MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
SPUN CONCRETE POLE AND DRILLED SHAFT FOUNDATION

a. Description. This work consists of designing, fabricating, furnishing, and installing a spun concrete pole and drilled shaft foundation for use as a closed circuit television (CCTV) camera pole. Ensure this work is done in accordance with the standard specifications, the plans, and as specified herein.

b. Design. Ensure the design of the spun concrete pole meets the following requirements:

1. Pre-stressed Spun Concrete Pole Specifications.

A. Ensure spun poles are pre-stressed with the concrete applied by the centrifugal spinning process. Maintain a minimum 3/4 inch cover over the reinforcing steel.

B. Furnish poles with a smooth form finish gray in color.

C. Design and construct spun poles in such a way wiring and grounding facilities are concealed within the pole. Furnish a minimum inside diameter raceway of 5 inches throughout the shaft of the pole. Cast all handholes, couplings, through-bolt holes, drain holes and ground wires into the pole during the fabrication process. Drilling holes after casting is prohibited.

D. Fabricate all cable entry in accordance with the selected location based on the requirements as determined by the pole foundation and as approved by the Engineer. Size the cable entry holes as required and free of sharp edges for the passage of electrical wiring.

Ensure the correct location of openings and all appurtenances on the spun pole. Ensure any modifications to the pole or the drilled shaft necessary to add or relocate openings or appurtenances due to incorrect fabrication are approved by the Engineer and completed at no cost to the contract.

E. Furnish the spun pole with a specially designed tenon bolted to the top of the pole for the installation of a Camera Lowering Device (CLD) as noted on the plans. See 20SP-826F - Surveillance System, Remote Site.

F. Furnish a continuous spun pole as detailed on the plans. Splicing of the pole is prohibited.

G. Ensure reinforcing steel lap splices are designed as tension lap splices to transfer the full tension capacity of the bar.

2. Design Specifications. Design poles and concrete skirts in accordance with the *LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (AASHTO LTS)* and *ASTM C1089*.

A. Design poles for the loading shown on the plans or the loading shown in Table 1, whichever is greater.

Table 1: Minimum Pole Loading

Height from Proposed Ground (ft)	Effective Projected Area (sft)	Total Weight (lb)
85	20.14	370.8
40	1.94	54.4
7	7.76	331.0

B. Include ice load in the extreme event load combination. Use 3 psf for the ice load. Apply ice load to the total surface of the structure and the attached devices.

C. Design poles to have a deflection not greater than 2.0 inches in a 30 mph continuous wind speed.

3. Identification Plate. The identification plate is to include the casting date, manufacturer, MDOT identification number and pole length. Ensure the identification plate is cast into the pole and connected in such a way that it cannot be easily removed.

c. Submittals. Ensure all submittals are in PDF files submitted to the Engineer.

1. Furnish complete detailed spun pole design calculations, shop drawings and QC plan to the Engineer for review and approval. Ensure the design for the spun pole is signed and sealed by a Professional Engineer licensed in the State of Michigan (the Designer). Ensure the calculations and plans are checked by another Professional Engineer licensed in the State of Michigan (the Checker) with qualifications meeting or exceeding those of the Designer who created the calculations and plans. Approval of calculations, shop drawings, and QC plan is required prior to any fabrication or construction.

A. Calculations. Furnish detailed design calculations, notes and material specifications on 8.5 by 11 inch sheets and include the Department's project designation (Control Section and Job Number), page number, date of preparation and initials of the Designer and Checker.

Furnish design calculations and explanatory notes that are legible and that demonstrate the design criteria have been met. Include all details, dimensions, quantities, and cross sections in the calculations including, but not limited to the following items:

(1) Design Standards. Show all design standards used in the calculations.

(2) Loadings. Document all design loads (including details of wind and ice load computations) in the calculations. Clearly indicate the load combinations used in the calculations.

(3) Materials. Clearly indicate the material type and strength.

B. QC Plan. Prepare detailed QC plan on 8.5 by 11 inch sheets including, but not limited to the following items:

(1) A checker is required to ensure the quality of calculations and shop drawings.

(2) Plans for furnishing certified manufacturer test reports, upon request from the Engineer, showing the results of all the tests required by this special provision.

C. Shop drawings. Prepare shop drawings on 11 by 17 inch sheets including borders. Furnish a title block in the lower right-hand corner of each sheet. Include the sheet number and the Department's project designations (Control Section and Job Number) within all title blocks.

Include all details, dimensions, quantities, and cross sections on the shop drawings necessary to construct the spun pole. Document all design loads on the shop drawings. Show the spun concrete pole and its equipment including the exact orientation of the spun pole.

