INDIANA DEPARTMENT OF TRANSPORTATION
Driving Indiana's Economic Growth

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Michael R. Pence, Governor
Michael B. Cline, Commissioner

AGENDA

February 21, 2013 Standards Committee Meeting

MEMORANDUM

February 05, 2013

TO: Standards Committee

FROM: Scott Trammell, Secretary

RE: Agenda for the February 21, 2013 Standards Committee Meeting

A Standards Committee meeting is scheduled for 09:00 a.m. on February 21, 2013 in the N955 Bay Window Conference Room. Please enter meeting through the double doors directly in front of the conference room.

The following agenda items are listed for consideration.

A. GENERAL BUSINESS ITEMS

OLD BUSINESS

1. Approval of the Minutes from the January 17, 2013 meeting.

NEW BUSINESS

(No items on this agenda)

B. CONCEPTUAL PROPOSAL ITEMS

OLD BUSINESS

(No items on this agenda)

NEW BUSINESS

(No items on this agenda)

C. STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS PROPOSED ITEMS

OLD BUSINESS

Item No. 01 01/17/13 (2012 SS)	Mr. Boruff	pg 05
SECTION 805	*TRAFFIC SIGNALS*	
SECTION 922	*TRAFFIC SIGNALS MATERIALS*	
Recurring Special Provisions:		
922-X-XXX	*CONTROLLER CELLULAR MODEM*	
805-X-XXX	*MAGNETOMETERS AND MICROLOOP DETECTORS*	
805-X-XXX	*PREFORMED PAVE-OVER LOOPS*	
805-X-XXX	*RADIO INTERCONNECTION*	
Standard Drawings:		
805-SGCF-01 thru 06	*(various titles)*	
~~805-SGLT-01~~	~~LOOP TAGGING SYSTEM~~	
805-SGSC-01 thru 04	*(various titles)*	

Item No. 03 01/17/13 (2012 SS)	Mr. Vancleave	pg 93
Recurring Special Provision:		
802-T-188	OVERHEAD SIGN STRUCTURES	
Standard Drawings:		
802-TCSS-01	*TRI-CHORD SIGN STRUCTURE DRAWING INDEX*	
802-TCSS-02	*TRI-CHORD SIGN STRUCTURE PLAN AND ELEVATION*	
802-TCSS-03	*TRI-CHORD SIGN STRUCTURE ISOMETRIC VIEWS*	
802-TCSS-04	*TRI-CHORD SIGN STRUCTURE PANEL DIMENSIONS SPANS 36’ THRU 83’*	
802-TCSS-05	*TRI-CHORD SIGN STRUCTURE PANEL DIMENSIONS SPANS 84’ THRU 130’*	
802-TCSS-06	*TRI-CHORD SIGN STRUCTURE MEMBER SIZES AND CAMBER*	
802-TCSS-07	*TRI-CHORD SIGN STRUCTURE CONNECTION DETAILS*	
802-TCSS-08	*TRI-CHORD SIGN STRUCTURE CONNECTION AND WELDING DETAILS*	
802-TCSS-09	*TRI-CHORD SIGN STRUCTURE CHORD FLANGE DETAILS*	
802-TCSS-10	*TRI-CHORD SIGN STRUCTURE TOP CAP AND CHORD END PLATE DETAILS*	
802-TCSS-11	*TRI-CHORD SIGN STRUCTURE SIGN ATTACHMENT DETAILS*	
802-TCSS-12	*TRI-CHORD SIGN STRUCTURE BASE PLATE, ANCHOR BOLT, AND I.D. TAG DETAILS*	
802-TCSS-13	*TRI-CHORD SIGN STRUCTURE HANDHOLE DETAILS*	
802-TCSS-14	*TRI-CHORD SIGN STRUCTURE DRILLED SHAFT FOUNDATION*	
802-TCSS-15	*TRI-CHORD SIGN STRUCTURE SPREAD FOUNDATION*	

NEW BUSINESS

Item No. 01 02/21/13 (2012 SS)	Ms. Phillips	pg 123
Recurring Special Provision:		
105-X-XXX	*STRUCTURE FLOWLINE VERIFICATION*	
Item No. 02 02/21/13 (2012 SS)	Ms. Phillips	pg 126
Recurring Special Provision:		
732-R-310	MODULAR CONCRETE BLOCK RETAINING WALL	
Item No. 03 02/21/13 (2012 SS)	Ms. Phillips	pg 138
111.09	*Stockpiled MSE Concrete Face Panels and Ground Reinforcement*	
111.~~09~~*10*	Additional Requirements	
111.~~10~~*11*	Method of Measurement	
111.~~11~~*12*	Basis of Payment	
Item No. 04 02/21/13 (2012 SS)	Ms. Phillips	pg 142
Standard Drawing:		
731-MSEW-01	MSE WALL PRECAST CONCRETE COPING	
Item No. 05 02/21/13 (2012 SS)	Mr. Pankow	pg 148
701.05(b)	Dynamic Pile Load Test	
701.15	Basis of Payment	
Item No. 06 02/21/13 (2012 SS)	Mr. Pankow	pg 151
702.05	Proportioning	
702.07	Mixing	
702.11	Cold Weather Concrete	
702.13	Forms	
702.14	Falsework and Centering	
702.15(e)	Polychloropene Joint Membrane	
702.21	Finishing Concrete Surfaces	
702.22	Curing Concrete	
702.24	Application of Loads to and Acceptance of New Concrete	
702.25	Field Drilled Holes in Concrete	
702.28	Basis of Payment	
Item No. 07 02/21/13 (2012 SS)	Mr. Pankow	pg 164
106.01(c)	Buy America Requirement	
Item No. 08 02/21/13 (2012 SS)	Ms. Gottschalk	pg 167
706.07	Basis of Payment	
Item No. 09 02/21/13 (2012 SS)	Ms. Gottschalk	pg 170
709.02	Materials	
709.04(c)	~~Other Portland Cement Concrete~~ *Non-Epoxy PCC Sealers*	
709.05(c)	~~Other Portland Cement Concrete~~ *Non-Epoxy PCC Sealers*	
709.5(d)	Clear Sealers	
909.10	~~Proprietary~~*Non-Epoxy* PCC Sealers	

Item No. 10 02/21/13 (2012 SS)	Ms. Gottschalk	pg 174
715.02(n)	Bridge Deck Drain System	
715.14	Basis of Payment	
Item No. 11 02/21/13 (2012 SS)	Ms. Gottschalk	pg 177
~~913.03~~	~~Wood Piles~~	
915.03~~.1~~	Pile Shoes	
Item No. 12 02/21/13 (2012 SS)	Mr. Pankow	pg 180
Recurring Special Provision:		
108-C-585	WORKING RESTRICTIONS DURING CERTAIN HOLIDAY PERIODS	
Item No. 13 02/21/13 (2012 SS)	Mr. Buening	pg 184
SECTION 612	UNSERSEALING	
Item No. 14 02/21/13 (2012 SS)	Ms. Gottschalk	pg 191
628.02(e)2	Printer	
628.04	Cellular Telephones~~/Radios~~	
628.05	Method of Measurement	
628.06	Basis of Payment	
Item No. 15 02/21/13 (2012 SS)	Ms. Gottschalk	pg 197
Recurring Special Provision:		
205-C-XXX	*TEMPORARY TURBIDITY CURTAIN*	
Standard Drawing:		
205-TECP-03	*TEMPORARY EROSION CONTROL PERIMETER TURBIDITY CURTAIN*	
Item No. 16 02/21/13 (2012 SS)	Ms. Gottschalk	pg 202
Recurring Special Provision:		
108-C-192	TEMPORARY EROSION CONTROL MEASURES	
Item No. 17 02/21/13 (2012 SS)	Mr. Pankow	pg 207
701.04(a)	Approval of Pile Driving Equipment	
Item No. 18 02/21/13 (2012 SS)	Mr. Pankow	pg 210
619.11	Shop Painting	
711.04	Certification of Fabricators	
Item No. 19 02/21/13 (2012 SS)	Mr. Boruff	pg 215
807.13	Luminaire ~~Installation~~	
807.19	Basis of Payment	
920.01(d)	Luminaires	

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cc: Committee Members (11)
FHWA (2)
ICA (1)

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS (OLD BUSINESS ITEM)

REVISION TO STANDARD SPECIFICATIONS, SPECIAL PROVISIONS, AND DRAWINGS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED:

Sections 805 and 922 of the INDOT Standard Specifications are entirely superseded by RSP 805-T-169 and 922-T-168. These recurring special provisions contain proprietary items that must be extracted before the RSP's can go into the Standard Specifications. Additionally, there are some outdated ASTM/NEMA/etc references and pedestrian push buttons, polymer concrete handholes, and signal backplates are not addressed.

Standard Drawing 805-SGLT-01 detailing the loop tagging table is not accurate and is redundant since the designer provides this information (see Design Memo 12-13).

PROPOSED SOLUTION:

Develop recurring special provisions for the proprietary items only and move the remaining portions of the recurring special provisions into section 805 and 922 of the Standard Specifications. Also specifications for pedestrian push buttons, signal backplates, polymer concrete handholes, and HDPE conduit have been added and the references to other publications have been updated.

Revise Standard Drawing 805-SGCF-04 for concrete handholes and create a version for polymer concrete handholes. Delete Standard Drawing 805-SGLT-01.

APPLICABLE STANDARD SPECIFICATIONS: 805, 920, and 922

APPLICABLE STANDARD DRAWINGS: 805-SGLT-01, 805-SGCF-04; 805-SGSC-02,-03, -04

APPLICABLE DESIGN MANUAL SECTION: 77 (Old), 502 (New Draft)

APPLICABLE SECTION OF GIFE: N/A

APPLICABLE RECURRING SPECIAL PROVISIONS: 805-T-169, 922-T-168

PAY ITEMS AFFECTED: Signal Cantilever Structures and their foundations, Signal Indication Backplates, Handholes

Submitted By: Dave Boruff

Title: Manager, Traffic Administration
Organization: INDOT
Phone Number: (317) 234-7975
Date: 1/28/2013
APPLICABLE SUB-COMMITTEE ENDORSEMENT: Yes, Traffic Standards Subcommittee, Industry, Traffic Signal Systems.

REVISION TO SPECIFICATIONS, PROVISIONS AND DRAWINGS (OLD BUSINESS ITEM)

SECTION 805 – TRAFFIC SIGNALS

The Standard Specifications are revised as follows:

SECTION 805, DELETE LINES 1 THROUGH 642.

SECTION 805, BEGIN LINE 1, INSERT AS FOLLOWS:

SECTION 805 – TRAFFIC SIGNALS

805.01 Description

This work shall consist of furnishing miscellaneous materials, not furnished by the Department, and installing traffic signals in accordance with these specifications and in reasonably close conformance with the lines, grades, and locations shown on the plans or as directed.

MATERIALS

805.02 Materials

Materials shall be in accordance with the following:

Castings for Handhole ..... 910.05(b)
Coarse Aggregate, Class E or Higher, Size No. 8 904
Concrete, Class A, B, or C 702
Loop Detector Sealant ..... 906.02(a)
Reinforced Concrete Pipe 907.02
Traffic Signal Materials and Equipment 922
Treated Lumber 911.02

The proposed work shall be examined in order to determine what materials not furnished by the Department are required to complete the contract. The Department will furnish only the materials specified on the Department Furnished Materials special provision. If materials to be furnished by the Contractor are listed, the list is only a guide for estimating purposes. All additional materials required to complete an operating installation as specified shall be furnished.

Signal handholes shall be Type I or Type II as shown on the plans.

Joint sealant material shall be compatible with the roadway materials. If polyethylene duct loop wire is used, only sealant in accordance with 906.02(a)1 shall be used.

Wood poles to be furnished shall be in accordance with the current ANSI specifications and dimensions. They shall be of the length and class specified, be fully treated in accordance with 922.10(b), and dry. Minimum circumference at the top and at a point 6 ft from the butt shall be in accordance with ANSI specifications.

Steel strain poles greater than 24 ft in length shall be in accordance with 922.10(a).

The battery cabinet and program timing module for solar powered flashing beacons shall be from the Department's Approved List of Traffic Signal and ITS Control Equipment.

CONSTRUCTION REQUIREMENTS

805.03 General Requirements

The Contractor shall maintain existing traffic signals in operation until the Engineer determines that the progress of the work necessitates their removal. The new installation shall not interfere with the operation of the existing signal. The work shall proceed in such a manner that the signals are not out of service at any 2 adjacent intersections at any time. When the operation of an existing traffic signal must be interrupted before the new signal is placed in operation, the traffic shall be controlled at all times. The work shall be scheduled so that the interruption is limited to a minimum amount of time and at off peak hours. When a new span, catenary, and tether are to be installed on an existing structure, the work shall be done so as not to damage the structure. If an existing structure is damaged, it shall be repaired or replaced as directed with no additional payment. The new span and catenary installation shall not interfere with the operation of the existing traffic signal. Traffic shall be controlled at all times during the changeover when the existing traffic signal is turned off and the new signal is turned on. This changeover shall take place such that the interruption is limited to a minimum amount of time.

When directed, temporary stop signs shall be erected at the intersection. When no work is in progress, the intersection shall have at least 2 operating signal faces for each approach. When the new installations are completed, all existing signal equipment and materials including wood poles, steel poles, and cast-iron handhole rings and covers which have not been used in the new installation shall be carefully removed. Regardless of the right to materials found on the project, as set out in other sections of these specifications, items designated in the contract documents, and field identified by the Department, as traffic signal equipment to be salvaged by the Department or local unit of government shall be stored at a secure site until such time as it is transported to the designated location, when designated as a pay item, or salvaged by the Department or local unit of government. The Contractor shall verify that the field identification placed by the Department has not been removed by vandalism or natural causes. If the Contractor has reason to believe field identifications have been removed, it shall contact the Department. The Contractor shall be responsible for all damage or loss of this equipment and shall repair or replace the damaged or lost equipment as directed. All signal equipment removed and not designated to be salvaged shall become the property of the Contractor and shall be disposed of in accordance with 202.

All existing painted metallic signal equipment to be reused, such as pedestals, bases, controller cabinets, signal weatherheads, pipe arms, shall be cleaned and painted with 2 coats of highway yellow enamel in accordance with 909.02(c). Existing metallic

signal heads to be reused shall be painted with 2 coats of black or highway yellow enamel as directed by the Engineer and in accordance with 909.02(c). Aluminum poles and signal support structures shall not be painted.

Existing concrete foundations, which have not been used in the new installation, shall be removed to a minimum of 4 in. below the adjacent grade. The openings shall be filled with concrete and the surface finished and broomed, if they are located in sidewalk areas. Otherwise, they shall be filled with acceptable material conforming with the surrounding area. Existing signal handholes to be removed, shall be filled after removing rings and covers, with B borrow with a minimum of 4 in. of concrete on top to bring it up to grade in a sidewalk area. Surfaces shall be finished and broomed. Otherwise, they shall be filled with acceptable material conforming with the surrounding area.

The signal controller timings will be provided and the Engineer shall be present when the signal intersection is to be placed in operation.

All electrical wiring terminations and splices; controller and cabinet set-up; and testing, review, and turn-on of all operational apparatus at each location shall be done by or in the presence of and under the responsible charge of an employee of the Contractor who holds a Traffic Signal Construction Technician Level II certification which has been granted by the International Municipal Signal Association. Installation inspections, troubleshooting, maintenance and repair of these systems shall be accomplished by or in the presence of and under the responsible charge of an employee of the Contractor who holds a Traffic Signal Construction Technician Level II certification or a Traffic Signal Field Technician Level II certification which has been granted by the International Municipal Signal Association. Supervision of non-electrical, traffic signal related construction work and traffic control shall be done by a person holding, at a minimum, a Work Zone Traffic Safety Specialist certification which has been granted by the International Municipal Signal Association, or an equivalent certification approved by the Department.

Before starting work, the Contractor shall provide the names of the Level II Traffic Signal Construction Technicians, the Level II Traffic Signal Field Technicians and Work Zone Traffic Safety Specialists who have been assigned to perform signal related work, and a photocopy of each such person's certification card. If the Level II Traffic Signal Construction or Field Technicians or Work Zone Traffic Safety Specialists are dismissed from the work, all signal related work requiring such certified personnel on the project site shall cease until the names and photocopies of certification cards for replacement personnel are provided to the Engineer.

Electrical work shall be executed in accordance with the requirements of the National Board of Fire Underwriters, the State Fire Marshal, and the power company which will furnish the electric service. The work shall be in accordance with any local regulations that may apply. The Department will arrange and provide for power service which the power company will bring to the point designated on the plans. Prior to the

start of construction, the schedule of activities shall be coordinated with the power company and they shall be contacted again at least 14 days prior to the time the service work is to be completed.

The Department will obtain permits from local officials, companies, or individuals for the use of poles, right-of-way, or other property incidental to the installation of traffic signal. Although entering into the contract implies permission and authority to cut into and push under pavement, sidewalks, and alleys, any damage to underground utilities or interruption of such service shall be the responsibility of the Contractor. The Contractor shall be in accordance with local regulations as well as 107.08. Protective devices shall be in accordance with 107.12 and 801.

The location of signal heads, controllers, signal poles, signal cantilever structures, detector housing, disconnect hangers, and other installation items will be shown on the plans. However, a change in the location of an item may be ordered during the progress of the work. The work shall be completed as shown on the plans except for those changes specifically authorized in writing.

Flashing beacons shall flash at a rate for each beacon of 50 to 60 times per minute with the illuminated period from 1/2 to 2/3 of the total cycle. Second beacons, if specified, shall flash alternately with the exception of intersection control beacons which shall flash simultaneously.

805.04 Pole Installation

Working drawings for strain poles or cantilever structures shall be provided in accordance with 105.02. Metal poles shall be erected on concrete foundations and shall be reasonably plumb after installation of signal heads. The handhole side of the pole shall be at right angles to the direction of the signal cantilever arm or span, catenary, and tether. Signal cables shall be brought up inside the poles. Any steel pole, signal cantilever arm, or hardware not galvanized shall be painted with structural steel coating system in accordance with 619.09(a). The surface shall be prepared in accordance with 619.08(a), 619.08(b) and 619.08(d). Paint shall be applied in accordance with 619. All rust, scale, and dirt shall be cleaned from the metal surface so that paint adheres to the surface.

The construction of concrete foundations shall be in accordance with 805.13. Wood poles shall be set a minimum of 7 ft in the ground and raked 12 in.

805.05 Placing Signal Heads

Signal cantilever arm and span mounted signal heads shall have 17.5 ft minimum and 22.5 ft maximum clearance over the roadway unless there are visual obstructions which require lowering the signal head. A signal head over the roadway shall not have a clearance of less than 15 ft. Such signal heads shall be located over the intersection as shown on the plans. Such signal heads shall have a uniform clearance, which will be determined. Signal heads not mounted over a paved roadway, on the top or side of a

pole, shall not be less than 10 ft nor more than 15 ft above the sidewalk or, if none, above the pavement grade at the center of the roadway. Signal faces shall be directed to the proper approach lane in each direction. Flasher signal faces that supplement signs shall be mounted with the bottom of the housing at not less than 3 ft nor more than 13 ft above the edge of pavement. Flasher signal faces that supplement signs shall be directed towards oncoming traffic. Pedestrian signal faces shall be mounted with the bottom of the housing at not less than 7 ft nor more than 10 ft above the sidewalk. The pedestrian signal shall be in line with the pedestrian's vision at the appropriate crosswalk being used. Pedestrian push-buttons shall be mounted at a height of 3 1/2 to 4 ft above the sidewalk as shown on the plans. A pedestrian actuated signal sign shall be mounted immediately above the push-button.

Signal heads shall be assembled and wired with 1 conductor, type THW, stranded wire. Where splices are made, a 2 ft minimum length of cable or wire in excess of that required for a continuous run shall be provided. Splices shall be twisted together and soldered or approved type connectors used. Each splice shall be completely insulated by wrapping with an approved tape and sealed with an approved electrical coating material. Splices shall be made in such manner that the connections are moisture proof. The cables coming out of the signal weatherhead shall be looped to form a drip loop. The drip loop shall be made so that the cables coming out of the weatherhead loop down below the elevation of the weatherhead to prevent water from following the cable into the weatherhead. If used, the splice indicated above shall be located in the top of the coils of cable forming the drip loop.

Overhead 3 section signal heads for through lanes shall have backplates, with the exception of signal heads installed on existing traffic signal cantilever structures. Backplates shall not be cut or altered upon installation.

Signal heads shall not be installed until all other work has been completed. If it becomes necessary to mount signal heads for more than 2 h before the lights are to be turned on, the signal heads shall be hooded by placing sacks or similar cover over them so as to conceal them from traffic. Hooded signal heads are not permitted to be in place for more than 5 days. No signal head shall be left over night with the lights out unless it is hooded. Signal heads shall be securely mounted. The polycarbonate signal face shall be used only when securely supported on both ends of the assembly. In a span cable installation, a tether cable would satisfy this requirement.

805.06 Grounding

All signal supports, signal controller supports, and entrance switches shall be grounded in accordance with the applicable requirements of 807.12.

805.07 Wire and Cable Installations

All cable runs attached to utility poles shall have code clearance relative to utility cables. They shall be no less than 18 ft above the ground level except over railroad tracks when a minimum of 27 ft clearance shall be maintained. All cable runs shall be installed

in continuous lengths without splices between terminals except when necessary at handholes, junction boxes, pole signal bases, and pedestal bases. The type of cable and the number of conductors as well as the gage shall be as shown on plans unless otherwise specified.

Cable rings shall be used to support the signal cable on the signal span cable. They shall be spaced 12 in. on center. Cable shall be pulled through the conduit to the terminal panel in the controller cabinet. Caution shall be used to prevent damage to the cable when it is being pulled through conduit.

Coded cable conductors shall be used throughout the installation. Cable conductors shall be tagged at all detector housings, handholes, signal pole bases, and controller cabinets. At the ends of each cable, the tag shall be placed between 4 and 8 in. from the end of the wire and on the outer jacket. At all other locations, the tag shall be placed in the middle of the length of cable stored at the location. The tag shall be 1/2 in. wide, thermal printed black on yellow or black on white, polyester or nylon tape with permanent adhesive and shall be water, chemical and scratch resistant. The font shall be arial, size 10. Tags shall be installed flag style around the cable with the backs of the tag ends placed together. Tags shall identify the cables by their use. The following are the uses which shall be indicated by the tags:

1. Power

2. Pedestrian Signal

3. Pedestrian Actuation

4. Signal

5. Detection Loop Identification

6. Interconnect

Signal cables shall be tagged to identify the direction of travel. Detector lead-in cables shall be tagged throughout the installation with the corresponding loop tag information.

The tagging material and fastening shall be approved prior to proceeding with this work. The color coded wires shall be connected properly. The white wire shall be the common or ground. Wire used for all identical indications of any individual phase shall be color coded and, where possible, shall use red wire to connect red lenses, orange wire to connect yellow lenses, and green wire to connect green lenses. Signal heads shall be assembled and wired before being installed. The testing of the loops shall be documented in the Loop Testing Table provided by the State.

REVISION TO SPECIFICATIONS, PROVISIONS AND DRAWINGS (OLD BUSINESS ITEM)
SECTION 805 – TRAFFIC SIGNALS

805.08 Controller Cabinet, Signal Service, and Detector Housing Installation

Three document packets shall be prepared in accordance with 922.02(b) for each cabinet. Each packet shall be labeled with the name of the contract number, the intersection, the commission number of the signal, and the date of installation. One paper packet shall be placed in the cabinet, one paper packet shall be submitted to the Engineer, and one electronic packet shall be submitted to the Electronic Technician Supervisor at INDOT's Logistical Support Center within 2 days after the signal is turned on. Information in the packets shall include all approved changes to the signal installation. All detector loop lead-in tags and detector rack labels shall reflect all approved changes to the signal installation.

Additional detector loop amplifier units and detector racks shall be supplied as directed by the Engineer. Additional detector racks shall include all cables or harnesses including, but not limited to a SDLC cable for each added rack, interface panels and a BIU to provide a complete and functional installation. Additional auxiliary BIU panels shall include all cables or harnesses including, but not limited to a SDLC cable for each additional auxiliary BIU panel, terminal strip on BIU panel and BIU to provide a complete and functional installation.

For signal cabinets installed by the Contractor, where no detector loop or lead-in work is included in the contract, the Contractor shall perform detector loop tagging, testing and vehicle simulator testing in accordance with 805.09, only to the extent of documenting the test readings and confirming that all existing detector loops are connected correctly and all detector related equipment in the cabinet is operating correctly.

The controller cabinet shall be mounted securely on a pole, pedestal, or concrete foundation. All cabinets on concrete foundations shall be installed with the anchor bolts inside. Controller cabinets on poles or pedestals shall be mounted at a height of 38 in. ± 2 in. Pole mounted controller cabinets shall be fastened with 2 stainless steel bands as shown in the plans. Signal cables and lead-in cable shall be run in conduit from the controller cabinet to the signal support base and to detector housing as indicated on the plans. Galvanized steel elbows shall be used on the detector housing as shown on the plans.

The Contractor shall wire the entrance switch and bring service cable up the riser and out the weatherhead and leave 4 ft of cable outside the weatherhead. The utility company, at their option, may bring the service cables to the load side of the entrance switch. Meter bases, if required, shall be obtained from the power company.

A minimum of 12 in. and a maximum of 18 in. of loop wire duct will be permitted in the detector housing for each loop lead. Concrete used in the installation of detector housings shall be in accordance with 506, except 506.05 will not apply. A CMDS in accordance with 502.03 shall be submitted, however, utilization of the Department

provided spreadsheet is not required. Where a portion of the road is closed or where there is no vehicular traffic, then class A concrete in accordance with 702 may be used. The concrete shall be placed flush with existing surface and shall be covered with a steel plate during the setting time.

805.09 Loop Wire Detector Installation

This work shall consist of placement and testing of loop wire detectors in accordance with the installation details shown on the plans.

(a) Layout

The number, size, arrangement, and locations of loops shall be as shown on the plans except that loop spacing shall be adjusted to avoid PCCP joints. Loops shall be of a regular octagon shape with sides of 2 1/2 ft in length or a circular shape with a diameter of 6 ft. Loops placed longitudinally adjacent in the same lane shall be spaced 15 ft from the center of one loop to the center of the next loop. Loops shall be arranged so that no loop wire will be bent at an angle less than 120°. Regardless of configuration, the loop installation shall match the intention of the loop tagging table.

Prior to installation, loop layout shall be approved in writing by the District Traffic Engineer. The Contractor shall notify the District Traffic Engineer a minimum of 2 business days prior to the date that loop layout approval is required. All roadway centerlines, edge-lines and stop-bars pertinent to loop layout shall be accurately and clearly identified at the time loop layouts are reviewed for approval. An outline shall be painted where the loops are to be placed. The Contractor shall ensure that the final installed location of each loop matches the intention and functionality of the approved layout for loop spacing, lane width and geometry.

(b) Installation

All loops and lead-in cables shall be tagged according to the plans and 805.07.

The slots shall be saw-cut as shown on the plans. A diamond cutting blade shall be used for sawing all loops. All saw-cut loops shall have individual saw cuts to the detector housing. Joints shall be overlapped such that the saw cut at the corner is full depth. Prior to installing roadway loop wire in the roadway saw cuts, the saw cuts shall be cleaned in accordance with the manufacturer's requirements for the joint sealant to be used. After proper cleaning, the loop wire shall be installed. All loops shall be wired clockwise as viewed from above. Loops shall be wired with 4 turns or as specified then gently tamped with a blunt non-metallic tool. Backer rod 2 to 4 in. in length shall be spaced every 12 in. around the saw cut above the wire and gently tamped to hold the loop wire snug in the bottom of the saw cut. Backer rod shall not be continuous around the saw cut. After installation of the loop wire, the saw cut shall be sealed with a joint sealant material. The sealant shall be poured into the saw cut making a water tight seal. The joint sealant material shall be installed in accordance with the manufacturer's recommendations and 906.02. However, the joint configuration shall not apply. A copy of the sealant manufacturer's written application instructions shall be submitted to the

Engineer prior to any sealant operations. If the Contractor elects to use a sealant complying with 906.02(a)2, the sealant material shall be heated in a kettle or melter constructed as a double boiler with the space between the inner and outer shells filled with oil or other heat-transfer medium. This melter shall have a positive temperature control and a mechanical agitator. A backer rod shall be used for both cold applied sealants and hot poured sealants. The sealant material shall fill the saw cut as shown on the plans. All excess joint sealant on the pavement surfaces shall be promptly removed.

The black lead-in wire shall be spliced to the loop wire which goes back to the field. Such wire shall be tagged as "Out/Loop (No.)". The white lead-in wire shall be spliced to the loop wire which comes in from the field. Such wire shall be tagged as "In/Loop (No.)".

(c) Splices

For each loop cable and lead-in cable entering a handhole, there shall be 6 ft of cable jacket remaining on each wire after the splice is complete. For each loop cable and lead-in cable entering a detector housing, there shall be 2 ft of cable jacket remaining on each wire after the splice is complete. For all loop splices, there shall be a maximum of 1/2 in. of non-jacketed wire measured from the end of each cable jacket to the edge of the splice waterproofing material. The splice of the loop wire and lead-in cable shall be soldered and waterproofed at the detector housing or handhole. Waterproofing shall consist of the use of heat shrink tubing which has an internal coating sealant material. The heat shrink tubing shall not be heated by means of a direct flame tool.

(d) Testing and Acceptance

All testing and acceptance procedures performed by the Contractor shall be performed in the presence of the Department personnel assigned by the Engineer. The Contractor shall notify the Engineer a minimum of 2 business days prior to the date testing is to be performed.

The Contractor shall meter all new loop wire detectors or a new bank of loop wire detectors by means of instruments capable of measuring electrical values for installed loop wires and lead-in cables. The instruments shall measure inductance in microhenries, resistance in ohms, induced AC voltage in volts, and leakage resistance in megohms. All measuring tests shall be performed at the detector housing before the loop wire is spliced to the lead-in cable, and at the cabinet after the loop wire is spliced to the lead-in cable.

1. Electrical Testing

a. Megohm Test Before Splice is Made at Detector Housing for Loop Wire

One of the megohm probes shall be connected to ground and the other probe shall be connected to the "in" or "out" loop wire. The remaining loop wire shall be isolated. The test shall then be performed.

b. Megohm Test Before Splice is Made at Detector Housing for Lead-in Cable

The 2 wires and shield of the lead-in cable at the cabinet shall be isolated and taped. The test shall consist of recording 4 readings taken at the detector housing or handhole as follows:

(1) Connect the 1st megohm probe to ground and the 2nd probe to the shield. Record the reading.

(2) Connect the 1st megohm probe to the 1st lead-in wire and the 2nd probe to the shield. Record the reading.

(3) Connect the 1st megohm probe to the 2nd lead-in wire and the 2nd probe to the shield. Record the reading.

(4) Connect the 1st megohm probe to the 1st lead-in wire and the 2nd probe to the 2nd lead-in wire. Record the reading.

The lowest of the 4 readings taken above shall be recorded on the testing document for acceptance.

c. Megohm Test After Splice is Completed at Cabinet

This test shall be performed after the splice at the detector housing is completed. A water solution of 1 tablespoon of baking soda per pint of water shall be placed in a metal container. The metal container shall be grounded and the splice shall be fully submerged in the solution for 2 min. With the splice submerged, the shield of the lead-in shall be connected to ground at the cabinet. One megohm probe shall then be connected to ground and the other probe connected to one of the lead-in wires and the reading recorded.

2. Delay Amplifier Settings and Vehicle Simulator Test

After all detector loop testing is complete, the detector amplifiers shall be installed and settings adjusted for proper operation at the intersection.

The frequency setting shall be adjusted using the amplifier's display so that adjacent loops in the roadway that are connected to different loop amplifiers have a minimum difference of 5 kHz. This operating frequency setting does not apply to loops that are adjacent to each other in the roadway but are connected to the same loop amplifier.

The sensitivity setting shall be adjusted using the amplifier's display. With an average size front wheel drive vehicle with the front axle centered over the back loop of a

series of loops, the sensitivity shall be adjusted in accordance with the manufacturer's recommendations.

The count output shall be enabled for all loops designated as counting loops. The number of loops setting shall be set for loops designated for counting purposes and shall be set to the number of loops connected to that loop amplifier.

This test shall be performed by dragging a test vehicle across the loops using a non-conducting string. The test vehicle shall be fabricated with an 8 ft length of No. 6 bare copper wire formed into a 2 1/2 ft diameter circle. The 2 ends shall then be electrically spliced. The test shall be started with all detector amplifiers turned 'Off' except for one approach. All amplifiers for that approach shall be turned 'On' and adjusted to the proper settings. All traffic for the approach being tested shall be stopped and not allowed to cross any loops during the test procedure for that approach. The simulator shall be dragged slowly across each loop system in the same direction as to simulate a vehicle driving through the loop system. As the simulator crosses each loop an IMSA level II certified Signal Technician shall verify that a call is displayed exclusively on the corresponding loop amplifier, controller detector input and controller phases. After completely verifying the loops on the first approach the amplifiers shall be left 'On', and the amplifiers for the next approach to be tested shall be turned 'On' and adjusted to the proper settings. The same procedure shall be followed for each remaining approach. With large intersections, as the test proceeds, it may become difficult to verify that the calls are going to the correct detector inputs. In this case, traffic control shall be used to stop vehicles before reaching the loops for as many approaches as needed to accurately complete the testing to the inspector's approval. Testing may be paused between lanes to allow traffic to clear.

3. Acceptance Criteria

The Contractor shall record all test readings, in triplicate, on tabular forms provided by the Department or by copying the 1 included elsewhere herein. The Contractor shall complete, sign, and date the forms before submitting them to the District Traffic Engineer. The District Traffic Engineer will use these forms for recording the Department's readings on the corresponding space provided.

In order for the loop detector installation to be accepted, the electrical values shall be as follows:

a. Inductance shall be between 80 and 800 μH. Inductance shall be determined by means of digital readout meter which drives the field loop system.

b. Resistance shall be less than or equal to 8 ohms.

c. Induced AC voltage shall be less than or equal to 3 V.

d. Leakage resistance shall be greater than 100 megohms.

Loop wire and/or lead-in cable failing to meet this requirement shall be replaced at no cost to the Department.

805.10 Other Vehicle Detection Systems

When required, the Contractor shall furnish and install an alternative vehicle detection system from the Department's list of approved Traffic Signal and ITS Control Equipment.

805.11 Steel Conduit

Conduit shall be installed to a depth of no less than 2 ft or more than 5 ft below the finished grade unless otherwise specified or approved. Pockets or traps where moisture might accumulate shall be avoided. Conduit shall be placed under existing pavement by approved jacking or drilling methods. Pavement shall not be disturbed without permission. If permission is granted, cuts in pavement areas shall be no greater than 24 in. wide. All cuts in the pavement and sidewalk areas shall be sawed. Sidewalk removal and replacement shall be to the nearest tooled joint. Jacking and drilling pits shall be kept at least 2 ft clear of the edge of any type of pavement or paved shoulder. Excessive use of water that may cause undermining of the pavement shall be avoided. Continuous conduit runs shall not exceed 200 ft in length, unless otherwise indicated on the plans.

Expansion fittings as detailed on structure plans shall be installed where conduit crosses an expansion joint in the structure. Where it is deemed inadvisable to install expansion fittings in closely confined areas, the installation of approved flexible tubing may be permitted. Such expansion joints or tubing shall be the same size as the conduit. Any existing underground conduit to be incorporated into a new signal installation shall be cleaned with a mandrel and blown out with compressed air before cable is drawn into pipe. All new conduit runs shall be cleaned and swabbed before cables are installed. All conduit ends shall be capped and shall remain capped until the Contractor is ready to pull cable into the conduit, at which time the caps shall be removed and conduit bushings placed on each end to protect the cable. The inside surface of the conduit shall be kept clean. Conduit to be installed, indicated on the plans for future use of signal cables, shall be left in place with a pull cord on its entire length.

Larger size conduit may be used with no additional payment, but when it is used, it shall be for the entire length of the run from outlet to outlet. Conduit runs as shown on the plans are for bidding purposes only and may be changed, with permission, to avoid underground obstructions. A change order may be authorized if the conduit runs can be made on the opposite side of the street to that shown on the plans in order to avoid obstruction and traffic inconvenience or to avoid unnecessary tearing up of existing pavement.

805.12 PVC, HDPE, and Fiberglass Conduit

The method of installing PVC, HDPE and rigid fiberglass conduit underground shall be the same as for steel conduit where applicable except trenches for the conduit in areas with class X material as described in 206.02 shall be backfilled with 2 in. of natural sand before the conduit is placed in the trench. Materials excavated may be used for backfill, if approved. If the Engineer deems it necessary, approved B borrow shall be placed over the conduit to a depth of 12 in. and the remainder of the trench shall be filled with excavated material.

Schedule 40 or 80 PVC, Schedule 40 HDPE, or rigid fiberglass conduit may be used for conduit placed in trenches with expansion fittings used every 200 ft unless otherwise indicated on the plans. Schedule 80 HDPE, or steel shall be used for conduit that is jacked or bored. Schedule 80 PVC or rigid fiberglass shall be used for conduit on bridges or other structures. A No. 6 AWG copper or No. 14 AWG aluminum ground wire shall be included in all PVC, HDPE, and rigid fiberglass conduit.

805.13 Foundations

Foundations for traffic signal structures, cabinets, and pedestals of the type specified shall be constructed, or existing M foundations shall be modified, as shown on the plans or as directed. Pedestal bases shall be plumb and firmly attached to the anchor bolts either by using leveling nuts or shims if top of the foundation is not level. Grouting shall be used when necessary to fill any gap between pedestal base and foundation. Pipe pedestals shall be screwed tightly into the bases and secured with a stainless steel pin. Power and signal cables shall then be pulled from the base into the cabinet. Curing of concrete shall be in accordance with 702.22.

The foundation concrete for traffic signal cantilever structures shall be placed monolithically and shall have no construction joint. Structure bases shall be plumb and attached to the anchor bolts using leveling nuts. A tooled line or other type of permanent marking shall be provided on the top of the foundation to indicate the direction of the conduits.

During excavation of the foundation, all material shall be removed to the full depth as shown on the plans, except if class X material is encountered, the work shall be performed in accordance with 206.02(b).

805.14 Final Clean-Up

When the installation is completed, all disturbed portions of sidewalk, pavement, shoulders, driveways, sod, etc., shall be cleaned and any excess excavation or other materials shall be disposed. All cutting in the sidewalk and pavement areas shall be done with a saw. Sidewalk removal and replacement shall be to the nearest tool joint. Unless otherwise directed, cuts in pavement areas shall be no greater than 12 in. in width.

805.15 Method of Measurement

Controller and cabinet; controller cabinet foundation; disconnect hanger; handhole, signal; loop detector delay amplifier; loop detector rack; pedestrian push button; pedestrian signal head; signal cantilever structure, combination arm; signal cantilever structure, drilled shaft foundation type; signal cantilever structure, dual arm; signal cantilever structure, single arm; signal cantilever structure, single arm, combination arm; signal cantilever structure, spread footing foundation type; signal detector housing; signal pole; signal pole foundation; signal service; span catenary and tether; traffic signal head; and traffic signal head, retrofit; will be measured by the number of units installed.

The pay length for a signal cantilever arm or combination arm will be the length shown in the Schedule of Pay Items.

