification for Total Lead Content in Synthetic Turf Fibers 2014 (Reapproved 2021).
- P. ASTM F2898 - Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method 2011 (Reapproved 2019).
- Q. ASTM STP322-1 - Field Testing of Soils, Chapter 1: Field Percolation Tests for Sanitary Engineering Application 1962.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct preinstallation meeting one week prior to start of work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

#### 1.5 SUBMITTALS

- A. Supplemental Bidding Information:
  - 1. Concurrently with Bid submission, submit a list of at least (5) five previous projects where the synthetic grass surfacing product proposed by the Bidder for this project has been previously installed.
  - 2. Concurrently with Bid submission, submit a preliminary field graphics submittal.
- B. Product Data: For all manufactured surfacing products, provide manufacturer's product data showing materials of construction, compliance with specified standards, installation procedures, and safety limitations.
  - 1. Include STC and IPEMA certifications where required.
  - 2. Treated Wood Products: Provide information on wood treatment chemical content, toxicity level, and life-cycle durability.

- C. Shop Drawings, Carpet Roll: Show locations of seams and methods of seaming.
  - 1. Field Graphics: Include methods of seaming.
- D. Samples: For each product for which color must be selected provide color chart showing full range of colors.
- E. Samples: Provide following prior to ordering material:
  - 1. Synthetic Grass carpet: Two (2) 12 inch by 12 inch pieces.
  - 2. Infill material: Two 1-gallon bags for each type.
  - 3. Seamed synthetic grass carpet: Two (2) 12 inch by 24 inch pieces seamed together for each seaming method indicated on drawings.
  - 4. Shock absorbing material: Two (2) 1-gallon bags for each type.
  - 5. Field graphics synthetic grass carpet: Two (2) 12 inch by 12 inch pieces for each color indicated on drawings.
- F. Percolation Test Report: Describing test method used and results.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.
- I. Maintenance Data:
  - 1. For manufactured surfacing products, provide manufacturer's recommended maintenance instructions and list of repair products, with address and phone number of source of supply.
  - 2. For loose fill surfacing products, provide detailed re-ordering information to enable Owner to match installed material exactly.
- J. Manufacturer's Field Report.
- K. Topographical survey of loose fill layer prior to installation of synthetic grass carpet.
- L. Certification: Certified impact attenuation test results per ASTM F1936.
- M. Certification: Certified rainfall permeability test results per ASTM F2898
- N. Warranty Inspection Summary

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company regularly engaged in manufacturing products specified in this section, with not less than three (3) years of documented experience.
  - 1. Surfacing installed in minimum ten (10) sites and been in successful service minimum five (5) years.
  - 2. Manufacturer's Representative: Provide name, company name and address, and qualifications.

- B. Installer Qualifications: Company certified by manufacturer for training and experience installing protective surfacing; provide installer's company name and address, and training and experience certificate.
- C. Compaction and Density testing will be performed by Owner. All other testing to be provided by Contractor.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store synthetic grass surfacing to project site in accordance with manufacturer's recommendations.
- B. Store materials in dry, covered area, elevated above grade.

#### 1.8 FIELD CONDITIONS

- A. Ambient Conditions: Cease work of this section when:
  - 1. Temperatures are below 55 degrees F.
  - 2. Humidity levels are above adhesive manufacturer's requirements.
  - 3. Rain is imminent or falling.
  - 4. Surfaces are wet or damp.

#### 1.9 WARRANTY

- A. Provide 10-year minimum warranty from date of substantial completion for the various individual materials, installation, and total installed system performance covering:
  - 1. Excessive wear.
  - 2. Fiber tensile strength.
  - 3. Deterioration or fading from UV light.
  - 4. Seam integrity.
  - 5. Shock absorption.
  - 6. Drainage rate.

### **PART 2 PRODUCTS**

#### 2.1 SYNTHETIC GRASS SURFACING

- A. Synthetic Grass Carpet: Yarn fibers tufted through and adhered to porous fiber backing.
  - 1. Total Weight: 74 oz per sq yd minimum.
  - 2. Pipe Height: 2-1/4"
  - 3. Tuft Bind Strength: Greater than 10 lbs
  - 4. Grab Tear Strength: Greater than 200 lbs
  - 5. Permeability: 25 inches of water per hour, minimum.

6. Lead Content: 100 ppm, maximum, in accordance with ASTM F2765.
  7. Roll: 15 feet wide, minimum.
  8. Noncombustible: Pass ASTM D2859 for flammability.
  9. Field Graphics:
    - a. Applied Marking: Permanent per manufacturer's approval.
    - b. Inlaid Marking: Synthetic grass of same manufacturer in colors indicated on drawings.
  10. Product:

Synthetic grass surfacing shall be a blend of slit film and monofilament strands

    - a. Shaw Sports Turf, Legion Pro 2.25, [www.shawsturf.com](http://www.shawsturf.com)
    - b. RamTurf, Controlled Products, LLC
    - c. FieldTurf USA Incl., FieldTurf Vertex Prime 2.25" [www.fieldturf.com/#sle](http://www.fieldturf.com/#sle).
    - d. Approved equal based on substitution submittal process.
- B. Synthetic Grass Infill: 3 pounds per square foot minimum.
1. Type: SBR rubber, free of metals, nonmetal fibers, and contaminants.
  2. Sand: Silica, 10 to 20, free of silts, clays, and contaminants, roundness of subangular, minimum, per ASTM F1632.
- C. Shock Absorbing Course:
1. Recycled Rubber Fill: Loose fill; 100 percent recycled rubber chips, shreds, granules, or nuggets; installed over subgrade.
    - a. Chip Size: 3/8 inch
    - b. Depth: As indicated on drawings.

## 2.2 MATERIALS

- A. Edge Anchoring: Pressure treated lumber complying with ASTM D6662; factory finished, free of sharp vertical edges, protruding elements, and trip hazards, capable of being secured to border.
  1. Size(s): 2 inch by 4 inch
  2. Size: As indicated on drawings.
  3. Minimum Edge Radius: 1/2 inch
- B. Border: Permanent element surrounding edge anchoring, consisting of:
  1. Concrete Curb: As indicated on drawings.
- C. Drainage (Loose Surfacing) Course: Fractured, non-rounded gravel; washed; free of dust, clay, dirt, organic material, hazardous substances, or foreign objects; sieved in compliance with ASTM C136/C136M in specified gradation range.
  1. 3/8 inch clean.
  2. Depth: As indicated on drawings.
- D. Drainage (Base Stone) Course: Fractured, non-rounded gravel; washed; free of dust, clay, dirt, organic material, hazardous substances, or foreign objects; rounded particles, either naturally or mechanically; sieved in compliance with ASTM C136/C136M in specified gradation range.

1. 3/4 inch clean.
  2. Depth: As indicated on drawings.
- E. Drainage Pipes: Uniform material, free of defects:
1. Material: HDPE
  2. Material: As indicated on drawings.
- F. Geotextile: Nonwoven polypropylene sheet

### 2.3 ACCESSORIES

- A. Fasteners: In accordance with turf manufacturer recommendations and requirements.
1. Sewing Thread: As recommended by manufacturer
  2. Bonding:
    - a. Adhesive: As recommended by manufacturer
- B. Rebar: Number 4 rod.
- C. Cementitious Grout: Fine, in compliance with ASTM C476.
- D. Joint Sealant: As recommended by curbing manufacturer, in compliance with ASTM C920.
- E. Grooming Equipment: Grooming equipment recommended by turf manufacturer shall be provided to the Owner prior to substantial completion. Grooming equipment can be either self-propelled or pull-behind type. Owner will provide tow vehicle for pull-behind equipment

### 2.4 SOURCE QUALITY CONTROL

- A. Supply individual components from single source.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Lay out entire project perimeter as indicated on drawings prior to starting work.
- B. Measure location of all synthetic grass elements, including access and egress points, hard surfaces, walls, fences, and structures.
- C. Verify location of underground utilities and facilities in project area. Damage to underground utilities and facilities will be repaired at Contractor's expense.

### 3.2 SUBGRADE

- A. Excavate unsuitable soils in accordance with the earthwork specification.

- B. Correct irregularities to ensure that required depth of drainage layer can be installed, and elevation is in accordance with manufacturer's requirements.
- C. Remove all obstructions that extend into drainage layer within composite nailer boards.
- D. Perform rough and finish grading.
- E. Shape to profile indicated on drawings and compact by proof rolling to minimum 95 percent, in compliance with ASTM D698.
- F. Flatness Tolerance: 1/2 inch in 10 feet, maximum.
- G. Perform percolation test at lowest elevation of subgrade, in compliance with ASTM STP322-1.
  - 1. Report results to Architect/Engineer.
  - 2. If percolation is less than 1 inch in 3-hour period, do not proceed.
- H. Verify that subgrades are at proper elevations and that smooth grading is complete.

### 3.3 TRENCHING AND BACKFILLING

- A. Lay out trenching for entire drainage network prior to excavation, as indicated on drawings.
- B. Excavate trenches in accordance with drawings.
- C. Mirror base of trenches to finish grade.
- D. Open trenches require presence of daily site activity.
- E. Repair deviations from plans after drainage pipe installation and prior to installing geotextile.

### 3.4 DRAINAGE PIPE

- A. Install all piping and fittings as indicated on drawings.
- B. Install collector lines prior to laterals with deepest excavations first.
- C. Connect collector lines to discharge outlet prior to field use.
- D. Completion of installation in accordance to design requires approval by Architect/Engineer.

### 3.5 GEOTEXTILE

- A. Verify that subgrade is free of ruts or protruding objects.
- B. Install geotextile over subgrade in drainage trenches first, prior to field installation.
- C. Lap minimum 36 inches width at seams. Adhere seams in accordance with manufacturer's recommendations.

- D. Install smooth, and free of tensile stresses, folds, or wrinkles.
- E. Protect from clogging, tears, or other damage during surfacing installation.
- F. Repair or replace damaged geotextile in accordance with manufacturer's recommendations.

### 3.6 DRAINAGE AGGREGATE

#### A. Loose Fill Surfacing:

- 1. Install aggregate subbase as indicated on drawings. Compact aggregate to minimum 95 percent, in compliance with ASTM D1557.
- 2. Flatness Tolerance: 1/4 inch in 10 feet, maximum.
- 3. Correct high and low areas in accordance with design drawings.
- 4. Match top of layer with top of edge anchoring.
- 5. Prevent base stone from entering into loose fill surfacing layer. Prevent loose fill from entering into base stone layer.
- 6. Prevent disturbance to geotextile during installation.

#### B. Base Stone:

- 1. Install aggregate subbase as indicated on drawings.
- 2. Compact to minimum 95 percent density, in compliance with ASTM D698.
- 3. Flatness Tolerance: 1/2 inch in 10 feet, maximum.
- 4. Correct high and low areas in accordance with design drawings.
- 5. Mirror base stone elevations to final elevations.
- 6. Prevent disturbance to geotextile during installation.
- 7. Approval of drainage piping by Architect/Engineer required prior to commencement of installation. Prevent disturbance of drainage piping during installation.

### 3.7 SHOCK ABSORBING COURSE

#### A. Recycled Rubber Fill:

- 1. Install to thickness meeting critical fall heights, as determined by ASTM F1292, or according to drawings.
- 2. Install in smooth level manner without depressions or rises.
- 3. Compact until adult foot depressions do not occur.

### 3.8 EDGE ANCHORING

- A. Layout composite nailer boards. Approval of locations by Architect/Engineer required prior to installing.
- B. Install along full perimeter of synthetic grass.

- C. Fasten to border with case hardened screws at 24 inch on center, minimum or as designated by manufacturer.
- D. Set top of edging flush or recessed 1/2 inch below top of border, maximum, or as designated by manufacturer.

### 3.9 BORDER

- A. Verify that site furnishings and composite nailer boards located within project area are complete.
- B. Install border curbs according to design drawings.
- C. Sidewalks: Match to top elevation or increase by 1/2 inch above edge anchoring, maximum.