2. At the request of the Department, the manufacturer must submit a QA report on 8.5 by 11 inch sheets to the Department prior to the shipment of each pole and must include the following minimum information:

A. MDOT job number and MDOT's identification number;

B. Submit minimum and maximum tip wall thicknesses and steel coverages (to inside and outside) measurements made at 3 inches from the tip;

C. Submit minimum and maximum butt wall thicknesses and steel coverages (to inside and outside) measurements made at 3 inches from butt;

D. Condition of pole interior and any evidence of exposed rings or reinforcement steel;

E. Proper hole and insert locations and sizes;

F. Any evidence of cracking during or after two-point handling;

G. Actual manufactured pole weight;

H. Report of any repairs made to the pole;

I. Date of manufacture and inspection(s); and

J. QC Inspector's seal.

3. Furnish a General Certification on 8.5 by 11 inch sheets in accordance with the *MQAP Manual* that all spun concrete poles have been inspected to ensure they are true to size, free from defects that may impair their strength and durability, and all other contract requirements are being met.

4. Notify the Engineer at least 5 working days prior to delivery of the pole to the job site

and submit to the Engineer an installation plan on 11 by 17 inch sheets including equipment required, traffic control and installation schedule. Do not unload the poles until the Engineer has inspected them for damage.

5. If the pole is to be stored on site for more than 21 calendar days prior to installation, ensure a pole storage plan on 8.5 by 11 inch sheets is submitted to the manufacturer as well as the Engineer, and approved by both prior to delivery.

6. Submit a drilled shaft installation plan per subsection 718.03.A of the Standard Specifications for Construction. Ensure the drilled shaft installation plan is submitted at the preconstruction meeting.

d. Materials.

1. Pre-Stressed Spun Concrete Pole.

A. Concrete. Use concrete per the material requirements of subsection 1004.02 of the Standard Specifications for Construction and ensure maximum size of coarse aggregate is not greater than 3/4 the clear spacing between reinforcing steel and/or the surface of the pole. Ensure the concrete has a minimum 28 day compressive strength of 8,000 psi. The required release strength is 70 percent of 28 day compressive strength. Ensure freeze-thaw dilation of coarse aggregate does not exceed 0.030 percent per 100 cycles. Type III cement is prohibited.

B. Reinforcing Steel. Use prestressing strands and steel bar reinforcement per section 905 of the Standard Specifications for Construction as modified by the contract, except Grade 80 steel bar reinforcement is permitted.

C. Spiral Reinforcement. Ensure spiral reinforcement conforms to *AASHTO M336M/M336 for Steel Wire and Welded Wire, Plain and Deformed, for Concrete Reinforcement*. Ensure welded wire reinforcement is equal to or greater than 0.15 inches in diameter.

D. Structural Steel. Use *ASTM A36/A36M* steel, hot-dip galvanized in accordance with *ASTM A123/A123M*.

E. Hardware. Use stainless steel nuts, bolts, and washers according to *ASTM A320/A320M*.

(1) Furnish and install tamper resistant operational handhole bolts. Ensure bolts are round button head, 6-point star-shaped (6-lobe). Use head diameter of 0.437 inches and 3/4 inch length from head to end of bolt. Ensure full thread with a 1/4 inch-20 size.

F. Electrical Ground. Use a continuous length of *Lightning Protection Institute (LPI) Class II* stranded copper down conductor cast into the pole's wall terminated at the pole top lug to pole base lug. Ensure grounds are *UL/LPI* compliant.

G. Identification Plate. Use aluminum plate 6061-0/6061-T6, 1100 alloy H14, or approved equal.

H. Rodent Screens. Use material in accordance with subsection 909.11 of the Standard Specifications for Construction.

2. Drilled Shaft Foundation and Concrete Skirt.

A. Concrete. Furnish concrete in accordance with section 718 of the Standard Specifications for Construction.

B. Ensure drilled shaft casing material is as specified in subsection 919.10 of the Standard Specifications for Construction unless otherwise shown on the plans.

3. Non-Structural Flowable Fill. Furnish non-structural flowable fill consisting of a mixture of Portland cement, fly ash, sand (2NS) and water. Use materials in accordance with the standard specifications except as modified by this special provision. All non-structural flowable fill is intended to be removable using conventional mechanical excavation methods. Use either Type I or IA Portland cement in accordance with section 901 of the Standard Specifications for Construction and Class F or C fly ash as specified by *ASTM C618* except there is no limit on loss on ignition.

Produce a mix of cement, fly ash, sand and water in the following proportions.

Portland Cement	50 pounds per cubic yard (lb/cyd)
Fly Ash	500 lb/cyd
Sand	2850 lb/cyd
Water	approximately 376 lb/cyd (sufficient to produce desired flowability)

4. Aggregate. Use 46G aggregate obtained from geologically natural sources in accordance with section 902 of the Standard Specifications for Construction.