Conduit of the type specified will be measured by the linear foot from outside to outside of foundations. Signal cable will be measured by the linear foot.

Saw cut for roadway loop detector and sealant will be measured by the linear foot for the full depth of slot cut in the pavement as shown on the plans or as directed.

The accepted quantities for payment for signal cable will be the quantities shown in the Schedule of Pay Items. Such quantities may be corrected if they are in error by more than 25%.

If class X material is encountered during foundation excavation, measurement will be made in accordance with 206.10.

Traffic signal installation, flasher installation, miscellaneous equipment for traffic signals, and final cleanup in accordance with 805.14 will not be measured for payment.

Traffic signal equipment removal will be measured per each installation to be removed. Transportation of salvageable signal equipment will not be measured.

805.16 Basis of Payment

Traffic signal installation and flasher installation, all of the type and the location number specified, will be paid for at a contract lump sum price.

If specified as pay items; controller and cabinet; controller cabinet foundation; disconnect hanger; handhole, signal; loop detector delay amplifier; loop detector rack; pedestrian push button; pedestrian signal head; signal cantilever structure, single arm; signal cantilever structure, combination arm; signal cantilever structure, single arm, combination arm; signal cantilever structure, dual arm; signal cantilever structure, drilled shaft foundation type; signal cantilever structure, spread footing foundation type; signal detector housing; signal pole; signal pole foundation; signal service; span

catenary and tether; traffic signal head; and traffic signal head, retrofit;; will be paid for at the contract unit price per each.

Conduit of the type specified will be paid for at the contract unit price per linear foot. The cost of any backfill, ground wire, or expansion fittings shall be included in the cost of conduit.

Saw cut for roadway loop detector and sealant, and signal cable will be paid for at the contract unit price per linear foot.

The removal of existing traffic signal equipment designated to be removed will be paid for at the contract unit price per each for traffic signal equipment, remove for each location removed. When designated as a pay item, the transportation of salvageable signal equipment will be paid for at the contract lump sum price for transportation of salvageable signal equipment.

Class X excavation will be paid for in accordance with 206.11.

Miscellaneous equipment for traffic signals will be paid for at a contract lump sum price.

Payment will be made under:

Pay Item	***Pay Unit Symbol***
Conduit ____ (type)	*LFT*
Controller and Cabinet, _____ (type)	*EACH*
Controller Cabinet Foundation, _____ (type)	*EACH*
Disconnect Hanger	*EACH*
Flasher Installation, _____, Location No. _____ (type)	*LS*
Handhole, Signal, _____ (type)	*EACH*
Loop Detector Delay Amplifier, _____,_____ Channel (type no.)	*EACH*
Loop Detector Rack	*EACH*
Miscellaneous Equipment for Traffic Signals	*LS*
Pedestrian Push Button, _____ (type)	*EACH*
Pedestrian Signal Head, _____, _____ (type lens size)	*EACH*
Saw Cut for Roadway Loop Detector and Sealant	*LFT*

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Signal Cable, _____, No. _____ Copper, _____ C/ _____ .....LFT
type conductors/size
Signal Cantilever Structure, Combination Arm _____ ft .....EACH
length
Signal Cantilever Structure, Drilled Shaft Foundation, _____.....EACH
type
Signal Cantilever Structure, Dual Arm ___ ft, ___ ft.....EACH
length length
Signal Cantilever Structure, Single Arm _____ ft .....EACH
length
Signal Cantilever Structure, Single Arm ___ ft, Combination Arm ___ ft .....EACH
length length
Signal Cantilever Structure, Spread Footing Foundation, _____.....EACH
type
Signal Detector Housing.....EACH
Signal Pole,_____, _____ ft.....EACH
type length
Signal Service.....EACH
Signal Pole Foundation, _____ in. x _____ in. x _____ in. .....EACH
Span, Catenary, and Tether .....EACH
Traffic Signal Equipment, Remove .....EACH
Traffic Signal Head, _____, Section, _____.....EACH
no. lens sizes & colors
Traffic Signal Head, _____ Section, Retrofit .....EACH
no.
Traffic Signal Installation, _____, Location No. _____ ..... LS
type
Transportation of Salvageable Signal Equipment..... LS

The cost of the controller and cabinet, conduit, foundations, vehicle detection, pedestrian signals, signal heads, signal poles, signal service, signal cable and all equipment or materials required to complete the installation shall be included in the cost of traffic signal installation.

The cost of the controller and cabinet, conduit, foundations, signal heads, signal poles, signal service, signal cable and all equipment or materials required to complete the installation shall be included in the cost of flasher installation. For a solar powered flasher, the cost of the solar panel, battery cabinet, program timing module, signal heads, wiring, and all hardware required to complete the installation shall be included in the cost of flasher installation.

The cost of the controller assembly, standard loop detector racks, all wiring, hardware, and associated equipment required to operate the intersection shall be included in the cost of controller and cabinet.

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The cost of concrete, conduits, grounding bushings, ground rod, ground wire, drainage, anchor bolts, and all hardware required to complete the installation shall be included in the cost of controller cabinet foundation.

The cost of concrete reinforcing pipe and ring or polymer concrete box, cover and attachment hardware, handhole bottom if required, and aggregate as shown on the plans shall be included in the cost of handhole, signal.

The cost of any supplementary loop detector rack, all wiring, hardware, detector panel, BIU, and associated equipment shall be included in the cost of the loop detector rack.

The cost of the push button, pedestrian actuated signal sign, any accessible pedestrian signal components as shown on the plans, and all hardware required to complete the installation shall be included in the cost of pedestrian push button.

The cost of signal face hook-up wire, pole plates and arms for side mounts, pipe arms, signal brackets, bulbs, weatherhead, and all additional hardware required to assemble a combination of pedestrian signal indications as shown on the plans shall be included in the cost of pedestrian signal head.

The cost of the slot cut on the pavement, backer rod, loop sealant, and all testing in accordance with 805.09 shall be included in the cost of saw cut for roadway loop and sealant.

The cost of all work and hardware required to properly install overhead or underground signal cable as shown on the plans or as directed shall be included in the cost of signal cable.

The cost of signal pole section 2 and combination arm, all hardware including the metal skirt base plate, where necessary, to complete the installation as shown on the plans shall be included in the cost of the signal cantilever structure, combination arm.

The cost of concrete, reinforcing steel, conduits, ground rod, ground wire, grounding bushings, anchor rods, and all hardware required to complete the installation shall be included in the cost of signal cantilever structure, drilled shaft or spread footing foundation.

The cost of signal pole and dual arms, all hardware including the metal skirt base plate, where necessary, to complete the installation as shown on the plans shall be included in the cost of the signal cantilever structure, dual arm.

The cost of signal pole section 1 and single arm, all hardware including the metal skirt base plate, where necessary, to complete the installation as shown on the plans shall be included in the cost of the signal cantilever structure, single arm.

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The cost of signal pole section 1, 2 and single arm, combination arm, all hardware including the metal skirt base plate, where necessary, to complete the installation as shown on the plans shall be included in the cost of the signal cantilever structure, single arm, combination arm; when structure with single arm and combination arm is required in the same contract.

The cost of aluminum casting, enclosure concrete, conduit and elbow, and all hardware required to complete the installation shall be included in the cost of signal detector housing.

For a steel signal pole, the cost of the base plate, metal skirt base plate, handhole and cover grounding lug, 2 in. pipe cable entrance, J hook, and top cover as shown on the plans shall be included in the cost of signal pole.

For a wood signal pole, the cost of downguys, anchor rods, downguy guards, and hub-eyes as shown on the plans, and all hardware required to complete the installation shall be included in the cost of signal pole.

For a signal pedestal, the cost of the pedestal metal base, pedestal pole, pole cap, and all hardware required to complete the installation shall be included in the cost of signal pole.

The cost of concrete, reinforcing steel, conduits, ground rod, ground wire, grounding bushings, anchor rods, and all hardware required to complete the installation shall be included in the cost of signal pole foundation.

The cost of weatherhead, 1 in. conduit riser, entrance switch, 1 to 2 in. conduit reducer, ground rod, ground wire, and all hardware required to complete the installation, including the meter base when required and supplied by the utility company shall be included in the cost of signal service.

The cost of steel pole bands or straight eye bolts, span, catenary, and tether of wire rope cables, cable rings, type A support cable, wire rope clips, safety cable, thimble, service sleeve, and all hardware required to complete the installation as shown on the plans shall be included in the cost of span, catenary, and tether.

The cost of signal face hook-up wire, pole plates and arms for side mounts, mid-mast arm mount, pipe arms, signal brackets, visors, louvers, bulbs, span hanger, backplates, balance adjuster, weatherhead, and all additional hardware required to assemble a combination of signal faces as shown on the plans shall be included in the cost of traffic signal head.

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SECTION 805 – TRAFFIC SIGNALS

The cost of removing the existing traffic signal head, replacing the signal head housing, attaching the backplate and then reinstalling shall be included in the cost of traffic signal head, retrofit.

The cost to repair or replace damaged or lost salvageable traffic signal equipment shall be at the Contractor's expense.

The cost of excavation, backfill, final cleanup in accordance with 805.14, the cost of re-painting existing metallic equipment to be re-used and necessary incidentals shall be included in the cost of the pay items in this section.

REVISION TO SPECIFICATIONS, PROVISIONS AND DRAWINGS (OLD BUSINESS ITEM)

SECTION 922 – TRAFFIC SIGNAL MATERIALS

The Standard Specifications are revised as follows:

SECTION 922, DELETE LINES 1 THROUGH 1850.

SECTION 922, AFTER LINE 1, INSERT AS FOLLOWS:

SECTION 922 – TRAFFIC SIGNAL MATERIALS

922.01 Description

All traffic signal materials and equipment shall be in accordance with the NEMA TS2-2003 Standards Publication, and be compatible with the Department's current inventory of signal equipment, unless specifically outlined in the following specification.

922.02 Traffic Signal Control Equipment

Models shall be selected from the Department's list of approved Traffic Signal and ITS Control Equipment, unless otherwise specified.

(a) Model Approval

Each model of controller assembly, CA, and all major units, as defined in NEMA TS2-2.1.1, will be tested and evaluated by the Department's Logistical Support Center, and approved prior to use. The CA, as defined by NEMA TS2-1.1.7, as being a complete electrical unit, shall include major units operational in a TS2 environment. Major units of the CA are defined as controller unit, CU; malfunction management unit, MMU; bus interface unit, BIU; cabinet power supply; load switches; vehicle detector equipment; cellular modems; radio modems, and flasher. The evaluation of a product will be considered when the Department receives the preliminary product evaluation submittal form. The Department will advise the manufacturer or vendor, of the date of delivery at which time a presentation of the product will be required accompanied by the product brochure, the operational manual containing procedures for all features incorporated in the CU's design, and the maintenance manual containing all schematics, pictorial parts layouts, components parts listings, and documented theory of operation. Certification in accordance with 922.02(d) shall also accompany the preliminary product evaluation form. If a product has TS2 communicative capabilities, then a data analysis interpretation offered in a decimal form expressing frames by an SDLC protocol analyzer shall accompany the initial documentation as well. When accuracy of documentation is validated, the evaluation period may commence. In addition, all computer system software applicable to a manufacturer's product shall work with the Department's current operating systems so that upgrades will not be needed to recognize the full potential of the product. Any product under evaluation that has an operational failure occurring during the bench test procedure will be rejected and returned to the submitter. The product will not be considered for future evaluation without a cover letter documenting failures encountered and changes to the design to correct the failures. A presentation by the manufacturer of the product in question and explanation of why the product failed will be required. Resubmittal of the original product will be expected for testing, evaluation, and approval. Furthermore, 2 more rejections of a product submitted for evaluation will be cause to deny approval of that model permanently.

The controller model shall be fully NTCIP 1202 compliant, and be capable of logging time-stamped controller event data at 100 ms resolution. The events collected shall be logged in the Department specified data file format and shall include but are not limited to, start and termination of all phase green, amber, and red, pattern changes, and all detector actuations and terminations. Data log file shall be accessible for standard FTP retrieval directly from the controller model's internal FTP server via the IP addressable RJ-45 Ethernet port.

Continued failures indicative of a trend, repeated random malfunctions, or NEMA non-compliance of an approved product shall be cause to remove that model from the Department's list of approved Traffic Signal and ITS Control Equipment. If the manufacturer makes any changes to an approved model of major unit and/or controller cabinet terminal/facilities to correct a non-NEMA compliant or safety issue, the Department is to be notified immediately. The manufacturer will be required to correct all existing equipment purchased by the Department either directly, by contract, or through agreement prior to the change being incorporated at the manufacturer's production level.

A design change to an approved model of a CA or any major unit will require a submittal of documented changes. At the discretion of the Department, resubmission of the model for testing, evaluation, and approval may be required. The permanent addition or removal of component parts or wires, printed circuit board modifications, or revisions to memory or processor software, are examples of items that are considered to be design changes.

(b) Controller Assemblies or Major Units Furnished and Installed by the Contractor

A CA, as defined by NEMA TS2-1.1.7, shall be provided by the Contractor and shall be built to the specifications of the intersection design.

Each CA shall be supplied with 3 documentation packets. The documentation shall be provided in both paper hard copy and electronically as specified for each document. Each packet shall consist of:

1. *One complete set of wiring and schematic diagrams for all of the CA's panels, racks and wiring; the electronic document shall have a minimum of 1 indexed page for each paper sheet.*

2. *A parts list indicating contract number, vendor, category, manufacturer, model, serial number, software/firmware version as applicable, and inventory number of all major units incorporated in the CA; the electronic document format and the blank worksheet shall be obtained from the Department's Logistical Support Center.*

3. *An 11 by 17 in. intersection design plan.*

4. A completed Department approved loop tagging table; the electronic document format and the blank worksheet shall be obtained from the Department's Logistical Support Center.

5. Packet number 2 shall also include a paper hard copy and an indexed and searchable electronic format file of the instructional programming manual identical in nature to that approved for use during the evaluation of each product and shall include a TS2 type 2 to TS2 type 1 adapter harness.

All electronic documents shall be saved to CD in the specified format for each document. Each packet shall be labeled with the name of the intersection, the contract number, the commission number and the date of installation. Packet destinations shall be as per 805.08.

A 60-day burn-in period of traffic control equipment shall be required prior to acceptance of the contract. The Contractor shall be responsible for all costs associated with vendor or manufacturer warranty service until acceptance of the contract, or acceptance of that portion of the contract where the traffic control equipment is installed.

(c) Warranty

The manufacturer's or vendor's warranty shall be provided for the following components: all major units operating in a TS2 environment, light emitting diode, LED, signal indications, load switches and flashers. Warranty periods shall commence from the date of field placement of the device or on the date of signal turn-on as shown on the IC 636A form if purchased through a contracting agent.

(d) Certification of NEMA TS2 Traffic Control Equipment

The following certifications shall be furnished.

1. Certification of a Production Run Model

A certification representing each model of approved major unit of a CA shall be on file with the Department. A certification of a production run model for a CU will be valid for a maximum period of 5 years from the date of approval or unless a significant change is made in the CU. If a significant change is made, a new certification shall be submitted. A significant change shall be the addition or deletion of any function or feature in the control unit, or any other change as defined in 922.02(a) to the circuitry in the product.

2. Certification of Environmental Testing

A certification shall be furnished with each major unit approval request indicating it has been tested and is in accordance with the tests from NEMA TS2-2. The certification shall specify the model and serial number of the product being tested. A complete log of each test shall be provided to the Department and will be maintained by

the Department. The log shall show which, if any, controller component failed during the test, when it failed, and what steps were taken to repair the controller. The log shall include the date of testing, name and title of person conducting the tests, a record of conditions throughout the tests, and a temperature and humidity verses time chart. The maximum report interval of any chart shall be 24 h. The chart shall be from a recording machine used to monitor the status of the environmental chamber during testing.

(e) NEMA TS2 Fully Actuated Solid State Controller Unit, CU

The following requirements are the minimum for the design and operation of a 16 channel fully actuated solid state CU. The NEMA TS2 configuration will consist of 2 types of CU's, type A1 and type A2, as defined in NEMA TS2-3.2.

The CU shall be in accordance with NEMA TS2 Standards, all provisions contained herein, and the Department's specifications. Manufacturer specific enhancements are acceptable; however, no function or device shall preclude the interchangeability of a CU with another CU of like NEMA specification within a controller assembly.

1. General Requirements

The CU shall be microprocessor based and both versions shall contain a 3-port configuration and shall operate in the NEMA TS2 type A1 environment.

The CU shall include provisions for time-of-day programming. The CU shall be capable of a minimum of 50 programmed events and be in accordance with NEMA TS2-3.8.

A removable nonvolatile EEPROM module or removable serial, flash-based, non-volatile data module shall be utilized in each CU to maintain all programmed data. A real-time clock shall be either battery-backed or powered by a super capacitor and active during a power outage so as to provide complete time keeping functions and leap year corrections. A switch or other means shall be provided to turn off or disconnect battery power during storage. This shall be accomplished without physical removal of the battery. Batteries within the CU shall be turned off or disconnected during storage and shipment.

Programming and maintenance manuals for approved CU's shall be identical in nature to that approved for use during the evaluation period of the CU. The Department shall be notified of any changes to the manuals.

Serial number and model numbers shall be permanently applied on or near the front of circuit boards of the CU and viewable without removing or disconnecting the board. Serial number and model number of the main frame shall be permanently applied externally on top or on the front panel.

2. CU Requirements

The requirements set forth herein refer to a type A1 and A2 CU. Where differences occur between types, it will be designated.

The CU shall have, as a minimum, the internal diagnostics defined by NEMA TS2-3.9.3.

The CU shall monitor and log the status of events as specified in NEMA TS2-3.9.3.1.5 in non-volatile memory and shall be selectable via program entry and be retrievable by the system computer via NEMA port 2 or 3. In addition, the CU shall have the ability to log an MMU fault as it occurs. A minimum of 16 entries shall be stored in non-volatile memory. When capacity is exceeded, the oldest entry will be replaced by the newest. Logged entries shall at minimum contain the date and time denoted in military style with minute resolution, description of the fault as it would appear on the MMU, and the status of each of the channel inputs at the time the fault occurred, clearly denoting the presence of activity on a channel.

The CU shall be capable of all inputs and outputs listed by controller type in NEMA TS2-3. Pedestrian timing shall be provided on all phases of a CU. The CU shall be keyboard programmable to permit initialization in any color and phase. Initialization shall occur after a recognized power interruption, upon MMU reset, or upon return from manual or time-of-day flash. The CU shall be programmable from a closed loop computer system, a laptop computer using the RS232 port, front panel programming, and by downloading from another like CU through the RS232 port.

Keystroke buttons shall be clearly marked as to function. All programming buttons and indicators pertinent to the operation of a phase shall be on the front of the CU and shall have programmable phase omitting and phase skipping capabilities.

The TS2 type A2 CU shall be in accordance with all applicable requirements for a type A2 CU as defined by NEMA TS2-3 and shall contain a full compliment of connectors.

The CU shall have an RJ-45 ethernet port on the front panel and ethernet module that provide 10/100 base T interface in half or full duplex and which supports auto-configuration of the link parameters.

3. Internal Modules

All plug-in modules shall be equipped for easy removal or installation without the use of tools and shall be readily accessible for maintenance. All internal module plugs and edge card plugs shall have the corresponding pin connector position labeled with the first and last numbers or the first and last letters.

4. CU Enclosure

The enclosure shall be of adequate strength to protect the components during normal handling. The keypad, liquid crystal display and all interface connectors required for the operation and standard field adjustments shall be mounted on the front panel. Fusing shall be on the front panel of the CU and shall provide protection from internal or external overload.

The front panel of the controller shall be fastened to the frame such that no special tools shall be required to remove or replace printed circuit board modules nor to gain access through the front panel. All hinges shall have stainless steel pins.

5. Firmware and Software Revisions

The Department's Logistical Support Center shall be notified each time an update or revision of the firmware or software is released, explain the changes, and the benefits of the change. The Department will determine if and to what extent a revision is to be placed into field operation and may fully re-evaluate the CU with the revision.

(f) NEMA TS2 Cabinet, Auxiliary Equipment, and Terminal and Facilities, TF, Requirements

These standards define the minimum requirements for a TS2 type A1 cabinet, both inside and out. The performance and construction of the cabinet shall be in accordance with the applicable requirements of NEMA TS2 sections 4, 5, 6, and 7. The serial number and model number of the auxiliary equipment shall be permanently applied externally on or near the front of the product. Programming and maintenance manuals for approved products shall be identical in nature to that approved for use during the evaluation period of the product. The Department shall be notified of all changes to the documentation. Manufacturer specific enhancements are acceptable, however no function or device shall preclude the interchangeability of an auxiliary product with another product of like NEMA specification within a controller assembly.

1. Controller Cabinet Requirements

The NEMA TS2 type A1 controller cabinet shall be in accordance with the following requirements.

a. General

The cabinet and the shelves shall be fabricated of aluminum. The cabinet shall be 1/8 in. minimum thickness sheet aluminum or 1/4 in. minimum thickness die-cast aluminum. The cabinet exterior and interior including shelves shall have a sandblasted, roughened, or chemically etched finish that reduces gloss, reflection, and glare.

The main cabinet door shall use a Corbin lock No. 2 and each cabinet shall be furnished with 2 No. 2 keys. The lock shall open in a counterclockwise motion only. The door shall be capable of being opened and stopped in at least the following 2 ranges of degree opening as measured from the face of the cabinet door on the hinged side: 80 to 100°, and 170 to 190°. The door shall be hinged on the right side of the cabinet. The

main door and the police panel door shall close against a weatherproof and dustproof gasket seal, which shall be permanently bonded to the cabinet. A standard police panel key shall be provided with each cabinet.

A rain channel shall be incorporated into the design of the main door panel to prevent liquids from entering the enclosure. A 1 1/2 in. deep drawer shall be provided in the cabinet, mounted directly beneath the controller support shelf. The drawer shall have a hinged top cover and shall be capable of accommodating 1 complete set of cabinet prints and manuals. This drawer shall support 50 lb in weight when fully extended. The drawer shall open and close smoothly. Drawer dimensions shall make maximum use of available depth offered by the controller shelf and be a minimum of 24 in. wide.

b. Switches, Auxiliary, and Environmental Feature Requirements

The cabinet shall have a police door and a police control panel within the main door. The police panel shall have 3 different switches, 1 switch for field indication cutoff, 1 switch for flashing operation, and 1 switch for Auto and Manual with a manual control jack to accept a 1/4 in. monaural phone plug jack. The switches shall be protected from water when the cabinet door is open.

A test switch panel shall be mounted on the inside of the main door. The test switch panel shall include, as a minimum, the following switches. An auto/flash switch shall be installed so that when in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. A stop time switch shall be installed so that when in the 'On' position the controller shall be stop-timed in the current interval. A controller equipment power On/Off switch shall be installed which shall control AC power to the CU, MMU, and cabinet power supply. All switches mounted on the switch panel on the inside of the main door shall have in place a mechanism to prevent accidental activation of the switch. "Locking bat" type switches or side switch guards are acceptable. Switch guards, if used, shall be in place for each switch, shall be made of the same material as the cabinet, and shall permit the operation of the switch without the use of tools.

All switch functions shall be permanently and clearly labeled. Hand written labeling will not be permitted.

The cabinet shall include all required wiring, connectors and adapters to provide full compatibility and interchangeability with either a TS2 type A1 or type A2 controller.

c. Receptacle

The cabinet shall contain 1 duplex convenience outlet and a lamp receptacle that is actuated and turns on when the door is open and goes off upon closing of the door and an internal On/Off switch which can override the preceding. The convenience outlet shall be duplex, 3-prong, NEMA type 5-15R grounding outlet in accordance with NEMA WD-6, with ground-fault circuit interruption as defined by the National Electric Code. These units shall be protected with a 15-ampere cartridge fuse wired ahead of the

multibreakers. An additional outlet shall be provided in each cabinet and shall be a duplex, 3-prong, NEMA type 5-15R grounding outlet wired after the cabinet surge protection. This unit shall be protected with a 10-ampere cartridge fuse. The additional outlet in master cabinets shall be powered by the 10-ampere circuit breaker and through a separate power interrupt switch providing separate control of the master CU power supply.

d. Fan and Filter

The cabinet shall contain a thermostatically controlled ventilating fan and a vent with a commercially classified uniform 1 in. thick filter. The thermostat shall be manually adjustable from 90 to 115°F. The fan shall be mounted internally at the top and toward the front of the cabinet to exhaust out the front top lip of the cabinet. The fan shall be rated at a minimum of 100 cu ft per minute as designated by NEMA TS2-7.9.1. The thermostat shall be located within 6 in. of the fan.

The filter size will be according to the provisions for the type of cabinet as stated in NEMA TS2-7.9.2.3 and shall be a replaceable pleated air filter with a minimum efficiency reporting value, MERV, rating of 5 or higher as defined by the ASHRAE 52.2-2007 specification. The cabinet ventilation shall be in accordance with NEMA TS2-7.9. The diameter of circular openings for cabinet ventilation shall not exceed 3/8 in. The short dimension for slotted openings shall not exceed 3/8 in.

Each inductive device, including the fan, shall have a separate power surge protection.

2. Load Switch and Flasher Requirements

The cabinet shall contain a jack mounted type 3 solid state non-repairable flasher in accordance with NEMA TS2-6.3 electrical and physical dimensions.

The pedestrian load switch and the signal load switch shall be an approved unit meeting all electrical and physical dimension requirements in accordance with NEMA TS2-6. The load switch shall not use a printed circuit board to transmit the 115V AC line input or signal buss output. Each load switch shall offer 3 indicators, 1 for each circuit indicating the status of the input to the load switch.

The load switch signal outputs shall be brought to a separate terminal strip for hook-up of the signal displays. Load switches inputs shall be capable of being programmed for flash, overlap, vehicular, or pedestrian phases with the use of a standard slotted or phillips screwdriver via the cabinet terminal strip. The load switch input programming of the TS2 type A1 CU shall be accomplished through front panel data entry of a TS2 type A1 or a TS2 type A2 CU.

3. Terminal and Facilities Requirements

a. General Requirements

The TF layout shall be in accordance with NEMA TS2-5.2.7. The cabinet shall contain a main TF panel complying with NEMA TS2- 5 standards. The model number of the main panel shall be permanently applied to the front of the panel, where it is easily readable, without removing or disconnecting the panel. Each controller input and output circuit shall terminate on the main TF panel or on a supplementary panel. The phase arrangement of the controller shall coincide with the channel arrangement of the load switches and MMU. All outputs on channels 9 through 12 field connections shall have a 1μF capacitor placed at each output terminal on the front of the TF panel. All TFs within the cabinet shall be readily accessible for field connection without removing the controller or associated equipment and for maintenance in the cabinet. All stranded wiring shall be tinned. A 24 volt relay shall be used on the TF to remove 24V DC from the common side of the load switches, effectively taking the mercury relay out of the circuit when the signal is put in mechanical flash. The TF panel shall be hinged at the bottom and capable of swinging down, to allow accessibility of the wiring and terminals at the rear of the panel. The backpanel shall be attached to the cabinet such that access to the backside of the backpanel, for maintenance purposes, shall be accomplished without the use of special tools or removal of auxiliary panels, shelving, or other cabinet appurtenances. A bracket extending at least half the length of the NEMA load switch shall support all load switches.

Terminals shall be consecutively numbered on both sides of the TF panel and shall be in compliance with the appropriate schematic diagrams. All positions for load switches, flasher, and mechanical relays shall have reference designators on both sides of the TF panel. All nomenclature shall be on or adjacent to the component or terminal. All nomenclature shall be machine produced and not handwritten. Cabinet prints shall identify the function of each terminal position.

CU and MMU harness cables shall be of sufficient length to allow units to be placed on either shelf or on top of the cabinet while remaining in operational mode. RS485 port 1 communications cable shall also be of sufficient length to allow any port 1 cable to be utilized with any TS2 unit within the CA. The RS485 harness shall be constructed of a high quality shielded communications cable. The TF panel shall contain a resistor/capacitor network circuit which will provide an external restart pulse to initiate the startup sequence upon initialization from flash.

Remote flashing shall be provided for all signal circuits. Unless otherwise indicated on the plans, phases 2 and 6 shall be wired to flash yellow. All other phases shall be wired to flash red. Flashing for signal circuits shall be activated on 1 circuit for odd numbered phases and on the other circuit for even numbered phases.

b. Power Panel Requirements

A transparent plexiglass cover shall be provided over the CA power supply panel. The cover shall leave the switches on the breakers exposed as well as leave access to terminals at the bottom of the panel for wiring purposes. No terminals on the power panel shall have silicon protectant on them in lieu of the plexiglass cover. The panel shall contain a multi-breaker with one 10 A circuit breaker to provide overload protection to the CU, MMU, BIU, +12/24V DC cabinet power supply, and detection devices. It shall also contain 1 main circuit breaker of 35 or 40 A, to provide over-load protection to the signal and flash buss load. All breakers shall have line and load terminals clearly labeled. The signal bus shall be connected to the incoming AC line through a mercury contact switch or a solid state control device functionally equivalent to the NEMA 5.4.2.3 specified contact switch. The terminals for AC + and − input to the cabinet shall be capable of accepting a No. 6 wire.

With the CA 10 A and main 35 or 40 A circuit breakers 'Off' (tripped), all units inside the cabinet and the intersection display shall be 'Off'. With the 10 A breaker 'On' and main 35 or 40 A circuit breaker 'Off', the signal output shall be 'Off' and the major units within the cabinet shall function. With the 10 A breaker 'Off' and main 35 or 40 A circuit breaker 'On', the intersection shall be in flash mode and all units within the cabinet will be 'Off'.

The cabinet shall contain a 50 kA 8 x 20 μs surge suppressor. The surge suppressor shall be a 120V AC, 15 A, minimum 2-stage parallel/series type device and protect lines: line-neutral, line-ground and neutral-ground, have a maximum continuous operating voltage of 140V AC, maximum clamp voltage of 350 volts and device status indicators of green/good and red/failed. The device shall plug into a NEMA 12 position terminal base wired before and in parallel with the 35 or 40 A main signal buss circuit breaker and in series with the 10 A circuit breaker for the solid state equipment and provide for a tool-free replacement of the device. There shall be a minimum of 2 electrical receptacles on the equipment side of the device for future auxiliary equipment. The surge suppressor shall operate between -30 to 165°F. The dimensions of the unit shall not exceed 4 1/2 in. wide by 7 in. long by 3 1/2 in. deep.

All equipment capable of operating at 12 or 24V DC typically powered by an individual receptacle type power supply shall have a power cable permanently wired into the cabinet and the device shall be powered by the cabinet TS2 power supply.

4. MMU Requirements

The cabinet shall contain a MMU and shall be in accordance with the standards of NEMA TS2- 4. The MMU shall be wired to monitor each load switch output.

5. BIU Requirements

All BIU's shall be in accordance with NEMA TS2 2008, Section 8. Edge mounted printed circuit boards and rack cards shall not have jumper wire modifications unless the jumper wires are permanently bonded to the PCB over its entire length. BIU's shall be

supplied with each cabinet to allow for maximum phase and function utilization for which the cabinet is designed.

6. Loop Amplifier Units and Rack Requirements

a. General

All loop amplifier units shall be in accordance with NEMA TS2-6 and shall follow type C, 2 channel with delay and extend, as stated in NEMA TS2-6.5.2.2.1. All amplifiers shall be selected from the Department's List of Approved or Prequalified materials for each type of amplifier. In addition, loop amplifiers shall have an LCD display or a RS232 serial data connection and software interface capable of displaying loop status including but not limited to operating frequency and -ΔL/L, diagnostics, and all amplifier settings and operating parameters. Edge mounted printed circuit boards and rack cards shall not have jumper wire modifications unless the jumper wires are permanently bonded to the PCB over its entire length.

All detection components including amplifiers, racks, auxiliary BIU, interface panels, lead-ins, and all connecting harnesses shall provide 1 count output channel per lane of each approach within project limits.

All loop amplifiers designated for counting shall meet all requirements as above and shall additionally transmit channel 1 and 2 count pulses on the edge connection assigned to channels 3 and 4 respectively. Counting amplifiers shall be configured with count outputs mapped to and recorded in the CU detector logs. The status output of each active counting channel (3 and/or 4) shall be set to logic ground by software configuration within the amplifier or externally by use of jumper card in the adjacent slot.

An auxiliary BIU panel may be used strictly for count outputs (channels 3 and/or 4 only); in this configuration, the status outputs for those count output channels may be wired to logic ground on the BIU panel. The status outputs for all standard output channels shall provide accurate status data at all times. All detector input data to the CU shall remain accurate at all times.

All M and P-1 cabinets shall incorporate a 16 channel detector rack, configuration No. 2, as per NEMA TS2-5.3.4 and shall allow operation of a 2 channel detector in each slot and the capability of operation of a 2 channel counting amplifier in each even-numbered slot with the respective count outputs in each odd numbered slot. The number of detector racks provided shall be determined by the loop tagging table. All G cabinets shall incorporate an 8 channel detector rack, configuration No. 1, as per NEMA TS2-5.3.4.

All detector loop panels and detector racks shall be labeled according to the loop tagging table and as follows.

All detection shall be labeled in such a way that the numbering for any loop is consistent throughout the cabinet; the loop terminated as Loop or Detector 17 shall be Detector Channel 17 in the detector rack and Detector Input 17 to the controller.

b. Loop Termination Panel

Each loop lead-in panel shall be labeled on the upper left corner with the loop numbers that are terminated on that panel as follows: (1-16), (17-32), (33-48), (49-64). Each loop termination point shall be labeled with the corresponding loop number. Example: For panel 17-32: loops terminated on this panel will start with 17 and end with 32.

c. Detector Rack

Each detector rack shall be labeled at the bottom of the rack with a continuous label. The label shall be 1 in. wide, thermal printed black on clear, white or matte polyester tape with permanent adhesive, water, chemical and scratch resistant printed with 4 lines of Arial, size 10 font. Below the BIU shall be the BIU number and detector channel numbers that are contained within the rack as follows: (1-16), (17-32), (33-48), (49-64). This area shall also contain the intersection for diamond interchanges controlled from 1 cabinet. Each slot shall be labeled below the module with the corresponding loop tag information; the count output number portion of the information shall be under the first part of the tag information. For each 2-channel module, channel 2's label shall be below channel 1's label.

7. Cabinet Power Supply Requirements

The TS2 cabinet power supply shall adhere to the guidelines of NEMA TS2-5.3.5. The power supply shall be encased on all sides so that no circuitry is exposed to the user.

(g) Cabinets

1. G Cabinet (Size 3)

The G cabinet shall be pedestal-mounted or pole-mounted. As per NEMA TS2-5.3, the TS2 type 1 G cabinet, at minimum, shall house an 8-load switch bay (configuration 2) terminal and facilities panel and shall have 1 adjustable shelf located 12 in. below the top of the cabinet. The bottom of the cabinet shall be reinforced to ensure a secure pedestal mounting. The G cabinet shall have dimensions of 25 in. wide, 38 in. high, 18 in. deep with a tolerance of + 4 in. in any or all dimensions.

A cabinet slipfitter shall be used to attach the cabinet to the pedestal. The slipfitter shall fit a 4 1/2 in. outside diameter pipe and shall have a minimum of 3 set screws equally spaced around the slipfitter.

A vent of adequate size shall be provided. The size of the vent and the filter requirements shall be in accordance with the manufacturer's recommendations.

2. M Cabinet (Size 5)

As per NEMA TS2-5.3, the TS2 type 1 M cabinet, as a minimum, shall house at minimum an 8-load switch bay (configuration 2) terminal and facilities panel and shall have 2 adjustable shelves with the first shelf located 15 in. below the top of the cabinet and the second located 7 in. below the first shelf.

The M cabinet shall be ground-mounted on a concrete foundation at locations and dimensions as shown on the plans.

The M cabinet shall have dimensions of 30 in. wide, 48 in. high, and 16 in. deep with a tolerance of ± 2 in. in any or all dimensions.

Anchor bolts shall be steel in accordance with ASTM A 36. Diameter of the bolt shall be 1/2 in. or 5/8 in. and the minimum length shall be 15 in. plus 3 in. right angle hook on the unthreaded end.

The top 6 in. of the bolt shall be threaded with 13 NC threads on 1/2 in. bolts and 11 NC threads on 5/8 in. bolts. The hexagon nut, the flat washer, and the threaded end of the bolt shall be galvanized in accordance with ASTM A 153 or be mechanically galvanized and in accordance with the coating thickness, adherence, and quality requirements of ASTM A 153, class C.

The cabinet shall include 1 loop detector rack.

3. P-1 Cabinet (Size 6)

The P-1 cabinet shall be ground mounted on a concrete foundation at locations and dimensions as shown on the plans with anchor bolts in accordance with 922.02(g)2. As per NEMA TS2-5.3, the TS2 type 1 P-1 cabinet, at minimum, shall house a 16-load switch bay (configuration 3) terminal and facilities panel and shall have 2 adjustable shelves with the first shelf a minimum of 30 in. above the bottom of the cabinet, the second shelf having a minimum clear opening of 11 in. above the first shelf.

The cabinet shall be 44 in. wide, 52 in. high, and 24 in. deep with a tolerance of ± 3 in. in any or all dimensions.

The cabinet shall include 2 loop detector racks.

4. R Cabinet (Size 7)

The R cabinet shall be ground mounted on a concrete foundation at locations and dimensions as shown on the plans with anchor bolts in accordance with 922.02(g)2. As per NEMA TS2-5.3, the TS2 type 1 R cabinet, at minimum, shall house a 16-load switch bay (configuration 3) terminal and facilities panel and shall have 3 adjustable shelves with the first shelf located a minimum of 30 in. above the bottom of the cabinet, the second shelf having a minimum clear opening of 11 in. above the first shelf and the third shelf having a minimum clear opening of 11 in. above the second shelf.

The cabinet shall be 44 in. wide, 72 in. high, and 24 in. deep with a tolerance of ± 3 in. in any or all dimensions.

The cabinet shall include 3 loop detector racks.

5. Flasher - Two Circuit Alternating Flasher

Two circuit alternating flasher shall be solid state.

a. General

The solid state flasher shall periodically interrupt a source of alternating current line power. Solid state shall mean electrical circuits, the active components of which are semi-conductors, to the exclusion of electromechanical devices or tubes.

The flasher shall be a type 3 solid state flasher conforming to NEMA TS1-1989. The flasher output circuit carrying the signal load shall consist of opto or photo isolated solid state power relays and shall be hard wired to the flasher connector.

Three schematic diagrams and 3 descriptive parts lists shall be furnished with each flasher.

Two circuit flashers shall be plug-in design. The flasher design shall not permit the unit to be inserted improperly into the plug-in base. The flasher shall have heavy-duty plugs and jacks capable of handling the rated load current. The rate of flash shall be 50 to 60 flashes per minute.

The flasher shall operate between 95V and 135V AC 60 Hz. No degradation of performance shall be experienced in environmental changes from -20 to 165°F and 0 to 90% relative humidity.

b. Cabinet Requirements

The cabinet shall be weatherproof and fabricated from cast aluminum or aluminum sheeting with a minimum thickness of 1/8 in. The cabinet door shall be the entire front of the cabinet and shall be hinged on the right or left side of the cabinet. A Corbin No. 2 lock and 2 No. 2 keys shall be furnished. The lock shall be located near the center of the door on the side opposite the hinge.