### 3.10 SYNTHETIC GRASS

- A. Carpet Rolls:
  - 1. Unroll all carpet in same direction.
  - 2. Prevent seams from being located over impact mats.
  - 3. Allow carpet to rest for at least 4 hours after unrolling and prior to seaming.
  - 4. Smooth seams and edges, eliminate overlaps and gaps.
- B. Seaming:
  - 1. Cut: Straight, with clean and smooth edge.
  - 2. Method:
    - a. Per manufacturer requirements and recommendations.
- C. Securing: Staple carpet to edging per manufacturer requirements.
- D. Field Graphics:
  - 1. Applied Marking: Per manufacturer recommendations, in dimensions and color patterns indicated on drawings.
    - a. Alternating shades of green every five yards.
    - b. White football field markings per MSHSAA regulations.
    - c. Minimum 50' tall Hallsville logo at midfield. A digital version of the Hallsville logo can be provided upon request.
    - d. Combination 1' white/5' Owner selected color end zone border.
    - e. Combination 1' white/5' Owner selected field border.
    - f. 6' white official's box from 25 yard line to 25 yard line.
    - g. 6' coach's box in Owner selected color with white outline from 25 yard line to 25 yard line.
    - h. Player's box in Owner selected color with white outline from 25 yard line to 25 yard line extending to the track.
    - i. End zones in color selected by Owner with 15' Block letters in color selected by Owner with white trim. Text to be "HALLSVILLE" on north end and "INDIANS" on south end.

- j. Colors available for Owner selection shall be Purple, White, and Vegas Gold.

2. Inlaid Marking:

- a. Shearing: Cut synthetic grass through backing, in dimensions and pattern indicated on drawings.
- b. Inlay: Bond synthetic grass in colors indicated on drawings within sheared patterns.

3.11 INFILL

- A. Apply during dry weather without signs of moisture on synthetic grass.
- B. Thoroughly brush synthetic grass prior to infill installation.
- C. Apply infill uniformly in multiple lifts, brush fibers between each application.
- D. Measure depth to confirm accordance with plans.

3.12 FIELD QUALITY CONTROL

- A. Drainage aggregate completion requires approval by Architect/Engineer.
- B. Owner or Owner's representative will inspect synthetic grass after installation to verify that surfacing is of proper type and meets specified design safety and accessibility requirements.
- C. Repair or replace rejected work until compliant with specified requirements and design criteria.
- D. Confirm rainfall permeability meets design, per ASTM F2898.
- E. Confirm impact attenuation meets design, per ASTM F1936.
- F. Replace damaged products before Date of Substantial Completion.

3.13 CLEANING

- A. Clean surrounding areas of excess construction materials, debris, and waste.
- B. Remove excess and waste material and dispose of off-site in accordance with requirements of authorities having jurisdiction.

3.14 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Restore adjacent existing areas that have been damaged by work of this section.

3.15 DEMONSTRATION AND TRAINING

- A. Provide a minimum of four (4) hours of training to Owner on proper maintenance of synthetic grass surfacing.

### 3.16 WARRANTY INSPECTION

- A. At approximately 11 months following substantial completion, and in the presence of the Owner and Architect/Engineer, perform a warranty inspection of the installed field and report results in writing. The inspections, testing, and correction of any observed deficiencies shall be completed at no cost to the Owner. At a minimum, inspect and complete the following:
  - 1. Confirm impact attenuation complies with original project specifications by performing impact attenuation tests per ASTM F1936.
  - 2. Confirm rainfall permeability complies with original project specifications by performing rainfall permeability testing per ASTM F2898.
  - 3. Inspect playing surface for localized low spots and ponding

**END OF SECTION**

**SECTION 321823**  
**SYNTHETIC TRACK SURFACE**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Design & Engineering of Subgrade, Drainage, Base Courses, Pavements and Surfacing.
- B. Synthetic track surface
- C. Track surface preparation
- D. Marking lines for synthetic surfaces.

1.2 REFERENCE STANDARDS

- A. American Sports Builders Association (ASBA)
- B. National Federation of State High School Associations (NFHS) Rule Book
- C. Missouri State High School Association (MSHSA)

1.3 SUBMITTALS

- A. Manufacturer's Certificate: Certify materials meet or exceed specified requirements.
- B. Product Data: Submit manufacturer's product data, including surface and crack preparation and application instructions.
- C. Manufacturer's Project References: Submit manufacturer's list of successfully completed rubberized running track surface coating system projects, including project name, location, and date of application.
- D. Applicator's Project References: Submit applicator's list of successfully completed rubberized running track surface coating system projects, including project name, location, type and quantity of color coating system applied, and date of application.
- E. Submit one (1) representative track samples in the color of surfacing to be installed.
- F. Provide a letter stating that the surfacing contractor has reviewed the asphalt specification and accepts the specification as a base for the synthetic surface installation.
- G. Submit evidence that the synthetic surfacing contractor is a current member of the American Sports Builders Association (ASBA).
- H. Submit evidence that confirms the synthetic surfacing contractor has a minimum of two (2) certified track builders on staff recognized by the American Sports Builders Association (ASBA).

#### 1.4 QUALITY ASSURANCE

- A. Work shall be performed by a surfacing contractor experienced in the design, layout, construction, and resurfacing of all-weather track systems.
- B. Installer: Company specializing in performing the Work of this Section with a minimum of three (3) years of documented experience.
- C. Installer shall be a member of the American Sports Builder's Association and have a Certified Track Builder on staff.

#### 1.5 WARRANTY

- A. Warranty Period: Work under this Section shall be warranted for a minimum of three (3) years from the date of substantial completion. A one (1) year warranty shall be provided for the line markings.
- B. Warranty Coverage: Warranty shall cover all materials and workmanship which occur during the warranty period, including but not limited to abnormal aging, color changes, and surface failure.
- C. Warranty shall include the Contractor's responsibility for full removal and replacement of deficient Work installed under this Section

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and Handling Requirements:
  - 1. Store and handle materials in accordance with manufacturer's instructions.
  - 2. Keep materials in manufacturer's original, unopened containers and packaging until application.
  - 3. Store materials in clean, dry area indoors.
  - 4. Store materials out of direct sunlight.
  - 5. Keep materials from freezing.
  - 6. Protect materials during storage, handling, and application to prevent contamination or damage.
  - 7. Close containers when not in use.

#### 1.7 AMBIENT CONDITIONS

- A. Do not apply rubberized running track surface coating system when air or surface temperatures are below 50 degrees F during application or within 24 hours after application.
- B. Do not apply asphalt rubberized running track surface coating system when rain is expected during application or within 24 hours after application.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. The synthetic surfacing shall be a 13 mm thick, permeable, structural spray system, with a paved in place rubber granule and polyurethane binder base layer. Two coats of a mixture of colored polyurethane and EPDM rubber granules are structurally sprayed onto the base to form a textured finish.

### 2.2 MATERIALS

#### A. POLYURETHANE

1. PRIMER- Polyurethane-base primer- specifically formulated to be compatible with the base and track surfacing materials.
2. POLYURETHANE BINDER– shall be a single component, 100% polyurethane, moisture curing, middle viscosity polyurethane binding agent based on MDI/TDI. The level of the tolylene diisocyanate monomer is very low, less than ½ of 1%. Importantly the binder contains no solvents and no extenders (plasticiser).
3. Polyurethane Structural Spray – a two component spray coating that is mixed 1 part w/w red polyurethane to 2 parts polyurethane binder by weight.
4. SBR Rubber – SBR rubber granules shall be recycled black rubber that is processed and graded to 1-3 mm in size containing no fiber or metal and contains less than 4% dust.
5. EPDM Rubber – EPDM colored virgin rubber granules that are processed and graded to 0.5 – 1.5 mm in size unless otherwise specified. The rubber shall contain a minimum of 20% EPDM and be approved by the resin manufacturer. The specific density shall be 1.60 +/- 0.08 and Shore A hardness of 60.
6. EPDM rubber dust is a residual product made from the excess granules listed in E above. The material is 0.0 – 0.5 mm in size.

- B. LINE MARKING PAINT – Polyurethane based paint specifically manufactured to be compatible with polyurethane synthetic track surfaces. Color shall be **White** and layout shall be per NFHS rules of competition.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine asphalt track surface that was recently placed to verify that the running track surface is acceptable.
- B. Notify Engineer of conditions that would adversely affect application or subsequent use.
- C. Do not begin surface preparation or application until unacceptable conditions are corrected.

### 3.2 SURFACE PREPARATION

- A. Protection of In-Place Conditions: Protect adjacent surfaces and landscaping from contact with synthetic track surface coating system.
- B. Prepare surfaces in accordance with manufacturer's instructions.
- C. Remove dirt, dust, debris, oil, grease, vegetation, loose materials, and other surface contaminants which could adversely affect application of synthetic track surface coating system. Pressure wash entire surface.
- D. Repair cracks, depressions, and surface defects in accordance with manufacturer's instructions before application of synthetic track surface.
- E. Level asphalt depressions 1/8 inch and deeper with patch binder in accordance with manufacturer's instructions.
- F. Ensure surface repairs are flush and smooth to adjoining surfaces.

### 3.3 TRACK SURFACING

- A. Apply synthetic track surface coating system in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Mix materials in accordance with manufacturer's instructions.
- C. Track Surface: Apply track material to prepared surfaces in accordance with manufacturer's instructions in order to achieve the minimum surface thickness of one half of an inch (1/2").
- D. Allow material drying times in accordance with manufacturer's instructions before applying other materials or opening completed surface to foot traffic.
- E. SPECIFIC SLOPES
  - 1. Concrete curbs - All top elevations of any continuous concrete curbs shall be a constant elevation.
  - 2. Track oval – running direction 0.1 %; lateral slope 2.0 % max. NFHS, 1% NCAA and IAAF.
  - 3. D areas (high jump) – towards cross bar 1 % downward
  - 4. Run ups same as oval unless located in the "D".

### 3.4 LINE MARKINGS

- A. Lay out running track line markings in accordance with appropriate governing body
  - a. National Federation of State High School Associations (NFHS)
- B. Apply a minimum of 2 coats of line paint in accordance with manufacturer's instructions.

### 3.5 PROTECTION

- A. Allow a minimum of 24 hours curing time before opening asphalt rubberized running track for play.

- B. Protect applied synthetic track surface coating system to ensure that, except for normal weathering, coating system will be without damage or deterioration at time of Substantial Completion.

### 3.6 FIELD QUALITY CONTROL

- A. Upon completion of the installation, the Contractor shall supply the Owner with all necessary computations and drawings, as well as a letter of certification attesting to the accuracy of the markings in accordance with NFHS competition rules.

END OF SECTION 321823

**SECTION 323113**  
**CHAIN LINK FENCES AND GATES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Chain-Link Fences: Industrial
  - 2. Gates: Swing & Cantilever
- B. See Division 26 Sections for electrical service and connections for motor operators, controls, limit and disconnect switches, and safety features and for system disconnect switches.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations, components, materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

**PART 2 - PRODUCTS**

2.1 CHAIN-LINK FENCE FABRIC

- A. General: Height indicated on Drawings. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:
  - 1. Steel Wire Fabric: Metallic-coated wire with a diameter of 0.148 inch.
    - a. Mesh Size: 2 inches.
    - b. Metallic (Zinc) Coating: ASTM A 392, Type II.
  - 2. Selvage: Knuckled top and bottom.

2.2 INDUSTRIAL FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe, and the following:
  - 1. Group: IA, round steel pipe, Schedule 40.
  - 2. Fence Height: 4 feet or 6 feet, see plans for heights.
  - 3. Strength Requirement: Heavy industrial according to ASTM F 1043.
  - 4. Coating for Steel Framing:
    - a. Metallic coating.

## 2.3 TENSION WIRE

- A. General: Provide horizontal tension wire at bottom of fence fabric.
- B. Metallic-Coated Steel Wire: 0.177-inch- diameter, marcelled tension wire complying with ASTM A 817 and ASTM A 824.
  - 1. Metallic Coating: Type III, Zn-5-Al-MM alloy.