5. Furnish cobblestone in accordance with section 910 of the Standard Specifications for Construction.

6. Furnish geotextile liner in accordance with section 916 of the Standard Specifications for Construction.

e. Construction.

1. General. Refer to the plans for the spun concrete pole location.

2. Fabrication Requirements.

A. The spun pole manufacturer must have at least 5 years of experience designing and fabricating spun cast prestressed concrete poles.

B. Notify the Engineer a minimum of 14 calendar days prior to start of fabrication. Furnish access to the Engineer or MDOT designated representative for QA inspection. This inspection is not considered a substitute for the manufacturer's QC requirements as stated herein. The need and amount of QA will be determined by the Engineer. The Engineer may witness the following:

(1) Set-up and strand placement/tensioning;

(2) Concrete placement;

(3) Cylinder casting/curing and breaking;

(4) Sample strand for acceptance testing; and

(5) Document progress of work.

C. Compressive strength tests are required for each pole.

D. Recess pre-stressing strands on the ends 1.5 inches from the concrete end surface. Fill the recess with non-shrink grout approved by the Engineer. As an alternative, cut pre-stressing strands flush with the ends and seal ends completely with an epoxy approved by the Engineer.

E. Manufacturing Tolerances.

(1) Ensure all dimensional tolerances conform to *ASTM C1089*.

(2) Surface defects on the top bearing surface must not exceed 0.0625 inches per foot.

3. Workmanship. The manufacturer must make adequate tests and inspections to determine that each of the poles furnished is in accordance with this special provision. At the request of the Department, the manufacturer must submit a QA report as specified in subsection c.3 of this special provision.

4. Testing and Inspection.

A. Workmanship, Finish and Appearance. Furnish a smooth finish free of any fractures, on all surfaces. Ensure the pole is within the tolerances mentioned herein.

B. Repairs. Repair the pole, as approved by the Engineer, due to imperfections in manufacturing, handling damage or construction. Repair at no additional payment in accordance with section 712 of the Standard Specifications for Construction.

C. Ensure repairs are sound, properly finished and cured, and the repaired section must conform to this special provision.

D. Possible causes for rejection include, but are not limited to, the following:

(1) Fractures or cracks in the pole;

(2) Defects that indicate imperfect proportioning, mixing, and/or forming;

(3) Honeycombed or open textured surfaces; or

(4) Incorrect location of any couplings, handholes and/or grounding lugs.

E. Quality Assurance. All material and workmanship are subject to inspection,

examination and testing for conformance to the requirements of this special provision by the Engineer. The inspection, examination, or testing can be done at any time during material procurement, manufacturing, storage periods, transit, or at the pole destination. Inspection, examinations, and tests may be waived by the Engineer, but in no case must this be interpreted as releasing the manufacturer from the manufacturer's responsibilities for delivering poles that meet the requirements of this special provision.

The manufacturer must furnish certified test reports to the Engineer, upon request, showing the results of all the tests required by this special provision as part of the QC plan. Ensure this is part of the manufacturer's QC plan. Ensure the QC plan is submitted along with the shop drawings for review and approval.

The manufacturer must furnish a General Certification in accordance with the *MQAP Manual* that all spun concrete poles have been inspected to ensure they are true to size, free from defects that may impair their strength and durability, and all other contract requirements are being met.

Failure of the manufacturer to comply with these requirements will be sufficient reason for rejection of any or all poles which do not comply with these specifications.

5. Pole Delivery. Notify the Engineer at least 5 working days prior to delivery of the pole to the job site and submit to the Engineer an installation plan including equipment required, traffic control and installation schedule. Do not unload poles until the Engineer has inspected them for damage.

Support the poles while transporting them so their own dead load will not cause them to sag or oscillate.

Ensure the poles are lifted and supported during stockpiling, transporting and installation operations only at the points shown on the shop drawings.

Ensure, upon delivery, poles are free of defects and blemishes which would have a detrimental effect on the structure capacity and/or longevity of the pole. Ensure they also are smooth, unscarred and in new condition. Ensure poles not meeting these requirements are repaired or replaced by the manufacturer at no additional cost to the contract. Poles failing to meet strength requirements, poles with circumferential or longitudinal cracks, poles failing to meet manufacturing tolerances or cover requirements, poles with exposed steel and poles with cavities that absorb water will be rejected by the Engineer and replaced by the manufacturer at no cost to the contract.

6. Pole Storage. If the pole is to be stored on site for more than 21 calendar days prior to installation, ensure a pole storage plan is submitted to the manufacturer as well as the Engineer and approved by both prior to delivery. Ensure the pole is stored in a way to prevent any defects, including but not limited to the following:

A. Sagging and oscillation;

B. Circumferential and longitudinal cracks; or

C. Blemishes and scarring.

Prior to installation, ensure stored poles are inspected for damage by the Engineer. Damaged poles will be rejected by the Engineer and replaced by the Contractor at no cost to the contract.