Minimum dimensions for the cabinet shall be 12 in. deep, 12 in. wide, and 12 in. high. The maximum dimensions shall be 18 in. deep, 15 in. wide, and 18 in. high.

The cabinet shall have 2 pole plates for stainless steel band mounting of the cabinet on a pole with a minimum diameter of 4 in. and a maximum diameter of 18 in. Two blank cover plates shall be provided. Two hub plates for 1 in. diameter conduit shall be provided with gaskets, 8 bolts at 4 bolts per plate, nuts, and washers for attaching the hub plates to the cabinet. The cabinet shall be drilled for the mounting of the pole plates or hub plates as shown on the plans.

It shall have a screened vent in the bottom with a minimum size of 1 3/4 sq in., and a minimum of 1 louvered and screened vent towards the top of the cabinet.

The panel in the cabinet shall be capable of being removed and reinstalled with simple hand tools. A 25 ampere radio interference filter and surge arrestor wired ahead of a 15 ampere circuit breaker shall be mounted on the panel. A terminal block capable of the following electrical connections shall be mounted on the panel.

Circuit 1 - for connection of field signals (flash circuit 1)
Circuit 2 - for connection of field signals (flash circuit 2)
Circuit 3 - for connection of field signals (field neutral)
AC plus - capable of accepting a No. 6 wire
AC minus - capable of accepting a No. 6 wire
Ground lug - capable of accepting a No. 6 wire

922.03 Signal Head Components

The components shall be in accordance with the Institute of Transportation Engineers for Adjustable Face Vehicular Traffic Control Signal Heads. All new traffic signal and flasher installations that include new indications shall be fitted with LED modules. All LED indications shall be selected from the Department's list of approved Traffic Signal and ITS Control Equipment.

(a) General

The signal faces shall be sectional in construction, requiring 1 section for each lens and furnished in the nominal size of 12 in. Each section of a face shall have a rectangular silhouette when viewed from the front or the rear.

(b) Housing, Door, and Visor

The top and bottom of each housing shall have an integral locking ring with 72 serrations to permit rotation of the signal housing in 5° increments. Hub openings in the top and bottom of the signal housing shall accommodate standard 1 1/2 in. bracket arms. The thickness of the hub at the top and bottom of the housing shall be a maximum of 1 in. and a minimum of 3/8 in. The 12 in. door shall have 2 simple locking devices. The door on the hinged side shall be attached with hinge pins. Each lens shall have the standard cap type visor. All screws, latching bolts, locking devices, and hinge pins shall be stainless steel.

(c) Signal Indications

1. LED Signal Indications

All LED indications shall be selected from the Department's list of approved Traffic Signal and ITS Control Equipment.

All LED indications shall have a permanent indelible sticker affixed to the back of the module indicating month and year of initial installation.

All LED indications provided shall be individually listed on a parts list indicating the contract number, vendor, category, manufacturer, model, serial number, and inventory number. Hard copy and electronic copies shall be provided. The electronic document format and the blank worksheet shall be obtained from the Department's Logistical Support Center.

2. Incandescent Signal Indications

All new traffic signal and flasher installations that include new indications shall be fitted with LED's. The minimum design requirements for replacement incandescent light bulbs to be used in a traffic signal face shall be in accordance with the Institute of Transportation Engineers standard for traffic signal bulbs.

(d) Wiring

The field wiring leads shall be terminated with screw spade lug type connectors. The LED module wiring leads shall be terminated with 1/4 in. female type connectors for ease of connection to the terminal block.

(e) Section Coupling

Any method to connect 2 or more sections together may be used, if the following requirements are met:

1. *Two or more sections, when jointed together, shall maintain structural integrity when loaded in accordance with Institute of Transportation Engineers Standards.*

2. *The opening between joined sections shall accommodate two 1/2 in. cables.*

3. *The maximum length of bolts used to connect sections together shall be 4 in.*

Nuts, bolts, and lock washers shall be galvanized in accordance with ASTM A 153 or be mechanically galvanized and be in accordance with the coating thickness, adherence, and quality requirements of ASTM A 153, class C.

(f) Terminal Block

The center section of the 3-section signal head, both center sections of the 4-section head, one section of the 2-section signal head, and each 1-section signal head shall be equipped with a 5-position terminal block for termination of field wiring. Each section shall have provisions for two 5-position terminal blocks. Each terminal screw shall have a 1/4 in. corresponding spade tab. The terminal block shall have a minimum

spacing between screw connections of 1/2 in. The height of the insulating ridge between screw connections shall be a minimum of 19/32 in. from the base of the terminal blocks.

(g) Material Requirements

1. Polycarbonate Signal Head

The housing, door, and visor of the section shall be made of ultraviolet and heat stabilized polycarbonate. The black color shall be permanently molded into the components.

2. Die-Cast Aluminum Signal Head

The housing, door, and visor of the section shall be made of a die-cast, corrosion resistant, copper free, non-ferrous metal which shall be in accordance with ASTM B 85. All surfaces of the housing, doors, and visor shall be shop painted or powder coated. The finish shall be nonreflecting flat black, color 37038, in accordance with Federal Standard 595.

(h) Signal Backplates

The traffic signal backplate shall be one piece and made of sheet aluminum. The sheet aluminum shall have a nominal thickness of 0.063 in. and shall be according to ASTM B 209, Alloy 5052. The backplate shall be designed to be attached to a signal face without interfering with the opening and closing of the traffic signal door. It shall be rectangular in shape with round corners and shall be of such dimensions as to give an exposed margin of 5 in. on each side.

The backplate shall have a 2 in. wide yellow retroreflective strip applied to the outside perimeter of the backplate. The sheeting shall be Type IV in accordance with 919.01(b) and applied in the orientation for the maximum angularity according to the manufacturer's recommendations.

The aluminum backplates shall be shop painted or powder coated. The finish shall be nonreflecting flat black, color 37038, in accordance with Federal Standard 595.

(i) Certification

A material certification shall accompany each order certifying that a signal head from a normal production run within the past 12 months, passed the Institute of Transportation Engineers criteria for breaking strength and deflection. Deflection testing is not required in the certification for polycarbonate signal heads.

922.04 Pedestrian Signal Components

(a) Pedestrian Signal Head

A pedestrian signal shall be 1 section and rectangular in shape. The dimensions of each side may vary from 18 to 19 in., including the visor and the hinges. The signal shall contain 2 figures with 2 different colored messages. The first figure shall transmit

an upraised hand symbol message, and the second figure shall transmit a walking person symbol message. All new installations including new pedestrian indications shall use Light Emitting Diodes with countdown displays. All pedestrian LED indications shall be selected from the Department's list of approved Traffic Signal and ITS Control Equipment. The pedestrian signal shall be in accordance with the standard of the Institute of Transportation Engineers for Pedestrian Traffic Control Signal Indications.

1. Housing, Door, and Visor

The housing shall be equipped with mounting device hardware, such as clamshell, and round openings at top and bottom for mounting with brackets made of iron pipe standard, to fit the 1 1/2 in. pipe. The openings shall have a common vertical centerline through the housing to permit 360° rotation after it is mounted. The openings shall have a serrated ring which permits locking of the housing in 5° increments throughout the entire 360° of rotation. The brackets or the clamshell shall serve as the electrical conduit for the pedestrian signal. The housing shall be black and made of die-cast, corrosion resistant, copper free, non-ferrous metal which shall be in accordance with ASTM B 85.

The door on the front of the housing may be hinged from any side. The door shall be gasketed to maintain a weather-tight enclosure when secured to the housing. The door and the visor shall be made of the same material as the housing or of polycarbonate. All materials shall be clean, smooth, and free from flaws, cracks, blowholes, or other imperfections.

The polycarbonate components shall be black in color. The metal components shall be painted or powder coated. The finish shall be nonreflecting flat black, color 37038, in accordance with Federal Standard 595.

2. Message

The upraised hand and walking person symbols shall each be a minimum of 11 in. in height. The width of the upraised hand symbol shall be a minimum of 7 in. The width of the walking person symbol shall be a minimum of 6 in. Message configuration, color, and size shall be in accordance with the standard of the Institute of Traffic Engineers for Pedestrian Traffic Control Signal Indications.

Each pedestrian signal shall be completely wired internally, and ready for connection of the field wiring. A suitable terminal block for connection of the internal wiring and the incoming field wires to the pedestrian signal head shall be provided in the signal housing.

The light source shall be designed and constructed so that if an electrical or mechanical failure occurs, the upraised hand and walking person symbols shall also remain dark.

(b) Pedestrian Push-Button

REVISION TO SPECIFICATIONS, PROVISIONS AND DRAWINGS (OLD BUSINESS ITEM)
SECTION 922 – TRAFFIC SIGNAL MATERIALS

Pedestrian push-button assemblies shall be ADA compliant, vandal and weather resistant, be pressure activated with minimal movement, and cannot be stuck in a closed or constant call position. A red latching LED and audible tone shall be provided for confirmation of an actuation call.

1. Housing

The pedestrian push-button housing shall be constructed of cast aluminum or stainless steel and powder coated yellow, and furnished with suitable mounting hardware.

2. Latching LED

The normal state of the LED shall be off. When the push button is pressure activated, the LED shall be lighted and remain on until the beginning of the walk phase. The latching relay shall be mounted in the signal cabinet, controlling two pedestrian phases.

3. Actuator

The actuator shall be stainless steel with a solid state electronic Piezo switch rated for a minimum of 20 million cycles with no moving plunger or moving electrical contacts. The operating voltage shall be 12-24V AC/DC. The actuator's nominal operating force shall be approximately 1 lb.

4. Sign

The pedestrian information sign shall be according to the MUTCD. The legend on the sign shall either be all words or a combination of words and symbol to match the pedestrian signal. The sign base shall be sheet aluminum in accordance with 919.01(b).

922.05 Blank

922.06 Disconnect Hanger Junction Box

Traffic signal disconnect hanger junction boxes shall consist of a span hanger, a balance adjuster, a disconnect hanger clevis, and a housing with a hinged door with a positive latching device. The span hanger, balance adjuster, and all related hardware shall be galvanized in accordance with ASTM A 153 or be mechanically galvanized and conform to the coating thickness, adherence, and quality requirements of ASTM A 153. The housing shall be made of a die-cast, corrosion resistant, copper free, non-ferrous metal which shall be in accordance with ASTM B 85. The balance adjuster fitting shall be made of ferrous or non-ferrous metal. When made of ferrous metal it shall be galvanized in accordance with the requirements for the components and related hardware as set out above.

The disconnect hanger shall be designed so that the maximum allowable space or play between the span hanger and the eye-bolt of the balance adjuster and between the balance adjuster and the disconnect hanger clevis, at points where they are attached to each other by rivet pins or hex head bolts and nuts with lock washers, shall be 0.062 in.

The span hanger bolt where the eye-bolt or the balance adjuster is attached shall be 5/8 in. diameter.

When serrated locking rings are not integrally cast in the components, the component and locking ring shall be designed so that when the locking ring is placed flush against the component, the component and locking ring shall not rotate or slide when torque is applied. The serrated components shall have 72 serrations to permit rotation of the disconnect hanger clevis, hub plate, or signal head in 5° increments.

There shall be no thread in contact with a wearing surface. Locking rings shall have a minimum thickness of 3/16 in. and a maximum thickness of 1/4 in. from the base of the ring to the serration peaks. The inside diameter shall be 2 in. and the outside diameter shall be 2 7/8 in.

The terminal block shall have an 18-point terminal block permanently engraved or etched with sequential numbers indicating the circuits. The terminal block shall not have a method of connection which allows a screw point to damage wires when the wires are securely connected. Each point of connection shall accommodate a minimum of four No. 14 gauge wires.

The disconnect hanger shall have 2 side entrance holes on opposite sides capable of receiving a 1 1/2 in. plastic or rubber insert to reduce water infiltration. It shall be capable of supporting signal faces in the ambient temperature range of -35 to 120°F without failure.

The balance adjuster shall have hex head bolts, lock washers, and nuts for securing the main body of the balance adjuster firmly onto and around the eye-bolt to prevent any twisting or turning of the head suspended below it. The span hanger shall have 2 J-bolts, lock washers, and hex head nuts adequate in size to securely fasten the hanger to a messenger cable up to 1/2 in. in diameter.

A type C certification in accordance with 916 shall be provided.

922.07 Free Swinging Signal Support Assemblies

(a) Clearance

The maximum allowable space or play between the hanger assembly and the eyebolt of the balance adjuster and between the balance adjuster and the weatherhead clevis, at points where they are attached to each other by rivet pins or hex head bolts and nuts with lock washers, shall be 0.062 in. No bushings or shims will be allowed in this assembly.

(b) Balance Adjuster

The balance adjuster shall consist of a hex head bolt, a lock washer, and nuts for securing the main body of the balance adjuster onto and around the threads of the eye-bolt to prevent any twisting or turning of the adjuster.

(c) Span Hanger

The span hanger, balance adjuster, weatherhead, and all related hardware shall be made of a non-corrosive metal or shall be galvanized in accordance with ASTM A 153 or be mechanically galvanized and conform to the coating thickness, adherence, and quality requirements of ASTM A 153. The weatherhead shall have a minimum of 2 1/2 in. of exposed threads. The weatherhead shall have 2 set screws to fasten the nipple to the weatherhead. If the weatherhead and threaded pipe has a slip-in connection, the locking device shall be a double nut assembly. If the weatherhead and threaded pipe has a screw-in connection, the locking device shall be a double set screw assembly.

The span hanger shall be furnished with 2 each of J-bolts, lock washers, and hex head nuts. The J-bolt shall be a minimum of 1/4 in. diameter and shall have sufficient threads to be able to secure the hanger to a 1/4 in. or to a 1/2 in. span cable.

(d) Tether Bracket

The tether bracket shall attach to a 1/8 in. to 1/4 in. messenger cable and prevent the bottom of the head from moving side-to-side on the cable. Where backplates are installed on the signal heads; the tether bracket shall be of the proper length for the backplate so that the cable is mounted below the bottom of the backplate to avoid interference with head alignment and damage to the backplate.

(e) Pipe Arm Assemblies

The multiple pipe arm assembly shall consist of a span hanger assembly, a balance adjuster, a signal weatherhead, a 2, 3, or 4 way pipe arm, 1 1/2 in. pipe, a lower arm assembly, and all related hardware necessary for a complete assembly.

The 2, 3, or 4 way pipe arms shall have a minimum of 2 in. of exposed thread. Each arm of the pipe arm shall be furnished with two 72 serration locking rings. One locking ring shall have a 3 in. outside diameter and one locking ring shall have a 2 3/8 in. outside diameter.

ASSEMBLY MAXIMUM	*ALLOWABLE WEIGHT*
2 Way	*19 lbs*
3 Way	*25 lbs*
4 Way	*28 lbs*

922.08 Signal Cantilever Mount Signal Bracket

The bracket shall permit the following 4 adjustments:

(a) rotational adjustment about bracket axis;

(b) vertical adjustment;
(c) rotational adjustment about signal cantilever arm; and
(d) rotational adjustment right and left from vertical plane

The bracket shall be fastened to the supporting arm or structure with stainless steel bands. The bracket shall adjust to fit all sizes of round, octagonal, elliptical, or other shape structure without special tools or equipment.

The bracket shall attach to the signal by clamping the signal head both top and bottom and shall be designed to accommodate the specified signal configuration. Each bracket shall be complete with all necessary hardware to attach the traffic signal to the bracket and the bracket to the support.

All electrical wiring shall be concealed within the bracket, except that which runs from the bracket to the signal cantilever arm.

Upper and lower arms shall be cast from aluminum in accordance with ASTM B 26, alloy 713.0-T5 or 356.0-T6. The vertical support tube shall be extruded from aluminum in accordance with to ASTM B 241, alloy 6063-T6 or 6061-T6, and the strapping to attach the bracket to the arm shall be stainless steel. All steel or malleable iron parts shall be galvanized in accordance with ASTM A 153 or be mechanically galvanized and conform to the coating thickness, adherence, and quality requirements of ASTM A 153, class C.

922.09 Pedestal Poles and Cast Aluminum Pedestal Bases

The pedestal base used for mounting pedestrian signal heads or control cabinets shall be in accordance with 922.09(a). The length of the pedestal pole shall be as shown in the plans.

(a) Cast Aluminum Pedestal Base

A pedestal mounted G cabinet shall have a cast aluminum pedestal base. The cabinet and pedestal base shall be ground mounted on a concrete type A foundation at locations and dimensions as shown on the plans.

The cast aluminum base shall be made of aluminum in accordance with ASTM B 179, alloy ANSI 319.1 or 319.2, or in accordance with ASTM B 26, alloy ANSI 356.0 - T6. The square base shall include an access door and anchor bolts with nuts and washers. The base shall be 13 3/8 in. square and 15 in. in height ± 1/4 in. The weight shall be 22 lbs ± 5%.

The base shall be designed to support a 150 lbs axial load and 11 sq ft of signal head area rigidly mounted. For design purposes, the distance from the bottom of the base to the center of the signal head area is 18 ft. In addition to the dead load, the base shall be designed to withstand wind and ice loads on the specified signal head area and on all surfaces of the support, in accordance with the AASHTO Standard Specification for

Structural Supports for Highway Signs, Luminaires and Traffic Signals. Wind speeds used for design shall be based on a 10 year mean recurrence interval and a wind drag coefficient of 1.2 or as shown in the plans. The base shall contain an access door, which is 8 by 8 1/4 in. ± 1/4 in. with a stainless steel hex head bolt for attaching the door.

The base shall be attached to a foundation by 4 anchor bolts, with an anchor bolt circle of 12 3/4 in. Slotted lugs shall be integrally cast into the 4 corners of the base for attachment of the anchor bolts. The anchor bolts shall be steel in accordance to ASTM A 36. The diameter of the anchor bolt shall be 3/4 in. with a minimum length of 18 in. ± ½ in., plus 2 1/2 to 3 in. right angle hook on the unthreaded end. The top 4 in. of the bolt shall be threaded with 10 NC threads. The threads, plus 3 in., shall be coated after fabrication in accordance with ASTM A 153 or be mechanically galvanized and in accordance with the coating thickness, adherence, and quality requirements of ASTM A 153, class C. Each anchor bolt shall be provided with 2 hex head nuts in accordance with ASTM A 325 and 3 washers. Two of the washers shall have a minimum 2 in. and maximum 2 1/8 in. outside diameter and be in accordance to ANSI B 27, type B regular series and one shall be a nominal 3/4 in. series W washer, in accordance with ASTM F 436.

The cast aluminum pedestal base shall be in accordance with the dimensions and requirements shown in the plans. The casting shall be true to pattern in form and dimensions; free from pouring faults, sponginess, cracks, and blowholes; and free from other defects in positions affecting the strength and value of the intended use for the casting. The base shall not have sharp unfilleted angles or corners. The surface shall have a workmanlike finish.

The door and bolt for the door shall be interchangeable on cast bases from the same manufacturer.

(b) Pedestal Pole

The top of the base shall accommodate a pole having a 4 1/2 in. outside diameter. The threads inside the top of the base shall be 4 in. national standard pipe threads. The pole shall be either a steel pedestal pole or an aluminum pedestal pole.

A steel pedestal pole shall be a seamless schedule 40 carbon steel pipe in accordance with ASTM A 53, grade B. The pole shall have an outside diameter of 4 1/2 in. The pole shall weigh approximately 10.8 lbs/ft. The length of the pole shall be as shown on the plans. The pole shall have full depth national standard pipe threads on one end of the pole. The length of threads shall be 2 1/2 in. The pole shall be galvanized, after threading, in accordance with ASTM A 123. The threads shall be cleaned of all excess galvanizing and protected by a suitable shield.

An aluminum pedestal pole shall be in accordance with ASTM B 241 for seamless aluminum alloy, schedule 40, 6061-T6. The outside diameter of the pole shall be 4 1/2 in.. The length of the pole shall be as shown on the plans. The pole shall weigh

approximately 3.7 lbs/ft. The pole shall have full depth national standard pipe threads on one end of the pole. The length of threads shall be 2 1/2 in. and protected by a suitable shield. The pole shall have a spun finish.

(c) Pole Cap

A pole cap shall be supplied for the top of the pole if the pole is used for the mounting of pedestrian signal faces or side mounted signal control cabinets. The pole cap shall be either a cast pole cap of aluminum or a pole cap of spun aluminum.

A cast pole cap shall be made of aluminum, in accordance with ASTM B 179, alloy ANSI 319.1 or 319.2. The cap shall fit freely on the 4 1/2 in. outside diameter pole. A set screw using a 3/4 in. No. 12 hex head machine screw shall be supplied to hold the cap on the pole. A standard foundry draft will be allowed on the casting.

A pole cap made from spun aluminum shall be in accordance with ASTM B 209, alloy 1100-0. The cap shall fit tightly when placed on the end of the pole.

922.10 Signal Supports

All welding shall be in accordance with 711.32. Welds shall generate the full strength of the shaft. Only longitudinal continuous welding will be permitted on the pole shaft. Contacting joint surfaces shall be cleaned before fabrication then sealed by means of welding. Working drawings shall be submitted in accordance with 105.02.

(a) Steel Strain Pole

The steel strain pole shall be an anchor base type pole and shall include a handhole and a pole top or cap. The poles shall be furnished in lengths specified.

The pole shall have a handhole within 18 in. of the base. The pole shall have a top or cap with a set screw that can be removed with small hand tools.

The pole material shall be in accordance with ASTM A 595 or A 572 with a minimum yield strength of 50,000 psi. The pole shall be galvanized after fabrication in accordance with ASTM A 123.

All hardware, handhole cover and latching device, band type steel polebands, steel bolts, nuts, and washers shall be galvanized in accordance with ASTM A 153 or be mechanically galvanized and conform to the coating thickness, adherence, and quality requirements of ASTM A 153, class C. All nuts and bolts, except anchor bolts, shall be in accordance with ASTM A 307. If a cast pole top or cap is used it shall be in accordance with ASTM A 126 and shall be galvanized with a minimum coating of 2 oz/sq ft.

The polebands shall fit the pole as planned. The wire rope shall not be in contact with any 90° edges or with any threads on the band. The pole band material shall be in accordance with ASTM A 572, grade 50; ASTM A 606; or ASTM A 36 with minimum yield of 50,000 psi. The minimum width of the bands shall be 3 in. and the bands shall be

capable of supporting the pole design load. Each half of the band shall be stamped with the corresponding size number.

The pipe coupling for the weatherhead and base plate shall be installed prior to galvanizing. The threads shall be cleaned of all excess galvanizing. An internal J-hook shall be installed near the top of the pole for wire support.

The steel strain pole shall be capable of supporting a 8,000 lb load applied horizontally 18 in. below the top of the pole with a maximum allowable deflection of 0.16 in. per 100 lb of load. The pole shall be tapered 0.14 in./ft of length.

A one piece base plate shall be secured to the base of the pole and shall develop the full strength of the pole. The base plate material shall be in accordance with ASTM A 36, A 572, or A 588. The base plate shall have 4 holes of adequate size to accommodate 2 1/4 in. anchor bolts. The bolt circle shall have a 22 in. diameter and bolt square of 15 1/2 in.

Four high strength steel anchor bolts, 2 1/4 in. in diameter and 96 in. long, including the hook, shall be furnished with each pole. Each bolt shall have 2 hex nuts and 2 washers in accordance with ASTM A 307, grade A. The anchor bolt material shall be in accordance with ASTM A 576 or ASTM A 675 with a minimum yield strength of 55,000 psi or ASTM A 36, special quality, modified to 55,000 psi or approved equal. The threaded end of the anchor bolt shall have 12 in. of 4 1/2 NC threads and shall be galvanized the length of the threads, plus 3 in.. The threaded end shall be coated after fabrication in accordance with ASTM A 153 or be mechanically galvanized and be in accordance with the coating thickness, adherence, and quality requirements of ASTM A 153, class C. The unthreaded end of the anchor bolt shall have a standard L bend for a distance of 9 in. from the centerline of the anchor bolt to the end of the L. In lieu of the standard bend a steel plate 4 1/2 sq in. and 1 1/4 in. thick may be welded to the embedded end of the anchor bolt.

(b) Wood Strain Pole

Wood strain poles shall be made from southern yellow pine and shall be in accordance with the current ANSI Specifications and Dimensions for Wood Poles No. 05.1. They shall be of the length and class specified.

All poles shall be full length pressure treated by the full cell process in accordance with current specifications as set forth in the AWPA Standard UC4B using preservative as outlined in standard P5 and set forth in 911.02(h).

Treatment, handling, and storage methods shall be in accordance with the current AWPA Standards.

(c) Signal Cantilever Structures

REVISION TO SPECIFICATIONS, PROVISIONS AND DRAWINGS (OLD BUSINESS ITEM)

SECTION 922 – TRAFFIC SIGNAL MATERIALS

1. General

All traffic signal cantilever structures, with or without combination arm, shall be as shown on the plans.

There shall be no threads in the wearing surface plane at the point of connection between the clevis clamp and the signal face assembly. The clevis clamp shall have an 11/16 in. diameter bolt hole to receive the signal face assembly.

The signal cantilever structure pole, sections 1 and 2, signal arm, and combination arm shall be a round or multi-sided tapered tube, except the upper 4 to 6 ft of a signal pole may be non-tapered. The pole and arms taper rate shall be 0.14 in./ft. A 1/2 in. 13 NC threaded grounding nut or approved equivalent shall be provided and be accessible through the handhole. The pole cap shall be secured in place with setscrews. The pole shall be provided with a removable pole cap and integral wire support hook for the luminaire electrical cable. The cable shall be attached to the hook by a service drop clamp.

The signal cantilever arm and combination arm, if required, shall be attached to the pole as shown on the plans. The arms shall have cable inlets as shown on the plans. All signal heads on the arm shall be attached as shown on the plans and installed parallel to the horizontal plane and centered to the cantilever arm. The cantilever arms shall be used as an enclosed raceway for wiring and shall be free of burs or rough edges.

The pole top luminaire for roadway lighting, if required, shall be installed on these structures as shown on the plans.

2. Base Plate

A one piece anchor base shall be supplied as shown on the plans. Four removable bolt covers shall be provided with each base and each cover shall attach to the upright portion of the body of the base by means of 1 hex head cap screw.

3. Materials

The signal cantilever pole, arms, base plates, arm flange plates, gusset plates, ring stiffeners, and pole splice plates shall be in accordance with ASTM A 595 or A 572 with a minimum yield strength of 50,000 psi.

4. Hardware

Bolts for the pole splice shall be in accordance with ASTM A 490 and shall be galvanized. The contact area for both pole splice plates shall be class B in accordance with AASHTO 10.32.3c with a minimum slip coefficient of 0.5. The surfaces shall be blast cleaned with class B coatings. The arm flange plate connection bolts shall be in accordance with ASTM A 325. All other hardware shall be in accordance with ASTM A 307 and galvanized in accordance with ASTM A 153, or be mechanically galvanized and in accordance with the coating thickness, adherence, and quality requirements of ASTM

A 153, class C. A cast pole cap shall be in accordance with ASTM A 126 and shall be galvanized with a minimum coating of 2 oz/sq ft.

5. Anchor Bolts

Four steel anchor bolts, each fitted with 2 hex nuts and 2 flat washers, shall be furnished with each pole. The anchor bolt shall be as shown on the plans with a minimum of 15 in. of 7 NC threads on the upper end. The threads, nuts, and washers shall be galvanized in accordance with ASTM A 153 or be mechanically galvanized and conform to the coating thickness, adherence, and quality requirements of ASTM A 153. The steel for the bolt shall be in accordance with ASTM F 1554, with a yield strength of 36,000 psi or 55,000 psi, or approved equal.

6. Finish

All steel material shall be fully galvanized. Galvanizing shall take place after all welding is accomplished and holes cut.

7. Working Drawings

Working drawings and design calculations shall be submitted in accordance with 105.02.

(d) Downguys, Anchors, Rods, and Guards

Pole anchors shall be 8 way expanding with a minimum area of 135 sq in. when expanded or a 10 in. diameter screw anchor. They shall have a minimum holding strength of 10,000 lb. They shall be painted and in accordance with ASTM A 575. Anchor rods for expanded anchors shall be 3/4 in. diameter steel and for screw anchors shall be 1 1/4 in. diameter steel, 8 ft long, in accordance with ASTM A 659, and be galvanized in accordance with ASTM A 153.

Guy guards shall be made of 18 gauge galvanized steel, polyethylene, polyvinylchloride, or melamine phenolic, and shall be 7 ft long. The steel guy guard shall have a tight gripping, non-scarring hook for quick attachment to the guy wire. The bottom shall have a clamp that fits over the anchor rod and securely grips by tightening the bolt. Steel guy guards shall be in accordance with ASTM A 659. The nonmetallic guy guard shall be a helical pigtail which shall resist upward movement, a lock strap to secure the lower end, and a guy guard sleeve. Non-metallic guy guards shall be gray or yellow.

(e) Support Cable

1. Messenger Cable

Messenger cable shall be zinc-coated steel wire strand, contain 7 wires, and have a nominal diameter of 3/8 in. The cable shall be in accordance with ASTM A 475, Siemens-Martin Grade.

2. Span, Catenary, and Downguy Cable

Span, catenary, and downguy cable, shall be aircraft cable for non-aircraft use, and shall be 3/8 in. nominal diameter, made of stainless steel wire, and consist of 7, 19 wire flexible steel strands. The 3/8 in. cable shall have a minimum breaking strength of 12,000 lbs. It shall be in accordance with Military Specifications MIL-W-83420D.

3. Tether and Support Cable

Tether and support cable shall be aircraft cable, for non-aircraft, and shall be 3/16 in. nominal diameter, made of stainless steel wire, and consist of 7, 7-wire flexible steel strands. The 3/16 in. cable shall have a minimum breaking strength of 3,700 lbs. It shall be in accordance with Military Specifications MIL-W-83420D.

4. Cable Hardware

a. Messenger Hangers

Messenger hangers shall be either a 3-bolt clamp or a 3/8 by 1 3/4 in. steel hanger with a 90° bend extending from the pole 3 3/4 in. The hanger shall have a curved groove and clamp capable of receiving a 5/16 to 1/2 in. cable.

The messenger shall be clamped by two 1/2 in. high carbon steel bolts. The angle hanger shall be mounted with a 5/8 in. through bolt and a 1/2 in. lag screw. The 3-bolt clamp shall be mounted with a 5/8 in. through bolt. The angle hanger shall be in accordance with ASTM A 575. The bolts shall be in accordance with NEMA PH 23.

b. Cable Ring

Cable rings shall be galvanized steel in accordance with IMSA 51-1.

c. Clamps

Clamps shall be made of 3/8 in. steel and in accordance with ASTM A 575.

Two bolt clamps shall be a minimum of 3 3/4 in. long and 1 1/4 in. wide with two 1/2 in. bolts which shall clamp cable of 1/8 to 1/2 in. diameter.

Three bolt clamps shall be a minimum of 6 in. long and 1 5/8 in. wide with three 5/8 in. bolts which shall clamp cable of 5/16 to 1/2 in. diameter.

The bolt heads shall be large enough to provide maximum clamping area and shall have oval shoulders to prevent the bolts from turning while tightening. The bolts shall be in accordance with NEMA PH 23.

d. Servi-Sleeves

Servi-sleeves shall be 1 1/4 to 2 1/4 in. in length and shall hold the size of the cable specified. The sleeves shall be in accordance with ASTM A 659.

e. Straight Eye-Bolts

Straight eye-bolts shall be 3/4 in. diameter drop forged steel, a minimum of 14 in. long, and have 6 in. of thread. The steel washers shall be 2 1/4 by 2 1/4 by 3/16 in. in size with a 13/16 in. hole in the center. All parts shall be in accordance with ASTM A 575 and shall be galvanized in accordance with ASTM A 123.

f. Hub-Eyes

Hub-eyes shall be made of drop forged steel and in accordance with ASTM A 575. They shall receive a 3/4 in. mounting bolt and have a full rounded thimble eye for protection of the guy cable.

922.11 Signal Cable

(a) Hook-up Wire

Signal hook-up wire shall be stranded 1 conductor wire, type THW 7 strand No. 14 AWG, with a thermoplastic sheath 3/64 in. thick and a 600 volt rating. Insulation shall be color coded, as required, and labeled with gauge, voltage rating, and insulation type.

(b) Signal Control Cable

Signal control cable shall be in accordance with IMSA 19-1 or 20-1 and shall be stranded No. 14 AWG wire.

(c) Service Cable

Traffic signal service cable shall be color coded, stranded copper No. 8 AWG wire, 3 conductor cable, type THWN.

922.12 Signal Interconnect

(a) Integral Messenger Interconnect Cable

Integral aerial interconnect cable shall be figure "8" self-supporting type cable consisting of a messenger cable and 7 conductors No. 14 AWG signal cable in accordance with IMSA 20-3.

(b) 6 Pair/19 Telemetry Cable

6 pair telemetry cable shall contain 6 twisted pairs of 19 gauge conductors and shall be in accordance with IMSA 40-2 for underground application and IMSA 40-4, integral messenger, for aerial application.

(c) Fiber Optic Interconnect Cable

Fiber optic cable shall contain twelve (12) strand multimode, graded index, optic fibers with a minimum of one non-metallic central strength member. The cable shall be gel-free design, loose tube, all dielectric construction, suitable for outdoor use in conduit or on aerial supports. Each length of fiber optic cable in nonmetallic conduit shall include a No. 14 AWG aluminum or No. 6 AWG copper tracer wire.

Each individual fiber shall be 2.5/5 mils (62.5/125 µm) diameter, core/color-coded clad, and each color-coded set of fibers shall be encased in a loose tube buffer with water blocking tape on the outside and fully water blocked inside using craft-friendly, water-swellable yarns. The fiber optic cable shall be constructed with Kevlar braid and outer polyethylene jackets as a minimum. If an inner jacket is used it shall be PVC. Maximum attenuation of the cable shall be 4.0 dB/km nominal, measured at room temperature at 850 nm. The bandwidth shall not be less than 160 MHz/km, also at 850 nm. Each fiber shall be continuous with no factory splices except for joining standard length cables to form longer, continuous jacketed cable to fit installation requirements. The cable shall have standard nylon rip cords. Kevlar rip cords will not be accepted.

The cable shall be in accordance with the generic requirements for optical fiber and optical fiber cable per ANSI/ICEA S-104-696 design and test criteria.

The exterior of the polyethylene outer cable jacket shall be stenciled so that every 16.4 ft on each reel is marked with a number. The 16.4 ft of each reel shall be marked with a 5, the 32.8 ft marked with a 10, and so on until the end of the reel. The stencil shall be applied to the outer jacket using permanent ink and shall be permanently engraved into the jacket to provide long lasting readability.

(d) Radio Interconnect Using Spread Spectrum Radio Modems

Spread spectrum radio modems for communications between local controllers and the system master controller shall be on the Department's list of approved Traffic Signal and ITS Control Equipment.

922.13 Detection Components

(a) Loop Detector Lead-in Cable

Runs 700 ft and less of loop detector lead-in cable shall be in accordance with IMSA 50-2 and shall be stranded 2 conductor No. 16 AWG, 19 strands of No. 29 wire.

Runs greater than 700 ft shall use 14 AWG wire. The nominal capacitance between conductors shall be 57 pF/ft and 98 pF/ft between one conductor and the other conductor connected to the shield.

(b) Roadway Loop Wire

Roadway loop wire shall be 14 AWG gauge IMSA 51-7 duct-loop wire with polyvinyl chloride or polyethylene outer jacket of 1/4 in. diameter.

(c) Other Vehicle Detection Systems

Other vehicle detection systems shall be selected from the Department's list of approved Traffic Signal and ITS Control Equipment.

922.14 Ground Wire

The ground wire shall be copper wire No. 6, AWG soft-drawn, solid copper in accordance with ASTM B 3.

922.15 Splicing Kit

Splicing kits shall contain a 2 piece, transparent snap-together mold body and include an epoxy and sealing compound contained in a unipak. It shall be capable of insulating and splicing nonshielded cables rated up to 5 kilovolts and multi-conductor cables rated up to 600 volts.

922.16 Ground Rod and Connections

Ground rods shall be 1/2 in. in diameter by 8 ft long with a machined point and chamfered top. They shall be made of steel with a molecularly bonded outer layer of electrolytically applied copper. A single electrode shall have a maximum resistance to ground of 25 ohms. Single electrodes that do not have resistance to ground of 25 ohms or less shall be augmented by additional electrodes, grids, or plates until resistance to ground of 25 ohms or less is achieved. Resistance shall be measured using a 3-point ground tester using the fall of potential method. Data, graphs, resistance in ohms, date of test, make and model of ground tester, and the individual's initials performing the test shall be recorded and submitted to the District Office. Resistance in ohms shall be tagged at the ground connection.

The finished rod shall be cold-drawn and shall have the following minimum physical properties:

PHYSICAL PROPERTY	*MINIMUM*
Tensile strength	*97,000 psi*
Yield strength, 0.2% offset	*85,000 psi*
% of elongation	*13 psi*

The ground rod and wire connection shall be made by a thermo weld process or approved equal. The welding material shall cover and secure the conductor to the rod and shall be porous free.

An acceptable alternate shall be a ground grid connection properly sized and shall consist of a shear head bolt, a "C" shaped body, nest, and wedge. The connector components shall be fabricated from an aluminum-bronze alloy, silicone-bronze alloy, and copper.

922.17 Handholes

(a) Type I (Concrete Handhole)

A Type I handhole shall be made of class III reinforced concrete pipe with a cast iron ring and cover. The concrete shall be in accordance with section 907.02. Reinforcement shall be provided as shown on the plans or in accordance with the manufacturer's design. If reinforcement deviates from the plans, provide calculations

showing that the modified design supports HS-20-44 loading. The ring and cover for handholes shall be in accordance with 910.05(b).

(b) Type II (Polymer Concrete Handhole Box and Cover)

A Type II handhole shall be made of polymer concrete. The handhole box of polymer concrete shall be reinforced with a heavy weave fiberglass. The box and cover shall meet or exceed ANSI/SCTE Tier 15 requirements. The handhole shall be stackable.

1. Polymer Concrete Handhole Box

The handhole box shall be heavy duty. The inner surface of the handhole shall be smooth and free from cracks and imperfections.

2. Polymer Concrete Handhole Cover

The cover shall be marked with logo imprints of "TRAFFIC SIGNAL" and the ANSI/SCTE Tier rating- "TIER XX". The cover shall be secured with stainless steel, 300 series, 3/8 in., 16NC hex bolts and washers. The cover shall have a friction coefficient of at least 0.5.

922.18 Entrance Switch

The entrance switch shall be a double pole, 50 A, 120V AC circuit breaker in a NEMA type 3R enclosure in accordance with NEMA 250-2008. The minimum dimensions of the enclosure shall be: 5 in. wide, 3 3/4 in. deep and 9 1/4 in. height. A 1 in. rain-tight detachable hub shall be supplied in the top of the enclosure. The enclosure shall have knockouts on the sides, bottom and back with diameters of 7/8 in. to 1 3/4 in. The enclosure shall contain the circuit breaker, an insulated solid bar for connection of AC neutral, a separate lug for attachment of earthground, have provisions for a padlock, and shall be surface mounted.

The enclosure shall be made of galvanized steel with a rust inhibiting treatment and finished in the manufacturer's standard color of baked enamel.