## 2.4 INDUSTRIAL SWING GATES

- A. General: Comply with ASTM F 900 for single and double swing gate types.
  - 1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1083 and ASTM F 1043 for materials and protective coatings.
  - 2. Metal Pipe and Tubing: Aluminum. Comply with ASTM B 429 and ASTM F 1043 for materials and protective coatings.
- B. Frames and Bracing: Fabricate members from round galvanized steel tubing with outside dimension and weight according to ASTM F 900 and the following:
  - 1. Gate Fabric Height: 2 inches less than adjacent fence height.
  - 2. Leaf Width: As indicated.
  - 3. Frame Members:
    - a. Tubular Steel: 1.90 inches round.
- C. Frame Corner Construction:
  - 1. Assembled with corner fittings and 5/16-inch- diameter, adjustable truss rods for panels 5 feet wide or wider.
- D. Hardware: Latches permitting operation from both sides of gate, hinges, center gate stops and keepers for each gate leaf more than 5 feet wide. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.

## 2.5 CANTILEVER GATES

- A. General: Comply with ASTM F 1184 for single slide gate types.
  - 1. Classification: Type I Overhead Slide.
  - 2. Classification: Type II Cantilever Slide, Class 1 with external roller assemblies.
  - 3. Metal Pipe and Tubing: Aluminum. Comply with ASTM F 699 for materials and protective coatings.
- B. Frames and Bracing: Fabricate members from square, aluminum tubing with outside dimension and weight according to ASTM F 1184 and the following:
  - 1. Gate Fabric Height: 6 feet
  - 2. Gate Opening Width: As noted on Drawings.
  - 3. Frame Members:
    - a. Tubular Aluminum: 2 inches rectangular.

- 4. Bracing Members:
  - a. Tubular Aluminum: 2 inches rectangular.

C. Frame Corner Construction:

- 1. Welded frame and 5/16-inch- diameter, adjustable truss rods for panels 5 feet wide or wider.

D. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame as required for gate assemblies.

E. Overhead Track Assembly: Manufacturer's standard track, with overhead framing supports, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.

F. Roller Guards: As required per ASTM F 1184 for Type II, Class 1 gates.

G. Hardware: Latches permitting operation from both sides of gate, locking devices, hangers, roller assemblies and stops fabricated from Grade 319 aluminum-alloy casting with stainless-steel fasteners. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.

## 2.6 FITTINGS

A. General: Comply with ASTM F 626.

B. Finish:

- 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.

## 2.7 CAST-IN-PLACE CONCRETE

A. Materials: Portland cement complying with ASTM C 150, Type I aggregates complying with ASTM C 33, and potable water.

- 1. Concrete Mixes: Normal-weight concrete air entrained, MoDOT B-1, 4,000 psi at 28 days.

## 2.8 FENCE GROUNDING

A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

- 1. Material above Finished Grade: Aluminum.
- 2. Material on or below Finished Grade: Copper.
- 3. Bonding Jumpers: Braided copper tape, 1 inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.

B. Connectors and Grounding Rods: Comply with UL 467.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. General: Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
  - 1. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
- D. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment.
- E. Line Posts: Space line posts uniformly at 10 feet o.c. maximum.
- F. Post Bracing and Intermediate Rails: Install according to ASTM F 567. Install braces at end and gate posts and at both sides of corner and pull posts.
- G. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing.
- H. Top Rail: Install according to ASTM F 567.
- I. Bottom Rails: Install, spanning between posts.
- J. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1 inch between finish grade or surface and bottom selvage, unless otherwise indicated.
- K. Tie Wires: Attach wire per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.
- M. Privacy Slats: Install slats in direction indicated, securely locked in place.

#### **3.2 GATE INSTALLATION**

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

#### **3.3 GROUNDING AND BONDING**

- A. Fence Grounding: Install at maximum intervals of 1500 feet.

- B. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
  - 1. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location.
- C. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
  - 1. Connections: Make connections so possibility of galvanic action or electrolysis is minimized.
- D. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

### 3.4 FIELD QUALITY CONTROL

- A. Grounding-Resistance Testing: Engage a qualified independent testing agency to perform field quality-control testing.

END OF SECTION 323113

**SECTION 328400**  
**PLANTING IRRIGATION**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Work under this section includes furnishing all labor, materials, tools, equipment, appurtenances, and design and installation of a complete and operable landscape irrigation system.
- B. Obtain and pay for necessary permits.
- C. Excavation of all trenches and installation of sleeves.
- D. Provide necessary heads, valves, and piping.
- E. Provide necessary control system and wiring.
- F. Install required valves.
- G. Install miscellaneous irrigation system appurtenances.
- H. Install water supply including Reduced Pressure Backflow Preventer (RPZ) in accordance with the applicable codes. The supply and accessories shall be tested and certified.
- I. Restore the site to the original or proposed condition, whichever applies.
- J. After completion of installation, submit record drawings to the Owner showing locations of all sprinkler heads, valves, drains, sleeves, and piping. These drawings shall be to a recognized scale and dimensioned.
- K. An irrigation schedule for the system shall be submitted showing zones, sprinkler type, precipitation rate, run time, run days, program, and inches of water per week for each zone.

1.2 SUBMITTALS

- A. Product Data: For all materials supplied. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data, head layout, piping layout and sizes, and valve locations.
- D. Zoning Chart: Show each irrigation zone and its control valve.
- E. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

- F. Field quality-control reports.
- G. Operation and maintenance data for all equipment.
- H. Available water pressure test results (min. continuous 24 hour period).

1.3 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design layout location shown on the plans is approximate. Maintain 100 percent irrigation coverage of areas indicated.
- C. Delegated Design: Design 100 percent coverage irrigation system using performance requirements and design criteria indicated.
  - 1. Contractor to confirm soil type and conditions to be considered in the design.
- D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
  - 1. Irrigation Main Piping: 200 psig.
  - 2. Circuit Piping: 150 psig.
- E. Watering Requirements: the target water demands for the system shall be as follows:

PLANT TYPE	WATER DEMAND / WEEK
Field Turfgrass	1 ½ - 2 inches

1.4 QUALITY ASSURANCE

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

**PART 2 - PRODUCTS**

2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. Galvanized-Steel Pipe: ASTM A 53/A 53M, Standard Weight, Type E, Grade B.
  - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless-steel pipe with threaded ends.
  - 2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
  - 3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.

4. Cast-Iron Flanges: ASME B16.1, Class 125.
- C. Ductile-Iron Pipe with Push-on Joint: AWWA C151, with push-on-joint bell and spigot ends.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Gaskets: AWWA C111, rubber.
- D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
  3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- E. Hard Copper Tube: ASTM B 88, Type L, and ASTM B 88, Type M, water tube, drawn temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
  3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- F. PE Pipe with Controlled ID: ASTM F 771, PE 3408 compound; SDR 15.
1. Insert Fittings for PE Pipe: ASTM D 2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.
- G. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedule 40.
1. PVC Socket Fittings: ASTM D 2466, Schedule 40.
  2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
  3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
- H. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, SDR 21.
1. PVC Socket Fittings: ASTM D 2467, Schedule 80.
  2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.
- 2.2 PIPING JOINING MATERIALS
- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## 2.3 MANUAL VALVES

### A. Curb Valves:

- 1. Description:
  - a. Standard: AWWA C800.
  - b. NPS 1 and Smaller Pressure Rating: 150 psig.
  - c. NPS 1-1/4 to NPS 2 Pressure Rating: 150 psig.
  - d. Body Material: Brass or bronze with ball or ground-key plug.
  - e. End Connections: Matching piping.
  - f. Stem: With wide-tee head.

### B. Curb-Valve Casing:

- 1. Standard: Similar to AWWA M44 for cast-iron valve casings.
- 2. Top Section: Telescoping, of length required for depth of burial of curb valve.
- 3. Barrel: Approximately 3-inch diameter.
- 4. Plug: With lettering "WATER."
- 5. Bottom Section: With base of size to fit over valve.
- 6. Base Support: Concrete collar.

### C. Shutoff Rods for Curb-Valve Casings: Furnish one steel, tee-handle shutoff rod(s) with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve for Project.

### D. Brass Ball Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. DynaQuip Controls.
  - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
  - e. Hammond Valve.
  - f. Jamesbury; a subsidiary of Metso Automation.
  - g. Jomar International, LTD.
  - h. KITZ Corporation.
  - i. Legend Valve.
  - j. Marwin Valve; a division of Richards Industries.
  - k. Milwaukee Valve Company.
  - l. NIBCO INC.
  - m. Red-White Valve Corporation.

n. RuB Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded or solder joint if indicated.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

E. Bronze Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Crane Co.; Crane Valve Group; Crane Valves.
- d. Hammond Valve.
- e. Lance Valves; a division of Advanced Thermal Systems, Inc.
- f. Legend Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Red-White Valve Corporation.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded or solder joint if indicated.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

F. Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. KITZ Corporation.
- d. Sure Flow Equipment Inc.
- e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-72.
- b. CWP Rating: 200 psig.
- c. Body Design: Split body.
- d. Body Material: ASTM A 126, gray iron.
- e. Ends: Flanged.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel.
- i. Port: Full.

G. Plastic Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Asahi/America, Inc.
- c. Colonial Engineering, Inc.
- d. Fischer, George Inc.
- e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
- f. IPEX Inc.
- g. Jomar International, LTD.
- h. KBI (King Bros. Industries).
- i. Legend Valve.
- j. NIBCO INC.
- k. Sloane, George Fischer, Inc.
- l. Spears Manufacturing Company.
- m. Thermoplastic Valves Inc.
- n. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-122.
- b. Pressure Rating: 150 psig.
- c. Body Material: PVC.
- d. Type: Union.
- e. End Connections: Socket or threaded.
- f. Port: Full.

H. Iron Gate Valves, Resilient Seated:

1. Description:

- a. Standard: AWWA C509.
- b. Pressure Rating: 250 psig minimum.
- c. Body Material: Ductile or gray iron with bronze trim.
- d. End Connections: Mechanical joint or push-on joint.
- e. Interior Coating: Comply with AWWA C550.
- f. Body Design: Nonrising stem.
- g. Operator: Stem nut.
- h. Disc: Solid wedge with resilient coating.

I. Iron Gate Valve Casings:

1. Standard: AWWA M44 for cast-iron valve casings.
2. Top Section: Adjustable extension of length required for depth of burial of valve.
3. Barrel: Approximately 5-inch diameter.
4. Plug: With lettering "WATER."
5. Bottom Section: With base of size to fit over valve.
6. Base Support: Concrete collar.

J. Operating Wrenches for Iron Gate Valve Casings: Furnish one steel, tee-handle operating wrench with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut for Project.

2.4 AUTOMATIC CONTROL VALVES

A. Bronze, Automatic Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Buckner; a division of Storm Manufacturing Group Inc.
  - b. Ceres Products Company.
  - c. Champion Irrigation Products.
  - d. Netafim USA.
  - e. Superior Controls Co., Inc.
  - f. Toro Company (Irrigation Division).
  - g. Weathermatic.
2. Description: Cast-bronze body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid, 150 psi.

B. Plastic, Automatic Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Buckner; a division of Storm Manufacturing Group Inc.
  - b. Ceres Products Company.
  - c. Champion Irrigation Products.
  - d. Dig Corporation.
  - e. Greenlawn Sprinkler Company.
  - f. Hit Products Corporation.
  - g. Hunter Industries Incorporated.
  - h. Irritrol Systems.
  - i. Nelson, L. R. Corporation.
  - j. Netafim USA.
  - k. Olson Irrigation Systems.
  - l. Orbit Irrigation Products, Inc.
  - m. Rain Bird Corporation.
  - n. Superior Controls Co., Inc.
  - o. Toro Company (Irrigation Division).
  - p. Weathermatic.

2. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid, 150 psi.

## 2.5 AUTOMATIC DRAIN VALVES

- A. Description: Spring-loaded-ball type of corrosion-resistant construction and designed to open for drainage if line pressure drops below 2-1/2 to 3 psig.

## 2.6 SPRINKLERS

- A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

- B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Buckner; a division of Storm Manufacturing Group Inc.
- b. Champion Irrigation Products.
- c. Hunter Industries Incorporated.
- d. Irritrol Systems.
- e. K-RAIN Manufacturing Corporation.
- f. Nelson, L. R. Corporation.
- g. Rain Bird Corporation.
- h. Toro Company (Irrigation Division).
- i. Weathermatic.

