NORTHWESTERN UNIVERSITY

DESIGN GUIDELINES
AND
TECHNICAL STANDARDS

Date of Issuance: January 1, 2014
DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 1216 – ASPHALT PAVING

1. General: This section includes general requirements for hot asphalt paving, including the following:
   a. Cold milling of existing hot-mix asphalt pavement.
   b. Hot-mix asphalt patching.
   c. Hot-mix asphalt paving.
   d. Hot-mix asphalt paving overlay.
   e. Asphalt surface treatments.
   f. Pavement-marking paint.
   g. Traffic-calming devices.

2. Project Conditions:
   a. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of IDOT for asphalt paving work.
   b. 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:
      i. HMA Temperature: Delivered between 250 deg F and 350 deg F
      ii. Prime Coat: Minimum surface temperature of 60 deg F
      iii. Slurry Coat: Comply with weather limitations in ASTM D 3910.
      iv. Asphalt Base Course: Minimum surface temperature of 40 deg F in the shade and rising at time of placement.
      v. Asphalt Surface Course: Minimum surface temperature of 45 deg F in the shade at time of placement and rising at time of placement.
   c. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F. When more restrictive, manufacturer limits shall be adhered to.
   d. Imprinted Asphalt Paving: Proceed with coating imprinted pavement only when air temperature is at least 50 deg F and rising and will not drop below 50 deg F within 8 hours of coating application. Proceed only if no precipitation is expected within two hours after applying the final layer of coating.
3. Products:

a. Aggregates:
   i. General: Use materials and gradations that have performed satisfactorily
      in previous installations.
   ii. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel.
   iii. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared
        from stone, gravel, or combinations thereof.
   iv. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by
       weight of the total aggregate mass.
   v. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other
      inert material.

b. Asphalt Materials:
   i. Asphalt Binder: AASHTO M 320 and AASHTO MP 1a, PG 58-28, PG58-22, PG64-22
   ii. Prime Coat: ASTM D 2027, medium-curing cutback asphalt matching
       IDOT MC-30 per Section 1032 of the Standard Specifications for Road
       and Bridge construction.
   iii. Tack Coat: IDOT SS-1, SS-1hP, CSS-1, CSS-1hP, emulsified asphalt or
       cationic emulsified asphalt, slow curing, diluted in water, per Section 1032
       of the Standard Specifications for Road and Bridge Construction and of
       suitable grade and consistency for application.
   iv. Tack Coat: Where Paving Geotextile as an interlayer is used; Performance
       Grade asphalt binder of the same grade as the overlaying pavement.
   v. Fog Seal: AASHTO M 140, emulsified asphalt, or AASHTO M 208
       cationic emulsified asphalt, slow curing, factory diluted in water, of
       suitable grade and consistency for application.

c. Herbicide: Commercial chemical for weed control, registered by the EPA.
   Provide in granular, liquid, or wettable powder form.

d. Sand: AASHTO M 29 Grade Nos. 2 or 3.

e. Paving Geotextile (Reflective Crack Control): AASHTO M 288-06, nonwoven
   polypropylene; resistant to chemical attack, rot, and mildew; and specifically
   designed for paving applications.
i. Weight: ASTM D1910, minimum 4.1 oz/sq. yd.

ii. Grab Tensile Strength: ASTM D4632, minimum 101 lbs

iii. Asphalt Retention: ASTM 6140, minimum 0.20 gal/sq. yd.

f. Joint Sealant: ASTM D 6690 or AASHTO M 324 Type II or III Type II Type IV, hot-applied, single-component, polymer-modified bituminous sealant.

g. Pavement-Marking Paint Type 1: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N Type F Type S; colors complying with FS TT-P-1952.

   i. Colors: Yellow and/or White. Accessible spaces shall typically be yellow with blue and white signage.

h. Pavement-Marking Paint Type 2: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of no more than 15 minutes

   i. Colors: Yellow and/or White. Accessible spaces shall typically be yellow with blue and white signage.