All wire terminations and breaker to buss-bar contact points inside the enclosure shall be coated with an anti-oxidant to prevent oxidizing and corrosion of components.

922.19 Conduit and Fittings

(a) Steel Conduit

Steel conduit, couplings, and elbows shall be galvanized rigid steel conduit in accordance with UL 6. The conduit shall be galvanized by the hot dip method on the interior and exterior surfaces. Conduit threads shall be cut after galvanizing. The conduit shall be supplied with a threaded coupling attached to one end and the other threaded end protected by a suitable shield.

The various conduit fittings such as bands, bodies, straps, lock nuts, and threadless connectors, shall be in accordance with Federal Specifications A-A-50553 and

shall be galvanized if not stainless steel. Conduit straps shall be 2 hole straps with a minimum thickness of 1/8 in. Conduit lock nuts 3/8 to 1 1/2 in. in size shall be made of steel. Other sizes shall be made of either steel or malleable iron. All conduit lock nuts shall be galvanized. Other nuts shall be either stainless steel or galvanized steel.

(b) Polyvinyl Chloride, PVC, Schedule 40 or 80 Conduit

Conduit, fittings, and accessories shall be manufactured from polyvinyl chloride meeting ASTM D 1784 and shall comply with all the applicable requirements of NEMA TC2 and UL 651. Each length of pipe shall include a coupling.

(c) Fiberglass Conduit

Rigid fiberglass conduit and fittings shall be filament wound consisting of E-glass and corrosion resistant epoxy resin manufactured for use at temperatures from -40 to 230° F. Rigid fiberglass conduit shall be pigmented with carbon black for ultraviolet protection and fire resistant per UL 94. All rigid fiberglass conduit shall have tracer wire, be heavy walled, HW, and meet the specifications, labeling and testing of ANSI/NEMA TC9.

(d) High Density Polyethylene, HDPE, Schedule 40 or 80 Conduit

Conduit shall be smooth wall, Type III, Grade P-33, Category 5, Class C, coilable, high density polyethylene, HDPE. Standard dimension ratio, SDR, 13.5 may be used for Schedule 40 HDPE and SDR 11 may be used for Schedule 80. Conduit and fittings shall meet the applicable requirements of ASTM D 1248, ASTM D 3350, ASTM F 2160 and UL 651.

Schedule 40 or 80 HDPE conduit shall be marked in accordance with ASTM D 3485 with the producer code and designation type indicated. HDPE conduit shall be produced from material with an orange color and ultraviolet stabilization code of C, D, or E in accordance with ASTM D 3350. Schedule 40 HDPE conduit for use above ground shall be black.

922.20 Detector Housing

The entire housing casting shall be made from aluminum alloy in accordance with ANSI 320.

922.21 Certification

Unless otherwise specified, all materials covered herein shall have a type C certification in accordance with 916.

REVISION TO SPECIAL PROVISIONS (OLD BUSINESS ITEM)

PROPOSED NEW 922-X-XXX CONTROLLER CELLULAR MODEM

922-X-XXX CONTROLLER CELLULAR MODEM

The Standard Specifications are revised as follows:

SECTION 922, BEGIN LINE(TBD, at §922.02(f)7), INSERT AS FOLLOWS:

7. Cabinet Power Supply Requirements

The TS2 cabinet power supply shall adhere to the guidelines of NEMA TS2-5.3.5. The power supply shall be encased on all sides so that no circuitry is exposed to the user.

8. Cellular Modems

a. Service Provider

All data, power and antenna cables and all supplemental hardware shall be provided. The modem shall be compatible with the Department's current cellular carrier/provider (Verizon as of 07/07) and the traffic control device and closed loop communications software that it is supplied for.

b. Modem Hardware

Cell modems shall be Airlink GX440 (4G) or similar modem with the following specifications: The cellular modem shall be capable operating in CDMA dual mode (both 800 MHz cellular and 1.9 GHz PCS bands), supporting both circuit switched and 1XRTT packet switched services. The operating voltage range shall include 12V and 24V DC and shall draw less than 250 mA while transmitting and receiving at 12V DC. The modem shall have LED indications for power, signal status/strength, and TX/ RX either separately or combined. The serial interface shall be RS232 with a DB9 (male or female) connector.

c. Modem Antenna

The RF antenna connection shall be a 50 Ω TNC connector. The antenna shall be a low profile, puck style, flat mount dual band, (800 and 1900 MHz) with low loss RG58 cable and TNC connector.

d. Modem Software

The modem configuration shall be editable and viewable with MS-Windows provided software or with proprietary software that is included and designed to run on a MS-Windows operating system. The software shall auto-detect connection parameters and display settings when connected.

e. Installation

Service and activation shall be requested and/or confirmed for each cellular device to be installed prior to installation. The ESN and 10-digit phone number shall be clearly labeled on the exterior of the modem. The cellular modem shall be installed, configured and tested to allow data communication from the central closed loop software to the field master and subsequent secondary controllers, or directly to a secondary controller per the design. All data, power and antenna cables and all supplemental mounting hardware shall be installed. The modem shall be powered by the cabinet power

REVISION TO SPECIAL PROVISIONS (OLD BUSINESS ITEM)

PROPOSED NEW 922-X-XXX CONTROLLER CELLULAR MODEM

supply from a terminal location on the cabinet back panel or the power distribution panel. A low profile antenna shall be mounted externally and the mounting location includes a watertight seal. The antenna shall have no more than 3 ft excess RG58 cable in the cabinet.

REVISION TO SPECIAL PROVISIONS (OLD BUSINESS ITEM)

PROPOSED NEW 805-X-XXX MAGNETOMETERS AND MICROLOOP DETECTORS

(Note: statements from RSP 805-T-169 and 922-T-168)

805-X-XXX MAGNETOMETERS AND MICROLOOP DETECTORS

(Adopted xx-xx-xx)

Description

This work shall consist of furnishing and installing magnetometer or microloop vehicle detection, as specified in the plans.

Materials

Materials for microloop detectors shall be selected from the Department's approved materials list. The microloop detectors selected shall be capable of counting vehicles in addition to detecting vehicle presence.

Each microloop detector location shall include the following items:

1. Non-invasive probe, lead-in cable and carriers for microloop detector as shown on the plans;

2. 3-in. diameter schedule 80 HDPE conduit containing the probes, lead-in cable and carriers;

3. Buried service wire encapsulation kit compatible with microloop detector for all splicing between the lead-in cable and the home run cable;

4. Installation kit, one for each conduit containing probes;

5. All mounting hardware, conduit bushings, wiring, connectors, grounding wires, ground rods, grounding cables, etc., necessary to complete the microloop detector location installation.

Testing

Before installation of magnetometer or microloop probes the Contractor shall confirm the adequacy of the magnetic field intensity, to be sure that the range is suitable for their operation.

The Contractor shall demonstrate that the microloop count data recorded in the controller's detector log is within 5% of count data obtained visually over a 15-minute period for every detector installation. The test shall be performed by the Contractor in the presence of the Engineer. If detector sensitivity or calibration settings are adjusted in order to meet this test, the new settings shall be recorded on the wiring diagram in the cabinet.

Installation

Arrangement of probes shall be located at maximum distance from metal objects as per manufacturer's recommendation. Probes shall be installed with their long dimension vertical, and with the cable end at the top. Probes shall be firmly supported, so the lateral and vertical motion is restricted. Probes shall be connected in series. The splice

REVISION TO SPECIAL PROVISIONS (OLD BUSINESS ITEM)

PROPOSED NEW 805-X-XXX MAGNETOMETERS AND MICROLOOP DETECTORS

shall be soldered by means of hot iron, or pouring or dripping without flames, with rosin core solder and shall be insulated and waterproofed in accordance with the manufacturer's specifications.

Conduit for the microloop detector probes shall be directionally pushed beneath the pavement at the depth and slope determined by the manufacturer to ensure proper carrier and probe installation. The Contractor shall repair any damage to the pavement that occurs during the installation. The microloop detector probe location in each lane shall be per the manufacturer's recommendation.

Method of Measurement

Magnetometer detector and microloop detector probe will be measured by the number of units installed.

Basis of Payment

If specified as pay items, magnetometer detector and microloop detector probe will be paid for at the contract unit price per each.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
Magnetometer Detector	EACH
Microloop Detector Probe	EACH

The cost of coring the pavement, sealant, and all work necessary for proper installation and operation of the in-pavement sensors shall be included in the cost of magnetometer detector.

The cost of the detector unit, lead-in cable, and all work necessary for proper installation shall be included in the cost of magnetometer detector or microloop detector probe. The cost of all hardware and work required to provide and install signal cable from microloop detector probe, including extra-low voltage (home-run), from the handhole adjacent to the detector probe to the controller cabinet shall be included in the cost of signal cable.

REVISION TO SPECIAL PROVISIONS (OLD BUSINESS ITEM)

PROPOSED NEW 805-X-XXX PREFORMED PAVE-OVER LOOPS

(Note: statements from RSP 805-T-169 and 922-T-168)

805-X-XXX PREFORMED PAVE-OVER LOOPS

(Adopted xx-xx-xx)

Description

This work shall consist of furnishing and installing preformed pave-over loop vehicle detection, as specified in the plans.

Materials

Preformed pave-over loops shall be designed for use with HMA, SMA or PCCP as applicable. Preformed pave-over loops shall be selected from the Department's list of approved Traffic Signal and ITS Control Equipment.

All components of preformed pave-over loops designed for HMA paved-over application shall have a minimum temperature rating of 300°F.

The size of a preformed pave-over loop shall be 6 ft diameter, 18.9 ft circumference round or 6 ft octagonal, 20 ft perimeter. The loops placed in the same lane shall be spaced 15 ft from the center of one loop to the center of the next loop.

Preformed pave-over loops may be constructed as a single loop or as 2, 3 or 4 loops in series. Each individual loop shall be wired with 4 turns of wire unless otherwise specified. Loops constructed in a series shall also be wired in series.

Construction Requirements

Loop wire shall be installed in accordance with 805.09. Preformed pave-over loops may be installed as a 1, 2, 3 or 4 loop configuration. Pave-over loops shall be secured in place prior to paving.

Method of Measurement

Preformed pave-over loops will be measured by the number of loops placed. Each loop will be measured only once, regardless of the number of signal cable turns. Signal cable from preformed pave-over loops to handholes, detector housings or from loop to loop will not be measured for payment.

Basis of Payment

Preformed pave-over loops will be paid for at the contract unit price per each.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
Signal Cable, Preformed Pave-Over Loop	EACH

The cost of signal cable from preformed pave-over loops to handholes, detector housings or from loop to loop shall be included in the cost of the preformed pave-over loop.

REVISION TO SPECIAL PROVISIONS (OLD BUSINESS ITEM)

PROPOSED NEW 805-X-XXX RADIO INTERCONNECTION

(Note: statements from RSP 805-T-169 and 922-T-168)

805-X-XXX RADIO INTERCONNECTION

(Adopted xx-xx-xx)

Description

This work shall consist of furnishing and installing spread spectrum radio equipment for interconnecting traffic signal controllers at signalized intersections.

Materials

The Contractor shall select radio equipment materials from the Department's list of approved Traffic Signal and ITS Control Equipment. The Contractor shall furnish 2 copies of the instructions for hardware installation, programming and system commissioning.

The spread spectrum radio modems shall provide all the needed features to communicate with NEMA TS2 type 1 and type 2 traffic signal controllers in a coordinated closed loop system. Radio modems shall be capable of both Ethernet and serial data transfer. The radio modems shall be software configurable to be either a master, repeater, repeater/slave, or slave radio. The radio modem shall require no user license from the FCC; operate in the 900 MHz range, and be of frequency hopping spread spectrum, FHSS, technology; support data rates from 1.2 kbps to 115.2 kbps asynchronous; have a receiver sensitivity of at least -110 dBm; have a minimum RF output level of 1 watt; have a minimum of 50 user-selectable hopping patterns and a minimum of 50 RF non-overlapping channels allowing multiple systems to operate in the same line-of-sight path; operate as a transparent RS232, or RS422/RS485, or FSK 1200 baud types of links for use in a point-to-multipoint system; provide an RJ-45 10/100BaseT Ethernet interface; be IP addressable; have an external SMA female type or N-female RP-TNC female antenna connector; and be supplied with power supply for 120V AC operation. The modems shall be rack or shelf mounted in standard NEMA TS2 type 1 or type 2 cabinets. The modems shall have an operation temperature of -40 to 176°F, have a maximum current draw of 500 mA for the transmission of 1 watt of RF output power, while operating on 12V DC. Lighting and transient protection on all data lines and antenna connector, and AC/DC power distribution, shall be provided with the system.

The spread spectrum radio modems must include a Windows based, configuration software package, which will include a graphical user interface, GUI, allowing for ease of programming, through pre-written drivers for all Department approved traffic controllers and have the ability to automatically determine, and connect, at their radios baud, stop and parity settings. The configuration software must allow for signal level, RSSI, data integrity, message polling, and spectral analysis testing. The software must also permit all the radios within a system to be configured from a single location. All radio equipment and cables shall be delivered preconfigured and ready for field operation.

REVISION TO SPECIAL PROVISIONS (OLD BUSINESS ITEM)

PROPOSED NEW 805-X-XXX RADIO INTERCONNECTION

The manufacturer, or vendor, shall supply with each modem, the operational manual containing procedures for all features incorporated in the modem.

a. Transient Protection

Transient protection shall be installed between the radio modem and the field antenna. The transient protection shall be flange mounted in the cabinet and have a minimum transient current of 40 kA for 8 x 20 µs pulse, an insertion loss or < 0.1 dB, have an operating frequency in the 900 MHz range, allow throughput energy to be < 220 µJ for 6 kV /3 kA @ 8/20 µs waveform, have throughput voltage ≤ 144 Vpk, and turn –on voltage shall be ± 600 volts. The unit impedance shall be 50 Ω.

b. Antennas

The antenna for the radio modem at the system master/local controllers shall be capable of providing a transmission range adequate for communication with all radio modems or repeaters in the system and must be configured as a single omni, single-yagi, or dual-yagi (2 single-yagi antennas on differing alignments) for each radio as described below.

(1) Omni Antennas

All omni antennas shall be capable of producing between 6 dBd and 10 dBd (8.15 dBi and 12.15 dBi) of gain while operating in, and covering the entire 902-930 MHz frequency range. The voltage standing wave ratio, VSWR, of the omni antenna shall be 1.5:1 or less when the antenna coax feed impedance is 50 Ω. Omni antennas shall be fabricated of fiberglass, brass, copper, and/or aluminum and shall be rated for wind velocities of at least 100 mph. The minimum length of the omni antenna shall be 60 in. and it shall be designed and fabricated with a fiberglass radome with a minimum diameter of 2 in. to prevent ice from collecting directly on the driven element. All omni antennas shall have a cableless N-female connector directly affixed and sealed to the antenna body. All hardware and fastenings devices shall be fabricated from stainless steel.

(2) Yagi / Dual-Yagi Antennas

All yagi antennas shall be capable of producing between 10 dBd and 13 dBd (12.15 dBi and 15.15 dBi) of gain while operating in, and covering the entire 902-930 MHz frequency range. The voltage standing wave ratio,VSWR, of the omni antenna shall be 1.5:1 or less when the antenna coax feed impedance is 50 Ω. The front to back ratio must be at least 20 dB for each yagi antenna. Yagi-directional antennas shall be fabricated of either anodized or powder coated 6061/T6 aluminum rod and seamless drawn pipe and shall be rated for wind velocities of at least 100 mph. All yagi antennas shall have a cableless N-female connector directly affixed and sealed to the antenna body. The yagi antenna shall be designed and fabricated so that polarization changes (vertical to horizontal) can be made on the antenna mount without adjusting the mast. Single yagis shall be connected by a low loss N-female "T" splitter/coupler and LMR-400 cable to form dual-yagi systems. All hardware and fastenings devices shall be fabricated from stainless steel.

c. Antennas Cable and Hardware

The coaxial cable used as the transient protection to antenna lead shall have no greater than 3.8 dB loss per 100 ft of length and shall be LMR-400.

All LMR-400 connections are to be stripped, deburred, and crimped using the ST-400-EZ LMR-400 stripping tool, DBT-01 LMR-400 deburring tool, and a 0.429 in. hex crimp die for solderless LMR-400 connections respectively. All connections shall be completely sealed by heat shrinking double walled, adhesive lined shrink tubing for weather proofing and strain relief.

Cables shall be included to interface the radio equipment to the transient protection. The antenna mounting hardware shall securely attach the antenna to the strain pole/cantilever arm. The coaxial cable fitting on the antenna shall not support the weight of the coaxial cable run to the base of the strain pole/cantilever arm.

d. Data Cables

Cables shall be included to interface the radio equipment to the system master, co-located secondary controller, remote secondary controllers and any communication interface panels as needed. Cables shall include strain relief back shells designed to mate and lock with the telemetry connector on the system master and local controllers. All radio equipment and cables shall be delivered preconfigured and ready for field operation.

All miscellaneous equipment necessary to complete the installation shall be as specified by the radio modem manufacturer.

Construction Requirements

To receive maximum signal strength, the radio antennas shall be positioned by adjusting the antenna direction while monitoring signal strength through the telemetry radio. The radio antenna mounts shall be securely fastened to the poles. Coaxial cable shall be installed inside metal poles and conduits. External cable on poles shall not exceed 3 ft unless approved by the Engineer. Approved external cable runs exceeding 3 ft shall be secured using manufacturer specified hangers at a maximum spacing of 3 ft. Cable terminations shall be in accordance with the manufacturer’s recommendations. Connectors outside of cabinets shall be sealed in accordance with the manufacturer’s recommendations. The Contractor shall deburr any holes made in metal poles and install grommets for protection. Drip loops shall be provided between the antenna connector and the metal pole entrance or first pole clamp. Cable bends shall be in accordance with the manufacturer’s specified bending radius.

Testing

Test of the radio interconnection system shall be performed after the installation is complete. Notice of the testing shall be provided to the district traffic office at least 2 work days prior to the test. The Contractor shall adjust the radio antennas to optimize the communication signal for the system. The strength of the communication signal shall be determined using computer software provided by the radio interconnection system manufacturer. The test shall be conducted

REVISION TO SPECIAL PROVISIONS (OLD BUSINESS ITEM)

PROPOSED NEW 805-X-XXX RADIO INTERCONNECTION

with complete foliage on deciduous trees in the vicinity or on a date approved by the Engineer. The test results shall include the signal strength, site polling results using long message polling, and noise levels. The test results shall be above the minimum guidelines set by the radio interconnect system manufacturer.

Method of Measurement

Radio antenna; radio interconnect; radio splitter; will be measured by the number of units installed.

Radio, interconnection system testing will not be measured for payment.

Basis of Payment

Radio, interconnection system testing will be paid for at the contract lump sum price.

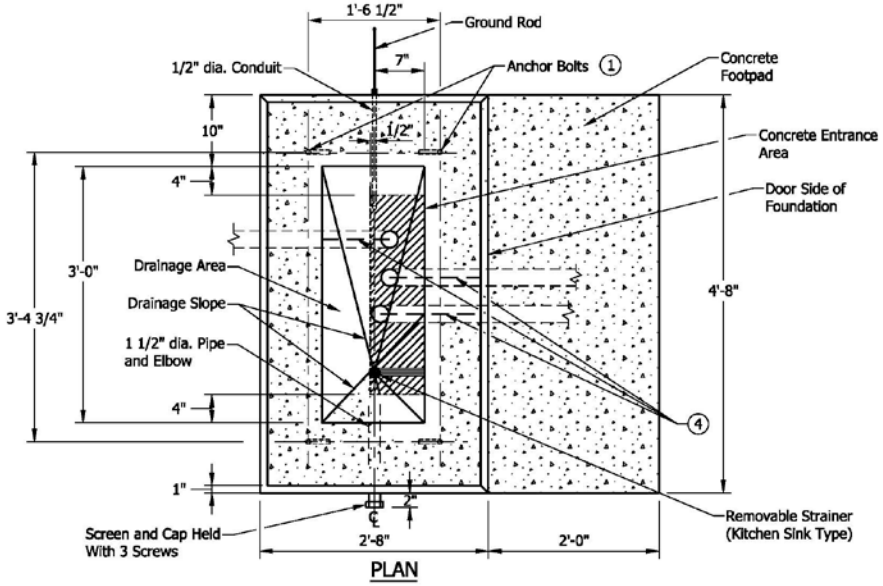
If specified as pay items, radio antenna; radio interconnect; radio splitter; will be paid for at the contract unit price per each.

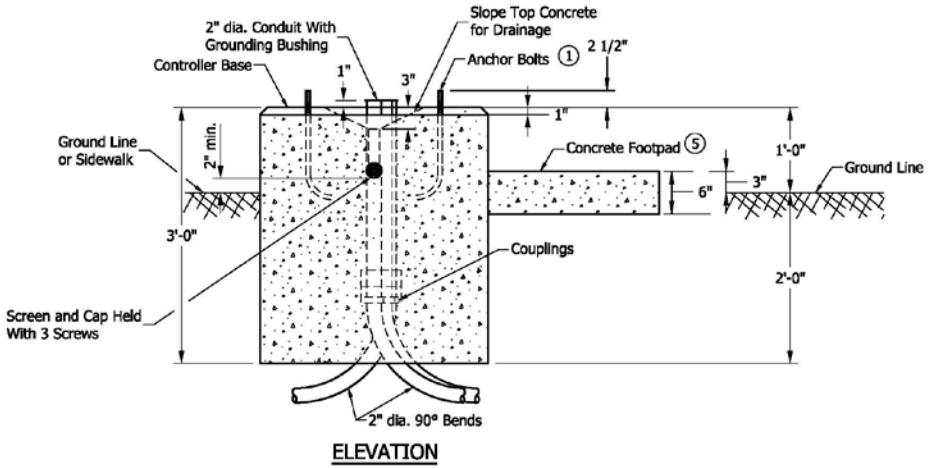
Payment will be made under:

Pay Item	**Pay Unit Symbol**
Radio Antenna	EACH
Radio, Interconnect	EACH
Radio, Interconnection System Testing	LS
Radio Splitter	EACH

REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGCF-01 CONTROL CABINET FOUNDATION TYPE P-1 (DRAFT, REFORMATTED)





GENERAL NOTES

(1) See Standard Drawing E 805-SGPB-01 for anchor bolt details.

2. Install minimum 3 - 2" dia. conduits for each foundation.

3. Conduits not used shall be capped below grade. More inlets shall be installed as required on plans.

(4) Make a permanent line on top of the concrete foundation indicating the direction of the 2" conduits' exit.

(5) Concrete footpad shall be constructed of the same class concrete as the foundation.

INDIANA DEPARTMENT OF TRANSPORTATION

SIGNAL CONTROLLER CABINET FOUNDATION TYPE P-1

SEPTEMBER 2013

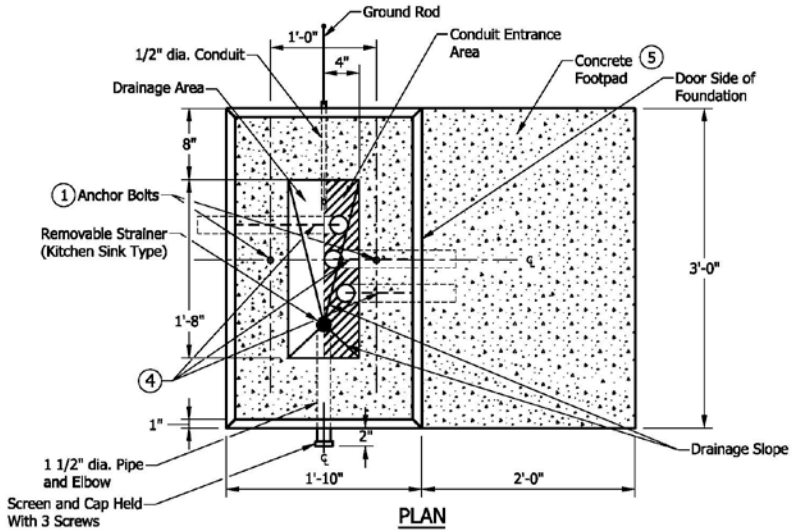
STANDARD DRAWING NO. E 805-SGCF-01

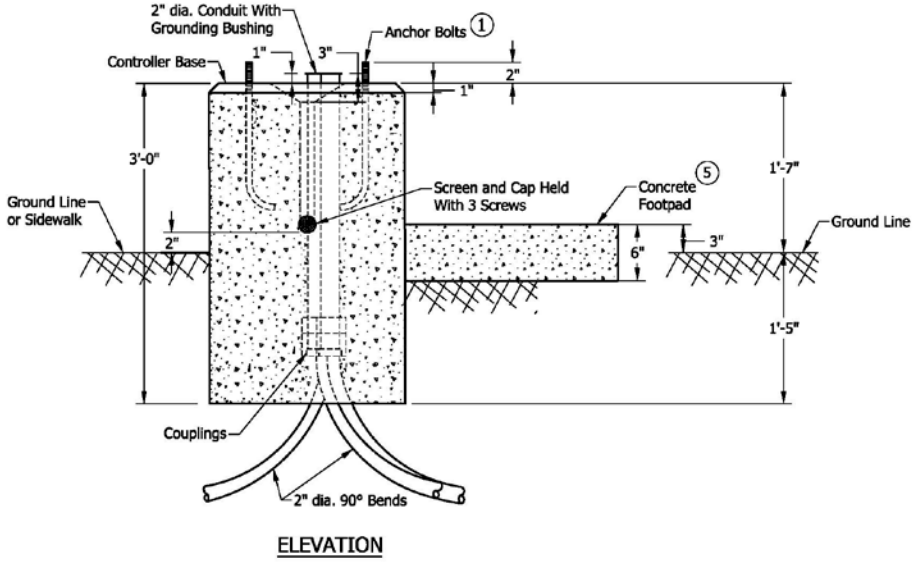
DESIGN STANDARDS ENGINEER DATE

CHIEF ENGINEER DATE

REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGCF-02 CONTROL CABINET FOUNDATION TYPE M (DRAFT, REFORMATTED)





GENERAL NOTES

1. See Standard Drawing E 805-SGPB-01 for anchor bolt details.
2. Install minimum 3 - 2" dia. conduits for each foundation.
3. Conduits not used shall be capped below grade. More inlets shall be installed as required on plans.
4. Make a permanent line on top of the concrete foundation indicating the direction of the 2" conduits' exit.
5. Concrete footpad shall be constructed of the same class concrete as the foundation.

INDIANA DEPARTMENT OF TRANSPORTATION

SIGNAL CONTROLLER CABINET FOUNDATION TYPE M

SEPTEMBER 2013

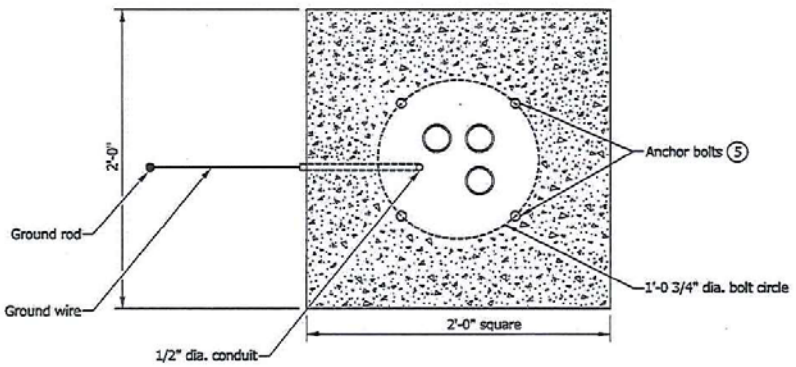
STANDARD DRAWING NO. E 805-SGCF-02

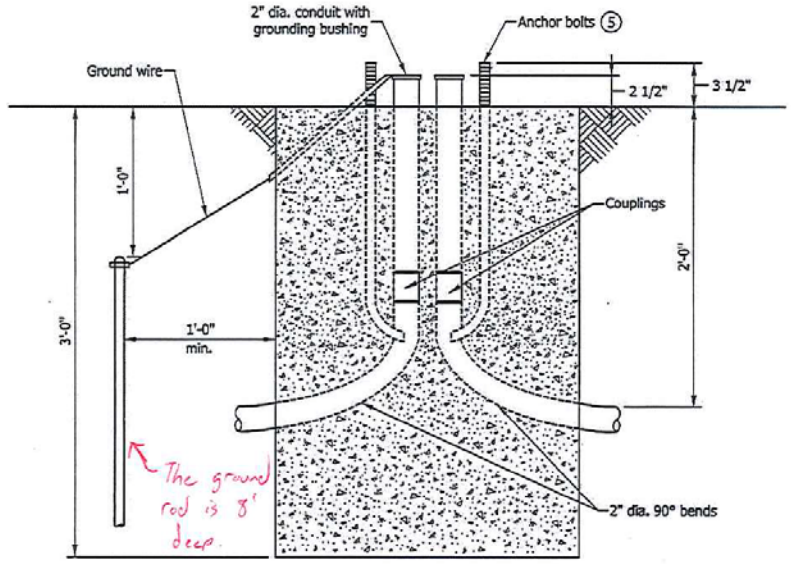
DESIGN STANDARDS ENGINEER DATE

CHIEF ENGINEER DATE

REVISION TO SPECIAL PROVISIONS (OLD BUSINESS ITEM)

805-SGCF-03 SIGNAL PEDESTAL FOUNDATION TYPE A (WITH MARKUP)





GENERAL NOTES

1. Concrete walk shall be constructed of the same class of concrete as the foundation.
2. A minimum of three 2 in. dia. conduit inlets shall be installed per foundation.
3. Conduit inlets not used shall be capped below grade. More inlets shall be installed as required on plans.
4. Foundation Types P-1 and M shall conform to all minor differences of individual designs for all accepted cabinets.
5. See Standard Drawing E 805-SGPB-01 for anchor bolt details.
6. For sidewalk installation, the concrete footpad shall be flush with the sidewalk.

INDIANA DEPARTMENT OF TRANSPORTATION

SIGNAL PEDESTAL
FOUNDATION TYPE A

SEPTEMBER 2012

STANDARD DRAWING NO. E 805-SGCF-03

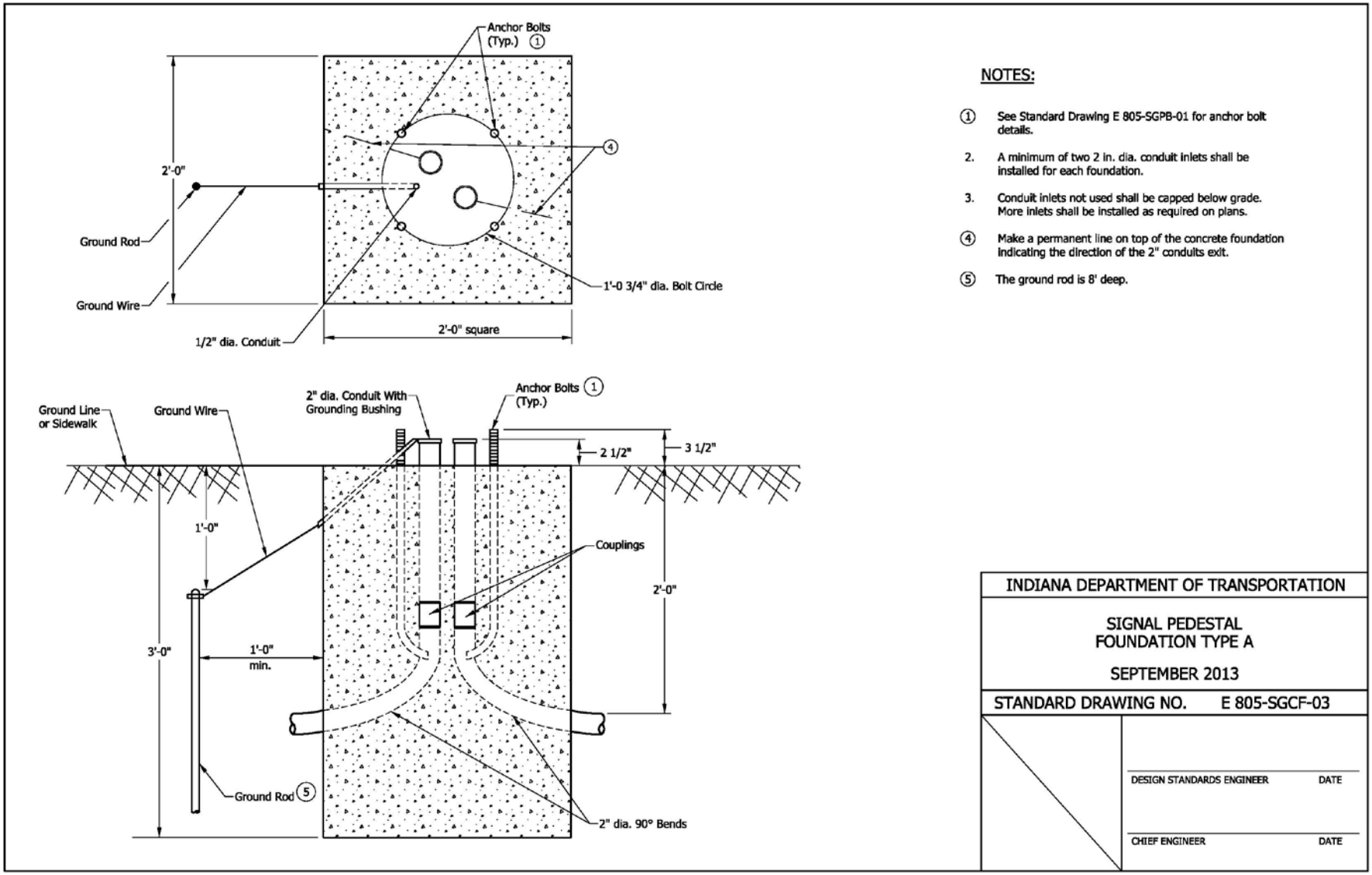
RICHARD L. VanCLEAVE REGISTERED NO. 9750 STATE OF INDIANA PROFESSIONAL ENGINEER

/s/ Richard L. VanCleave 09/04/12
SUPERVISOR, ROADWAY STANDARDS DATE

/s/ Mark A. Miller 09/04/12
CHIEF ENGINEER DATE

REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGCF-03 SIGNAL PEDESTAL FOUNDATION TYPE A (DRAFT)



NOTES:

① See Standard Drawing E 805-SGPB-01 for anchor bolt details.

2. A minimum of two 2 in. dia. conduit inlets shall be installed for each foundation.

3. Conduit inlets not used shall be capped below grade. More inlets shall be installed as required on plans.

④ Make a permanent line on top of the concrete foundation indicating the direction of the 2" conduits exit.

⑤ The ground rod is 8' deep.