2. Description:

- a. Body Material: ABS.
- b. Nozzle: Brass.
- c. Retraction Spring: Stainless steel.
- d. Internal Parts: Corrosion resistant.

3. Capacities and Characteristics:

- a. Flow: 86 gpm.
- b. Arc: Full, Half and Quarter circle.
- c. Radius: 57 foot

## 2.7 QUICK COUPLERS

- A. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.

1. Locking-Top Option: Vandal-resistant locking feature. Include one matching key.

## 2.8 CONTROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Buckner; a division of Storm Manufacturing Group Inc.
2. Champion Irrigation Products.
3. Hit Products Corporation.
4. Hunter Industries Incorporated.
5. Irritrol Systems.
6. K-RAIN Manufacturing Corporation.
7. Nelson, L. R. Corporation.
8. Netafim USA.
9. Orbit Irrigation Products, Inc.
10. Rain Bird Corporation.
11. Superior Controls Co., Inc.
12. Toro Company (Irrigation Division).
13. Weathermatic.

B. Description:

1. Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each station.
2. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.
  - a. Body Material: Molded plastic.
  - b. Mounting: Surface type for wall mount.
3. Interior Control Enclosures: NEMA 250, Type 12, dripproof, with locking cover and two matching keys.
  - a. Body Material: Molded plastic.
  - b. Mounting: Surface type for wall.
4. Control Transformer: 24-V secondary, with primary fuse.
5. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
  - a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
  - b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
  - c. Surge Protection: Metal-oxide-varistor type on each station and primary power.
6. Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.
7. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
  - a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.

- b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
  - c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.
8. Concrete Base: Reinforced precast concrete not less than 36 by 24 by 4 inches thick, and 6 inches greater in each direction than overall dimensions of controller. Include opening for wiring.

## 2.9 BOXES FOR AUTOMATIC CONTROL VALVES

### A. Plastic Boxes:

- 1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
  - a. Size: As required for valves and service.
  - b. Shape: Round
  - c. Sidewall Material: PE
  - d. Cover Material: PE
  - 1) Lettering: "IRRIGATION".

- B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch minimum to 3 inches maximum.

## 2.10 SLEEVES

- A. All sleeves shall be SDR-21 ASTM D224 PVC and shall be twice the size of the irrigation pipe housed within.

## 2.11 WATER SOURCE

- A. Provide water service as shown on the drawings and in accordance with water department permit and requirements.
- B. Install curb stop, valves, meter setter, meter, and meter pit in accordance with water department permit and requirements.
- C. Install a reduced pressure principle backflow preventer assembly (RPZ) in accordance with plumbing code.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. This work shall consist of design & construction of the irrigation system.

- B. Water pressure shall be measured and continuously recorded for a period of 24 consecutive hours to determine the available water pressure at the project site. The system shall be designed for the lowest pressure available. During the test period a pressure regulator shall be installed to reduce the pressure to the lowest available during the test. Regulator shall be of sufficient size to provide the largest flow rate required to operate the irrigation system.

### 3.2 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."
- B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.
- C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches, to 12 inches below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:
  - 1. Irrigation Main Piping: Minimum depth of 36 inches below finished grade, or not less than 18 inches below average local frost depth, whichever is deeper.
  - 2. Circuit Piping: 12 inches.
  - 3. Drain Piping: 12 inches.
  - 4. Sleeves: 24 inches.

### 3.3 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.
- H. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.
- I. Install expansion loops in control-valve boxes for plastic piping.
- J. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- K. Install ductile-iron piping according to AWWA C600.

- L. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- E. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.
- F. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
- G. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- H. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.
- I. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

### 3.5 VALVE INSTALLATION

- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.

1. Install valves and PVC pipe with restrained, gasketed joints.

C. Aboveground Valves: Install as components of connected piping system.

D. Throttling Valves: Install in underground piping in boxes for automatic control valves.

E. Drain Valves: Install in underground piping in boxes for automatic control valves.

### 3.6 SPRINKLER INSTALLATION

A. Install sprinklers after hydrostatic test is completed. After all new pipe lines and risers have been installed, flush out the system prior to installation of the sprinkler heads.

B. Install sprinklers at manufacturer's recommended heights.

C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.

D. A coverage test shall be performed in the presence of the Owner and Architect/Engineer upon completion of installation. Adjustments in coverage shall be made if determined necessary by the Architect/Engineer.

### 3.7 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

A. Equipment Mounting: Install interior controllers on wall.

1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases.

1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Install control cable in same trench as irrigation piping and at least 2 inches below piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

### 3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.

1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Division 31 Section "Earth Moving" for warning tapes.

### 3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 4. A hydrostatic test shall be performed on all pipe lines to a pressure of 100 psi for a minimum of one hour. Any leaks shall be repaired prior to backfilling.
- C. Any irrigation product will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.10 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

### 3.11 PIPING SCHEDULE

- A. Install components having pressure rating equal to or greater than system operating pressure.
- B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.
- C. Aboveground irrigation main piping, NPS 4 and smaller, shall be the following:
  - 1. Galvanized-steel pipe and galvanized-steel pipe nipples; galvanized, gray-iron threaded fittings; and threaded joints.
  - 2. Schedule 40, PVC pipe; socket-type PVC fittings; and solvent-cemented joints.
  - 3. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
- D. Underground irrigation main piping, NPS 4 and smaller, shall be the following:
  - 1. NPS 3 and NPS 4 ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings and gaskets; and gasketed joints.

2. Schedule 40, PVC pipe and socket fittings, and solvent-cemented joints.
3. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
4. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.

E. Circuit piping, NPS 2 and smaller, shall be the following:

1. SIDR 7, PE, controlled ID pipe; insert fittings for PE pipe; and fastener joints.
2. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
3. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

F. Circuit piping, NPS 2-1/2 to NPS 4, shall be the following:

1. SIDR 7, PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.
2. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
3. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

G. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.

1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.

H. Risers to Aboveground Sprinklers and Specialties: Type L hard copper tube, wrought-copper fittings, and soldered joints.

I. Risers to Aboveground Sprinklers and Specialties: Schedule 80, PVC pipe and socket fittings; and solvent-cemented joints.

J. Drain piping shall be the following:

1. SIDR 9, 11.5, or 15, PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.
2. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
3. SDR 21, 26, or 32.5, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

### 3.12 VALVE SCHEDULE

A. Underground, Shutoff-Duty Valves: Use the following:

1. NPS 2 and Smaller: Curb valve, curb-valve casing, and shutoff rod.
2. NPS 3 and Larger: Iron gate valve, resilient seated; iron gate valve casing; and operating wrench(es).

B. Aboveground, Shutoff-Duty Valves:

1. NPS 2 and Smaller: Bronze or Plastic ball valve.
2. NPS 2-1/2 and Larger: Iron ball valve.

C. Throttling-Duty Valves:

1. NPS 2 and Smaller: Bronze or Plastic automatic control valve.
2. NPS 2 and Smaller: Bronze or Plastic ball valve.
3. NPS 2-1/2 and NPS 3: Bronze or Plastic automatic control valve.
4. NPS 2-1/2 and NPS 3: Iron ball valve.

D. Drain Valves:

1. NPS 1/2 and NPS 3/4: Automatic drain valve.
2. NPS 1/2 and NPS 3/4: Bronze or Plastic ball valve.
3. NPS 1 to NPS 2: Bronze or Plastic ball valve.

3.13 WARRANTY

- A. Restore any settled trenches or settlement around valves and heads within the warranty period at no additional cost to the Owner.
- B. Inspect the system prior to expiration of the warranty period and make any adjustments or repairs as necessary.
- C. The system shall be guaranteed for labor, material, and workmanship for a period of one (1) year from the date of final acceptance.

END OF SECTION 328400

**SECTION 329219**  
**SEEDING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Prepare all disturbed earthen areas, fertilizer, seed, and mulch as specified herein, and needed for a complete and proper installation.
- B. Maintenance of newly seeded lawns for warranty period.

1.2 SUBMITTALS

- A. Manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials.
- B. Certification of seed mixture.
- C. Maintenance Instructions: Provide typewritten instructions to the Owner recommending procedures to be established for maintenance of landscape work for one (1) full year. Submit prior to expiration of required maintenance period(s).

1.3 SCHEDULING

- A. Planting seasons shall be as follows:
  - 1. Seeding shall be performed, preferably in the fall from September 1 to October 15. Spring seeding may occur March 1 to April 30.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at the project site.

1.5 WARRANTY

- A. Newly seeded lawns shall be warranted through the lawn maintenance period and until final acceptance.

1.6 QUALITY ASSURANCE

- A. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
- B. Analysis: Package standard products with manufacturer have certified analysis.

1.7 JOB CONDITIONS

- A. Utilities: Determine location of underground utilities and perform work in a manner, which will avoid possible damage. Hand excavate as required.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Architect/Engineer before planting.

1.8 RELATED WORK

- A. Section 312300 – Excavation and Fill.

1.9 REFERENCES

- A. ANSI Z60.1-1996 American Standard For Nursery Stock.

**PART 2 - PRODUCTS**

2.1 TOPSOIL

- A. Topsoil shall be placed prior to seeding operations.

2.2 SOIL AMENDMENTS

- A. Lime: Natural dolomitic limestone containing not less than 85% of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.

2.3 FERTILIZER

- A. Commercial Fertilizer: Provide a slow-release starter fertilizer with an analysis of 10-15-30 at a rate of 270 lbs./acre.

2.4 MULCH

- A. Mulch may be applied utilizing one of two methods:
- B. Vegetative mulch:
  - 1. Provide vegetative mulch for seeded areas of a high-quality, air-dried straw of wheat, rye, oats, beans, or other approved straw, free from grass, broom sedge, noxious weeds, and weed seeds detrimental to growth of grass.
  - 2. Mulch shall be applied at a rate of 2 ton per acre and stabilized by crimped in using a dull bladed in line disk with sufficient weight to crimp the straw approximately 2" into the soil.
- C. Hydraulic mulch:

1. Provide virgin wood cellulose fibers complying with the following properties (percent by weight):
  - a. Moisture content: 15.
  - b. Organic matter, minimum: 95.
  - c. Water holding capacity: 400.
  - d. pH: 4.3-8.5.

## 2.5 GRASS SEED

- A. General: Provide grass seed, which is:

1. Free from primary noxious weed seeds, and re-cleaned.
2. Certified test results from each lot of seed.

- B. Mixture:

1. Provide the following mixtures:

- a. Football Field:

80% Kentucky Bluegrass  
20% Perennial Ryegrass

- b. General Lawn Areas:

75% Fine Leaf Turf Type Fescue  
10% Perennial Ryegrass  
5% Redtop  
10% Creeping Red Fescue

- C. Seed and fertilizer applications may be modified to suit weather and soil condition at the time of seeding.

- D. Seeding Rate: The seeding rate shall be 6-8 lbs./1000 sq. ft. for new lawns and 3-4 lbs. /1000 sq. ft. for overseeding existing lawn areas.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. All proposed earthen areas and earthen areas disturbed during construction shall be re-vegetated.

### 3.2 PREPARATION

- A. Loosen subgrade of lawn areas to a minimum depth of 4 inches. Remove stones measuring over 1 inch in any dimension. Remove sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas that will be seeded the same day.

- B. Spread topsoil to the minimum rolled and settled depth required meeting Final lines, grades, and elevations shown on the grading plan. Add lime at a rate of one (1) ton per acre and mix thoroughly into upper 4 inches of topsoil.
- C. Where seeding is required for areas that have not been altered or disturbed by excavating or grading operations, prepare soil as follows: Till to a depth of not less than 4 inches, apply any required soil amendments and initial fertilizers, and remove high areas and fill depressions. Till soil to a fine texture, free of lumps, clods, stones, roots, and other deleterious matter. Existing grass, vegetation, and turf shall be removed and disposed prior to preparation of unchanged areas. Do not mix existing vegetation into soil being prepared for lawns.
- D. Apply specified commercial fertilizer and mix into upper two (2) inches of soil. Application of fertilizer shall precede the seeding operations by no more than two (2) days.
- E. If necessary, moisten the area to be seeded, being careful not to create a muddy soil situation.