7. Drilled Shaft Requirements. Unless directed otherwise by the Engineer, ensure construction of the drilled shaft foundation is in accordance with the details on the plans, section 718 of the Standard Specifications for Construction, and this special provision.

Ensure the drilled shaft installation plan is submitted at least 21 days before beginning drilled shaft installation. Ensure casings, if required, are advanced ahead of the drilling operation to ensure a quality bond between the shaft and surrounding soils and prevent damage of nearby structures or utilities, if present. A drilled shaft excavation that is uncased may not be left open overnight. If an uncased drilled shaft cannot be completed in one day, ensure excavation is backfilled with flowable fill. If a drilled shaft calls for added depth with aggregate backfill, ensure the extended portion of the drilled shaft and casing are filled using 46G aggregate material. Place the aggregate at the bottom of the drilled shaft prior to setting the pole and placing concrete. If required by the Engineer, seat the 46G aggregate using the auger flights or clean out bucket.

After fulfilling all the requirements for excavating the appropriate foundation and after receiving approval by the Engineer of the installation plan, the Contractor can install the pole and pour the concrete. Ensure the spun pole is temporarily supported in the plumb position until the concrete reaches a minimum compressive strength of 2,000 psi. The Contractor must include the proposed means by which they plan to temporarily support the pole in the installation plan for approval by the Engineer. When utilizing temporary supports, connecting, or anchoring to infrastructure is prohibited.

8. Pole Placement. Ensure representatives of CLD manufacturer are in attendance during installation of the first pole. See 20SP-826F - Surveillance System, Remote Site.

Assemble the pole equipment and complete pole wiring and conduit installation on the ground. Coordinate with the Engineer to ensure that all the camera mounting equipment is attached to the pole prior to the pole's installation.

Ensure all pole orientations are approved by the Engineer prior to installation.

Install conduit sweeps inside pole as shown on the plans. Connect longitudinal conduits approaching the pole to the conduit elbow inside of the access panel below grade. Grout around conduit at access hole using a product from the Qualified Products List (QPL) (1005.02B) to make a watertight seal.

Ensure the spun pole is electrically bonded by way of a welded connection to the ground rod sub-system.

Ensure the air terminal is installed as shown on the plans and in 20SP-826A - Grounding, Bonding, Lightning Protection, and Surge Protection for Electrical System Equipment. The air terminal will be paid for separately.

9. Flowable Fill. Produce and deliver the non-structural flowable fill at a minimum temperature of 50 °F. Transport mixture to the point of placement in a revolving drum mixer or agitator.

Secure all conduits within the pole to counteract buoyant effect of non-structural flowable fill. Place the material evenly to avoid dislocating conduits.

f. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
Spun Conc Pole, Type __	Each
Drilled Shaft and Conc Skirt, (type)	Each
Drilled Shaft and Conc Skirt, Add Depth	Foot
Drilled Shaft, Add Depth, Aggregate	Foot
Flowable Fill, Spun Pole Fdn	Cubic Yard

1. **Spun Conc Pole, Type** __ includes designing, fabricating, furnishing, and installing a spun concrete pole, conduit and wiring, grounding, and mounting miscellaneous hardware cast with the pole.

2. **Drilled Shaft and Conc Skirt, Cased** includes furnishing and installing a 20 foot deep, 48 inch diameter spun concrete pole drilled shaft, concrete skirt and temporary casing left in place or permanent casing as specified on the plans. This item includes excavation, concrete, slurry, disposal of excavated material, steel casing, grading around the pole, geotextile liner and cobblestone. **Drilled Shaft and Conc Skirt, Uncased** includes furnishing and installing a 20 foot deep, 48 inch diameter spun concrete pole drilled shaft and concrete skirt. This item includes excavation, concrete, slurry, disposal of excavated material, grading around the pole, geotextile liner and cobblestone.

3. In the event that the geotechnical data requires a deeper than 20 foot drilled shaft, the concrete portion of the drilled shaft past the 20 foot mark below grade will be paid as **Drilled Shaft and Conc Skirt, Add Depth**. This item includes excavating the additional depth, disposal of excavated material, multiple mobilizations, and the cost of furnishing the additional concrete, slurry and steel casing.

4. In the event that the geotechnical data requires a deeper than 20 foot drilled shaft, the aggregate portion of the drilled shaft past the 20 foot mark below grade will be paid as **Drilled Shaft, Add Depth, Aggregate**. This item includes excavating the additional depth, disposal of excavated material, multiple mobilizations, and the cost of furnishing, hauling, and placing 46G aggregate material, slurry and the additional steel casing.

5. **Flowable Fill, Spun Pole Fdn** includes furnishing and placing flowable fill for the purpose of filling the void of the concrete pole as detailed on the plans.