INDIANA DEPARTMENT OF TRANSPORTATION

SIGNAL PEDESTAL FOUNDATION TYPE A

SEPTEMBER 2013

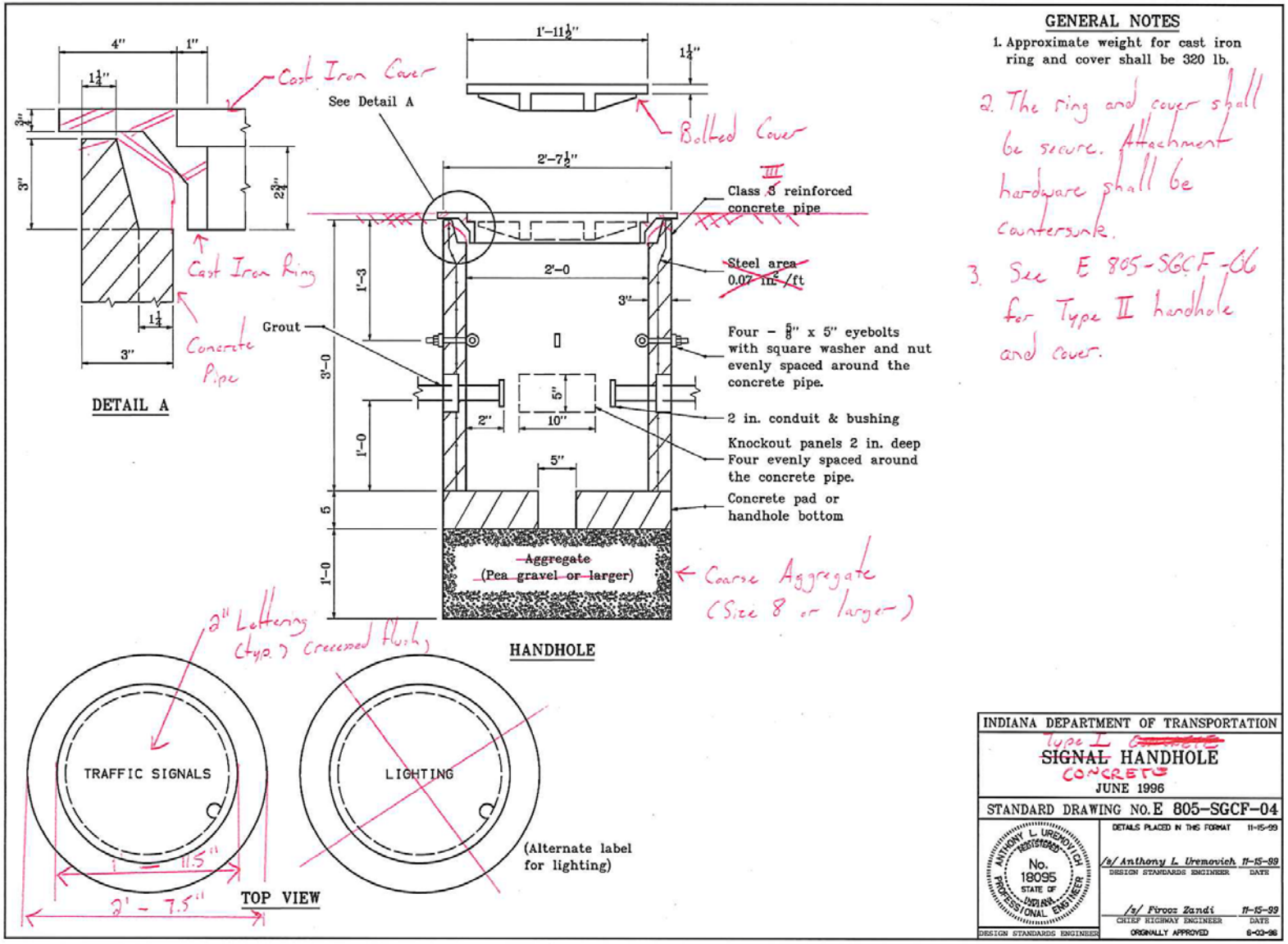
STANDARD DRAWING NO. E 805-SGCF-03

DESIGN STANDARDS ENGINEER DATE

CHIEF ENGINEER DATE

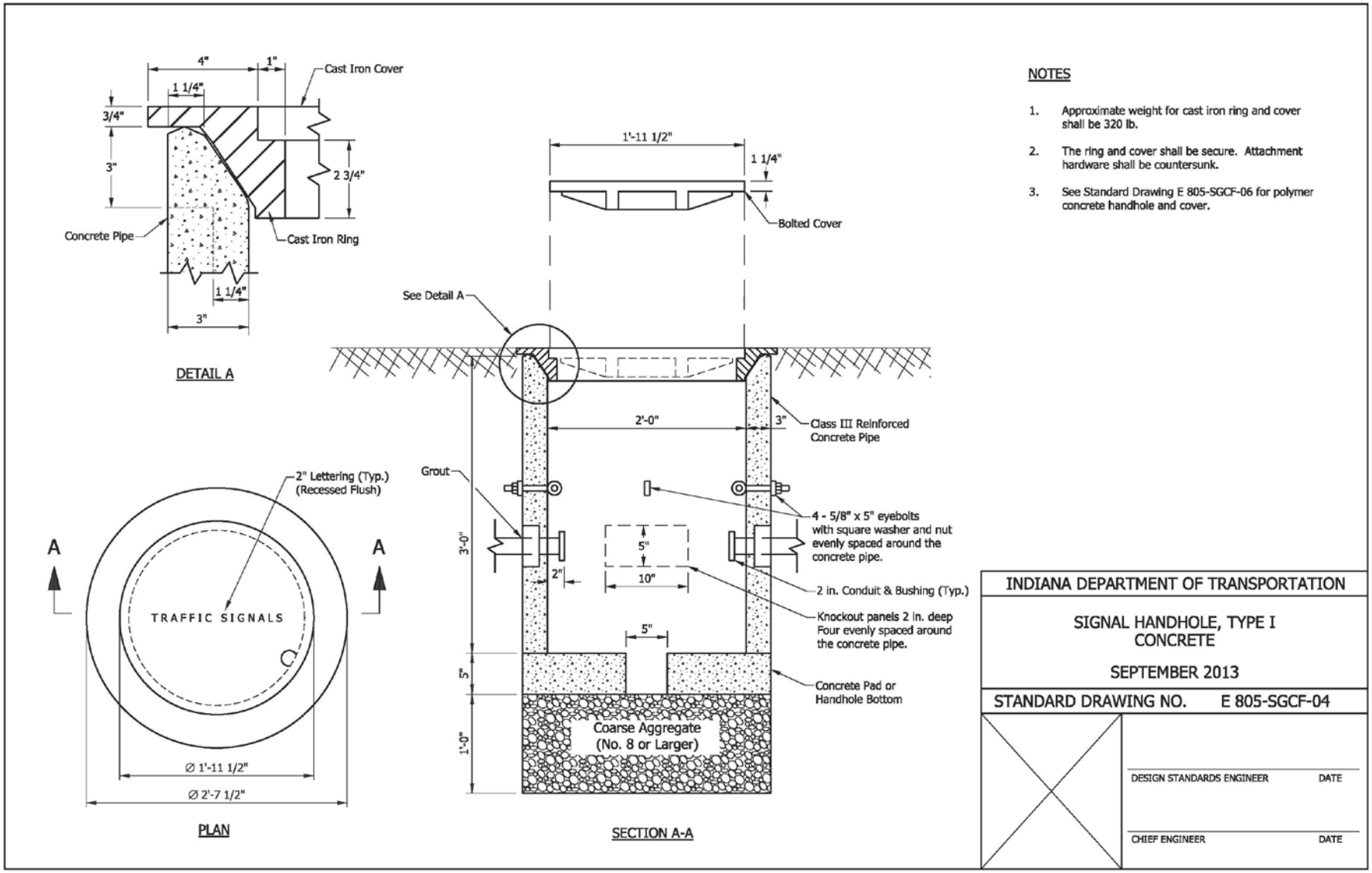
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGCF-04 SIGNAL HANDHOLE (WITH MARKUPS)



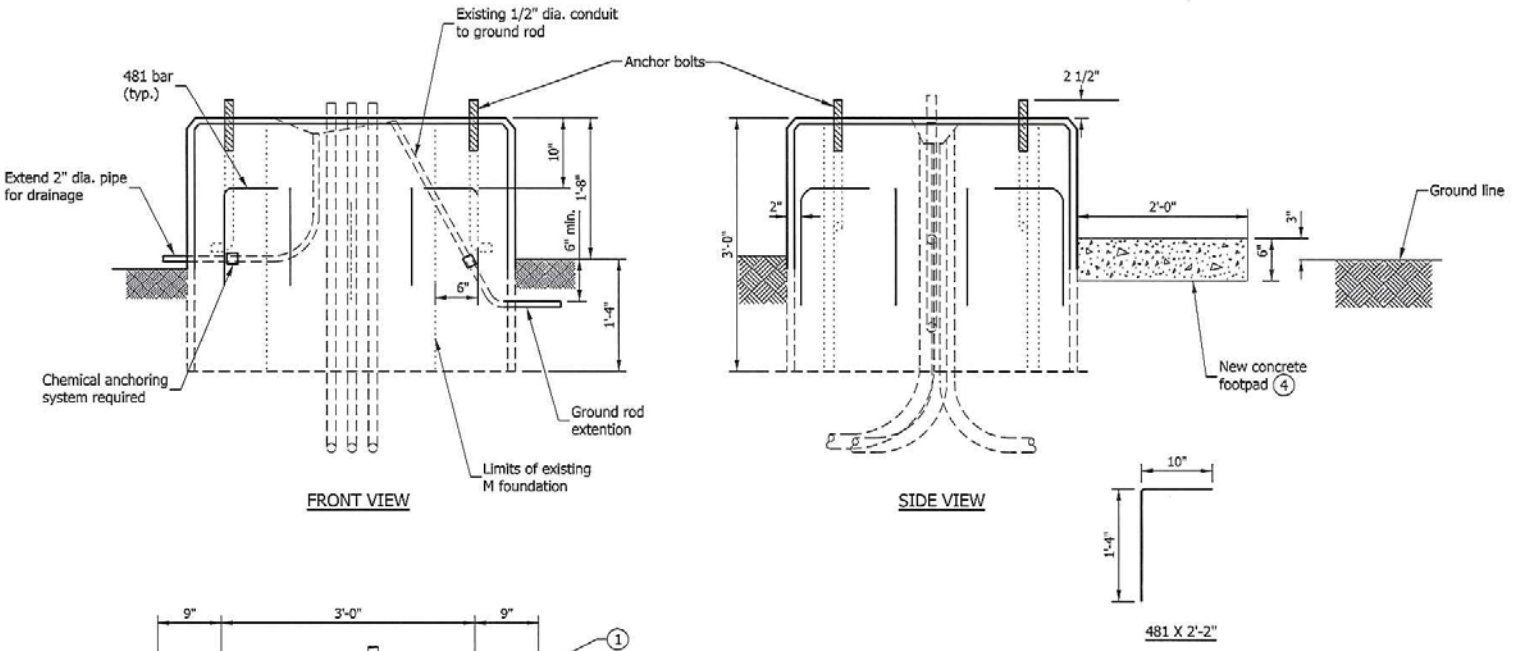
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGCF-04 SIGNAL HANDHOLE, TYPE I CONCRETE (DRAFT)



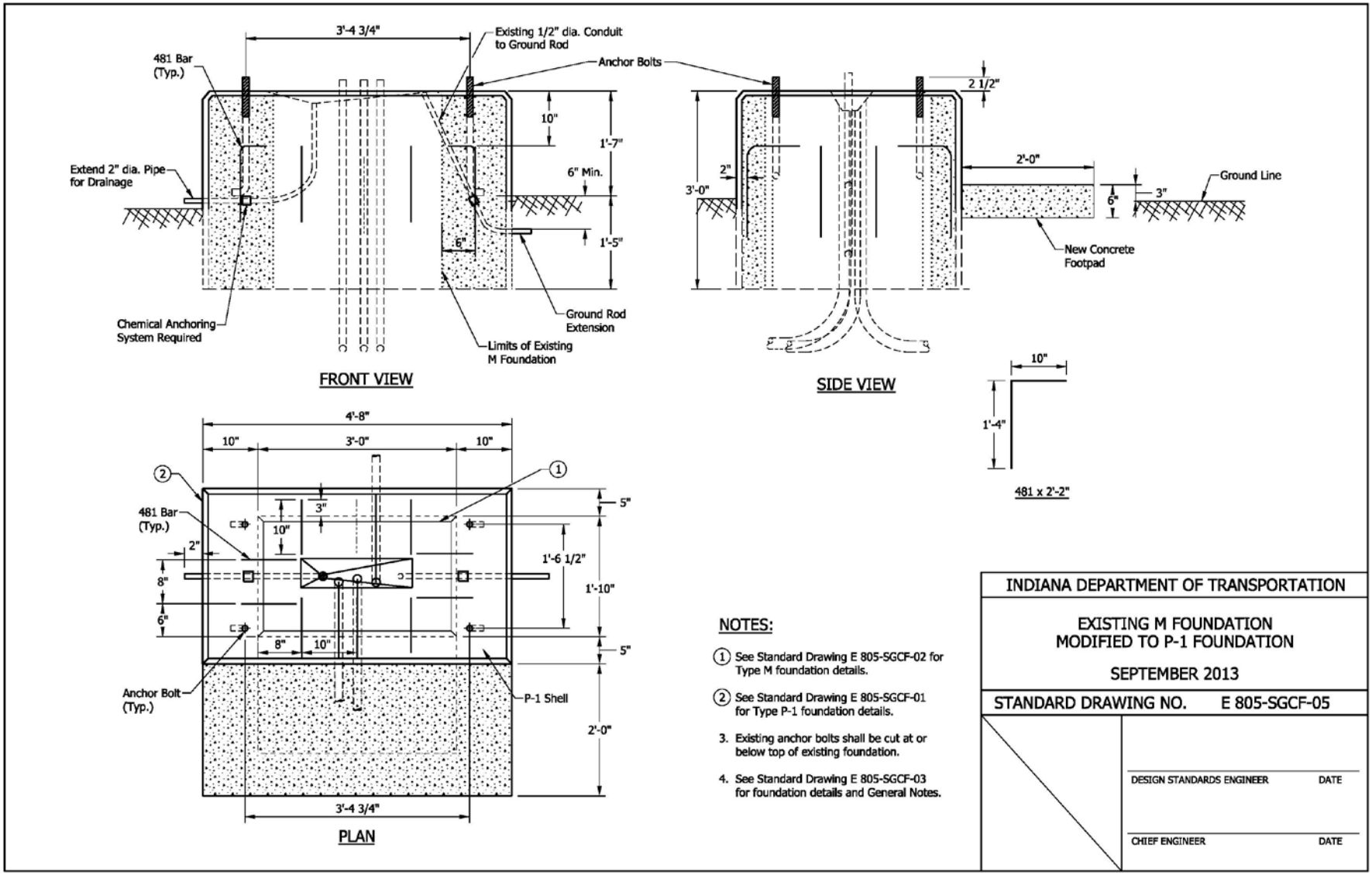
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGCF-05 EXISTING FOUNDATION MODIFIED TO P-1 FOUNDATION (WITH MARKUPS)



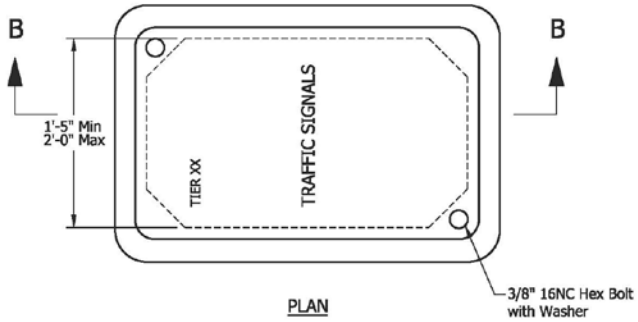
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGCF-05 EXISTING FOUNDATION MODIFIED TO P-1 FOUNDATION (DRAFT)

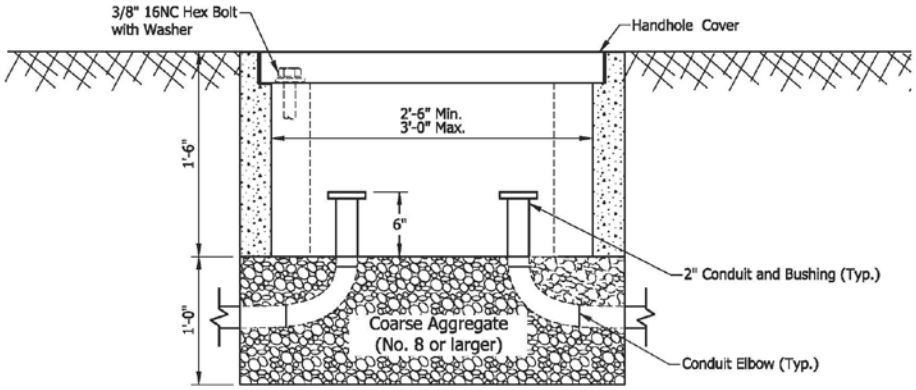


REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

PROPOSED NEW 805-SGCF-06 SIGNAL HANDHOLE, TYPE II POLYMER CONCRETE (DRAFT)



PLAN



SECTION B-B

NOTES

1. Handhole shall be without a bottom.
2. See Standard Drawing E 805-SGCF-04 for concrete handhole and cover.

INDIANA DEPARTMENT OF TRANSPORTATION	
SIGNAL HANDHOLE, TYPE II POLYMER CONCRETE SEPTEMBER 2013	
STANDARD DRAWING NO. E 805-SGCF-06	
	DESIGN STANDARDS ENGINEER DATE CHIEF ENGINEER DATE

REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGLT-01 LOOP TAGING SYSTEM (PROPOSED TO DELETE)

Each loop lead-in cable (2C/16) shall be tagged according to the designation shown on the plans. The tag numbers for lead-in cable shall be assigned as follows:

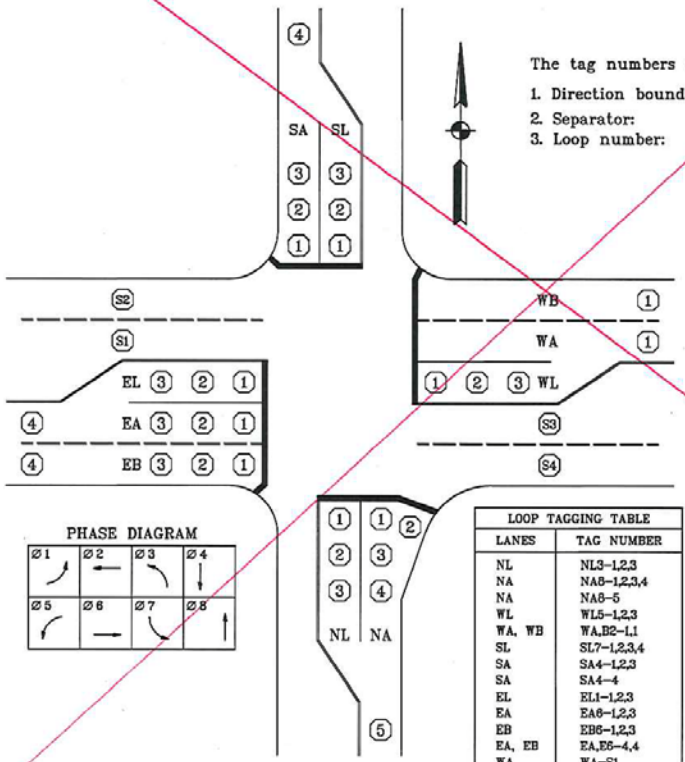
1. Direction bound: N, S, E, or W.
2. Lane designation: L = Left turn.
   A = Through lane closest to centerline of roadway.
   B = Next lane out from centerline of roadway.
   Alphabet is continued to lane closest to edge of pavement.
3. Phase number: 1 through 8.
4. Separator: –
5. Loop number: 1 = Loop closest to stop line.
   2 = Next loop away from stop line.
   Numbering is continued to loop farthest from stop line.

The tag numbers for system loops shall be assigned as follows:

1. Direction bound and lane designation are the same as for lead-in cable.
2. Separator: –
3. Loop number: S1 is used for the southernmost approach. Numbering is continued in a clockwise direction beginning with S2.

DELETE
(see Design Memo 12-13)

LOOP TAGGING SYSTEM



PHASE DIAGRAM

LOOP TAGGING TABLE

LANES	TAG NUMBER
NL	NL3–1,2,3
NA	NA8–1,2,3,4
NA	NA8–5
WL	WL5–1,2,3
WA, WB	WA,B2–1,1
SL	SL7–1,2,3,4
SA	SA4–1,2,3
SA	SA4–4
EL	EL1–1,2,3
EA	EA6–1,2,3
EB	EB6–1,2,3
EA, EB	EA,E6–4,4
WA	WA–S1
WB	WB–S2
EA	EA–S3
EB	EB–S4

INDIANA DEPARTMENT OF TRANSPORTATION

LOOP TAGGING SYSTEM

MARCH 1995

STANDARD DRAWING NO. E 805–SGLT–01

ANTHONY L. UREMOVICH REGISTERED No. 18095 STATE OF INDIANA PROFESSIONAL ENGINEER

DESIGN STANDARDS ENGINEER

DETAILS PLACED IN THIS FORMAT 11-15-99

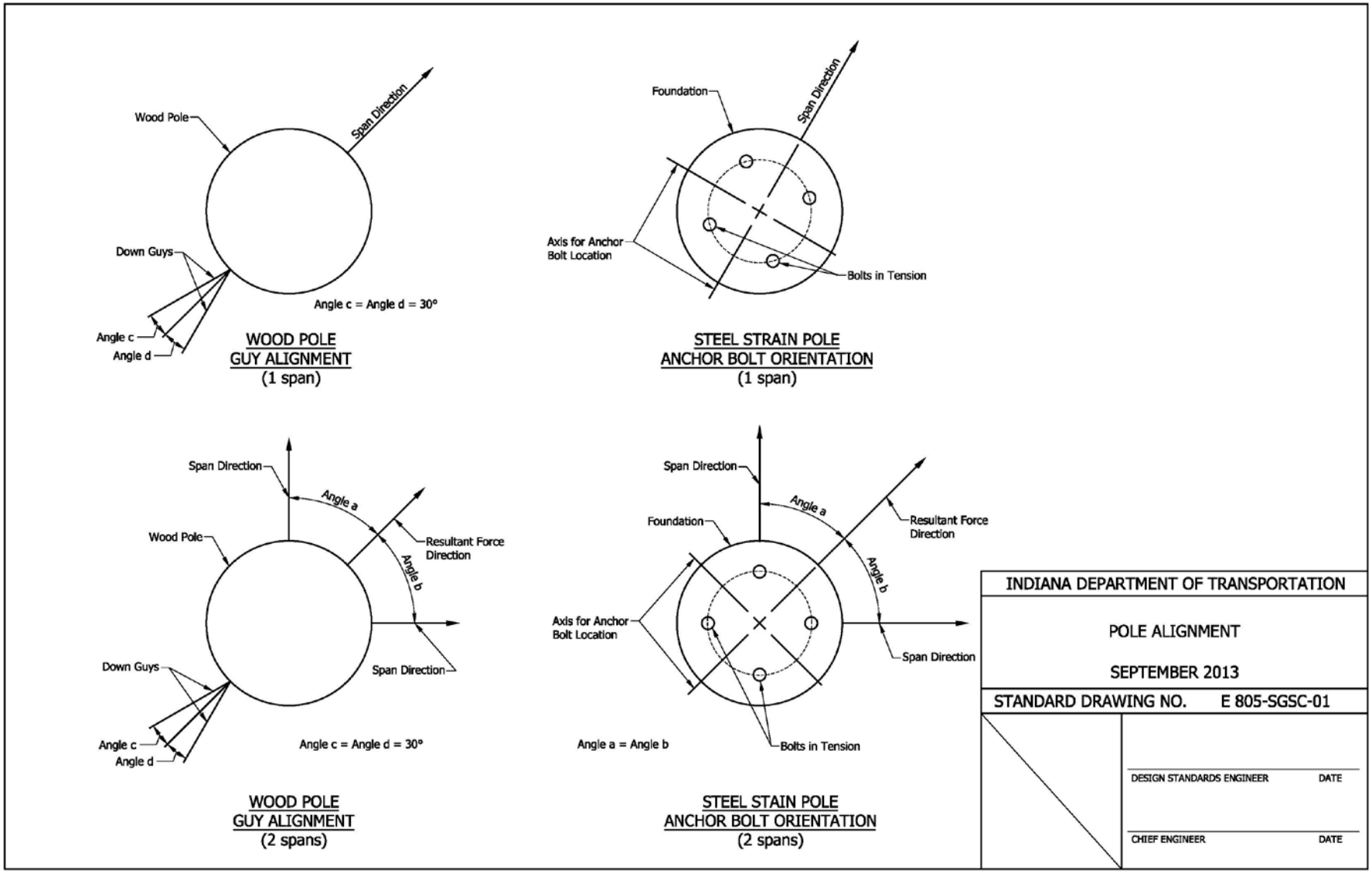
/s/ Anthony L. Uremovich 11-15-99
DESIGN STANDARDS ENGINEER DATE

/s/ Firooz Zandi 11-15-99
CHIEF HIGHWAY ENGINEER DATE

ORIGINALLY APPROVED 3-01-95

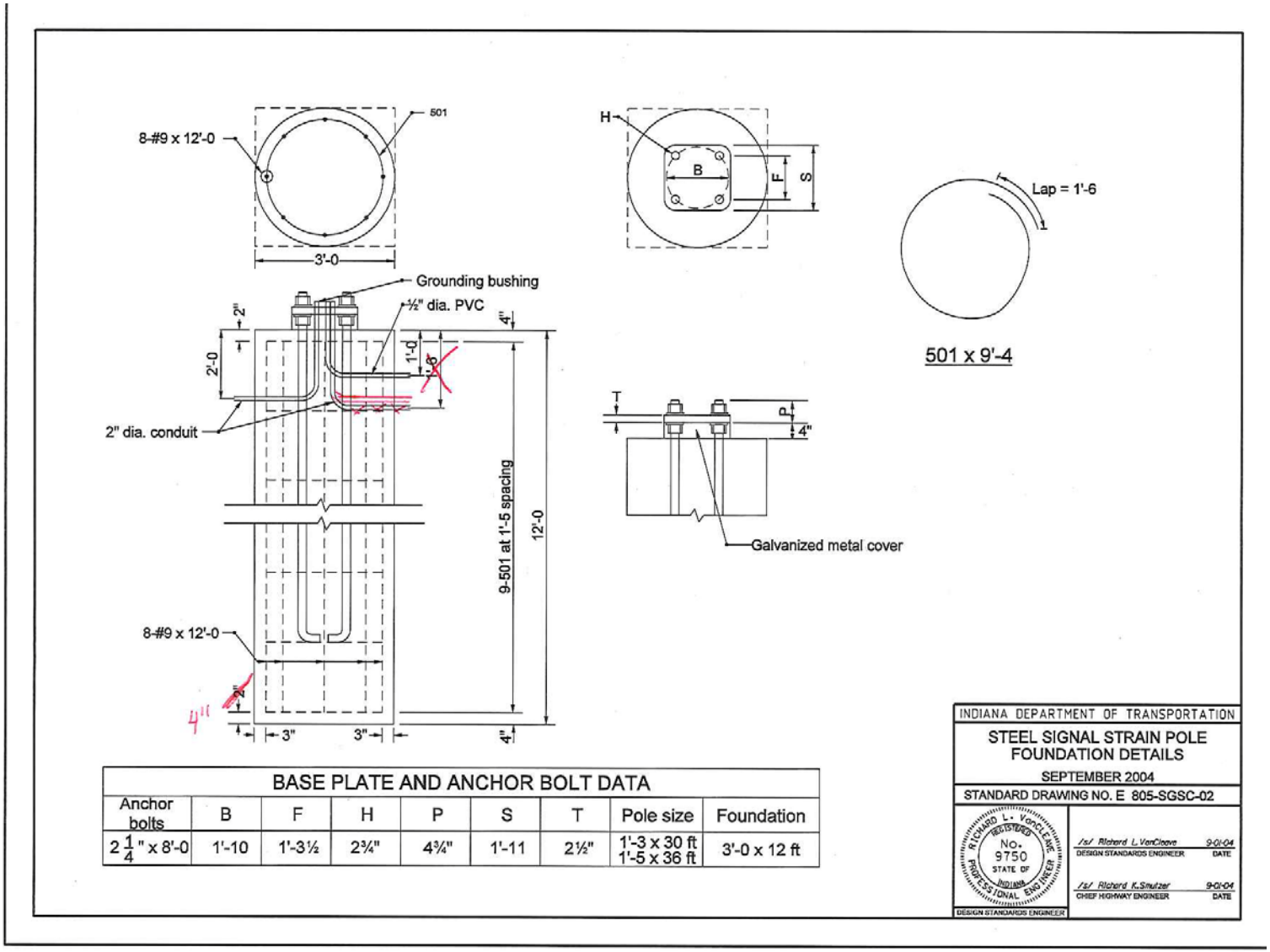
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGSC-01 POLE ALIGNMENT (DRAFT, REFORMATTED)



REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGSC-02 STEEL SIGNAL STRAIN POLE FOUNDATION DETAILS (WITH MARKUPS)



BASE PLATE AND ANCHOR BOLT DATA

Anchor bolts	B	F	H	P	S	T	Pole size	Foundation
2 1/4" x 8'-0	1'-10	1'-3½	2¾"	4¾"	1'-11	2½"	1'-3 x 30 ft 1'-5 x 36 ft	3'-0 x 12 ft

INDIANA DEPARTMENT OF TRANSPORTATION

STEEL SIGNAL STRAIN POLE FOUNDATION DETAILS

SEPTEMBER 2004

STANDARD DRAWING NO. E 805-SGSC-02

RICHARD L. VANCLEAVE REGISTERED No. 9750 STATE OF INDIANA PROFESSIONAL ENGINEER

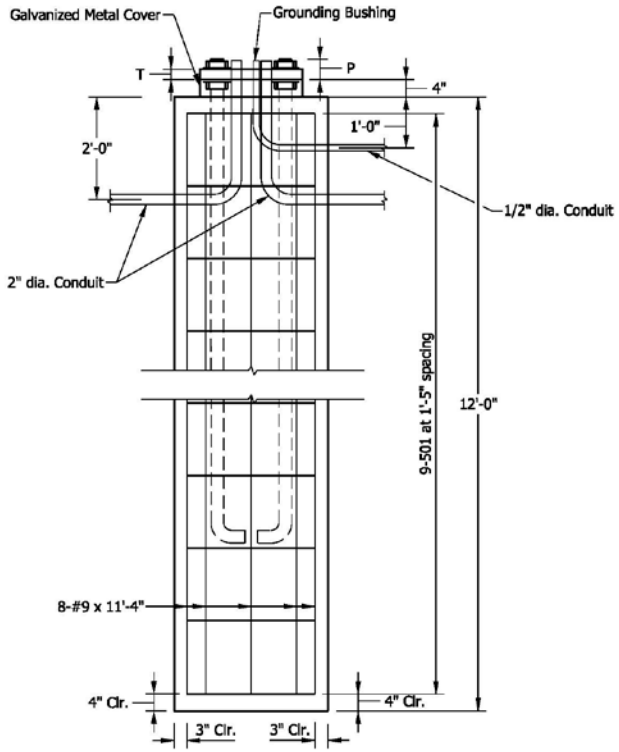
DESIGN STANDARDS ENGINEER

/s/ Richard L VanCleave 9-01-04
DESIGN STANDARDS ENGINEER DATE

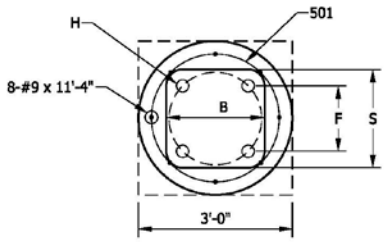
/s/ Richard K Smutzer 9-01-04
CHIEF HIGHWAY ENGINEER DATE

REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

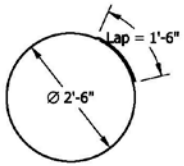
805-SGSC-02 STEEL SIGNAL STRAIN POLE FOUNDATION DETAILS (DRAFT)



ELEVATION



PLAN



501 x 9'-4"

BASE PLATE AND ANCHOR BOLT DATA								
Anchor Bolts	B	F	H	P	S	T	Pole Size	Foundation
2 1/4" x 8'-0"	1'-10"	1'-3 1/2"	2 3/4"	4 3/4"	1'-11"	2 1/2"	1'-3" x 30' 1'-5" x 36'	3'-0" x 12'

INDIANA DEPARTMENT OF TRANSPORTATION

STEEL SIGNAL STRAIN POLE FOUNDATION DETAILS

SEPTEMBER 2013

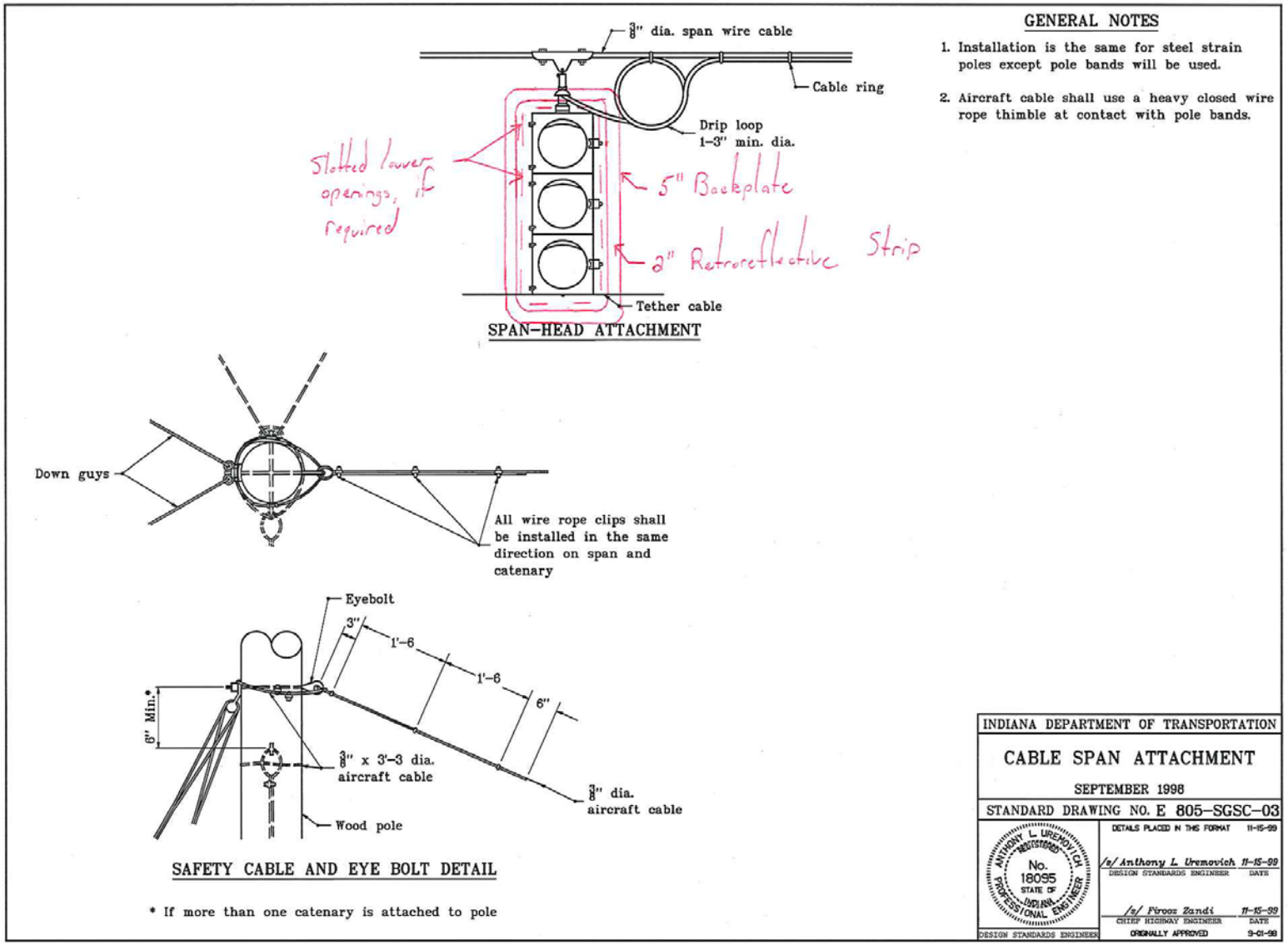
STANDARD DRAWING NO. E 805-SGSC-02

DESIGN STANDARDS ENGINEER DATE

CHIEF ENGINEER DATE

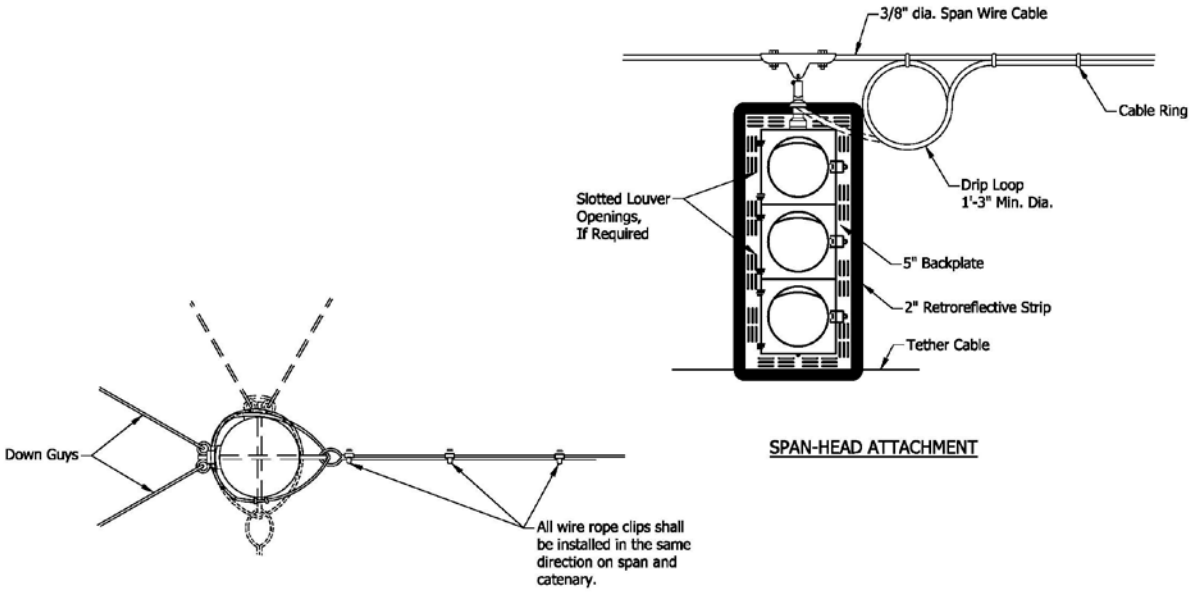
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGSC-03 CABLE SPAN ATTACHMENT (WITH MARKUPS)



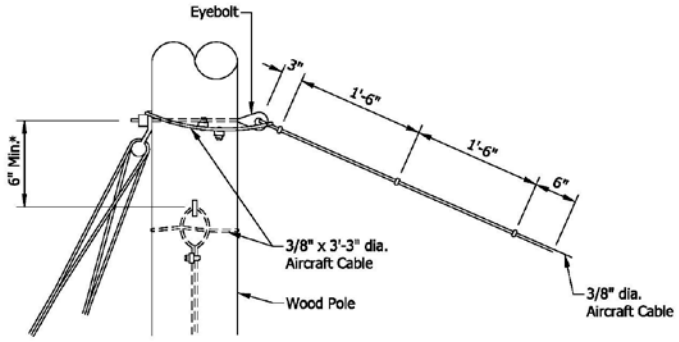
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGSC-03 CABLE SPAN ATTACHMENT (DRAFT)



SPAN-HEAD ATTACHMENT

TOP VIEW



SAFETY CABLE AND EYE BOLT DETAIL

* If more than one catenary is attached to pole.

NOTES:

1. Installation is the same for steel strain poles except pole bands will be used.
2. Aircraft cable shall use a heavy closed wire rope thimble at contact with pole bands.