### 3.3 FINISH GRADING

- A. Finish grading will be performed in coordination with Section 312300.
- B. Fine grade areas to be seeded to a smooth, even surface with a loose fine texture. Roll, rake, and drag area, removing ridges and depressions, as required to meet final grades on the grading plan.

### 3.4 SEEDING LAWNS

- A. Sow seed using a spreader or seeding machine. Distribute seed evenly over entire area by sowing equal quantity in two (2) directions at right angles.
- B. Rake the seed into the top 1/8" of soil, roll lightly, and water.
- C. Protect slopes 4:1 and steeper after seeding with erosion mat or netting to be approved by the Landscape Architect.
- D. Mulching: All seeded areas shall be mulched. Seeding shall be completed as a separate operation and shall not be added to the hydraulic mulch slurry if used. Mulch shall not be applied when ambient temperature is at or below freezing. To achieve full and even coverage, the hydraulic mulch shall be applied from two opposing directions if used. Mixing and application rates shall be in accordance with manufacturer's recommendations with a minimum application rate of 2500 lb/acre of hydro-mulch.
- E. Water all newly planted lawn areas and keep moist until the new turf is established.

### 3.5 MAINTENANCE

- A. The maintenance period shall begin immediately after planting.
- B. Maintain seeded lawns for not less than 30 days after substantial completion.
- C. If seeded in the fall and not provided 30 days of maintenance, the maintenance period shall continue into the following spring.

- D. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations as required to provide a smooth, acceptable lawn for final project acceptance.

### 3.6 CLEANUP AND PROTECTION

- A. Clean pavement and other site areas containing debris resulting from the seeding operations.
- B. Protect existing site elements from damage due to seeding operations. Protect seeded areas from damage by operations of other contractors and trespassers. Maintain protection during installation and the maintenance period. Treat, repair, and/or replace damaged areas.

### 3.7 INSPECTION AND ACCEPTANCE

- A. Upon completion of lawn work. The Owner and Landscape Architect will make a final inspection for final project acceptance.
- B. If lawn work does not comply with requirements, replace rejected work and continue maintenance until accepted.

END OF SECTION 329219

**SECTION 329300  
LANDSCAPING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Edging.
  - 2. Mulch.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples of mulch.
- C. Product certificates.

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- E. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site and confirm new undamaged condition.

## **PART 2 - PRODUCTS**

### **2.1 MULCHES**

- A. Mineral Mulch: Trap Rock
  - 1. Size Range: 3/4 inch maximum, 1/2 inch minimum.
  - 2. Color: To be selected by Owner from manufacturer standard samples and colors.

### **2.2 WEED-CONTROL BARRIERS**

- A. Polyethylene Sheeting: ASTM D 4397, black, 0.006-inch minimum thickness.
- B. Nonwoven Fabric: Polypropylene or polyester fabric, 4 oz./sq. yd. minimum. Typar. Dewitt or approved equal spunbonded polypropylene weed barrier having a tensile strength of 135 lbs. and a permeability of 70 gallons per square yard.

### **2.3 EDGING**

- A. Precast concrete edgers, nominal 12" long, 3.5" wide and 3.5" height.
- B. Pavestone "Edgestone" or approved equal.

## **PART 3 - EXECUTION**

### **3.1 PLANTING BED ESTABLISHMENT**

- A. Loosen subgrade of planting beds to a minimum depth of 6 inches. Remove stones larger than 1/2 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
  - 1. Apply superphosphate fertilizer directly to subgrade before loosening.
  - 2. Thoroughly blend planting soil mix off-site before spreading; or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
  - 3. Spread planting soil mix to a depth of 6 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

### **3.2 MULCHING**

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches. Tape or pin seams as recommended by manufacturer.
- B. Mulch backfilled surfaces of planting beds and other areas indicated. Provide mulch ring around trees in lawn areas.

1. Organic Mulch and Mineral Mulch: Apply 3-inch average thickness of mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

END OF SECTION 329300

**SECTION 331110**  
**SITE WATER DISTRIBUTION**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes pipe and fittings for site water line including domestic water line, fire water line and valves, fire hydrants.
- B. Related Sections:
  - 1. Section 312316 - Excavation and Fill.
  - 2. Section 312333 – Trenching and Backfilling.

1.2 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.3 REFERENCES

- A. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb Rammer and 12 inch Drop.
- B. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- C. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
- D. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
- E. AWWA C502 (American Water Works Association) - Dry Barrel Fire Hydrants.
- F. AWWA C509 (American Water Works Association) - Resilient Seated Gate Valves 3 in through 12 in NPS, for Water and Sewage Systems.
- G. AWWA C900 (American Water Works Association) - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

- C. Operation and Maintenance Data: Section 017700 - Contract Closeout.

#### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with manufacturer's standards.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

### **PART 2 - PRODUCTS**

#### 2.1 WATER PIPE

##### A. Manufacturers:

1. Johns-Manville Blue Brute PVC Class water pipe.
2. Substitutions: Section 01600 - Product Requirements.

##### B. PVC Pipe: AWWA C900 Class 150 DR-18:

1. Fittings: AWWA C111, cast iron. Cor-blue steel bolts.
2. Joints: ASTM D3139 compression gasket ring.
3. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Water Service" in large letters.

##### C. Push-on-Joint, Ductile-Iron Pipe: AWWA C 151, with push-on-joint, bell-and plain-spigot end, unless flanged ends are indicated. Class 150.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C 110, ductile- or gray-iron, standard pattern; or AWWA C 153, ductile-iron, compact pattern.
  - a. Gaskets: AWWA C 111, rubber.

##### D. Service Pipe: 2 inches or smaller:

1. Type K Copper.

#### 2.2 GATE VALVES - 3 INCHES AND OVER

##### A. Manufacturers:

1. Mueller.
2. American Flow Control.

- B. AWWA C509, Iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, mechanical joint ends, control rod, extension box, epoxy coated interior.
- C. R.W. Type. Open Left

### 2.3 HYDRANT

- A. Manufacturers:
  - a. Clow Model Medallion.
  - b. Mueller Model Centurion 200.
  - c. American Model B-84-B.
  - d. Substitutions: Section 01600 - Product Requirements.
- B. Hydrant: AWWA C502, UL 246, dry barrel type, inside dimension of 7 inches minimum, with minimum 5 inches diameter valve seat opening; minimum net water area of barrel not less than 190 percent of valve opening; 6 inch flanged type inlet connection with accessories, gland bolts, and gaskets.
- C. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length.
- D. Hose and Streamer Connection: Match sizes and type of thread with City of Hallsville requirements, two 2-1/2" hose nozzles, and one 4-1/2" pumper nozzle.
- E. Finish: Primer and two coats of enamel in color required by utility company and fire department. Barrels shall be painted green. The cover, cap and chain shall be painted white.
- F. Traffic model type. Open right.

### 2.4 BEDDING AND COVER MATERIALS

- A. Bedding: Fill Type A1 as specified in Section 310516.
- B. Cover: Fill Type A1, as specified in Section 310516.

### 2.5 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type specified in Section 030000.
- B. Service Boxes: Tyler 95E, with lid marked water.
- C. Mainline valve boxes: two piece, screw type Tyler Series 6850, with 5-1/4" drop lid marked water.
- D. Mainline Couplings: Smith-Blain 442 cast coupling or equal.
- E. Corporation and curb stops: Ball valve type. Corporations have CC tapered threads. Ford or Mueller. Corporation stops - Ford F600 or equal. Curb stops - Ford B21 or B22 or equal.
- F. Swivel quarter or eight bends: Ford L02 or LA02 or equal.

- G. Trace wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Water Service" in large letters.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Section 011115 - Administrative Provisions: Coordination and project conditions.
- B. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

#### **3.2 PREPARATION**

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

#### **3.3 BEDDING**

- A. Excavate pipe trench in accordance with Section 312333 for Work of this Section.
- B. Form and place concrete for pipe thrust restraints at any change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide 9 sq ft thrust restraint bearing on subsoil.
- C. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth; compact to 95 percent.
- D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact to 95 percent.
- E. Maintain optimum moisture content of fill material to attain required compaction density.

#### **3.4 INSTALLATION - PIPE**

- A. Maintain separation of water main from sewer piping in accordance with Missouri DNR requirements.
- B. Group piping with other site piping work whenever practical.
- C. Route pipe in straight line.
- D. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- E. Slope water pipe and position drains at low points.
- F. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.

- G. Establish elevations of buried piping to ensure not less than 5 ft of cover.
- H. Install trace wire continuous over top of pipe. Buried 6 inches below finish grade, above pipe line; coordinate with Section 312333. Bring tracer wire into valve boxes and coil at the top or bring to a junction box attached to a fire hydrant at the surface.
- I. Backfill trench in accordance with Section 312333.

### 3.5 INSTALLATION - VALVES AND HYDRANTS

- A. Set valves on solid bearing.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.
- C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.
- D. Set hydrants to grade, with nozzles at least 20 inches above ground.
- E. Locate control valve 4 inches away from hydrant.
- F. Provide a drainage pit 36 inches square by 24 inches deep filled with 1/2 inch washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening. Do not connect drain opening to sewer.
- G. Section 014500 - Quality Control: Testing and inspection services.
- H. Compaction testing will be performed in accordance with ASTM D698, ASTM D2922, ASTM D3017.
- I. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

END OF SECTION 331110

**SECTION 334100**  
**STORM UTILITY DRAINAGE PIPING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Provide storm sewerage system were shown on the Drawings, and as specified herein.
- B. Related work:
  - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 SUBMITTALS

- A. Comply with pertinent provisions of Section 013219.
- B. Product data: If requested by the Engineer/Architect (A/E), within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
  - 1. Materials list of items proposed to be provided under this Section.
  - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.3 REFERENCES

- A. *A. Standard Specifications for Missouri Department of Transportation, 2022*, herein noted as the Standard Specifications.

**PART 2 - PRODUCTS**

2.1 PIPE MATERIALS FOR SEWERS

- A. Sewer pipe shall comply with Sections 1026 & 1027 of the Standard Specifications for the type, class, and size of pipe as shown on the Plans and as described herein:
- B. In addition to the list of materials in Sections 1026 & 1027 the following materials shall be used when specified:
- C. Reinforced Concrete Pipe (RCP):
  - 1. Comply with ASTM C 76.
  - 2. Minimum Class III and as specified in Section 1042 of the Standard Specifications.
  - 3. Use tongue and groove joints wrapped with engineering fabric, unless a rubber O-ring or profile gasket complying with ASTM C 443 is specified.

- D. Polyvinyl Chloride Pipe (PVC):
  - 1. Solid wall PVC Pipe complying with ASTM D 3034 or ASTM F 679.
  - 2. PVC plastic meeting ASTM D 1784, Cell Classification 12454.
  - 3. SDR 26: Minimum pipe stiffness of 115 psi (pipe 4" to 15" diameter).
  - 4. Pipe stiffness per ASTM D 2412, 46 psi (pipe 18" to 27" diameter).
  
- E. High Density Polyethylene Pipe (HDPE):
  - 1. AASHTO M 294, Type S corrugated exterior and smooth interior.
  - 2. ASTM D 3350 minimum resin Cell Classification 335420 C.
  - 3. Minimum pipe stiffness at 5% deflection according to ASTM D 2412.
  - 4. Integral bell and spigot joints with elastomeric seals complying with ASTM F 477.
  - 5. Maximum 5% deflection of the average inside diameter by testing after installation.
  
- F. Corrugated Metal Pipe (CMP):
  - 1. AASHTO M 36, Type I.
  - 2. Zinc coating complying with AASHTO M 218.
  - 3. Corrugated steel circular section with annular or helical corrugations.
  - 4. Gage of pipe according to Mo DOT Specification section 725.1.3 or as specified in the contract documents.
  - 5. Coupling bands with annular or helical corrugations to match pipe ends.
  
- G. Pipe Drains, Underdrains and French Drains materials shall comply with Section 605 of the Standard Specifications for the type, class, and size of pipe as shown on the Plans and as described herein.
  