   ii. Glass Beads: AASHTO M 247, Type 1.

i. Wheel Stops:

   i. Locate sidewalks away from curbs to avoid the need for wheel stops.

   ii. If necessary, wheel stops shall be precast, air-entrained concrete, 3500-psi minimum compressive strength. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

j. Dowels: Reinforcing Bars: ASTM A 615, Grade 60; deformed

k. Imprinted Asphalt Materials:

   i. Templates: Imprinted-asphalt manufacturer's standard flexible templates for imprinting pattern into hot asphalt paving.

   ii. Pattern: Specify or indicate on Drawings.

l. Coating System: Imprinted-asphalt manufacturer's standard system formulated for exterior application on asphalt paving surfaces.

   i. Base Coating: Portland cement and epoxy-modified acrylic polymer blended with sand and aggregate, formulated for exterior application on asphalt paving surfaces.

   ii. Top Coating: Epoxy-modified acrylic polymer blended with sand and aggregate, formulated for exterior application on asphalt paving surfaces.
iii. Colorant: UV-stable pigment blend, added to each coating layer.

iv. Color: Specify or indicate on Drawings.

m. Mixes:

i. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes designed according to the Illinois Modified Strategic Highway Research Program criteria and the IDOT Special Provision “Superpave Bituminous Concrete Mixtures”.

ii. Binder Course Mixture N50, IL-19.0, Surface Course Mixture N50, IL-9.5, Mix “C” designed in accordance with Sections 1030 and Sections 406 and 407 of the Standard Specifications for Road and Bridge Construction and the special provision, “Quality Control/Quality Assurance of Bituminous Concrete Mixtures.”

iii. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

iv. Emulsified-Asphalt Slurry: ASTM D 3910, Type 1, consisting of emulsified asphalt, fine aggregate, and mineral fillers.

4. Field Quality Control"

   a. Testing Agency: NU will typically engage a qualified testing agency to perform tests and inspections.

5. Disposal: Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill. Contractor shall not allow milled materials to accumulate on-site.

END OF SECTION
DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 1313 – CONCRETE PAVING

1. General: This section includes general requirements for concrete paving, including the following:
   a. Driveways and roadways.
   b. Parking lots.
   c. Curbs and gutters.
   d. Walkways.
   e. Unit paver base.

2. Definitions:
   a. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

3. Project Conditions:

4. Products:
   a. Forms:
      i. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Use flexible or curved forms for curves with a radius 100 feet or less.
      ii. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   b. Steel Reinforcement:
      i. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
iii. Reinforcing Bars: ASTM A 615, Grade 60; deformed.

iv. Epoxy-Coated Reinforcing Bars: ASTM A 775 or ASTM A 934; with ASTM A 615, Grade 60 deformed bars.

v. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

vi. Epoxy-Coated Joint Dowel Bars: ASTM A 775; with ASTM A 615, Grade 60, plain steel bars.

vii. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

viii. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

ix. 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" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

c. Concrete Materials:

i. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:

1. Portland Cement: ASTM C 150, Type I II I/II III, gray, Supplement with the following:

   a. Fly Ash: ASTM C 618, Class F.

2. Blended Hydraulic Cement: ASTM C 595, Type IP, portland-pozzolan, or I PM, pozzolan-modified portland cement.


2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
iii. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:


2. Aggregate Source, Shape, and Color:

iv. Water: ASTM C 94/C 94M.


vi. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2. Retarding Admixture: ASTM C 494/C 494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

d. Curing Materials:

i. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

ii. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

iii. Water: Potable.

iv. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

v. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.