INDIANA DEPARTMENT OF TRANSPORTATION

CABLE SPAN ATTACHMENT

SEPTEMBER 2013

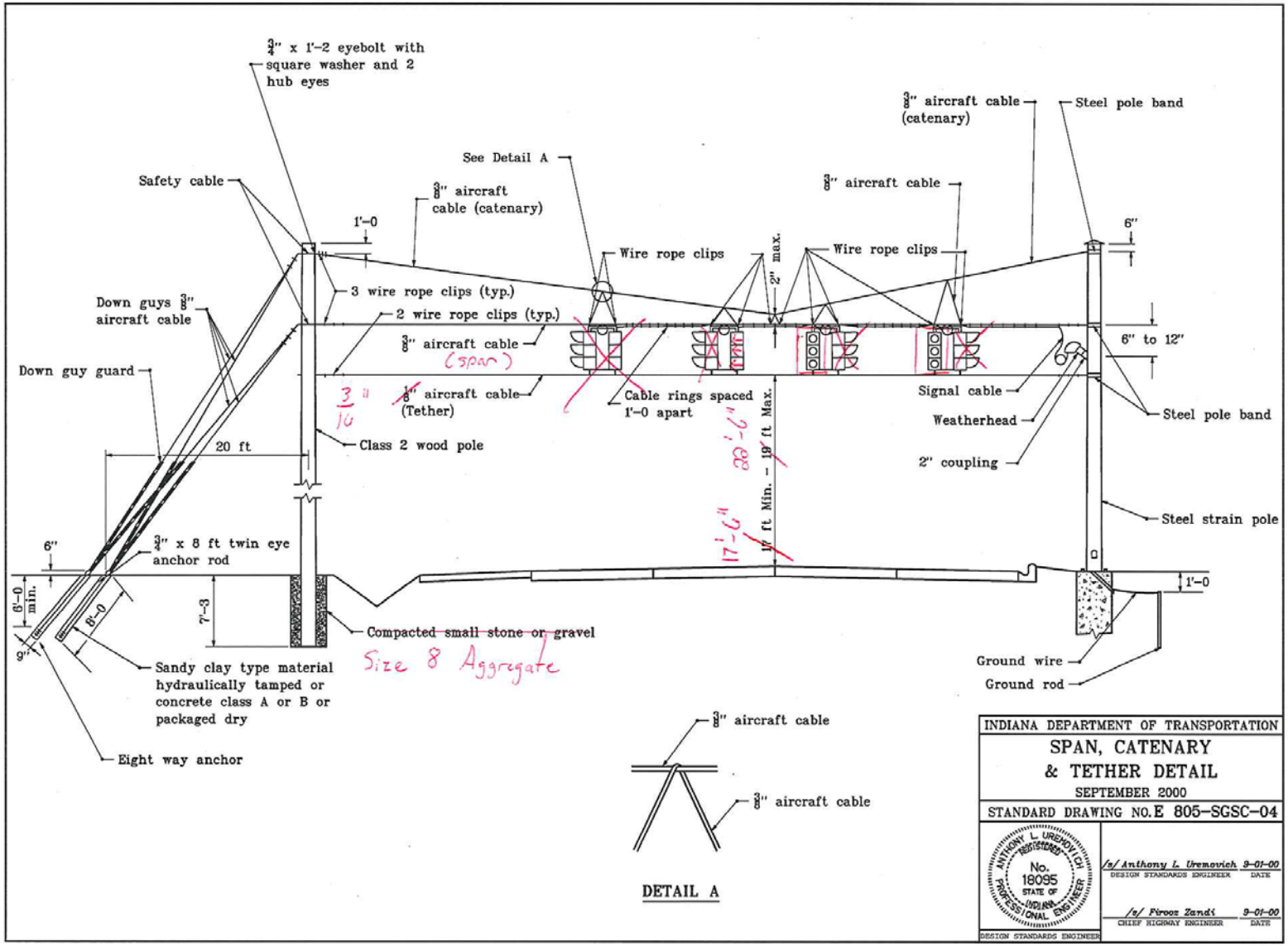
STANDARD DRAWING NO. E 805-SGSC-03

DESIGN STANDARDS ENGINEER DATE

CHIEF ENGINEER DATE

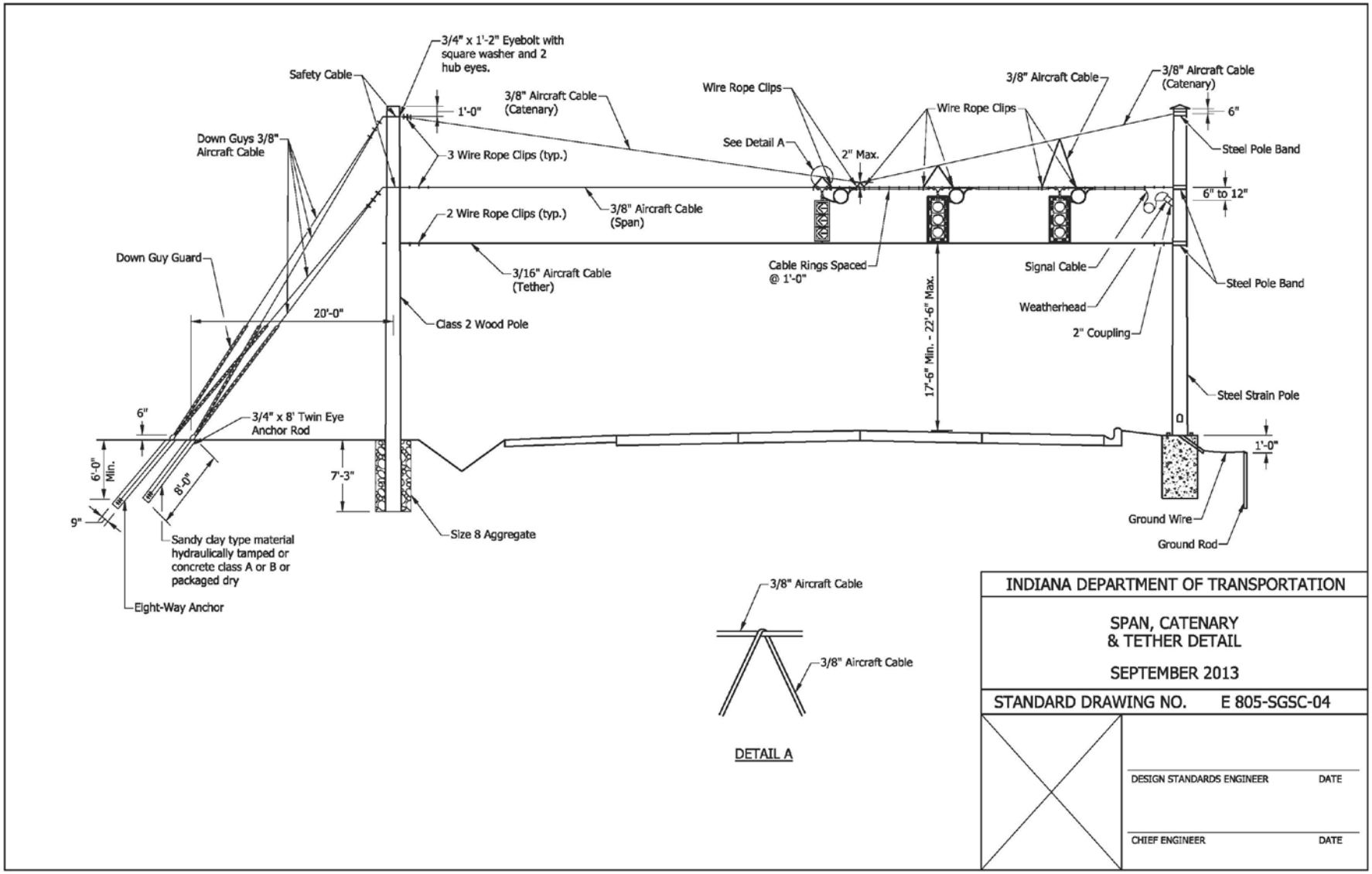
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGSC-04 SPAN, CATENERY & TETHER DETAIL (WITH MARKUPS)



REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGSC-04 SPAN, CATENERY & TETHER DETAIL (DRAFT)



REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

805-SGSC-04 SPAN, CATENERY & TETHER DETAIL (DRAFT)

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INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Design Memorandum No. 13-__
Technical Advisory

February 22, 2013 DRAFT

DESIGN MEMORANDUM No. 13-__
TECHNICAL ADVISORY

TO: **All Design, Operations, and District Personnel, and Consultants**

FROM: _____
David Boruff
Manager, Office of Traffic Administration
Traffic Engineering Division

SUBJECT: **Signal Display**

REVISES: ***Indiana Design Manual*** **Section 77-4.04**

EFFECTIVE: **To Be Determined**

Past editions of the *Indiana Manual on Uniform Traffic Control Devices (IMUTCD)* recommended that signal heads be painted yellow. INDOT has continued to follow this recommendation to enhance the conspicuity of signal heads. However, the current edition of IMUTCD no longer recommends the yellow housing color but does contain a recommendation for the use signal backplates to further enhance the conspicuity of signal heads. INDOT has determined that the effectiveness of backplates will be optimized if they contain retroreflective striping and if they attached to signal head housing that is black. Therefore, the subject *Indiana Design Manual* section has been revised and the revision is attached herewith.

jb:ep

77-4.04 Signal Display

The traffic-signal display consists of parts including the signal head, signal face, optical unit, visors, etc. The criteria set forth in the *MUTCD* Part IV, the INDOT *Standard Specifications, and* ITE's *Equipment and Material Standards of the Institute of Transportation Engineers* should be followed in determining appropriate signal-display arrangements and equipment. The following provides additional guidance for the selection of the signal display equipment.

1. Signal-Head Housing. This ~~are~~*is* made of polycarbonate (plastic). *For new traffic signal installations on the state highway system, the signal head housing should have a black color. For traffic signal modernization projects on the state highway system, the existing yellow signal heads may be reused if this is approved by the District Traffic Engineer.*

2 Signal Faces. Section 77-5.01 provides INDOT's preferred signal-face arrangements for use on a State highway. The signal lenses should be placed in a vertical line rather than horizontally except where overhead obstructions may limit visibility. Where protected left turns are followed by permissive left turns, the five-section signal head is the recommended arrangement choice. The *MUTCD Part* IV provides additional information on the arrangement of signal heads.

3. Lens Size. INDOT's preferred practice is to use only 12-in. diameter lenses. INDOT specifications require the use of plastic lenses in its signal displays.

4. Signal Illumination. Only Light-Emitting Diodes (LED) should be used.

5. Visors. A visor should be used with each lens. A visor is used to direct the signal indication to the appropriate approaching traffic and to reduce sun phantom. A tunnel visor provides a complete circle around the lens. A cutaway visor is a partial visor, with the bottom cut away. A partial visor reduces water and snow accumulation and does not let birds build nests within the visor. The decision on which visor type should be used is determined on a site-by-site basis. For a Department installation, partial visors are normally used. Visors are made of the same material as the housing.

6. Louvers. Louvers are sometimes used to direct the signal indication to a specific lane. Louvers are used where several signal heads may cause confusion for the approaching driver. One example of this problem is where an intersection has its approaches at angles less than 90 deg and the signal indications can be seen from

both approaches. The decision on whether to use louvers depends on site conditions and will be determined for each site.

7. Optically-Programmable Signal. Like louvers, an optically-programmable signal is designed to direct the signal indication to specific approach lanes and for specific distances. An advantage is that they can be narrowly aligned so that motorists from other approaches cannot see the indications. Applications include closely-spaced intersections or an intersection where the approaches have acute angles. An optically-programmable signal requires rigid mountings to keep the indicator properly directed. The cost is higher than for louvers but the improved visibility often makes it a better choice. The decision on whether to use an optically-programmable signal depends on site conditions and will be determined for each site.

8. Backplate. A signal indication loses some of its contrast value if viewed against a bright sky or other intensive background lighting such as advertising lighting. A backplate placed around a signal assembly enhance the signal's visibility and have been shown to provide a benefit in reducing crashes. However, a backplate adds weight to the signal head and can increase the effect of wind loading on the signal. ~~The decision on whether to use a backplate depends on site conditions and will be determined for each site~~. *A backplate should be used on overhead 3 section signal heads for through lanes and on other signal heads as determined by the District Traffic Engineer. Use on other signal heads should be identified in the plans.*

By Standard Specification backplates will include a 2 in. yellow retroreflective strip around the perimeter of the backplate to enhance the conspicuity of the signal head at night. For non-INDOT projects where the reflectorized surface is not desired the plans or special provisions should so indicate.

Traffic signal head retrofits may be specified instead of new signal heads when the existing LED's have some service life remaining but backplates are needed. Currently LED indicators have a service life of about 6 years. By the Standard Specifications a retrofit includes new housing along with the backplate. Retrofits should be indicated on the plans.

INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Design Memorandum No. 13-__
Technical Advisory

February 22, 2013 DRAFT

DESIGN MEMORANDUM No. 13-__
TECHNICAL ADVISORY

TO: **All Design, Operations, and District Personnel, and Consultants**

FROM: _____
David Boruff
Manager, Office of Traffic Administration
Traffic Engineering Division

SUBJECT: **Signal Electrical System**

REVISES: ***Indiana Design Manual*** **Section 77-5.05**

EFFECTIVE: **To Be Determined**

Significant cost savings can be achieved on a traffic signal project depending on the electrical system design. An estimate of the service connection charge from the local utility company that is included in the Contract Information Book can avoid expensive change orders later on. Polymer concrete handholes are also less expensive than concrete handholes and are appropriate for locations that are protected from heavy vehicles. Also, HDPE has now been added as an acceptable material for non-metallic conduit.Therefore, the subject Indiana Design Manual section has been revised and the revision is attached herewith.

Please note that sections 805.02, 805.16 and 922.17 of the INDOT *Standard Specifications* are being revised and Standard Drawing to allow the use of polymer concrete handholes.

77-5.05 Electrical System

The electrical system consists of electrical cables or wires, connectors, conduit, handholes, etc. Electrical connections between the power supply, controller cabinet, detectors, and signal poles are carried in conduit. The following should be considered in developing the traffic-signal wiring plan.

1. Service Connections. Service connections from the local utility lines should go directly to the service disconnect and then to the controller cabinet. The lines should be as short as practical. The service disconnect should be located as close to the controller cabinet as practical. These installations will be placed underground in separate conduits from other signal wires. Easy access to a shut-off device in the controller is required to turn the power supply off while performing system maintenance.

   The designer should contact the local utility company and obtain an estimate for the service connection cost. A unique special provision noting the cost should be included int the Contract Information Book.

2. Electric Cables. All electric cables and connections must satisfy national, State, and local electrical codes, in addition to the NEMA criteria, except for the green wire, which is used for the green indication or interconnect function and not for the system ground. The number of conductor cables should be kept to a minimum, usually only 3 or 4 combinations, to reduce inventory requirements. A 7- or greater-conductor cable is used between the controller cabinet and the disconnect hangers or cantilever base. A 5-conductor cable is used between the disconnect hanger or cantilever base and 3-section signal indication. A 7-conductor cable is used between the disconnect hanger or cantilever base and 5-section signal indication. A 5-conductor cable is used between the controller cabinet and the pedestrian-signal indication. A 5-conductor cable is used between the controller cabinet and each pair of pedestrian push buttons located in the same corner of the intersection. Connections to flashers use only a 3-conductor cable. The INDOT *Standard Drawings* illustrate the correct procedures for wiring and splicing cables.

3. Cable Runs. All cable runs should be continuous between the following:
   a. controller cabinet to base of cantilever structure or pedestal;
   b. controller cabinet to disconnect hangers;

c. controller cabinet to service disconnect;
d. disconnect hanger to signal indications;
e. base of cantilever structure to signal indications; and
f. controller cabinet to detector housing.

4. Handhole. A handhole should be located *off the travel pavement* and adjacent to the controller cabinet, each signal pole, and each detector location. *Type I handholes are made of reinforced concrete pipe and Type II handholes are made of polymer concrete. The material type that should be used will depend on the location. A Type I (concrete) handhole should be used for a location that will be closer to motor vehicles, such as in the shoulder or immediately adjacent to the unprotected edge of pavement. A Type II (polymer concrete) handhole should be used for a location that will not be exposed to motor vehicles, such as on sidewalk, behind guardrail or non-mountable curb, or as directed by the District Traffic or District Maintenance Offices. A handhole that will be placed directly in a travel or auxiliary lane will require a special design and plan detail and should be designated as a Type III.*

The INDOT *Standard Drawings* provide additional handhole and wiring details. The maximum spacing between handholes in the same conduit run is ~~250~~ *200* ft.

5. Underground Conduit. Underground conduit is used to connect the controller cabinet, traffic signals, and loop detectors together. Conduits run underneath the pavement and between the handholes, using a 2-in. diameter conduit. For a run with additional cables, the conduit size may need to be increased. The NEC should be checked to determine the appropriate conduit size for the number of electric cables that *can be contained within the conduit. The INDOT Standard Drawings provide additional placement details of underground conduit.*

The designer should indicate which material type should be used. The conduit type should be determined based on the guidelines as follows:

a. PVC Schedule 40, HDPE Schedule 40, or rigid fiberglass should be used conduit to be placed in a trench.

b. HDPE Schedule 80 should be used for conduit to be jacked or bored, e.g., underneath pavement.

c. Galvanized steel may be used as requested or confirmed by the district traffic engineer for a signal-modernization project to match the existing conduit or for new signal construction.

d. PVC Schedule 80 or rigid fiberglass should be used for conduit on bridges or other structures

As the practice of using HDPE, PVC or rigid fiberglass conduit becomes more prevalent, the need for the designer to indicate the conduit type may not be necessary, as contractors will gain experience in using the material type that is appropriate for the application.

6. Grounding. Each metal pole, cantilever structure, controller cabinet, etc., should be grounded. The INDOT *Standard Drawings* illustrate the correct methods for grounding these devices.

7. Detector Housing. A detector housing should be a cast-aluminum box encased in concrete. A detector housing is used to splice the wires from the loops to the lead-in cable to the detector amplifier. The INDOT *Standard Drawings* provide additional information on detector housings, including wiring details.

8. Disconnect Hangers. Disconnect hangers are used for a cable-span-mounted signal to provide a junction box between the signal heads and the controller.

9. Loop Tagging. Each loop-detector cable should be tagged in the controller cabinet to indicate which loop detector wire belongs to which loop detector. Each should be labeled according to street, direction, lane, and distance from the stop line, and if the loop is a count loop.

10. Interconnect Cable. A 7-conductor signal wire is used for hard-wiring interconnected signals. For a closed-loop system, the hard-wired connection should use a telecommunication cable consisting of either a fiberoptic cable or a 6-pair twisted cable.

COMMENTS AND ACTION (OLD BUSINESS ITEM)

SECTION 805 TRAFFIC SIGNALS
SECTION 922 TRAFFIC SIGNALS MATERIALS
922-X-XXX CONTROLLER CELLULAR MODEM
805-X-XXX MAGNETOMETERS AND MICROLOOP DETECTORS
805-X-XXX PREFORMED PAVE-OVER LOOPS
805-X-XXX RADIO INTERCONNECTION
805-SGCF-01 thru 06
805-SGLT-01 LOOP TAGGING SYSTEM
805-SGSC-01 thru 04

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: SECTION 805; 920 AND 922. Recurring Special Provision affected: 805-T-169; 805-T-173; 922-T-168. Standard Sheets affected: 805-SGCF-01 thru 06; 805-SGLT-01; 805-SGSC-01 thru 04. Design Manual Sections affected: SECTION 502. GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By _____ Addition or _____ Revision Frequency Manual Update Req'd? Y__N__ By _____ Addition or _____ Revision Received FHWA Approval? _____

Mr. Vancleave
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS (OLD BUSINESS ITEM)

REVISION TO SPECIFICATIONS, SPECIAL PROVISIONS AND DRAWINGS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Standardized structures are being added to INDOT standards to install small signs overhead on the conventional roads.

PROPOSED SOLUTION: The overhead Tri-chord sign structures were designed and drawings were developed meeting the AASHTO standard specifications for structural supports for highway Signs, luminaires and Traffic Signals, fifth edition.

APPLICABLE STANDARD SPECIFICATIONS: RSP 802-T-188

APPLICABLE STANDARD DRAWINGS: New Standard Drawings E 802-TCSS-01 thru 15

APPLICABLE DESIGN MANUAL SECTION: 502

APPLICABLE SECTION OF GIFE: N.A.

APPLICABLE RECURRING SPECIAL PROVISIONS: N.A.

PAY ITEMS AFFECTED: It will be paid under the existing pay items

Overhead Sign Structure, Tri-chord _____ type .....Each

Tri-chord Sign Structure Foundation, _____ type .....Each

Submitted By: Richard Vancleave

Title: Roadway Policy and Standard Supervisor

Organization: INDOT

Phone Number: 317-232-5347

Date: 01/22/2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Ad hoc review by industry, subcommittee from INDOT traffic section, Traffic System Division.

REVISION TO SPECIFICATIONS, SPECIAL PROVISIONS AND DRAWINGS

802-T-188 OVERHEAD SIGN STRUCTURES (OLD BUSINESS ITEM)

(Note: Proposed changes have shown highlighted gray. Basis for Use: Required for contracts with any 802 pay items. Current RSP has an effective date: 03-01-13.)

802-T-188 OVERHEAD SIGN STRUCTURES

(Adopted 11-16-12)

The Standard Specifications are revised as follows:

SECTION 802, BEGIN LINE 67, DELETE AND INSERT AS FOLLOWS:

802.06 Placing Concrete

Placing concrete shall be in accordance with 702, except that foundations incorporated into sections of concrete barrier wall shall receive a finish in accordance with 702.21. Exposed concrete shall have a smooth surface and beveled edges.

Anchor bolt alignment shall be maintained during concrete placement. Temporary positioning plate and associated nuts shall be removed upon completion of the foundation. The threads shall be protected during concrete placement. Any damage to galvanized coating shall be repaired prior to assembly.

Conduit and grounding shall be in accordance with 807.

802.07 Installing Supports

(a) Posts

Posts shall be vertical after installation. All damaged posts shall be removed and replaced with an acceptable post.

Square sign post foundations shall be reinforced anchor base or unreinforced anchor base as shown on the plans. If sign post type A or sign post type B is specified, square sign posts may be used. Splicing of square steel sign posts will not be permitted.

In locations where class X excavation is encountered, the Engineer will determine the design for the installation of foundations. If the total length of the anchor bolts cannot be used, they shall be cut off. A steel plate measuring 6 by 6 by 1/2 in. ~~(150 by 150 by 13 mm),~~ shall be welded to the bottom of the bolts. The plate shall have a hole cut which allows the bolt to pass through it and the plate and bolt shall be completely welded together around the circumference of the bolt on both sides of the plate. No butt welding is allowed. The length of the bolts shall allow the plate to be covered by 3 to 4 in. ~~(75 to 100 mm)~~ of concrete at the bottom of the foundation.

(b) ~~Structural Frames~~*Overhead Sign Structures*

When erection of the structure has been started, it shall be completed the same day. The structure shall be loaded, to prevent vibration, by attaching signs or lighting supports the same day.

An oxidation inhibitor in accordance with 802.07(b)4 shall be applied to all surfaces that mate with a dissimilar material.

Fasteners for chord splice connections shall be high-strength bolts conforming to ASTM A 325 with matching lock nuts having nylon or steel inserts. Installation shall be in accordance with 711.65. Other bolts and hardware shall conform to the requirements of 910.19.

Fasteners shall be tightened by turn-of-nut tightening, calibrated wrench tightening, or direct tension indicator tightening. The calibrated wrench shall be calibrated by an acceptable tension measuring device such as a Skidmore-Wilhelm.

The base plate bolt tightening shall be as follows:

a. Lower nuts and washers shall be in full contact with the base plate,

b. The top nuts shall be tightened to 1/6 turn beyond snug fit,

c. The lower nuts shall be retightened to assure that full contact with the base plate has been maintained.

Damage that is detrimental to the structural integrity of the frame or aesthetic appearance shall be repaired.

~~Field welding of aluminum shall be in accordance with 803. Field welding of steel shall be in accordance with 711.32.~~ *No field welding will be allowed.*

The grounding connection shall be located 12 in. ~~(300 mm)~~ from the bottom of the support and shall be easily accessible from the structure manhole.

Traffic shall be maintained in accordance with 801.16 during installation.

1. Trusses

When placed on blocks to produce the required camber, the truss sections shall fit together at the flange connections with a minimum gap of 1/16 in. ~~(1.5 mm)~~ on any flange assembly. The total of the gaps in any one connection shall not exceed 1/8 in. ~~(3 mm).~~ Gaps shall be shimmed with tapered shims before tightening the flange bolts.

Vertical truss members and vertical diagonals shall be machined to provide a snug tube-to-tube fit to the chord along the entire edge before welding. Horizontal truss members and horizontal diagonals shall be slotted for the dimensions shown on the plans and welded to the gusset plates. They shall be sealed against water penetration.

Chord ~~plates~~*flanges* shall be machined from solid rounds. Mating surfaces shall be flat within 1/64 in. ~~(0.4 mm)~~. Flanges shall be given an additional finish if necessary to ensure contact between plates.

The cap bolts used to attach the top caps of end-support columns shall be located so as to miss the J hook.

The camber shown on the plans is for fabrication only. It shall be measured with the truss fully supported. The allowable camber tolerance is 25% of the specified camber value.

All signs and walkway brackets shall be placed as close to the brace points as possible. The Contractor shall verify that the dimensions are suitable for the type of fixture to be supplied.

2. Monotube

The required camber shall be achieved in accordance with the manufacturer's recommendations as detailed on the working drawings.

3. Cantilever Arms

Cantilever arms shall fit together at the flange connections between sections with a minimum gap of 1/16 in. ~~(1.5 mm)~~ on any flange assembly. The total of the gaps in any one connection shall not exceed 1/8 in. ~~(3 mm).~~ *Double arm chords are octagonal tubular shape with 0.14 in./ft taper. Quadri-chord arms are circular shape with constant diameter.*

4. Bridge Brackets

The location of the sign bracket may be shifted to avoid joints or stiffeners on the bridge. Before placing aluminum in contact with concrete, both the concrete and aluminum surfaces shall be coated with an aluminum-impregnated caulking compound. Where aluminum surfaces are to be placed in contact with steel, the steel surface shall be given 1 coat of zinc chromate paint and the aluminum surfaces shall be coated with an aluminum-impregnated caulking compound before placement. After the bolts have been tightened, the excess caulking compound shall be removed. All openings around the flanges shall be fully painted and shall be flush with the caulking compound.

802.08 Installing Signs

If new signs are to be installed on existing ~~structural frames~~*overhead sign structures*, the existing mounting hardware, if applicable, may be reused. Bolts, nuts, and washers shall not be reused. Additional new hardware may be required to complete the mounting. All such sign hangers protruding above the new signs shall be cut off flush to the top of the signs. Splicing or overlapping of sign hangers will not be permitted. All unused sign hangers and hardware shall be removed.

SECTION 802, BEGIN LINE 234, DELETE AND INSERT AS FOLLOWS:

802.11 Method of Measurement

Sheet signs and panel signs will be measured by the square foot ~~(square meter)~~. Sheet signs will be measured as the smallest dimensions of a square or rectangle large enough to make the sign. However, triangular or trapezoidal signs will be measured as the smallest triangle or trapezoid required to make the sign.

If the pay unit for sheet signs is shown in the Schedule of Pay Items as each, the number of sheet signs specified, including posts, hardware, and erection, will be measured by the number of units installed.

Sign posts will be measured by the linear foot ~~(meter)~~. Square sign posts will be measured from the top of the post to the termination of the post in the anchor base.

Traffic sign support foundations will be measured by the number of units of each type installed. No reduction will be made in a unit if class X material is encountered during foundation excavation.

If class X material is encountered during foundation excavation, the quantity to be measured will be that authorized and removed and in accordance with 206.10.

Structural steel, breakaway, will be measured by the pound ~~(kilogram)~~. Such measurement will include the weight ~~(mass)~~ of breakaway sections such as stubs, stiffeners, base plates, and fuse plates. For rigid sections, the weight ~~(mass)~~ of the base plate will be included.

Reference posts, including post, sign, and hardware, will be measured by the number of units installed.

Backfill of traffic sign support foundations will be measured in accordance with 211.09.

Overhead sign structures ~~and bridge bracket assemblies~~ will be measured by the number of units of each type installed.

Overhead sign structures to be removed will be measured by the number of structures removed.

802.12 Basis of Payment

The accepted quantities of sheet signs and panel signs will be paid for at the contract unit price per square feet ~~(square meter)~~, of the type and thickness specified, with legend, complete in place.

Sign post will be paid for at the contract unit price per linear foot ~~(meter)~~ for the type specified.

Structural steel, breakaway, will be paid for at the contract unit price per pound ~~(kilogram)~~.

Ground mounted sign support foundations will be paid for at the contract unit price per each type specified.

Reference posts will be paid for at the contract unit price per each, complete in place.

Payment for class X material encountered during a foundation excavation will be made in accordance with 206.11.

Payment for backfill of support foundations will be made in accordance with 211.10.

The removal of signs, overhead structures, and sign assemblies, will be paid for at the contract unit price per each.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
Box Truss Sign Structure Foundation, _____ type	EACH
~~Bridge Bracket Assembly~~	~~EACH~~
Cable Span Sign Structure Foundation, _____ type	EACH
Cantilever Sign Support Foundation, _____ type	EACH
Overhead Balanced Cantilever Sign Structure Foundation, _____ type	EACH
Overhead Sign Structure, *Box Truss* _____ type	EACH
Overhead Sign Structure, Bridge Bracket Assembly	*EACH*
Overhead Sign Structure, Butterfly Cantilever	*EACH*
Overhead Sign Structure, Cantilever _____ *type*	*EACH*
Overhead Sign Structure, Monotube	*EACH*
Overhead Sign Structure, _____, Remove type	EACH
Overhead Sign Structure, Tri-chord _____ *type*	*EACH*
Reference Post	EACH
Sign and Supports, Wide Flange, Remove	EACH

Sign Post, _____ type .....LFT ~~(m)~~
Sign Post, Square, _____ type, Reinforced Anchor Base .....LFT ~~(m)~~
Sign Post, Square, _____ type, Unreinforced Anchor Base .....LFT ~~(m)~~
Sign, Double Faced, Sheet, With Legend, _____ thickness ..... SFT ~~(m2)~~
Sign, Overhead, Remove.....EACH
Sign, Panel, Relocate.....EACH
Sign, Panel, Remove .....EACH
Sign, Panel, With Legend..... SFT ~~(m2)~~
Sign, Sheet Assembly, Relocate.....EACH
Sign, Sheet, and Supports, Remove .....EACH
Sign, Sheet, Relocate.....EACH
Sign, Sheet, Remove .....EACH
Sign, Sheet, With Legend.....EACH
Sign, Sheet, With Legend, _____ thickness..... SFT ~~(m2)~~
Structural Steel, Breakaway .....LBS ~~(kg)~~
Tri-chord Sign Structure Foundation, _____ type.....EACH
Wide Flange Sign Post Support Foundation, _____ type .....EACH

The cost of staking sign and sign structure locations, including materials and labor, shall be included in the cost of the pay items in this section.

The cost of all hardware necessary to assemble and attach the sign to its structural supports, all legend, and adjustments necessary to eliminate specular reflection shall be included in the cost of sheet sign or panel sign.

The cost of all hardware to attach the sign to its structural supports, the reflective sheeting on both faces, and all legend shall be included in the cost of double-faced sheet signs.

The cost of all necessary hardware including sign hangers, clips, and U bolts required for the mounting of signs to existing or new overhead sign structures shall be included in the cost of the sign.

The cost of modifying existing hardware to mount a new sign shall be included in the cost of the new sign.

The cost of the reinforced anchor base or unreinforced anchor base, angle bolts, and rivets shall be included in the cost of sign post, square.

The cost of identification markings for signs shall be included in the cost of the sign.

The cost of sign removal, existing post removal, and all mounting hardware necessary to attach the existing sign to new posts, shall be included in the cost of the sign relocation.

The cost of roadway and bridge reference signs and posts to be removed, stored, and reinstalled shall be included in the cost of other pay items, unless otherwise specified. Roadway and bridge reference signs which are damaged by the Contractor shall be replaced with no additional payment.

The cost of furnishing and applying aluminum-impregnated caulking compound and zinc chromate paint as required in 802.07, shall be included in the cost of the pay items in this section.

The cost of removal of signs, sign assemblies, sign lighting circuitry, supports, concrete foundations, backfill material, sodding, seeding, and necessary incidentals shall be included in the cost of overhead sign structure, remove.

The replacement of posts damaged by the Contractor's activities shall be without additional payment.

The cost of concrete, reinforcement, stub, anchor bolts, conduit, and all necessary hardware shall be included in the cost of the support foundation.

The cost of cutting the reinforcing bars and anchor bolts, furnishing the steel plate and welding the plate to the ends of the anchor bolts when class X excavation is encountered shall be included in the cost of the pay items in this section.

No additional payment will be made if square sign posts are used in lieu of type A or type B posts.

The cost of excavation, except for class X material, and necessary incidentals shall be included in the cost of the pay items in this section.

The cost of walkway assembly where applicable shall be included in the cost of overhead sign structure.

SECTION 910, BEGIN LINE 1266, DELETE AND INSERT AS FOLLOWS:

910.19 Overhead Sign Structures

The complete structure with signs in place shall be able to withstand wind pressure in accordance with AASHTO Standard Specifications for Structural Supports for

Highway Signs, Luminaires and Traffic Signals. The structure shall be designed to resist fatigue of the material in accordance with the AASHTO specifications.

All prefabricated structural units shall be packed so that there is no injury or defacement during transportation to the point of destination.

All bolts, nuts, and washers for bridge bracket assemblies shall be stainless steel in accordance with ASTM F 738M.

Strain poles for cable span signs shall be in accordance with 922.05(a). Each strain pole shall include 3 band type attachments for span wire clamps. Such attachments shall be galvanized in accordance with ASTM A 153. Cable shall be in accordance with 922.06(b). Each cable shall include 3 wire rope clips at each end. Anchor bolts shall be in accordance with 922.05(c)6. All sign mounting hardware except for the extruded aluminum bar shall be galvanized in accordance with ASTM A 153.

Gratings for the walkway shall be of aluminum in accordance with ASTM B 221, alloy 6061-T6 or 6063-T6. Cross bars and bent connecting bars shall be of aluminum in accordance with ASTM B 221, alloy 6061, 6063, or 3003 conforming to ASTM B 210.

Material furnished under this specification shall be covered by a type C certification in accordance with 916.

(a) Aluminum *Trusses for* Overhead Sign Structures, Box Truss and ~~Bridge Attached~~*Dynamic Message Sign Structure Truss*

Extruded tubes *and other shapes* shall be of aluminum in accordance with ASTM B 221~~ (B 221M)~~, B 241~~ (B 241M)~~, or B 429, alloy 6061-T6. All other castings shall be of aluminum in accordance with ASTM B 26~~ (B 26M)~~, alloy 356.0-T6. *Gusset, flange and stiffner* ~~P~~*p*lates shall be of aluminum in accordance with ASTM B 209~~ (B 209M)~~, alloy 6061-T6. Plates shall be free of sharp edges and irregularities.

~~Welding material and procedures shall be in accordance with 803 and applicable AWS provisions.~~

Bolts, nuts, screws, and flat washers shall be passivated type 304 stainless steel. Bolts and screws shall be in accordance with ASTM A 193~~ (A 193M)~~, grade B8. Hexagon nuts and washers shall be in accordance with ASTM A 194~~ (A 194M)~~, grade 8. High strength bolts, nuts and washers for chord splice connections, *with matching lock nuts having steel inserts,* shall be in accordance with 910.02(g) and shall be galvanized in accordance with AASHTO M 232, *class C or D*.

~~The J hook shall consist of one 3/8 in. (10 mm) steel bar in accordance with ASTM A 307. It shall be spot welded to the inside of the end support member. The J hook shall be hot dip galvanized prior to welding or in the final assembly with the support column.~~

Neoprene pads shall be ultraviolet rated *and shall conform to the requirements in 915.04*.

~~The safety cable shall be in accordance with 922.06(b).~~

~~Anchor bolts, nuts and washers shall be in accordance with ASTM F 1554, Grade 36. A hexagon nut, leveling nut, and flat washer shall be furnished with each anchor bolt. Top ends of anchor bolts and associated hardware as shown on the plans, shall be coated in accordance with ASTM A 153 or be mechanically galvanized and conform to the coating thickness, adherence, and quality requirements of ASTM A 153, class C.~~

Welding material and procedures shall be in accordance with 803 and applicable AWS provisions.

Certified proof of the qualifications for a minimum of 2 welders shall be presented after the contract is awarded and before fabrication is started. This certification shall be from a commercial or public testing laboratory and qualifications shall be based on welding of aluminum alloy, 6061-T6 with consumable electrode type welding using aluminum alloy ER5356 filler material. Welders shall qualify by passing the requirements of "Procedure and Performance Tests of Qualification Standard for Welding Procedures, Welders, and Welding Operations", latest edition, formulated by the Boiler and Pressure Vessel Committee of the American Society of Mechanical Engineers.

Welding shall be checked ~~carefully~~ by visual inspection. Poor welding workmanship ~~as noted by visual inspection~~ shall be ~~sufficient cause for~~ reject~~ion~~*ed*.

Each complete structure shall be ~~warranted that it is~~ free from any misfits or structural deficiencies prior to shipment.

(b) Steel Overhead Sign Structures, ~~Box Truss,~~ Cantilever, Monotube, *Tri-Chord,* ~~and~~ Bridge Attached, *and End Supports for Box Truss and Dynamic Message Sign Structure*

End-support members for box truss and dynamic message sign structure shall be fabricated from constant cross-section tubular steel or extruded steel shapes as indicated on the drawings. Sections used for end-support columns, diagonal and horizontal members shall be constant cross-section tubular members in accordance with ASTM A 53, type E or S, grade B, minimum yield strength of 35,000 psi. Constant cross-section tubular steel with greater yield strength may be used with written approval, however, structural dimensions must remain as shown on the plans. Sections used for cross support beams shall be constant cross-section extruded W-shapes in accordance with ASTM A 709, grade 36. Base plates shall be in accordance with ASTM A 36. Base plates for columns shall develop the full strength of the columns. Structures shall be galvanized after fabrication in accordance with ASTM A 123.

REVISION TO SPECIFICATIONS, SPECIAL PROVISIONS AND DRAWINGS

802-T-188 OVERHEAD SIGN STRUCTURES (OLD BUSINESS ITEM)

Support columns for the cantilever structure shall be fabricated from constant cross-section tubular steel as indicated on the drawings. Column sections shall be in accordance with ASTM A 53, type E or S, grade B as shown on the plans. Members shall have minimum yield strength of 35,000 psi. Constant cross-section tubular steel with greater yield strength may be used, with written approval, however, structural dimensions must remain as shown on the plans. Base plates shall be in accordance with ASTM A 36. Base plates shall develop the full strength of the columns.

Cantilever arms shall be either double arms or quadri-chord trusses as shown on the plans.

Cantilever arms shall be fabricated from octagonal tubular member with 0.14 in./ft taper and in accordance with ASTM A 595 or ASTM A 572, grade 50. Quadri-chord arms shall be of constant cross-section tubular members in accordance with ASTM A 53, type E or S, grade B as shown on the plans. Members shall have minimum yield strength of 35,000 psi. Steel with greater yield strength may be used, with written approval, however, structural dimensions must remain as shown on the plans. Structures shall be galvanized after fabrication in accordance with ASTM A 123. Plates shall be free of sharp edges and irregularities.

High strength bolts, nuts and washers for chord to column connections, with matching lock nuts having steel inserts, shall be in accordance with 910.02(g) and shall be galvanized in accordance with AASHTO M 232, class C or D.

Bolts, U-bolts, nuts, screws, and flat washers shall be passivated type 304 stainless steel. Bolts and screws shall be in accordance with ASTM A 193, grade B8. Hexagon nuts and washers shall be in accordance with ASTM A 194, grade 8.

~~Steel sections used for upright members, cross beams, or horizontal members shall be either tapered or constant cross section tubular members as specified herein. The tubular members may be either circular or multi-sided.~~

~~Box truss and b~~*B*ridge attached structures shall be fabricated from constant cross section tubular steel in accordance with ASTM A 53, type E or S, grade B (minimum yield strength of 35,000 psi). Constant cross section tubular steel with greater yield strength may be used, with written approval. However, structural dimensions must remain as shown on the plans. Structures shall be galvanized after fabrication in accordance with ASTM A 123.

Tri-chord truss~~, cantilever, and monotube~~ structures shall be made of ~~tapered tubular members in accordance with either ASTM A 595 or ASTM A 572, grade 50 (A 572M, grade 345), or of~~ constant cross section tubular members in accordance with ~~API High Test Line Pipe, grade X 52~~ *ASTM A53, type E or S, grade B minimum yield strength of 35,000 psi*~~. Members shall have a minimum yield strength of 50,000 psi (345 MPa)~~. *Monotube structures shall be made of tapered tubular members in accordance*

with either ASTM A 595 or ASTM A 573, grade 50. Structures shall be galvanized after fabrication in accordance with ASTM A 123.

The J hook shall consist of one 3/8-in. steel bar in accordance with ASTM A 307. It shall be spot welded to the inside of the end-support member. The J hook shall be hot-dip galvanized prior to welding or in the final assembly with the support column.

Anchor bolts, nuts, and washers shall be in accordance with ASTM F 1554, grade 36. A hexagon nut, leveling nut, and flat washer shall be furnished with each anchor bolt. Top ends of anchor bolts and associated hardware as shown on the plans, shall be coated in accordance with ASTM A 153 or be mechanically galvanized and conform to the coating thickness, adherence, and quality requirements of ASTM A 153, class C.

Base plate skirts shall be 10 gage galvanized steel.

Welding material and procedures shall be in accordance with 711.32 and applicable AWS provisions.

Welding shall be checked by visual inspection. Poor welding workmanship shall be rejected.

Each complete structure shall be free from any misfits or structural deficiencies prior to shipment.

Strain poles shall be anchor bolt type complete with hand-holes and pole top or cap. They shall meet the requirements set out above for cantilever sign structures. Each pole is to include 3 band type attachments for span wire clamps. The band shall be from material in accordance with ASTM A 572, grade 50 ~~(A 572M, grade 345)~~; ASTM A 606; or approved equal. The bands shall not be of the U-bolt type. The poles shall have maximum deflections as shown below when loaded 18 in. ~~(450 mm)~~ from the top with a 100 lb ~~(445 N)~~ load.