- H. Manholes, Inlets, and Drainage Structure materials shall comply with applicable Section 604, 726, 731, 732 & 733 of the Standard Specifications for the type of structure, frame and grate or lid as shown on the Plans and as described herein.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION & LAYOUT**

- A. Before starting excavation, establish location and extent of underground utilities occurring in the work area. Utilities shown on the plans indicate the best knowledge of the Owner with regard to general location and nature of the facilities in the area. They are shown for the convenience of the Contractor and shall not relieve the Contractor of the responsibility to properly investigate and protect the utilities. The Contractor shall remain responsible for damages to existing utilities whether indicated on the plans or not.
  
- B. The Contractor shall notify the Missouri One Call System (1-800-DIG-RITE) and the Owner or his/her site representative 48 hours prior to start of work.
  
- C. Field Conditions: Verify location and elevation of existing facilities where connections are to be made.

3.2 INSTALLATION

- A. Storm sewer pipe and structures shall be installed in accordance with applicable Sections 604, 605, 726, 731, 732 & 733 of the Standard Specifications.
- B. Excavation and backfilling for sewers, manholes, structures and appurtenances, shall comply with governing Federal State laws and municipal Ordinances as may be necessary to protect life, property, or the work. In any event, the minimum protection shall conform to the rules and regulations of the Occupational Safety and Health Act (OSHA) Standards for Construction.
- C. Line and Grade
  - 1. Reference points and bench marks for controlling lines and grades are shown on the Drawings. All additional horizontal and vertical measurements that will be required to complete the work, in addition to the controlling lines and grades, shall be the responsibility of the Contractor.
- D. Backfilling Trenches
  - 1. Backfill above the center line of the pipe shall be in accordance with Section 726 of the Standard Specifications, as shown on the Drawings.
  - 2. Aggregate trench backfill shall be placed beneath and within 2 ft. of areas of proposed pavements, walks, footings, foundations, slabs or other structures.
  - 3. Jetting or watersoaking to obtain compaction will not be allowed.
  - 4. Compaction of the backfill shall be based on Standard Proctor Density (ASTM D698) methods and shall meet the following requirements:

a.	Area/Condition	Percent of Std Proctor
	Footings, Foundations	95%
	Pavements, walks, floor slabs	95%

END OF SECTION 334100

**SECTION 334101**  
**SANITARY SEWERAGE SYSTEM**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Provide sanitary sewerage system including construction and installation of piping, manholes, and structures as specified herein, and conforming in all respects to the lines and grades shown on the Drawings, together with all specified or necessary accessories and appurtenances.
- B. Related work:
  - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 SUBMITTALS

- A. Product data: Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
  - 1. Materials list of items proposed to be provided under this Section.
  - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 016600.

1.5 PERMITS AND ENTRY UPON LANDS

- A. The Owner will obtain permits and/or easements for entering upon private lands, public streets, roads and highways, railroads, etc. to the limits and lines shown on the Plans for construction purposes. The Contractor shall confine his operations to the outlined areas and shall comply with all special instructions shown on the Plans or set forth in the Contract Documents.

1.6 UTILITIES

- A. Existing underground utilities are herein defined as consumer service connections, such as water, gas, sewer, electric, telephone, etc., and also culverts, sanitary sewers, storm sewers,

combined sewers, water mains, underground power lines, gas mains and the usual appurtenances thereto.

1. No attempt is made to indicate or show accurate location of all underground utilities in the line of, or crossing the proposed work. In general, wherever record information was available of locations and wherever field location was possible during surveys, the approximate position of utilities is shown on the Plans. These are primarily for the purpose of indicating the approximate position of the underground lines with respect to the proposed sewer lines.
2. The determination of the exact location of all existing facilities, and all other pipes, services and structures, and their proper protection, support and maintenance during all construction operations; it is the expressed responsibility of the Contractor in the performance of this contract. Contractors are advised to secure any additional information, relative to the underground utility lines, by consulting with proper private and public officials, under whose jurisdiction the maintenance and operation of the utility lines lie, and/or by field investigations at his own expense.
3. Wherever underground utilities are disturbed or damaged as a result of the construction work proposed herein and such utilities can be replaced at their original locations and grades, all costs in connection with such replacement work shall be borne by the Contractor and no separate or extra payment will be made therefore.
4. Where existing underground utilities are in actual contact with the new work, so that such utilities cannot be replaced as originally found prior to excavation, and where relocation and changes are required, then the work shall be replaced or relocated by "others" at no cost to the Contractor. The Contractor shall so coordinate his work as to allow a reasonable time for such replacement or relocation and in no event shall extra compensation be allowed for such coordination or any reasonable delay occasioned therefrom. Should it be found necessary or desirable by the Owner for the Contractor to perform the work of replacement or relocation, the Engineer/Architect will issue in writing a field order defining the extent of the additional work and instructing the Contractor to proceed with such construction. Compensation for such work shall be determined as set forth in the General Specifications, under "Extra, Additional, or Omitted Work - Payment."

#### 1.7 TREES, SHRUBBERY, STRUCTURES AND ABOVE GROUND UTILITIES

- A. All trees, shrubbery, utility poles and the like in the line of work shall be protected and preserved except as shown on the Plans, unless permission of the Owner and approval of the Engineer/Architect are obtained for their removal. Construction operations may require hand trenching and tunneling under and adjacent to trees and poles, which are to be preserved.
1. Private and/or public walls, steps, walks, drives, roads, roadbeds, fences or other structures except trees in the line of work shall be replaced to as good a condition as prior to the start of excavation.
  2. All grassed surface areas shall be replaced to a condition equal to that found prior to the start of work.
  3. Erosion control measures shall be in accordance with Standard Specifications for Soil Erosion and Sediment Control as contained in IEPA/WPC/87-012 or current edition.
  4. Existing structures and markers such as inlet castings, fire hydrants, highway and street signs, valve boxes, etc., that may be disturbed during the progress of the work, shall be cleaned and reset in their original position in such a manner as may be required by the Engineer/Architect.

## **PART 2 - PRODUCTS**

### **2.1 SEWER PIPE**

- A. Vitrified Clay Pipe (ESVCP) conforming to ASTM C 700 (Extra Strength).
- B. Concrete Pipe, Reinforced (RCCP) conforming to ASTM C 76, Classes I, II, III, IV, or V.
- C. Ductile Iron Pipe (DIP) conforming to ANSI A-21.5I (AWWA C-15I) Thickness designed per ANSI A 21.50 (AWWA C-150) tar (seal) coated and/or cement lined per ANSI A-21.4 (AWWA C-104).
- D. Polyvinyl Chloride (PVC) Pipe conforming to ASTM D 1784 "Rigid Poly (Vinyl Chloride) and Chlorinated Poly (Vinyl Chloride) Compounds" and ASTM D 2241 latest revisions. Minimum acceptable SDR shall be 26. Include the appropriate ASTM Designations and Cell Classification Numbers (12454-B or 12454-C) or other approved classifications).

### **2.2 JOINTS**

- A. Extra Strength Vitrified Clay Pipe joints shall conform to ASTM C 425. Plain end VCP shall be with PVC bell material conforming to ASTM C 1784 and flexible gasket meeting ASTM C-425 specifications.
- B. Concrete Pipe joints shall be confined O-ring Type conform to the latest ASTM C 361.
- C. Ductile Iron Pipe shall have push-on or mechanical joints complying with the latest revision of ANSI/AWWA Specification C111/ A-21.II.
- D. PVC Pipe joints shall use flexible elastomeric seals per ASTM D 3212.

### **2.3 CONCRETE**

- A. All concrete for manhole bottoms, special structures, and incidental items shall be as specified in Section 033000.

### **2.4 CASING PIPE**

- A. Steel casing pipe of the diameter and thickness specified in the plans for Cathodically Protected Pipe or Non-Cathodically Protected pipe. Minimum yield strength of 35,000 psi.

### **2.5 SEAL PLUGS**

- A. Seal plugs for all service lateral openings shall be air tight, as manufactured by Fernco Joint Sealer Co., Ferndale, Mich., or approved equal.

## 2.6 MANHOLE

- A. Manholes shall be precast reinforced concrete manhole sections and bases with rubber gasket joints complying with latest revisions of ASTM C 478. Diameter shall be 48" for sewer pipes 15" and smaller, and 60" for sewer pipes up to 36".
- B. Manhole steps shall be copolymer polypropylene plastic with steel reinforcement, (PS2-PF), or equal, and meet or exceed ASTM specifications D 2146 under Type 2 Grade 49108.
- C. Opening for sewer pipe connections shall be resilient connectors meeting the latest revisions of ASTM C923.
- D. Manholes shall be provided with cast iron frame and closed lids, (Neenah R-1015) or equal when located within the roadbed or buried conditions. Use a Neenah R-1077-B Frame and Type B lid or equal at other locations. All manhole lids shall be furnished with small pick holes.

## 2.7 BEDDING OR GRANULAR CRADLE

- A. Bedding or Granular cradle material shall comply with ASTM D2321, Class II, consisting of coarse sands and gravels with a maximum particle size of 20 mm (3/4in.), including various graded sands and gravels containing small percentages of fines, generally granular and non-cohesive.

## 2.8 SELECT GRANULAR BACKFILL

- A. Select Granular Backfill materials shall consist of sand, crushed stone, pit run or crushed gravel well graded within the following limits.

## **PART 3 - EXECUTION**

### 3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- B. Field Measurements - Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

### 3.2 INSTALLATION - TRENCH EXCAVATION

- A. All excavation work for sewers, manholes, sewer structure and sewer appurtenances, as herein defined, includes the clearing of the site of the work, the loosening, loading, removal, transporting and disposing of all excavated materials, wet or dry, necessary to be removed and replaced (backfilling) for purposes of sewer construction. All excavation shall be unclassified unless otherwise specifically specified. The ground shall, in general, be excavated in open trenches unless otherwise shown on the Drawings to be bored and jacked and/or in tunnel.

- B. Trenches shall be excavated to the depth required for the bedding and foundations of the sewers and appurtenances shown on the Drawings and profiles; and, where conditions make it necessary, to such additional depths as may be directed in writing by the Engineer/Architect.
- C. Should the trench be excavated without written authority to a depth greater than that required by the said Drawings and profiles, the Contractor shall refill such excess excavation at his own expense, with crushed stone which shall be tamped until solid, with 2000 psi concrete, or as otherwise directed by the Engineer/Architect.
- D. Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unsuitable soil, unless other special construction methods are called for on the Drawings, all such unsuitable soil under the pipe and for the width of the trench shall be removed and replaced with well compacted bedding material, as may be directed in writing by the Engineer/Architect.
- E. Whenever excavation is made for installing sewer pipe across private property, the top soil disturbed by excavation operations shall be replaced as nearly as possible in its original position, and the whole area involved in the construction operations shall be left in a neat and presentable condition.
- F. The width of the trench at the top of the sewer pipes shall be as shown on the Drawings at Trench Detail. However, a greater width may be permitted by the Engineer/Architect, in writing, when it is necessary for the proper construction of the sewer according to the plan.
- G. In general, trenches shall be only of sufficient width to provide a free working space on each side of the sewer pipe according to the size of the pipe and the character of the ground as shown on the Drawings; but in every case there shall be sufficient space between the pipe and the side of the trench, not less than six (6) inches, to make it possible to thoroughly ram the bedding around the pipe and to secure proper tight joints.
- H. All surplus excavated material, debris and rubbish shall be removed from the site by the Contractor.
- I. When the Contractor constructs the trench with sloped sides or benched, backfilling for the full width of the excavation shall be as hereinbefore specified, except no additional compensation will be allowed for trench backfill material required outside the limits of the specified trench width.
- J. In general, the Contractor shall furnish suitable spoil areas, but the Engineer/Architect reserves the right to designate certain spoil areas, provided the haul distance shall not exceed one (1) mile.
- K. The Contractor must take full responsibility and the risk of meeting quicksand, hardpan, boulder clay, rubbish, unforeseen obstacles, underground conduits, railroad tracks, pavements, etc. No claim for any amount of money, beyond the contract price of the work, will be entertained or allowed on account of the character of the ground in which the trench or other excavations are made, except for removal of unsuitable sewer pipe foundation material as authorized by the Engineer/Architect.