1. Dries to low or medium luster, UV resistant, no color change.

2. Reduction of Water absorption (NCHRP Series II): 75% minimum

3. Reduction of Chloride Ion absorption (NCHRP Series II): 85% minimum.

e. Joint Filler: Two types of joint filler are listed below. Confirm use of sealant with NU.

ii. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1752, Polyethylene closed cell joint filler

f. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

g. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

h. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

i. Types I and II, non-load bearing IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

i. Chemical Surface Retarder: Water-soluble, liquid-set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

j. Pigmented Mineral Dry-Shake Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

k. Pavement Markings:

i. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N Type F.

ii. Color: Accessible Spaces Yellow

iii. Glass Beads: AASHTO M 247, Type 1.

l. Wheel Stops: Two types of wheel stops are described below. Review requirements with NU.

i. Wheel Stops – Type 1: Precast, air-entrained concrete, 3500-psi. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.

ii. Wheel Stops – Type 2: Solid, integrally colored, 96 percent recycled HDPE or commingled postconsumer and postindustrial recycled plastic; UV stabilized. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
iii. Dowels: Galvanized steel.

5. Concrete Mixtures:
   a. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
   b. Proportion mixtures to provide normal-weight concrete with the following properties:
      i. Minimum Compressive Strength (28 Days): 4,000 psi.
      ii. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.32-0.42.
      iii. Slump Limit: 4 inches, plus or minus 1/2 inch.
   c. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
      i. Air Content: 5 to 8 percent for 1-inch to 1-1/2-inch nominal maximum aggregate size.
   d. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
   e. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
      i. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   f. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.
   g. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

6. Concrete Mixing:
   a. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.
      i. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 45 minutes.
b. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

7. Field Quality Control:

a. Testing Agency: NU will typically engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION
DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 1400 – UNIT PAVING

1. General: This section includes general requirements for unit pavers set in aggregate setting beds.

2. Sustainability / Regional Materials:
   a. Precast concrete pavers and curbs shall be manufactured within 500 miles of Project site from aggregates and cement extracted and manufactured within 500 miles of Project site.
   b. Granite and natural stone curbs shall be manufactured within 500 miles of Project site from materials extracted and manufactured within 500 miles of Project site.
   c. Aggregate and soil extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

3. Warranty Requirements: Warranty shall include filling of paver joints 1 year after installation at no additional cost.

4. Materials:
   a. Review use of materials including precast concrete, clay pavers, and natural stone with NU Project Manager.

5. Products:
   a. Edge Restraints: Stainless Steel or Aluminum.
   b. Curbs: Precast concrete or Granite.

END OF SECTION
This page intentionally left blank
DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 8400 – PLANTING IRRIGATION

1. General:
   a. This irrigation system guideline is for design-build system as well as designed systems, and is considered minimum standards for Northwestern University.
   
   b. A sample technical specification Section 32 8400 – Planting Irrigation prepared by Northwestern University is available for information and reference. Review specific project requirements with the NU Project Manager during the design phase.
   
   c. Work specified or called for on the drawings, shall be executed in accordance with governing ordinances, laws, and regulations and shall meet local codes and conditions. Changes or additions in the work necessary to meet ordinances, regulations, and/or conditions shall have the prior written approval of Northwestern University.

2. Design Considerations:
   a. The design of the system shall be according to standard practices of the Irrigation Association, local codes, Northwestern Standards and manufacturer's recommendations.
   
   b. Irrigation should contain rain-sensors, soil moisture sensors, solar clocks where applicable and/or other sustainable friendly measures. When possible irrigation water source should be derived from site water collection and re-use such as a cistern.
   
   c. Maximum velocity of water through piping and equipment = 5ft per second all piping shall not exceed 75% of it rated GPM or psi capacity. Metallic pipe for any exposed piping, PVC pipe Sch40 1-1/2-inch and smaller SDR21 for 2-inch and larger 1-inch to 1-1/2-inch polyethylene may be used for lateral piping.
   
   d. Rotary heads are only allowed on areas exceeding 16’ spacing the rotor must be equipped with the stainless steel riser models for areas with head spacing up to 50’ Hunter I-20stainless for areas with head spacing exceeding 50’ or heavy use areas such as sports fields or open activity areas use Toro 640 series.
   