Pole Size	**Deflection**
15 in. by 30 in. ~~(380 mm by 910 mm)~~	0.16 in. ~~(4.1 mm)~~
14 in. by 26 in. ~~(356 mm by 790 mm)~~	0.12 in. ~~(3.0 mm)~~

The steel flanges at the center of the cross beam and at the ends of the horizontal arms shall be fastened to the tapered or straight sections by means of 2 circumferential welds. One of the circumferential welds shall weld the outside of the flange firmly to the tube. The flange connection shall develop fully the strength of the tubular sections being joined together by means of the flange connections.

REVISION TO SPECIFICATIONS, SPECIAL PROVISIONS AND DRAWINGS

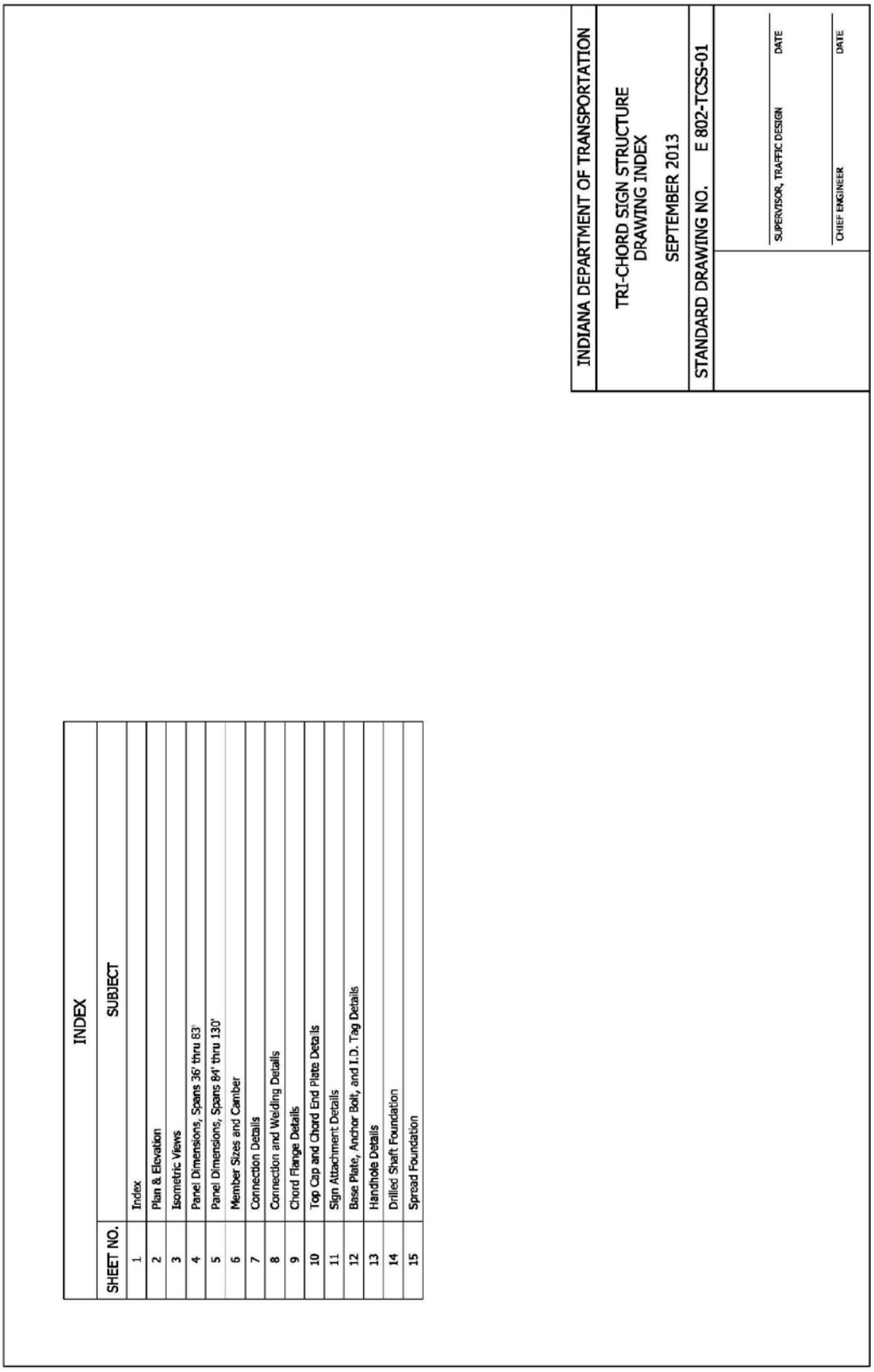
802-T-188 OVERHEAD SIGN STRUCTURES (OLD BUSINESS ITEM)

Gusset, flange, and base plates shall be in accordance with ASTM A 36 ~~(A 36M)~~ and shall be galvanized after fabrication in accordance with ASTM A 123. Base plates for upright poles shall develop the full strength of the poles. Castings for the vertical pole top and horizontal arm and cap shall be in accordance with ASTM A 126 and shall be galvanized with a minimum coating of 2 oz/sq ft ~~(610 g/m^2)~~. Bolts and nuts, except anchor bolts, shall be in accordance with ASTM A 325, ~~T~~*t*ype 1. Two nuts for use in plumbing upright poles shall be furnished with each anchor bolt. Anchor bolts for overhead steel structures shall be in accordance with 910.19(a). Steel bolts, nuts, washers, and the top ends of anchor bolts shall be coated in accordance with ASTM A 153 or be mechanically galvanized and conform to the coating thickness, adherence, and quality requirements of ASTM A 153, class C. Welding shall be in accordance with 711.32.

Beam clamp details and sign support assemblies shall be galvanized in accordance with ASTM A 153. Clamps shall be fabricated of high strength, low alloy steel in accordance with ASTM A 242 ~~(A 242M)~~, ASTM A 606, or approved equal. Stainless steel U-bolts may be used in lieu of the clamps for the attachment of the sign hangers to the arms of double arm cantilevers. The U-bolts shall be in accordance with 910.19(a) for stainless steel hardware.

REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS

PROPOSED NEW 802-TCSS-01 TRI-CHORD SIGN STRUCTURE DRAWING INDEX



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3	Isometric Views
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7	Connection Details
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11	Sign Attachment Details
12	Base Plate, Anchor Bolt, and I.D. Tag Details
13	Handhole Details
14	Drilled Shaft Foundation
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INDIANA DEPARTMENT OF TRANSPORTATION

TRI-CHORD SIGN STRUCTURE
DRAWING INDEX

SEPTEMBER 2013

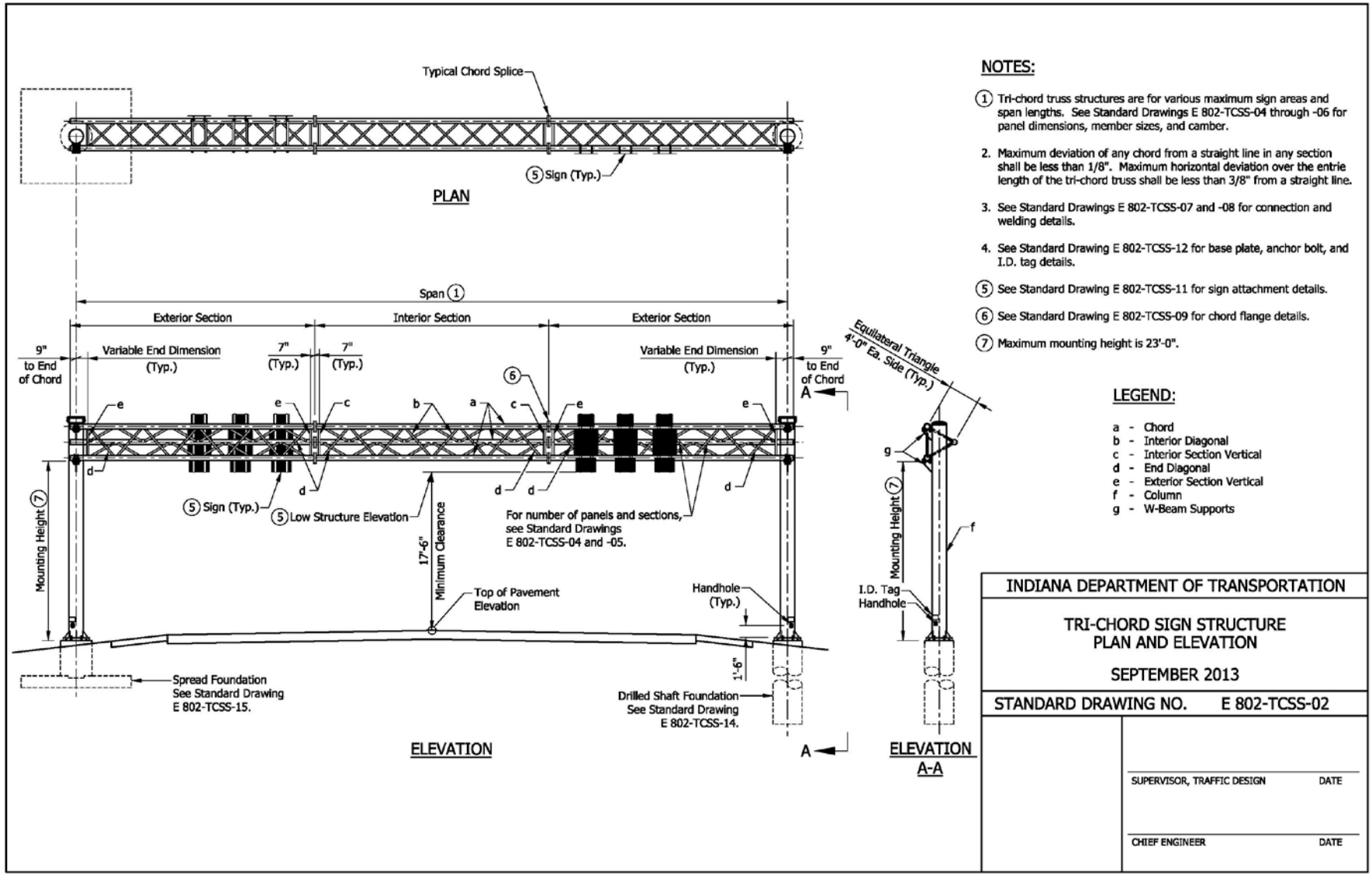
STANDARD DRAWING NO. E 802-TCSS-01

SUPERVISOR, TRAFFIC DESIGN DATE

CHIEF ENGINEER DATE

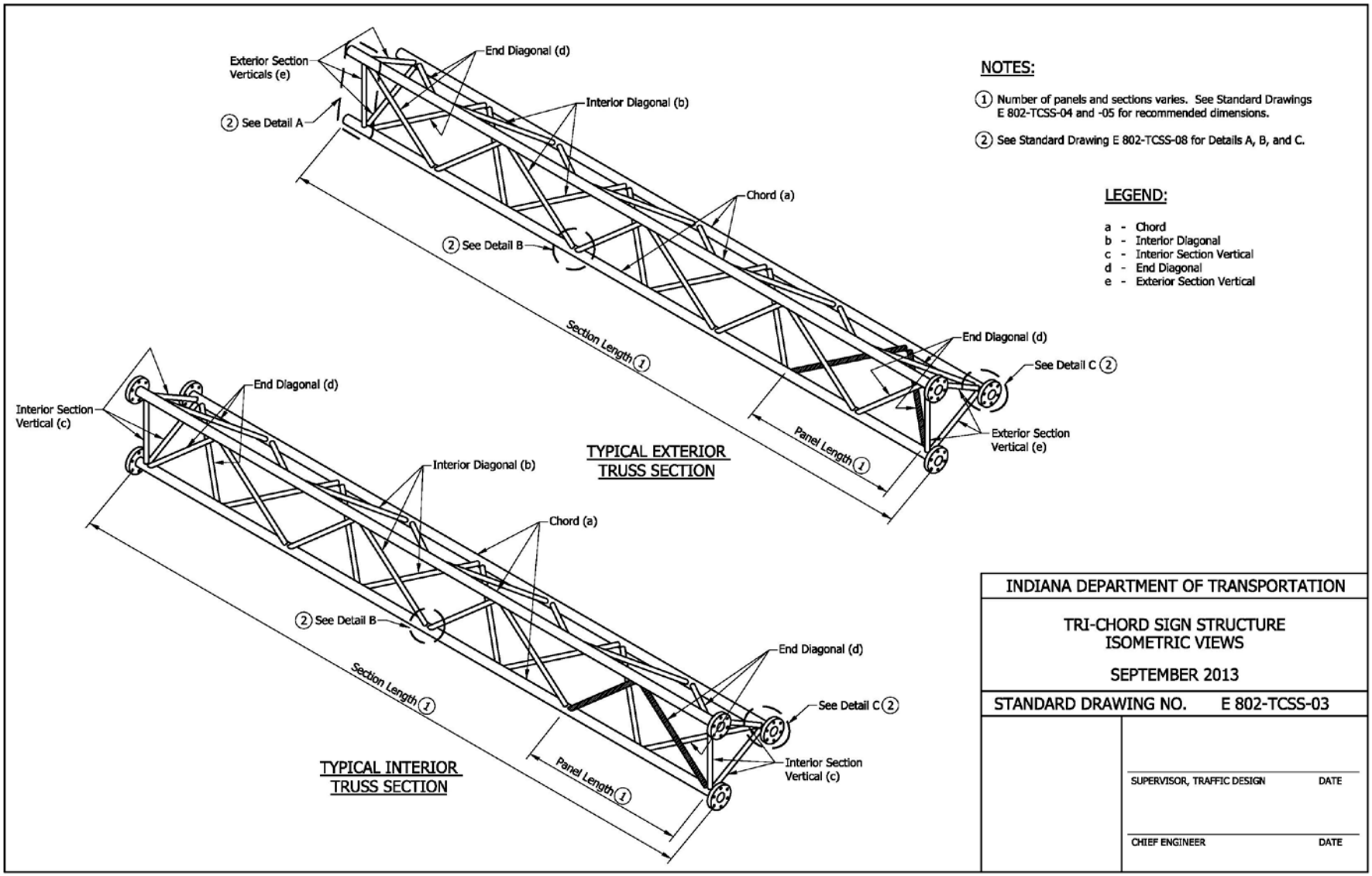
REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

PROPOSED NEW 802-TCSS-02 TRI-CHORD SIGN STRUCTURE PLAN AND ELEVATION



REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

PROPOSED NEW 802-TCSS-03 TRI-CHORD SIGN STRUCTURE ISOMETRIC VIEWS



REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

PROPOSED NEW 802-TCSS-04 TRI-CHORD SIGN STRUCTURE PANEL DIMENSIONS SPANS 36’ THRU 83’

RECOMMENDED PANEL DIMENSIONS FOR TRI-CHORD (36' THROUGH 83')

SPAN	EXTERIOR SECTIONS					INTERIOR SECTIONS			
SPAN-TRUSS LENGTH (FT)	NO. OF EXT. SEC.	NO. OF EXT. PANELS PER SEC.	VARIABLE END DIMENSION	PANEL LENGTH	SECTION LENGTH	NO. OF INT. SEC.	NO. OF INT. PANELS PER SEC.	PANEL LENGTH	SECTION LENGTH
36	2	5	1'-2"	3'-3"	18'-9"				
37	2	5	1'-3"	3'-4"	19'-3"				
38	2	5	1'-4"	3'-5"	19'-9"				
39	2	5	1'-5"	3'-6"	20'-3"				
40	2	5	1'-6"	3'-7"	20'-9"				
41	2	5	1'-7"	3'-8"	21'-3"				
42	2	6	1'-5"	3'-2"	21'-9"				
43	2	6	1'-5"	3'-3"	22'-3"				
44	2	6	1'-5"	3'-4"	22'-9"				
45	2	6	1'-5"	3'-5"	23'-3"				
46	2	7	1'-5"	3'-0"	23'-9"				
47	2	7	1'-4"	3'-1"	24'-3"				
48	2	7	1'-6 1/2"	3'-1 1/2"	24'-9"				
49	2	7	1'-5 1/2"	3'-2 1/2"	25'-3"				
50	2	7	1'-4 1/2"	3'-3 1/2"	25'-9"				
51	2	7	1'-7"	3'-4"	26'-3"				
52	2	7	1'-6"	3'-5"	26'-9"				
53	2	7	1'-5"	3'-6"	27'-3"				
54	2	7	1'-4"	3'-7"	27'-9"				
55	2	7	1'-6 1/2"	3'-7 1/2"	28'-3"				
56	2	7	1'-5 1/2"	3'-8 1/2"	28'-9"				
57	2	7	1'-4 1/2"	3'-9 1/2"	29'-3"				
58	2	7	1'-7"	3'-10"	29'-9"				
59	2	6	1'-4"	3'-0"	20'-8"	1	6	3'-0"	19'-2"
60	2	6	1'-5 1/2"	3'-1/2"	21'-1/2"	1	6	3'-1/2"	19'-5"
61	2	6	1'-7"	3'-1"	21'-5"	1	6	3'-1"	19'-8"
62	2	6	1'-8 1/2"	3'-1 1/2"	21'-9 1/2"	1	6	3'-1 1/2"	19'-11"
63	2	6	1'-10"	3'-2"	22'-2"	1	6	3'-2"	20'-2"
64	2	6	1'-7"	3'-3"	22'-5"	1	6	3'-3"	20'-8"
65	2	6	1'-8 1/2"	3'-3 1/2"	22'-9 1/2"	1	6	3'-3 1/2"	20'-11"
66	2	6	1'-10"	3'-4"	23'-2"	1	6	3'-4"	21'-2"
67	2	6	1'-7"	3'-5"	23'-5"	1	6	3'-5"	21'-8"
68	2	6	1'-8 1/2"	3'-5 1/2"	23'-9 1/2"	1	6	3'-5 1/2"	21'-11"
69	2	6	1'-10"	3'-6"	24'-2"	1	6	3'-6"	22'-2"
70	2	6	1'-9"	3'-2 1/2"	22'-4"	1	8	3'-2 1/2"	26'-10"
71	2	6	1'-5"	3'-3 1/2"	22'-6"	1	8	3'-3 1/2"	27'-6"
72	2	6	1'-6"	3'-4"	22'-10"	1	8	3'-4"	27'-10"
73	2	6	1'-7"	3'-4 1/2"	23'-2"	1	8	3'-4 1/2"	28'-2"
74	2	6	1'-8"	3'-5"	23'-6"	1	8	3'-5"	28'-6"
75	2	6	1'-4"	3'-6"	23'-8"	1	8	3'-6"	29'-2"
76	2	6	1'-5"	3'-6 1/2"	24'-0"	1	8	3'-6 1/2"	29'-6"
77	2	6	1'-6"	3'-7"	24'-4"	1	8	3'-7"	29'-10"
78	2	6	1'-7"	3'-7 1/2"	24'-8"	1	8	3'-7 1/2"	30'-2"
79	2	6	1'-8"	3'-8"	25'-0"	1	8	3'-8"	30'-6"
80	2	6	1'-4"	3'-9"	25'-2"	1	8	3'-9"	31'-2"
81	2	6	1'-5"	3'-9 1/2"	25'-6"	1	8	3'-9 1/2"	31'-6"
82	2	6	1'-6"	3'-10"	25'-10"	1	8	3'-10"	31'-10"
83	2	6	1'-7"	3'-10 1/2"	26'-2"	1	8	3'-10 1/2"	32'-2"

NOTES:

1. All panels on a truss shall be the same length. The minimum panel length is 3'-0" and the maximum is 4'-0".
2. A single interior unit shall have an even number of panels to maintain the pattern of the diagonals.
3. Use minimum number of sections for each truss. Keep the maximum section length at 35'-0".
4. See Standard Drawing E 802-TCSS-05 for required camber.

INDIANA DEPARTMENT OF TRANSPORTATION

TRI-CHORD SIGN STRUCTURE
PANEL DIMENSIONS
SPANS 36' THRU 83'
SEPTEMBER 2013

STANDARD DRAWING NO. E 802-TCSS-04

SUPERVISOR, TRAFFIC DESIGN DATE

CHIEF ENGINEER DATE

REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

PROPOSED NEW 802-TCSS-05 TRI-CHORD SIGN STRUCTURE PANEL DIMENSIONS SPANS 84’ THRU 130’

RECOMMENDED PANEL DIMENSIONS FOR TRI-CHORD (84' THROUGH 130')

SPAN	EXTERIOR SECTIONS					INTERIOR SECTIONS			
SPAN-TRUSS LENGTH (FT)	NO. OF EXT. SEC.	NO. OF EXT. PANELS PER SEC.	VARIABLE END DIMENSION	PANEL LENGTH	SECTION LENGTH	NO. OF INT. SEC.	NO. OF INT. PANELS PER SEC.	PANEL LENGTH	SECTION LENGTH
84	2	6	1'-8"	3'-11"	26'-6"	1	8	3'-11"	32'-6"
85	2	6	1'-9"	3'-11 1/2"	26'-10"	1	8	3'-11 1/2"	32'-10"
86	2	6	1'-10"	4'-0"	27'-2"	1	8	4'-0"	33'-2"
87	2	7	1'-6 1/2"	3'-8 1/2"	28'-10"	1	8	3'-8 1/2"	33'-10"
88	2	7	1'-7"	3'-9"	29'-2"	1	8	3'-9"	31'-2"
89	2	7	1'-7 1/2"	3'-9 1/2"	29'-6"	1	8	3'-9 1/2"	31'-6"
90	2	7	1'-8"	3'-10"	29'-10"	1	8	3'-10"	31'-10"
91	2	7	1'-8 1/2"	3'-10 1/2"	30'-2"	1	8	3'-10 1/2"	32'-2"
92	2	8	1'-8"	3'-8"	32'-4"	1	8	3'-5 1/2"	28'-10"
93	2	8	1'-8"	3'-8 1/2"	32'-8"	1	8	3'-6"	29'-2"
94	2	8	1'-8"	3'-9"	33'-0"	1	8	3'-6 1/2"	29'-6"
95	2	8	1'-8"	3'-9 1/2"	33'-4"	1	8	3'-7"	29'-10"
96	2	8	1'-8"	3'-10"	33'-8"	1	8	3'-7 1/2"	30'-2"
97	2	8	1'-8"	3'-10 1/2"	34'-0"	1	8	3'-8"	30'-6"
98	2	8	1'-8"	3'-11"	34'-4"	1	8	3'-8 1/2"	30'-10"
99	2	8	1'-8"	3'-11 1/2"	34'-8"	1	8	3'-9"	31'-2"
100	2	8	1'-8"	4'-0"	35'-0"	1	8	3'-9 1/2"	31'-6"
101	2	8	1'-10 1/2"	3'-1 1/2"	28'-2 1/2"	1	7	3'-1 1/2"	23'-1/2"
102	2	8	1'-9"	3'-2"	28'-5"	1	7	3'-2"	23'-4"
103	2	8	1'-7 1/2"	3'-2 1/2"	28'-7 1/2"	1	7	3'-2 1/2"	23'-7 1/2"
104	2	8	1'-6"	3'-3"	28'-10"	1	7	3'-3"	23'-11"
105	2	8	1'-4 1/2"	3'-3 1/2"	29'-0 1/2"	1	7	3'-3 1/2"	24'-2 1/2"
106	2	8	1'-10 1/2"	3'-3 1/2"	29'-6 1/2"	1	7	3'-3 1/2"	24'-2 1/2"
107	2	8	1'-9"	3'-3 1/2"	29'-9"	1	7	3'-4"	24'-6"
108	2	8	1'-7 1/2"	3'-4 1/2"	29'-11 1/2"	1	7	3'-4 1/2"	24'-9 1/2"
109	2	8	1'-6"	3'-5"	30'-2"	1	7	3'-5"	25'-1"
110	2	8	1'-8 1/4"	3'-5 1/4"	30'-6 1/4"	1	7	3'-5 1/4"	25'-2 3/4"
111	2	8	1'-10 1/2"	3'-5 1/2"	30'-5 1/4"	1	7	3'-5 1/2"	25'-4 1/2"
112	2	8	1'-9"	3'-6"	31'-1"	1	7	3'-6"	25'-8"
113	2	8	1'-7 1/2"	3'-6 1/2"	31'-3 1/2"	1	7	3'-6 1/2"	25'-11 1/2"
114	2	8	1'-6"	3'-7"	31'-6"	1	7	3'-7"	26'-3"
115	2	8	1'-8 1/4"	3'-7 1/4"	31'-10 1/4"	1	7	3'-7 1/4"	26'-4 3/4"
116	2	8	1'-10 1/2"	3'-7 1/2"	32'-2 1/2"	1	7	3'-7 1/2"	26'-6 1/2"
117	2	8	1'-9"	3'-8"	32'-5"	1	7	3'-8"	26'-10"
118	2	8	1'-7 1/2"	3'-8 1/2"	32'-7 1/2"	1	7	3'-8 1/2"	27'-1 1/2"
119	2	8	1'-6"	3'-9"	32'-10"	1	7	3'-9"	27'-5"
120	2	8	1'-8 1/4"	3'-9 1/4"	33'-2 1/4"	1	7	3'-9 1/4"	27'-6 3/4"
121	2	8	1'-10 1/2"	3'-9 1/2"	33'-6 1/2"	1	7	3'-9 1/2"	27'-8 1/2"
122	2	8	1'-9"	3'-10"	33'-9"	1	7	3'-10"	28'-0"
123	2	8	1'-9"	3'-5 1/2"	30'-9"	1	8	3'-9 1/2"	31'-6"
124	2	8	1'-11"	3'-5 1/2"	30'-11"	1	8	3'-10"	31'-10"
125	2	8	1'-9"	3'-6"	31'-1"	1	8	3'-10 1/2"	32'-2"
126	2	8	1'-7"	3'-6 1/2"	31'-3"	1	8	3'-11"	32'-6"
127	2	8	1'-9"	3'-7"	31'-9"	1	8	3'-11"	32'-6"
128	2	8	1'-11"	3'-7 1/2"	32'-3"	1	8	3'-11"	32'-6"
129	2	8	1'-9"	3'-8"	32'-5"	1	8	3'-11 1/2"	32'-10"
130	2	8	1'-7"	3'-8 1/2"	32'-7"	1	8	4'-0"	33'-2"

NOTES:

1. All panels on a truss shall be the same length. The minimum panel length is 3'-0" and the maximum is 4'-0".
2. A single interior unit shall have an even number of panels to maintain the pattern of the diagonals.
3. Use minimum number of sections for each truss. Keep the maximum section length at 35'-0".
4. See Standard Drawing E 802-TCSS-05 for required camber.

INDIANA DEPARTMENT OF TRANSPORTATION

TRI-CHORD SIGN STRUCTURE
PANEL DIMENSIONS
SPANS 84' THRU 130'
SEPTEMBER 2013

STANDARD DRAWING NO. E 802-TCSS-05

SUPERVISOR, TRAFFIC DESIGN DATE

CHIEF ENGINEER DATE

REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

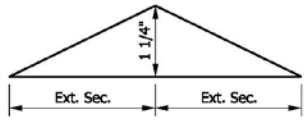
PROPOSED NEW 802-TCSS-06 TRI-CHORD SIGN STRUCTURE MEMBER SIZES AND CAMBER

TRI-CHORD SIGN STRUCTURE MEMBER SIZES

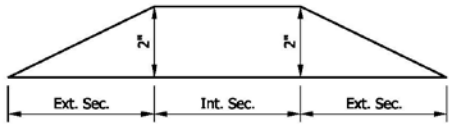
TRUSS TYPE	MAX SIGN AREA (SQ FT)	MAX MOUNTING HEIGHT, H	MAX SPAN (FT)	TRUSS MEMBERS										END SUPPORT MEMBERS		
				CHORD a		INT. DIAGONALS b		INT. SECTION VERT. c		END DIAGONALS d		EXT. SECTION VERT. e		COLUMN f		W-BEAM g
				DIAM. (IN.)	THICK (IN.)	DIAM. (IN.)	THICK (IN.)	DIAM. (IN.)	THICK (IN.)	DIAM. (IN.)	THICK (IN.)	DIAM. (IN.)	THICK (IN.)	DIAM. (IN.)	THICK (IN.)	
A	120	23'-0"	80	5.563	0.375	1.900	0.145	1.900	0.200	2.875	0.276	1.900	0.145	18.000	0.562	W 12 x 35
B			100	5.563	0.375	2.375	0.218	1.900	0.200	2.875	0.375	2.375	0.218	18.000	0.562	W 12 x 35
C			130	5.563	0.500	2.375	0.218	1.900	0.200	2.875	0.375	2.375	0.218	20.000	0.500	W 12 x 58
D	240	23'-0"	80	5.563	0.625	2.375	0.343	1.900	0.200	2.875	0.552	2.375	0.343	18.000	0.750	W 12 x 35
E			100	5.563	0.625	2.375	0.343	1.900	0.200	2.875	0.552	2.375	0.343	20.000	0.812	W 12 x 35
F			130	6.625	0.562	2.375	0.343	1.900	0.200	3.500	0.437	2.375	0.343	22.000	0.875	W 12 x 58

LEGEND:

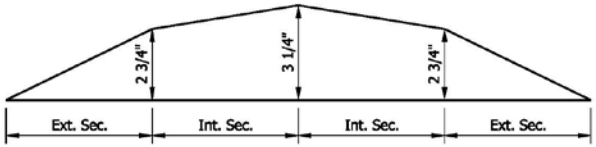
a - Chord
b - Interior Diagonal
c - Interior Section Vertical
d - End Diagonal
e - Exterior Section Vertical
f - Column
g - W-Beam Support



CAMBER DIAGRAM (2-Section Truss)



CAMBER DIAGRAM (3-Section Truss)



CAMBER DIAGRAM (4-Section Truss)

INDIANA DEPARTMENT OF TRANSPORTATION

TRI-CHORD SIGN STRUCTURE
MEMBER SIZES AND CAMBER

SEPTEMBER 2013

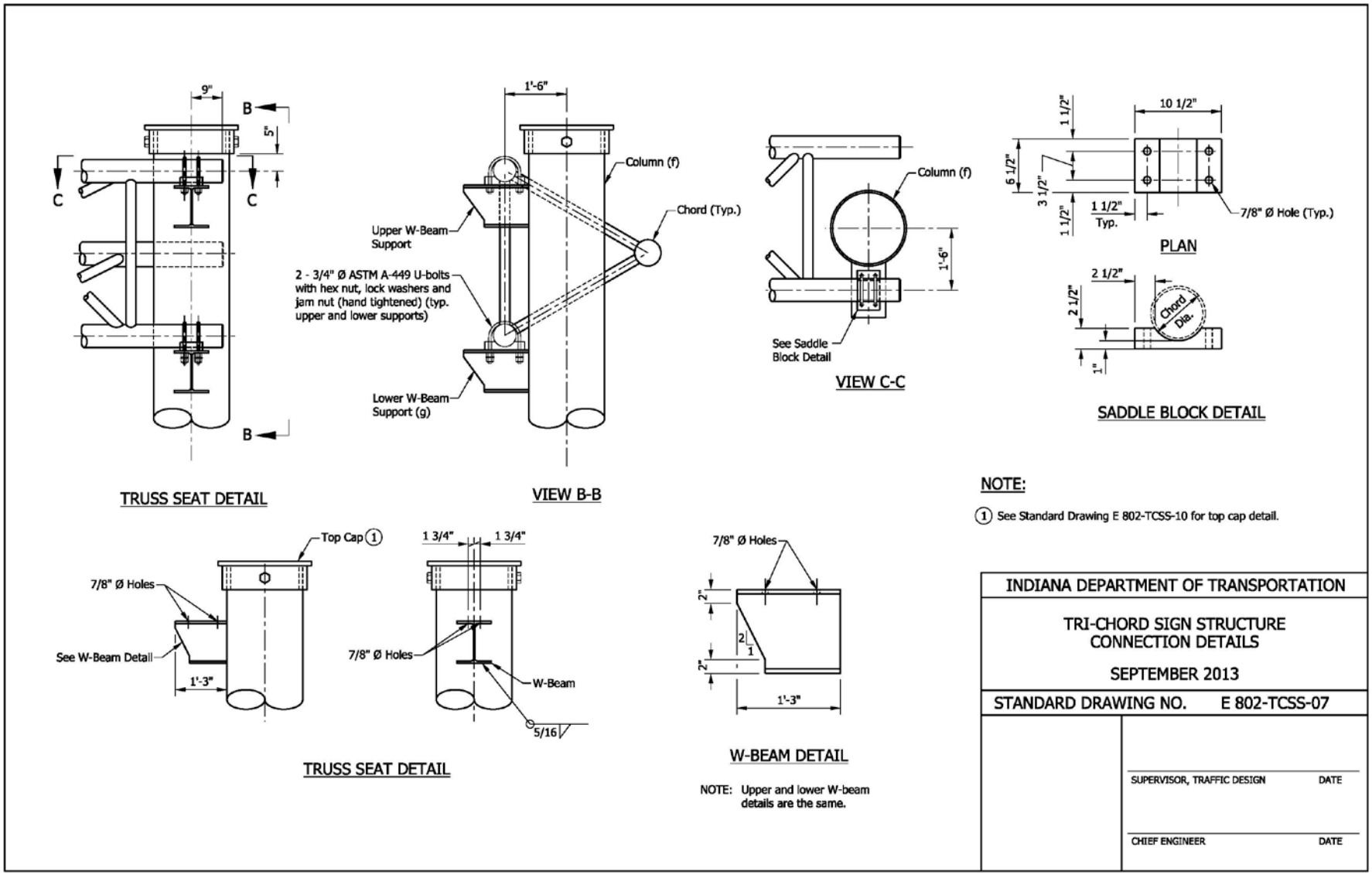
STANDARD DRAWING NO. E 802-TCSS-06

SUPERVISOR, TRAFFIC DESIGN DATE

CHIEF ENGINEER DATE

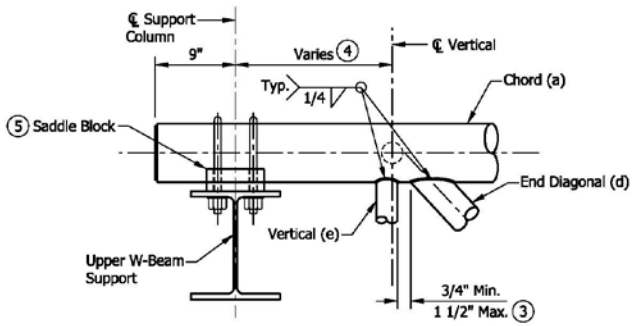
REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

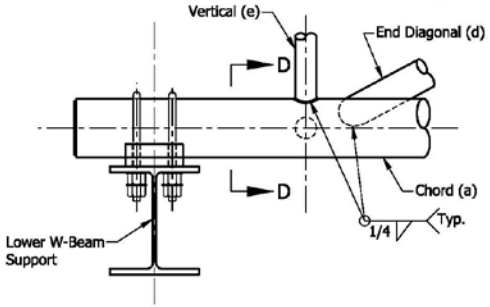
PROPOSED NEW 802-TCSS-07 TRI-CHORD SIGN STRUCTURE CONNECTION DETAILS



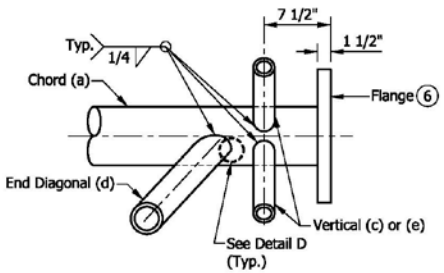
REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

PROPOSED NEW 802-TCSS-08 TRI-CHORD SIGN STRUCTURE CONNECTION AND WELDING DETAILS

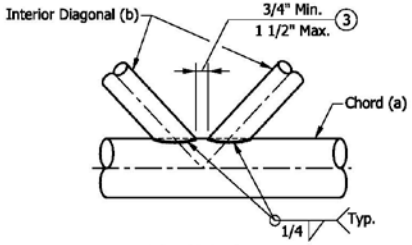




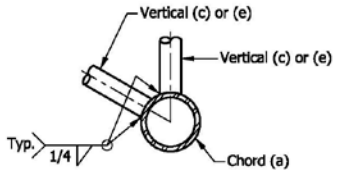
DETAIL A
SUPPORT END DETAIL FOR EXTERIOR SECTION



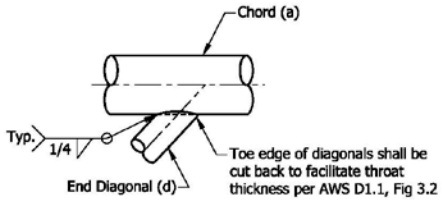
DETAIL C
TYPICAL PANEL CONNECTION



DETAIL B
TYPICAL PANEL CONNECTION



SECTION D-D
TYPICAL JOINT DETAILS



DETAIL D

NOTES:

1. All bracing members shall be machined to provide a snug fit to the chord members along the entire edge of bracing members before welding.
2. See Standard Drawing E 802-TCSS-03 for member location and see Standard Drawing E 802-TCSS-06 for member sizes.
3. Vertical and horizontal diagonals shall be detailed for minimum offset from the panel point based on the following: offset shall be such as to provide a 3/4" minimum to 1 1/2" maximum clearance between any diagonal and any horizontal or vertical member, and to provide clearance for U-bolt connections of signs.
4. Variable end dimension. See Standard Drawings E 802-TCSS-04 and -05 for table of recommended dimensions.
5. See Standard Drawing E 802-TCSS-07 for saddle block details.
6. See Standard Drawing E 802-TCSS-09 for chord flange details.

INDIANA DEPARTMENT OF TRANSPORTATION

TRI-CHORD SIGN STRUCTURE CONNECTION AND WELDING DETAILS

SEPTEMBER 2013

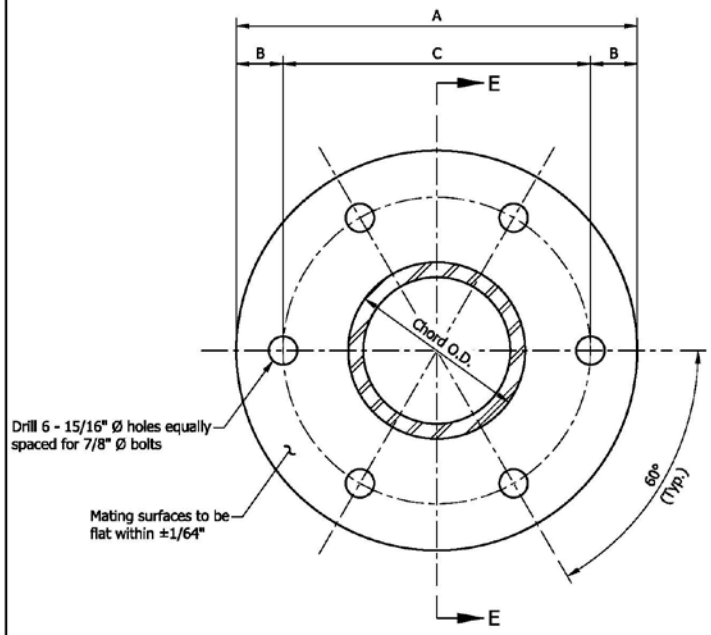
STANDARD DRAWING NO. E 802-TCSS-08

SUPERVISOR, TRAFFIC DESIGN DATE

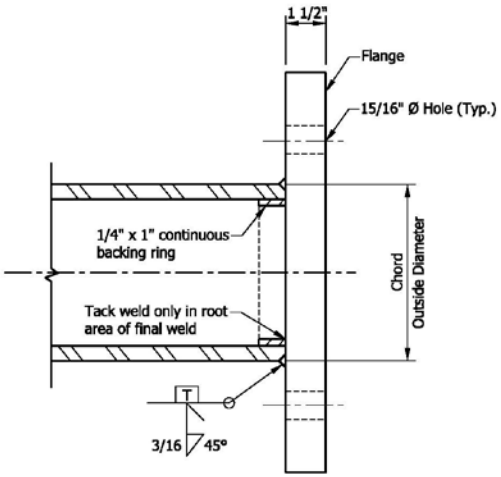
CHIEF ENGINEER DATE

REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

PROPOSED NEW 802-TCSS-09 TRI-CHORD SIGN STRUCTURE CHORD FLANGE DETAILS



FLANGE DETAIL



SECTION E-E

NOTES:

1. Mating surfaces to be flat within ±1/64". Flange shall be given additional finish if necessary to ensure contact between plates.
2. Use Type I ASTM A325 bolts with matching lock nuts. Lock nuts should have nylon or steel inserts.
3. Bolts and lock nuts must be hot dip galvanized in accordance with AASHTO M 232.
4. Install high strength bolts in accordance with 711.65.