### 3.3 LINE AND GRADE

- A. Reference points and bench marks for controlling lines and grades will be established by the Engineer/Architect. Such work shall consist of referenced locations of all points of intersection, or changes in direction or grade. Controlling grades shall consist of Bench Marks along the line

800 feet apart. All additional horizontal and vertical measurements that will be required to complete the work, in addition to the controlling lines and grades, shall be made by the Contractor and at his sole responsibility. No compensation shall be paid the Contractor for the cost of any of the work or for delay occasioned by giving lines and grades or for inspection; but such cost shall be included in the prices specified for the appropriate items.

### 3.4 ROCK EXCAVATION AND BLASTING

- A. Wherever rock is encountered in the trench excavation, it shall be removed to a depth of six (6") inches below the sewer pipe as shown in detail on the Drawings.
- B. Extreme care shall be used wherever blasting is necessary for the removal of rock, large boulders, or other hard material. The Contractor shall conform his acts to and shall obey all rules and regulations for the protection of life and property that may be imposed by any public authorities or that may be made from time to time by the Engineer/Architect relative to the storing and handling of explosives and the loading and firing of blasts. Signals of danger shall be given before the firing of any blast and blasts shall not be fired until all persons in the vicinity are known to have reached positions out of danger there from.
- C. In case injury occurs to any portion of the work, or to the materials surrounding or supporting the same, through blasting, the Contractor, at his own expense, shall remove such injured work and shall rebuild the same and shall replace the material surrounding or supporting the same, or shall furnish such material and perform such work or repairs or replacements as the Engineer/Architect may order. Any damage whatever to any existing structure due to blasting shall be promptly, completely, and satisfactorily repaired by the Contractor at his own expense.

### 3.5 SHEETING AND BRACING

- A. The Contractor shall furnish, install and maintain such sheeting, bracing, etc., as may be required to support the sides of the excavation and to prevent any movement which can in any way injure the sewers, diminish the necessary width of the excavation, or otherwise injure or delay the work or endanger adjacent pavements, buildings or other structures. Sheeting and bracing shall be provided in accordance with Missouri DNR Standards.
- B. For sheeting and bracing which is specifically shown upon the drawings, or ordered in writing by the Engineer/Architect, to be left in place, the Contractor shall receive payment, in accordance with the General Conditions.

### 3.6 PROTECTION AGAINST WATER

- A. The Contractor shall do all pumping and bailing, build all subdrains and drains, and do all other work necessary to keep the trench and sewer clear of groundwater, sewage, or storm water during the progress of the work. Where the excavation for its depth is in whole or in part in wet sand, or where conditions warrant it, in the judgment of the Engineer/Architect, the Contractor shall install a pumping system connected with well points so as to drain the water from the water-bearing strata effectively.
- B. When existing sewers and laterals have to be taken up or removed, the Contractor shall provide and maintain temporary outlets and connections for all private or public drains, sewers, or catch basins, and he (she) shall take care of all sewage and storm water which will be received from these drains and sewers and discharge the same; and for this purpose he (she) shall provide

and maintain at his own expense an efficient pumping plant and temporary outlets; and be prepared at all times to dispose of the water and sewage received from these temporary connections, until such time as the permanent connections shall be made by the Contractor in a careful and workmanlike manner.

### 3.7 PIPE LAYING OPERATIONS (EXCEPT PVC)

#### A. General:

1. Sewer pipe shall, under all conditions, be laid in a dry-trench on an even, firm bed throughout the full length of the barrel so that no uneven strain will come on any pipe. The intent of the specifications is to maintain a dry trench and to properly bed the sewer pipe as shown on the Drawings. Pipe laying operations shall be carried on in a manner, which will insure against subsequent misalignment laterally and vertically; and to eliminate subsequent groundwater infiltration. The trench shall be kept continuously dry at all times, and the pipe bedded full length of the barrel so that a firm, even bearing will result for the bottom quadrant of the pipe as shown on the Drawings. Bell holes for bell and pipe shall be carefully made and be no larger than required to properly free the bell from bearing on the subgrade and to properly make up the pipe joints.
  - a. Protect pipe during handling against shocks and free fall. Remove extraneous material from the pipe interior.
  - b. Lay pipe by proceeding upgrade with the spigot ends of bell-and-spigot pipe pointing in direction of flow.
  - c. Lay each pipe accurately to the indicated line and grade, aligning so that the sewer has a uniform invert.
  - d. Before making pipe joints, clean and dry all surfaces of the pipe to be joined.
  - e. Use lubricants, primers, and adhesives recommended for the purpose by the pipe manufacturer.
  - f. Place, fit, join, and adjust the joints to obtain the degree of water tightness required.

#### B. Foundations and Bedding:

1. All sewer pipe shall be laid on a crushed stone bedding Type "A" or Type "C" granular cradle, having a minimum thickness of 6 inches below the pipe and extending around and up to the pipe as shown on the Drawings.
2. In trenches where a dry, firm subgrade cannot be maintained due to groundwater seepage into the trench, the subgrade shall be excavated to a depth of six inches below sewer pipe and shall be backfilled with crushed stone to form subdrain pipe bedding to the shape and dimensions as detailed on the Drawings. This will not be a pay item unless ordered by the Engineer/Architect to be placed at a depth greater than six inches below bottom of pipe.
3. When solid rock is encountered, the trench excavation shall conform to the shape and dimensions shown on the detailed Drawings and shall be backfilled with crushed stone or sand to form the pipe bedding.

#### C. Sewer Joints:

1. In general all sewer pipes shall be jointed in accordance with the recommendations and instructions of the pipe manufacturer.
2. At manholes a compression type polyurethane joint complying with ASTM Specification C-425 shall be used to join each influent and effluent line to the manhole as manufactured by Moorbase or equal. The sewer pipe shall be securely and completely

- encased in a metallic grout mortar through the opening in the wall. The metallic grout mortar shall be Embeco Grout Mortar by Master Builders; or equal.
3. Wherever dissimilar types of pipe are to be joined together outside of a manhole or other structure, the pipe shall be joined with suitable adapters, such as Fernco Couplings as manufactured by the Fernco Joint Sealer Co., Ferndale, Michigan 48220, or equal.

D. Existing Drains, Sewers, and Laterals:

1. Any existing drain or sewer not in conflict with the new work, which is disturbed or removed on account of the new work under this contract, whether shown on the Drawings or not, shall be restored or reconnected. Existing drains and sewers encountered in the work which are not in conflict with new work are, in general, to be restored by and at the expense of the Contractor, excepting that extensions thereof ordered by the Engineer/Architect and new portions of such old drains or sewers authorized by the Engineer/Architect, will be paid for at the contract prices for sewer of the same size, or as extra work. Connection to be made to the new sewer shall be made through tees, or wyes in the main.
2. Existing laterals, sewers or drains shall be restored with pipe of the same size and equal or better in type and quality. They shall be firmly supported across the trench by timbering, blocking, masonry, or other suitable manner to prevent after-settlement.
3. No existing sewers or drains shall be connected to the new sewer except as specifically shown on the Drawings or approved by the Engineer/Architect.

### 3.8 PVC PIPE INSTALLATION AND FIELD TESTING

A. Installation:

1. Pipe shall be installed in full compliance with the Recommended Practice for "Underground Installation of Flexible Thermoplastic Sewer Pipe," ASTM Standard D 2321. In addition to the construction and testing procedures outlined in other sections of the specifications, the Contractor shall be required to install the pipe in such a manner so that the diametric deflection of the pipe shall not exceed 5% and the materials surrounding the pipe shall be compacted to the required Standard Proctor Densities outlined in D 2321. The area requiring compaction shall include the bed and sidefill material and also the material placed above the pipe for a distance of 6 inches over the top of the pipe. The Engineer/Architect may require up to 10 random compaction tests to be completed by an independent laboratory. If any of these tests indicate that the material has not been compacted to the required density, the Contractor shall recompact said material at no additional cost to the Owner, and the Engineer/Architect shall then have the right to require additional compaction tests to insure that this or other material is compacted to the proper density without any additional cost to the Owner.

B. Pipe Handling:

1. Care shall be taken during the transporting of the pipe to ensure that the binding and tie down methods do not damage or deflect the pipe in any manner. Pipe bent, deflected or otherwise damaged during shipping shall be rejected.
2. Pipe stored on the job site shall be covered with canvas or other opaque material to protect it from the sun's rays. Air circulation shall be provided under the covering.
3. PVC pipe shall not be removed from the pallet and/or laid out along the ditch until the bedding material is in place and ready to receive pipe. Only enough pipe should be laid out for one days' work.

C. Laying Pipe:

1. Lateral displacement of the pipe shall be prevented during embedment operations. Pipe shall not be laid in water, or under unsuitable weather or trench conditions.
2. Pipe laying shall begin at the lowest elevation, with bell ends facing the direction of laying except when reverse laying is permitted by the Engineer/Architect. Pipe jointing and installation shall be specifically in accordance with the manufacturer's recommendations except as otherwise specified herein, for the type used.

D. Backfill:

1. Backfill shall be placed in accordance with paragraph 3.9 below.

### 3.9 BACKFILLING TRENCHES

A. General:

1. After sewers are laid and bedded in open cut, the trench shall be backfilled to the original ground surface. Unless otherwise ordered, the backfilling shall not be left unfinished for more than three hundred (300) feet behind the completed pipe work.
2. As soon as the pipe is tested, the entire width of the trench shall be backfilled with material, as shown on the Trench Detail, and for the Case as shown in the plan and profile.

B. Backfill:

1. Case I:

- a. In this case backfill, from the center line of the pipe to the surface shall be made by any acceptable method, which will not dislodge or damage the pipe or cause bridging action in the trench. Only selected excavation material, free from clods or stones, shall be used in backfilling up to 6" above the top of the pipe.
- b. All trench backfill shall be compacted by jetting and watersoaking in the manner described below. The trench compaction shall be started at the point of lowest elevation of the trench and work up along the trench. Jetting and watersoaking shall not begin until the trench has been backfilled to within six (6) inches of the finished surface.
- c. The holes through which water is injected into the backfill shall be centered over the trench backfill and at longitudinal intervals of not more than six (6) feet. Additional holes shall be provided if deemed necessary by the Engineer/Architect to secure adequate settlement. All holes shall be jetted and shall be carried to a point one (1) foot above the top of the pipe. Drilling the holes by means of augers or other mechanical means will not be permitted. Care shall be taken in jetting so to prevent contact with, or other disturbance of the pipe.
- d. The water shall be injected at a pressure and rate just sufficient to sink the holes at a moderate rate. After a hole has been jetted to the required depth, the water shall continue to be injected until it begins to overflow the surface. The Contractor shall, at his own expense, bore test holes at such locations as the Engineer/Architect may designate in order to determine the effectiveness of the water soaking. An approved soil auger shall be used for boring test holes. As soon as the jetting and watersoaking has been completed, all holes shall be filled with soil and compacted. Surface depressions resulting from backfill subsidence caused by jetting and watersoaking shall be filled and recompact by tamping or rolling to the satisfaction of the Engineer/Architect. The location where Case I is required shall be indicated on the Drawings.

2. Case IV:

- a. This case applies to those areas where, in the opinion of the Engineer/Architect, due to the nature of the soil or other factors, the use of jetting or water-soaking for compaction of the trench will not give satisfactory results. In this case, backfill material above the granular cradle to a point twelve (12) inches above the top of the pipe shall be placed in layers of six (6) inches thickness, loose measure, and each layer firmly compacted by ramming or tamping with tools approved by the Engineer/Architect in such manner as not to disturb or injure the pipe. The balance of the backfill material shall be placed in uniform layers of twelve (12) inches thickness, loose measure, and each layer shall be compacted by ramming or tamping with tools approved by the Engineer/Architect. All compaction under this case shall be not less than 80% optimum, modified proctor, for the soil. The location where Case IV is required shall be indicated on the Drawings.