   e. Pop-up spray heads only. Use 4-inch pop-ups for turf areas and 12-inch pop-ups for plantings.
   
   f. The angel of trajectory of the sprinkler head should be calculated so that the spray will be above the expected mature plant elevation use Rainbird 1800 series.
   
   g. Planting beds and turf areas must be located on separate zones.
h. All sprinklers heads within a zone to operate at no more than a maximum loss of 3 psi from solenoid valve to farthest sprinkler head. The zone to have 25% available capacity for higher GPM nozzles or additional sprinklers.

i. The spray of the sprinklers shall not intentionally reach or spray over walk or pavement. Sprinkler heads spacing, only triangular or square sprinkler head spacing is to be used (signal row spacing is not allowed) 8’ maximum spacing for landscape planting areas. Detail all pipe sizes from the point of connection and all irrigation pipe sizes. Include a minimum of one quick coupler valve per 70’ hose can reach all areas.

j. Irrigation Controller to be housed in a stainless enclosure and UL listed. Controller to be internet based with all equipment including added lightening protection and flow meters to monitor all zones and to include starting at acceptance 1 year of Internet control programming communication of service Model Irritrols Rain Master Eagle Plus.

k. Show all details of tap, meter, meter pit, RPZ valve, RPZ enclosure, blowout connection and all other related details. Give a detailed description of winterization procedures and spring start-up, the description shall be detailed so Northwestern University can perform these procedures.

l. Pipe Depth – Minimum Finished Grade to Top of Pipe:
   i. Lateral 16-inches to 24-inches.
   ii. Mainline 24-inches to 36-inches.

m. Sleeves: Pipes under walks or pavement to be sleeved with the sleeve shall be 2 times larger than the pipe size all wire shall be in a separate conduit or sleeve.
   i. Minimum sleeve depth for walks: 24-inches.
   ii. For pavement with vehicle traffic: 36-inches.

2. Project Considerations:
   a. Submittals: Shop drawings and submittals are required shall be submitted and approved prior to starting work. Design drawings and submittals are to be prepared by an Illinois registered Professional Engineer or State of Illinois licensed Plumbing Contractor detailing the entire layout of the planned irrigation system.

   i. Minimum requirements include characteristics of the system including pipe type, pipe size, manufactures, part names, part numbers, model numbers, equipment type and layout, and fabrication.

   ii. The design shall include calculations indicating gallons per minute, pressure all water calculations are to be indicated at point of connection solenoid valves, sprinkler heads and any other pertinent equipment.
iii. An Illinois registered professional engineer or State of Illinois licensed Plumbing contractor shall stamp and put his or signature with identifying license number on each design drawing and submittal.

b. Record Documents: As-built drawings of the installed system must be submitted at time of system acceptance and indicate all items as described for shop drawing.

END OF SECTION
DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 9200 – TURF AND NATIVE / ADAPTIVE PLANTINGS

1. General:
   a. A sample technical specification Section 32 9200 – Turf and Native / Adaptive Plantings prepared by Northwestern University is available in the Appendix for information and reference. Review specific project requirements with NU during the design phase.

2. Project Conditions:
   a. Contractor shall obtain and submit copies to Northwestern University all necessary related city and environmental permits (e.g. irrigation - water department permits; use of city hydrants - city hydrant permit, etc.).

END OF SECTION
DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 9300 – PLANTS

1. General:
   a. A sample technical specification Section 32 9300 – Plants prepared by NU is available in the Appendix for information and reference.
   b. Review specific project requirements with Northwestern University during the design phase.

2. Project Conditions:
   a. Contractor shall obtain and submit copies to Northwestern University all necessary related city and environmental permits (e.g. irrigation - water department permits; use of city hydrants - city hydrant permit, etc.).

END OF SECTION