3. Case V:

- a. This case applies to those areas where watermains, pipe sewers, or other conduits are crossing open areas where early settlement is not critical. In this case, backfill, from the center line of the pipe to the surface, shall be made by any acceptable method, which will not dislodge or damage the pipe or cause bridging action in the trench. Only selected excavated material free from clods or stones shall be used in backfilling up to six (6) inches above the top of the pipe. Water-soaking or other methods of trench settlement will not be required in this case. Excess material shall be neatly rounded over the top of the trench as directed by the Engineer/Architect to allow for settlement of the trench. In final clean-up operations, the Contractor shall reshape the surface to level out any uneven settlement that has occurred. The location where Case V is required shall be indicated on the Drawings.

3.10 MANHOLE CONSTRUCTION

A. General:

1. Manholes shall be constructed at the locations, to the depths, and of the materials, shown on the Drawings. Backfill shall be as shown on the Drawings and shall be compacted as specified for the sewer pipe backfill.
2. Concrete bottoms shall be carefully shaped to channelize and direct the sewage flow, as shown on the manhole detail on the Drawings.
3. All unused holes in the precast concrete rings shall be closed with concrete plugs and sewer joint compound.
4. Where the flow line grade of an incoming sewer is more than two feet above the flow line grade of the manhole, a drop connection shall be provided as shown on the Drawings.
5. Standard manholes shall be constructed and backfilled within 48 hours after sewer pipe is laid and drop manholes within 96 hours after sewer pipe is laid at the manhole location.

3.11 TEMPORARY SEWER CONNECTIONS

- A. Where special junction chambers or structures are to be constructed or where existing sewers carrying sanitary sewage and storm water are encountered, the Contractor shall provide and maintain temporary connections to prevent public nuisances and to prevent pollution. The costs of all such temporary connections, pumping and diversions shall be considered incidental to the

scope of work. No separate payment will be made for such or similar items of work. No such existing sewers shall be connected to the new sewers unless shown on the Drawings or approved by the Engineer/Architect and/or the Owner.

### 3.12 SEWER PIPE AND WATER MAIN SEPARATION

A. Sanitary sewers, house sewers or storm drains that are laid in the vicinity of pipe lines designated to carry potable water shall meet the following conditions.

1. Parallel Installation – Sewers and Water Mains:

- a. Normal Conditions - Any sanitary sewer, storm sewer or sewer manhole shall be located at least 10 feet horizontally from water mains, whenever possible; the distance shall be measured from edge to edge.
- b. Unusual Conditions - When local conditions prevent a horizontal separation of 10 feet, a storm or sanitary sewer may be laid closer to a water main provided that:
  - 1) The bottom of the water main is at least 18 inches above the top of the sewer.
  - 2) Where this vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction for 10 feet measured perpendicular on either side of the water main.

2. Crossings – Sewers and Water Mains:

- a. Normal Conditions - Water mains crossing house sewers, storm sewers or sanitary sewers crossing water mains shall be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer.
- b. Unusual Conditions - When local conditions prevent a vertical separation as described above, the following construction shall be used:
  - 1) Sewers passing over or under water mains should be constructed of the materials equivalent to Watermain Standards.
  - 2) Construction of sewers crossing over water mains shall insure additional protection to the water main by providing:
    - a) A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main;
    - b) Adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking the water mains;
    - c) That the length of watermain type sewer pipe be centered at the point of crossing so that the joints will be equidistant and as far as possible from the water main.

### 3.13 CLEANING, INSPECTION AND TESTING

A. Cleaning and Maintenance:

1. Special care shall be taken during the construction of the sewers to prevent rubbish of every kind and description, and especially sand, from entering or remaining in the sewers. As the construction of the system approaches completion, the Contractor shall systematically and thoroughly clean and make any needed repairs to the entire length of

the sewers. He (she) shall furnish, at his own expense, suitable tools and labor for cleaning out all dirt and foreign substances from the sewers, and, if necessary, water for cleaning the sewers by flushing. The cleaning and the repairs above described shall be arranged as far as practicable to be completed upon the finishing of the whole construction work. The Owner will make, upon the completion of the cleaning operations, final inspection of the work.

B. Inspection:

1. The sewer shall be subject to inspection at such times as the Engineer/Architect may direct. All repairs necessary by the inspection shall be made. Broken or cracked pipe shall be replaced; defective joints, if any, replaced; all deposits removed; and the sewer left true to line and grade, entirely clean, free from lumps of protruding jointing material, etc., and ready for use. Each section of sewer between manholes shall show, upon examination from either end a reasonably full circle of light.

C. Testing:

1. Air Testing – General:

- a. The proposed sanitary and force mains will be tested for acceptability by the air testing technique. Special attention of the Contractor is directed to the requirement that all pipe laying will be permitted only in dry trenches having a stable bottom, inasmuch as it is imperative that all sewers and manholes be built practically or reasonably watertight and airtight. The Contractor must adhere rigidly to the specifications for materials and workmanship covering sewer construction. After completion, the sewers or sections thereof shall be tested with a low-pressure air test, which is a test to determine the rate at which air under pressure escaped from an isolated section of sewer. The rate of air loss is intended to indicate the presence or absence of pipe damage and whether or not the joints have been properly constructed. This test is not intended to indicate water leakage limits. In applying the low-pressure air test to sanitary sewers several factors should be understood and precautions followed during the test.
- b. Plugs should be securely braced to prevent the unintentional release of a plug, which can become a high velocity projectile. Plugs should not be removed until all air pressure in the test section has been released.
- c. For safety reasons, no one should be allowed in the trench or manhole while the test is being conducted.
- d. The testing apparatus should be equipped with a pressure relief device to prevent the possibility of loading the test section with the full compressor capacity.
- e. The pipe should be tested in a wet condition if at all possible.

2. Low Pressure Air Test:

- a. Provide necessary labor and equipment to test the proposed sewer extension by means of a low-pressure air test. Test each section manhole to manhole to determine its tightness. Should a section not pass the air test as set forth in the above specification, the Contractor will locate the defect and repair the leak. The ultimate responsibility for ensuring that the proposed sewer does perform according to the specification will be with the Contractor.

3. Air Testing – Procedure:

- a. The section of the sewer to be tested shall be backfilled and cleared, and plugged at each end by means of inflatable stoppers, securely braced to prevent possible

blow-out due to the internal air pressure. The pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested and then shall be inflated to 25 psig. Air is then added to the test section until the internal air pressure is raised to 4 psig above the average back pressure of ground water over the sewer pipe, and the air pressure shall be allowed to stabilize for at least 10 minutes and a maximum of 30 minutes.

- b. After the stabilization period, the pipe in the test section shall be pressurized to 3.5 psig and the time in minutes measured for the pressure to drop to 2.5 psig. If ground water is present, the air pressure in the line shall be increased to 3.5 psig above the level of the ground water and the drop of one pound of air pressure measured in minutes. The section being tested should be deemed acceptable when the time taken for the one (1) pound pressure drop is not less than that required by Missouri DNR Standards.

4. Time Limits for Loss of Air Pressure:

- a. The loss of air is acceptable and the line is considered to be reasonably free from defects, if the time in minutes and seconds for the pressure to go from 3.5 psig to 2.5 psig is not less than the time per inch of pipe diameter per length of sewer pipe as shown in the table above.

3.14 PVC PLASTIC PIPE TESTING

A. Air Testing:

1. The PVC sewer main shall be tested for acceptability by the air testing technique as specified above in Cleaning, Inspection and Testing.

B. Deflection Testing for Flexible Conduit:

1. The project engineer/architect shall randomly select portions of the project to be deflection tested. Such portions shall consist of the manhole intervals in the initial 1200 feet of sewer and not less than 10% of the remainder of the sewer project.
2. If the deflection test is to be run using a rigid ball or mandrel, it shall have a diameter equal to 95% of the base diameter of the pipe as established in proposed ASTM D-3034. The test shall be performed without mechanical pulling devices.
3. The individual lines to be tested shall be so tested no sooner than 30 days after they have been installed.
4. Wherever possible and practical, the testing shall initiate at the downstream lines and proceed towards the upstream lines.
5. No pipe shall exceed a deflection of 5%.
6. In the event that the deflection exceeds the 5% limit in 10% or more of the manhole intervals tested, the total sewer project shall be tested.
7. Where deflection is found to be in excess of 5% of the original pipe diameter, the contractor shall excavate to the point of excess deflection and carefully compact around the point where excess deflection was found. The line shall then be retested for deflection. However, if after the initial testing the deflected pipe fail to return to the original size (inside diameter) the line shall be replaced.

C. Final Cleaning:

1. Upon completion of all testing, the Contractor shall clean the PVC sewer in such a manner as to ensure that no foreign matter or debris has been left in the sewer. All

foreign matter and debris shall be removed and disposed of in a manner acceptable to the Engineer/Architect.

### 3.15 RESTORATION OF SURFACE AREAS

#### A. General:

1. After backfilling operations are completed, surface areas shall be replaced or restored as called for on the Drawings, which in general shall be to a condition equal to that existing prior to start of work. In areas with Case V backfill, the top of the trench shall be completed as shown on the Trench Detail, or reshaped once by machine with the backfill being left slightly mounded, not over 12 inches, above natural ground surface. Restoration shall not be done sooner than thirty (30) days after the backfill is placed.
2. All pavements and sidewalks shall be replaced to a condition equal to that previously existing and as shown in typical detail on the Drawings
3. At streets, street intersections, driveway entrances, and at any other pavement location disturbed during construction, the Contractor shall place crushed stone surfacing to maintain traffic.
4. In general the Contractor shall confine his damage of improved surfaces to a minimum, and any unnecessary damage shall be replaced by him (her) at his entire cost and expense. The Engineer/Architect shall determine what damage is unnecessary and his judgment shall be final.

#### B. Seeding:

1. The grass surface area disturbed during construction shall be seeded for the complete width of disturbed area in accordance with the applicable articles of the Missouri Department of Transportation, "Standard Specifications for Highway Construction."
2. The Contractor shall maintain the seeded area, watering, reseeding, patching, etc., as necessary, until a satisfactory acceptable stand of grass is obtained. Damage resulting from erosions, gullies, washouts, shall be repaired by filling with top soil, tamping, and reseeding, by the Contractor at his expense, if such damage occurs prior to final acceptance.
3. Seed mixture shall be in accordance with Section 329100.

### 3.16 MARKER TAPE

- A. An electrically detectable metalized foil marking tape shall be installed with the sewer main and laterals to facilitate locating the sewer with an electronic pipe finder. The marker tape shall consist of a 5.5 mil composition film containing one layer of metalized foil laminated between two layers of inert plastic film formulated for prolonged underground use, and shall be resistant to alkalis, acids and other destructive agents found in the soil. The tape shall be safety green in color, 3" wide, and shall bear a continuous message printed in permanent ink warning of the underground installation.
- B. Installation shall be continuous along the centerline for the full length of the sewer line and shall be installed at a depth of 2 to 3 feet.
- C. Installation shall be for all service laterals, and sewer mains where the manholes are buried. In lines with buried manholes, run tape from downstream exposed manhole, above sewer line and all buried manholes, to upstream exposed manhole.

- D. The tape shall be "Detectable Terra Tape" as manufactured by Reef Industries, Inc., Houston, Texas, or equal.
- E. No separate payment will be made for marker tape.

### 3.17 BORING AND ENCASEMENT

- A. At locations shown on the Drawings, the sewer pipe shall be ductile iron with steel encasing pipe installed in a bored hole.
- B. Bore holes shall be made in advance of the sewer construction so that, if necessary, minor adjustments can be made in alignment and grade with the approval of the Engineer/Architect. Bore pits shall be backfilled and compacted for settlement. See Drawings for backfill Case.
- C. Casing pipe shall be pushed through the embankment without use of pilot by the Boring-Jacking Method. This method utilizes an auger operating inside the pipe to carry out dirt, but not to cut in advance of the pipe itself.
- D. Where traffic must be maintained, the operations shall be carried on without encroachment upon the traveled way by either the excavation or by the storage of equipment or materials. Adequate sheeting and bracing shall be provided if the nature and condition of the soil or height of exposed faces is such as to endanger either the traveling public or the integrity of the road surfacing. Construction shall be in accordance with required permits for the work.

### 3.18 GUARANTEE

- A. The Contractor shall guarantee all materials and workmanship furnished, and shall replace or repair any damage due to settlement of backfill in trenches or pavement for a period of one (1) year from date of acceptance.

END OF SECTION 334101