DIMENSION TABLE				
TRUSS CHORD O.D.	BOLT SIZE	A	B	C
6.625"	7/8"	14"	2"	10"
5.625"	7/8"	13"	2"	9"

INDIANA DEPARTMENT OF TRANSPORTATION

TRI-CHORD SIGN STRUCTURE
CHORD FLANGE DETAILS

SEPTEMBER 2013

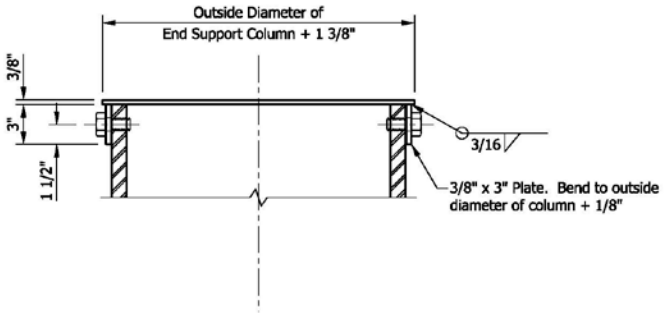
STANDARD DRAWING NO. E 802-TCSS-09

SUPERVISOR, TRAFFIC DESIGN DATE

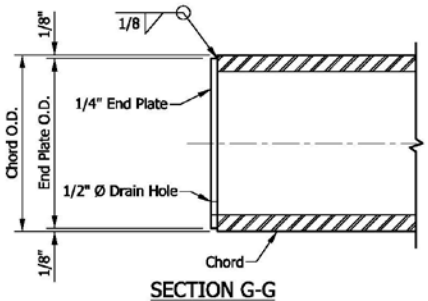
CHIEF ENGINEER DATE

REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

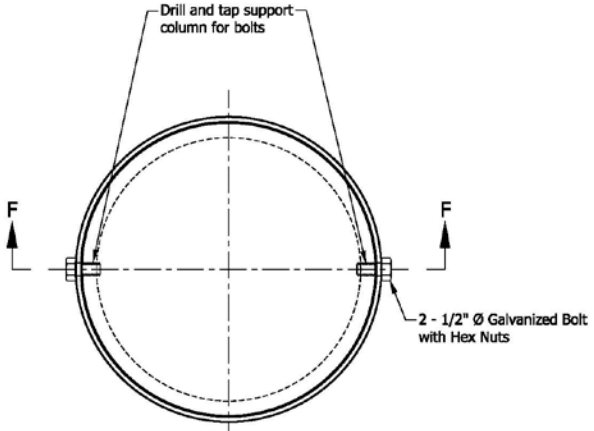
PROPOSED NEW 802-TCSS-10 TRI-CHORD SIGN STRUCTURE TOP CAP AND CHORD END PLATE DETAILS



SECTION F-F

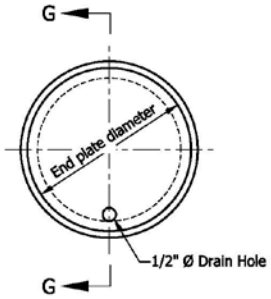


SECTION G-G



PLAN

COLUMN TOP CAP DETAIL



END VIEW

CHORD END PLATE DETAIL

INDIANA DEPARTMENT OF TRANSPORTATION

TRI-CHORD SIGN STRUCTURE
TOP CAP AND CHORD END PLATE DETAILS

SEPTEMBER 2013

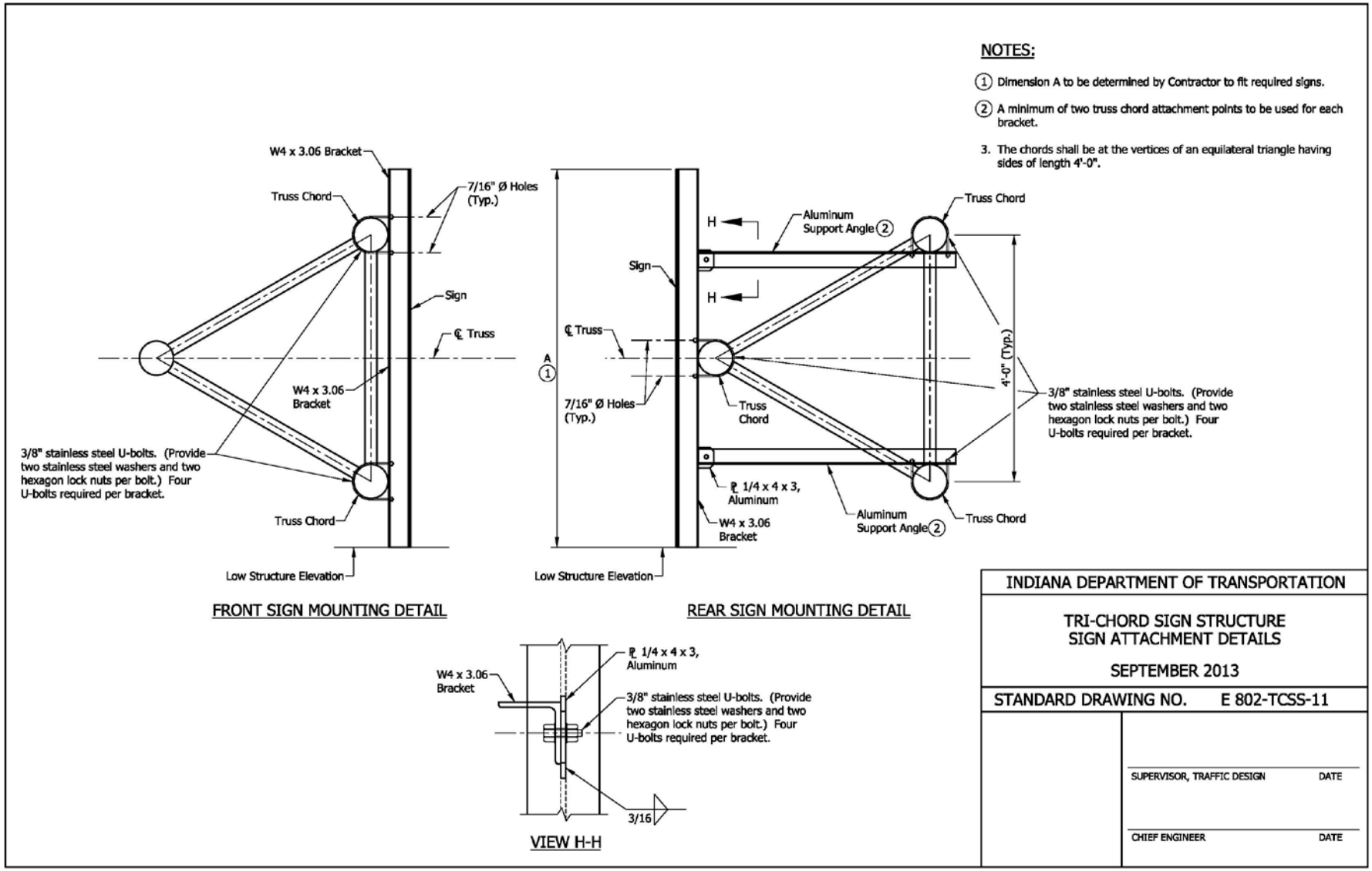
STANDARD DRAWING NO. E 802-TCSS-10

SUPERVISOR, TRAFFIC DESIGN DATE

CHIEF ENGINEER DATE

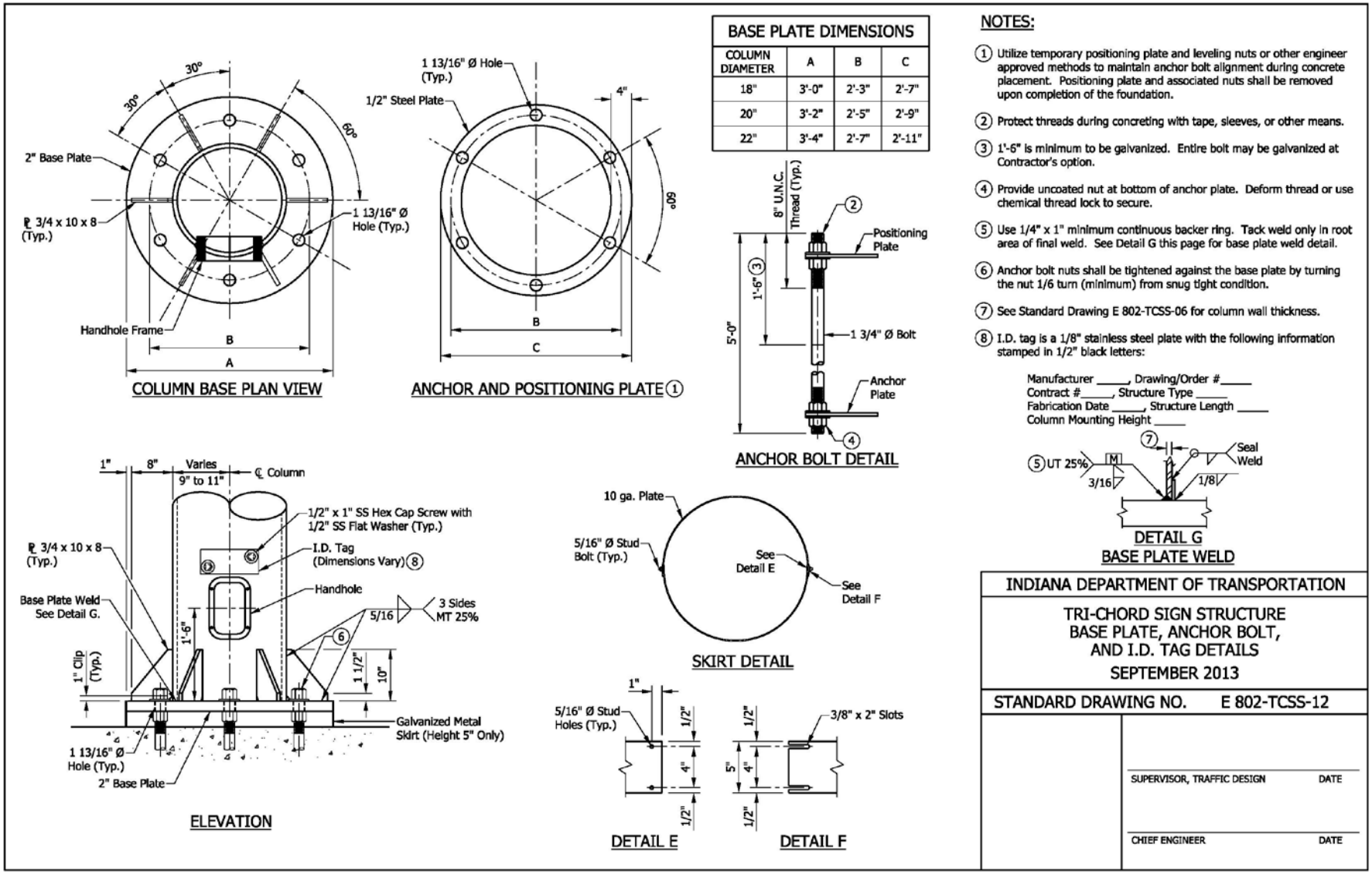
REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

PROPOSED NEW 802-TCSS-11 TRI-CHORD SIGN STRUCTURE SIGN ATTACHMENT DETAILS



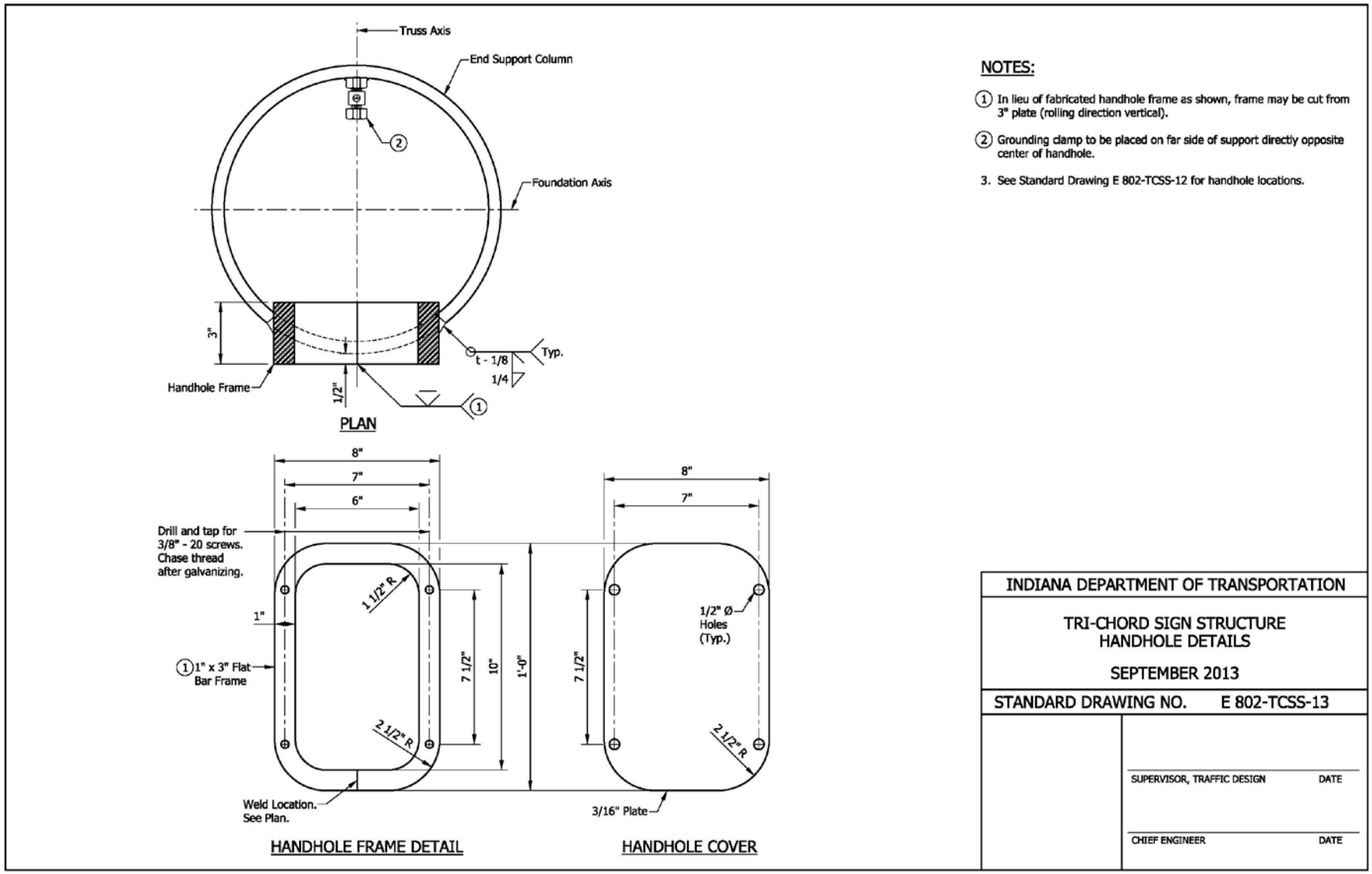
REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

PROPOSED NEW 802-TCSS-12 TRI-CHORD SIGN STRUCTURE BASE PLATE, ANCHOR BOLT, AND I.D. TAG DETAILS



REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

PROPOSED NEW 802-TCSS-13 TRI-CHORD SIGN STRUCTURE HANDHOLE DETAILS



NOTES:

1. In lieu of fabricated handhole frame as shown, frame may be cut from 3" plate (rolling direction vertical).
2. Grounding clamp to be placed on far side of support directly opposite center of handhole.
3. See Standard Drawing E 802-TCSS-12 for handhole locations.

INDIANA DEPARTMENT OF TRANSPORTATION

TRI-CHORD SIGN STRUCTURE HANDHOLE DETAILS

SEPTEMBER 2013

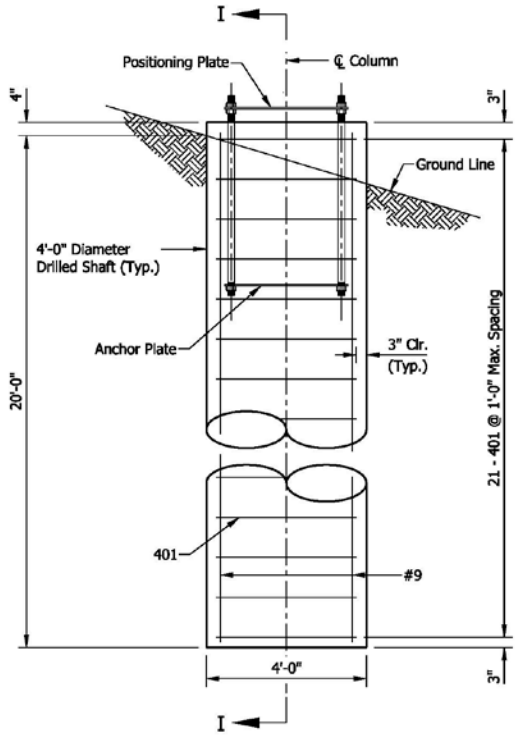
STANDARD DRAWING NO. E 802-TCSS-13

SUPERVISOR, TRAFFIC DESIGN DATE

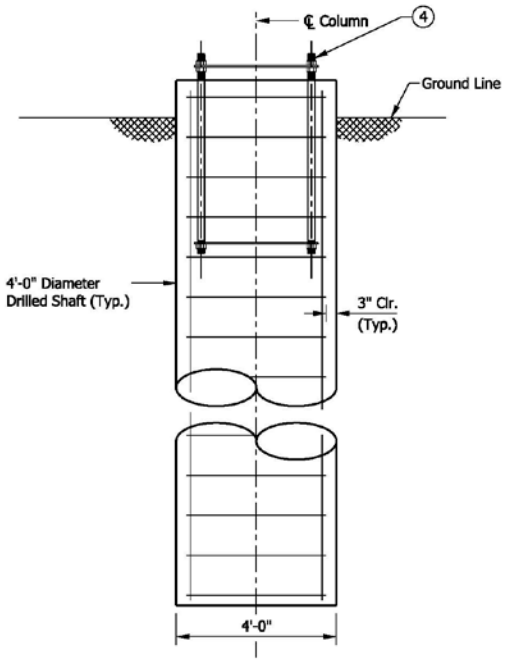
CHIEF ENGINEER DATE

REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

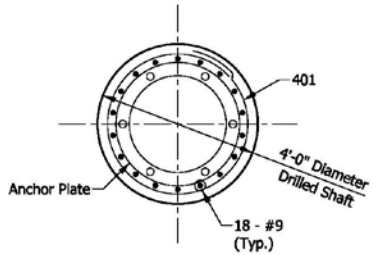
PROPOSED NEW 802-TCSS-14 TRI-CHORD SIGN STRUCTURE DRILLED SHAFT FOUNDATION



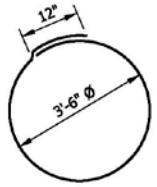
ELEVATION



SECTION I-I



PLAN



401 X 12'-0"

NOTES:

1. This standard foundation design is applicable for all tri-chord sign structures.
2. The design is based on clay soil with minimum unconfined shear strength of 750 psf or sandy soil with minimum friction angle of 30°.
3. All reinforcing bars to be epoxy coated.

(4) See Standard Drawing E 802-TCSS-12 for anchor bolts.

BILL OF MATERIALS			
EPOXY-COATED REINFORCING BARS			
MARK OR SIZE	NO. OF BARS	LENGTH	WEIGHT
901	18	20'-0"	
Total #9			1224 LBS
#4	21	12'-0"	
Total #4			168 LBS
Total Epoxy-Coated Reinforcing Bars			1392 LBS
MISCELLANEOUS			
Concrete, Class A			9.5 CYS
Surface Seal			0.5 SYS

INDIANA DEPARTMENT OF TRANSPORTATION

TRI-CHORD SIGN STRUCTURE
DRILLED SHAFT FOUNDATION

SEPTEMBER 2013

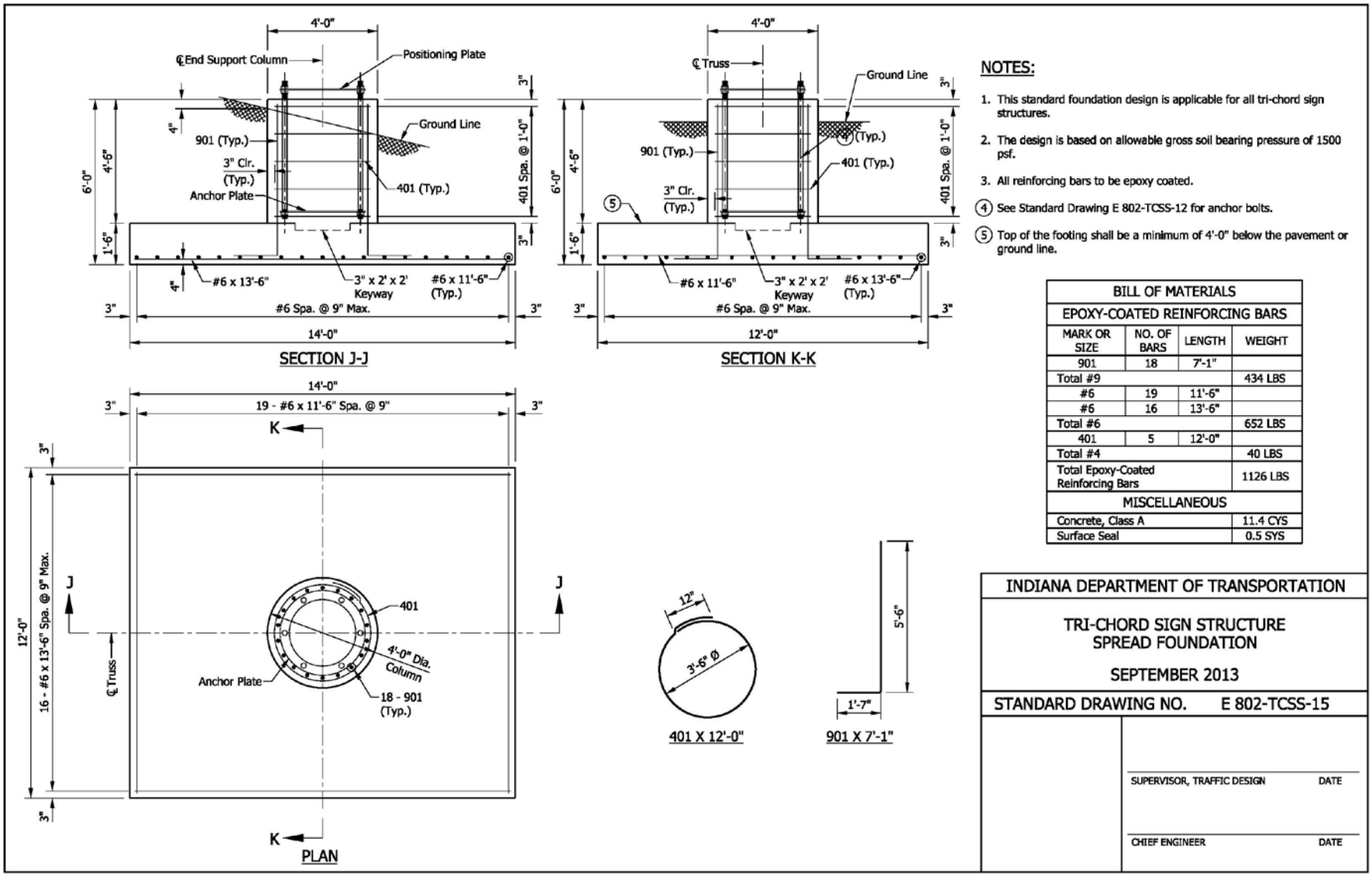
STANDARD DRAWING NO. E 802-TCSS-14

SUPERVISOR, TRAFFIC DESIGN DATE

CHIEF ENGINEER DATE

REVISION TO SPECIFICATIONS AND STANDARD DRAWINGS (OLD BUSINESS ITEM)

PROPOSED NEW 802-TCSS-15 TRI-CHORD SIGN STRUCTURE SPREAD FOUNDATION



NOTES:

1. This standard foundation design is applicable for all tri-chord sign structures.
2. The design is based on allowable gross soil bearing pressure of 1500 psf.
3. All reinforcing bars to be epoxy coated.
4. See Standard Drawing E 802-TCSS-12 for anchor bolts.
5. Top of the footing shall be a minimum of 4'-0" below the pavement or ground line.

BILL OF MATERIALS			
EPOXY-COATED REINFORCING BARS			
MARK OR SIZE	NO. OF BARS	LENGTH	WEIGHT
901	18	7'-1"	
Total #9			434 LBS
#6	19	11'-6"	
#6	16	13'-6"	
Total #6			652 LBS
401	5	12'-0"	
Total #4			40 LBS
Total Epoxy-Coated Reinforcing Bars			1126 LBS
MISCELLANEOUS			
Concrete, Class A			11.4 CYS
Surface Seal			0.5 SYS

INDIANA DEPARTMENT OF TRANSPORTATION

TRI-CHORD SIGN STRUCTURE SPREAD FOUNDATION

SEPTEMBER 2013

STANDARD DRAWING NO. E 802-TCSS-15

SUPERVISOR, TRAFFIC DESIGN DATE

CHIEF ENGINEER DATE

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REVISION TO SPECIFICATIONS, SPECIAL PROVISIONS AND DRAWINGS

802-T-188 OVERHEAD SIGN STRUCTURES
802-TCSS-01 thru -15 TRI-CHORD SIGN STRUCTURE

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 802 pg 720 thru 728; 910.19 pg 900 thru 903. Recurring Special Provision affected: 802-T-188 OVERHEAD SIGN STRUCTURES Standard Sheets affected: PROPOSED NEW *802-TCSS-01 thru -15* Design Manual Sections affected: SECTION 502. GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Ms. Phillips
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS

REVISION TO SPECIAL PROVISIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Changes in flowline elevation between the time of project survey and construction have cause some structures to be installed without an adequate sump. This can result in permit violations and fines.

PROPOSED SOLUTION: Provide a plan note directing the contractor to field-verify the flowline elevation. Create a recurring provision includes the cost of field-verifying the flowine elevation in the cost of Construction Engineering. Place guidance in the GIFE to advise the Engineer when adjustments must be made to the structure elevations to provide an adequate sump depth.

APPLICABLE STANDARD SPECIFICATIONS: 105

APPLICABLE STANDARD DRAWINGS: No

APPLICABLE DESIGN MANUAL SECTION: 203-2.06 (05)

APPLICABLE SECTION OF GIFE: Yes

APPLICABLE RECURRING SPECIAL PROVISIONS: TBD

PAY ITEMS AFFECTED: No.

Submitted By: Elizabeth Phillips

Title: Manager, Office Standards and Policy

Organization: Bridges

Phone Number: 232-6775

Date: January 22, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Ad hoc committee of Elizabeth Phillips, Jim Reilman, and Crystal Weaver

REVISION TO SPECIAL PROVISIONS

PROPOSED NEW 105-X-XXX STRUCTURE FLOWLINE VERIFICATION

105-X-XXX STRUCTURE FLOWLINE VERIFICATION

(Adopted XX-XX-13)

The Standard Specifications are revised as follows:

SECTION 105, BEGIN LINE 253, DELETE AND INSERT AS FOLLOWS:

(b) Construction Engineering by the Contractor

If set out as a pay item, the construction engineering, including all staking and layout usually done by the Department, shall be performed by the Contractor. Construction engineering shall include re-establishing the survey points and survey centerlines; referencing the necessary control points; running a level circuit to check or re-establish plan bench marks; running a level circuit to establish elevations on new bench mark tablets; setting stakes for right-of-way, culverts, slopes, subbase, underdrains, paving, subgrade, bridge piers, abutments, and all other stakes required for control lines and grades; ~~and~~ setting vertical control elevations, such as footings, caps, bridge seats, and screed elevations; *and obtaining flowline elevations*. Construction engineering shall also include documenting the underground wiring as located by the Department.

SECTION 105, BEGIN LINE 348, INSERT AS FOLLOWS:

When staking culverts, the Contractor shall perform the necessary checking to establish the proper location, length, skew, and grade. Prior to culvert installation the Engineer will approve adjustments in the location, length, skew, and grade to fit best the conditions on the site. The Contractor will not be responsible to verify that the culvert is of adequate opening.

Where sumping is required, the Contractor shall obtain the flowline elevation. This information will be used to verify that the planned sump depth match existing conditions. Prior to culvert or bridge installation the Engineer will determine adjustments in footing or invert elevation necessary to provide the appropriate sump depth.

COMMENTS AND ACTION

105-X-XXX STRUCTURE FLOWLINE VERIFICATION

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 105.08(b) pg 42 and 44. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: SECTION 203-2.06 (05). GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Ms. Phillips
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: The 918 geogrid section has been updtaed to include a specific geogrid for modular block walls, Geogrid Type III. The current RSP 211-R-608 revises requirements for Structure Backfill Type 3 and now longer matches the existing modular block provision.

PROPOSED SOLUTION: Revise the provision to reflect the new Geogrid Type III and refer to 211 for backfill requirement in lieu of stating them explicitly.

APPLICABLE STANDARD SPECIFICATIONS:

APPLICABLE STANDARD DRAWINGS: No

APPLICABLE DESIGN MANUAL SECTION: No

APPLICABLE SECTION OF GIFE: No

APPLICABLE RECURRING SPECIAL PROVISIONS: 732-R-310

PAY ITEMS AFFECTED: No.

Submitted By: Elizabeth Phillips

Title: Manager, Office Standards and Policy

Organization: Bridges

Phone Number: 232-6775

Date: January 8, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Jim Reilman and Elizabeth Phillips

REVISION TO SPECIAL PROVISIONS

732-R-310 MODULAR CONCRETE BLOCK RETAINING WALL

(Note: this RSP was approved by the Standards Committee on October 18, 2012 under Item 04 with an effective date on or after June 01, 2013. This RSP has not been posted.
Proposed changes shown highlighted gray.)

732-R-310 MODULAR CONCRETE BLOCK RETAINING WALL

(Revised 10-18-12)

The Standard Specifications are revised as follows:

SECTION 732, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 732 – ~~BLANK~~*MODULAR CONCRETE BLOCK RETAINING WALL*

732.01 Description

This work shall consist of design as required, furnishing materials, and placement of modular block wall units in accordance with 105.03. The modular block wall unit shall have ground reinforcement if shown on the plans or required by the manufacturer.

732.02 General Design Requirements

The modular block wall shall consist of an aggregate leveling pad, concrete modular block wall units, and if specified, ground reinforcement elements. Ground reinforcement shall have sufficient strength, frictional resistance, and quantity as required by design, and shall be mechanically connected to the facing units.

Modular block wall units shall be constructed as shown on the approved working drawings based on the requirements herein. The recommendations of the wall system supplier shall not override the minimum performance requirements shown herein.

The top of the modular block wall shall be designed to prevent the removal of the top course of blocks.

If the wall system provider needs additional information to complete the design, the Contractor shall be responsible for obtaining such information.

All appurtenances behind, in front of, under, mounted upon, or passing through the wall such as drainage structures, utilities, or other appurtenances shown on the plans shall be accounted for in the stability design of the wall.

The modular block wall design shall follow the general dimensions of the wall envelope shown on the plans. The working drawings shall show the location of the leveling pad at or below the theoretical leveling pad elevation shown on the plans. The top of the modular block wall unit shall be at or above the top of the wall elevation shown on the plans.

Cast-in-place concrete will not be an acceptable replacement for modular block wall unit areas indicated by the wall envelope.

REVISION TO SPECIAL PROVISIONS

732-R-310 MODULAR CONCRETE BLOCK RETAINING WALL

Modular block wall units shall be designed to accommodate a differential settlement of 1 linear unit in 100. Where shown on the plans, slip joints to accommodate excessive or differential settlement shall be included.

Only one typical modular block face finish shall be used per contract.

732.03 Design Criteria

The maximum modular block wall unit face area shall be 1 sq ft. The minimum depth of modular block wall units shall be 9 in.

Modular block wall units shall be dry stacked in a running bond configuration. Vertically adjacent units shall be connected with an approved shear connection. Approved shear connections consist of steel pins, concrete lips on the blocks, or other connections as approved by the Engineer.

The internal stability shall be the responsibility of the Contractor. The design for internal stability shall be in accordance with the AASHTO LRFD Bridge Design Specifications. The design by the Engineer will consider the external stability of the modular block wall mass including the applied bearing pressure, overturning, sliding, and stability of temporary construction slopes.

(a) Geotechnical Considerations

The theoretical failure plane within the soil mass shall be analyzed so that the soil-stabilizing component extends sufficiently beyond the failure plane to stabilize the material. External loads which affect the internal stability such as those applied through piling, bridge footings, traffic, crashwall, or slope surcharge, shall be accounted for in the design. The sizes of all structural elements shall be determined such that the design load stresses do not exceed the factored stresses shown in the AASHTO LRFD Bridge Design Specifications.

The internal friction angle, φ, for the internal design of the modular block wall backfill volume shall be assumed to be 34°. The φ of the backfill behind the modular block wall backfill volume shall be assumed to be 30°. The φ for the internal design of the foundation soils shall be assumed to be 30°. For the external design parameters, such as but not limited to, bearing capacity, sliding, overturning, eccentricity, and global stability, the actual soil strength parameters used shall be obtained from the geotechnical report.

The factored applied bearing pressures under the stabilized mass for each reinforcement unit's length shall be indicated on the working drawings. It shall not exceed the maximum factored soil bearing resistance shown on the plans. Passive pressure in front of the wall mass shall be assumed to be zero for design purposes.

(b) Height of Wall for Internal Stability

The wall limits shall be defined by the wall envelope shown on the plans.

REVISION TO SPECIAL PROVISIONS

732-R-310 MODULAR CONCRETE BLOCK RETAINING WALL

1. *For a wall with a level surcharge, the design height of the wall, H, shall be measured from the theoretical top of the leveling pad to the top of the coping or to the gutter line of the traffic barrier. The top of the wall shall be the theoretical top of the face panels only where a coping or barrier is not used.*

2. *For a wall with a sloping surcharge, the design height of the wall, Z, shall be measured from the theoretical top of the leveling pad to a point above the top of the wall as calculated from the formula as follows:*

$$Z = H + \frac{0.3H\tan\beta}{1-0.3\tan\beta}$$

where

β = surcharge slope angle as measured from the top of the coping, and

H = height of the wall from the theoretical top of the leveling pad to the top of the coping.

3. *For an abutment face, the design height of the wall, H, shall be measured from the theoretical top of the leveling pad to the top of the roadway surface.*

(c) Ground Reinforcement

The ground reinforcement length shall be the controlling length resulting from the internal or external design, or as shown on the plans. All of the ground reinforcement shall extend to and shall be connected to the modular block wall units.

The ground reinforcement shall be the same length from the bottom to the top of each wall section regardless of the type of ground reinforcement used. Differing ground reinforcement elements shall be marked for ease of construction. This element may be used individually or in a prefabricated grouping.

The ground reinforcement for modular block wall sections shall be sized using the lesser of the factored loads for each specific connection and each specific reinforcing element. The connection's applied factored load and effective pullout length shall be determined in accordance with the AASHTO LRFD Bridge Design Specifications.

For mats, grids, or strip steel, the minimum zinc coating thickness shall be 2 oz/sq ft. Such thickness shall be assumed to be 4 mils for purpose of calculation of reduced structural section.

REVISION TO SPECIAL PROVISIONS

732-R-310 MODULAR CONCRETE BLOCK RETAINING WALL

Where the presence of opposing walls limits the length of ground reinforcing, the design shall account for the reduced length and internal and external stability calculations shall be made to check for adequate factor of safety.

732.04 Submittals

The Contractor shall submit working drawings and design calculations in accordance with 105.02. Wall construction operations shall not begin until the Contractor receives written notice that the working drawings are approved.

(a) The working drawings shall include all details, dimensions, quantities, cross-sections, and general notes necessary to construct the wall and shall include, but shall not be limited to the following:

1. Plan and elevation sheets showing views which detail the placing position and connection of all ground reinforcing elements in areas where piling, utility, or other structures are near the wall.

2. Plan sheets of the wall that indicate the offsets from the construction centerline to the face of the wall at all changes in horizontal alignment.

3. Elevation views of the wall which shall include the following:

a. elevations at the top of the wall at all horizontal and vertical break points at least every 50 ft along the face of the wall,

b. all steps in the aggregate leveling pad,

c. the designation as to the type of modular block wall unit,

d. the length of ground reinforcement units,

e. the distance along the face of the wall to where changes in length of the ground reinforcement occur,

f. an indication of the original and final ground lines and maximum bearing pressures.

(b) All modular block wall units shall show all dimensions necessary to construct the element and the location of soil reinforcing system devices embedded in the units.

(c) The details for construction of walls around drainage facilities and the outletting of internal drainage from the modular block wall volume.

(d) All details of the architectural treatment.

(e) The details for diverting ground reinforcement around obstructions such as piles, catch basins, landscape plantings where the bottom of the root ball extends below the top level of ground reinforcement, and other obstructions.

(f) The details for mechanical connection between the modular block wall unit and the ground reinforcement.

MATERIALS

732.05 Materials
Materials shall be in accordance with the following:

Admixtures for Concrete 912.03*
Air Cooled Blast Furnace Slag 901.09
B Borrow 211.02
Coarse Aggregate, Class A or Higher, Size No. 91 904
*Coarse Aggregate, Class D or Higher, Size No. 8** 904*
Concrete 702
Fine Aggregate, Size No. 23 904
Fly Ash 901.02
Geogrid, Type ~~I~~III 918.05
Geotextile 918.03
Portland Cement .....901.01(b)
Structure Backfill 211.03.1
Water 913.01

* *Admixtures in accordance with ASTM C 1372 may be used for the modular block if approved by the Engineer.*

*~~** Coarse aggregate No. 8 used as drainage fill shall consist of 100% crushed stone.~~*

Aggregate for the leveling pad shall be compacted aggregate No. 53 and shall be in accordance with applicable requirements of 303. Drainage fill used immediately behind the modular block wall, as shown on the plans, shall be coarse aggregate No. 8, shall consist of 100% crushed stone and otherwise be in accordance with 904.03.

~~If ground reinforcement is required, it shall be either steel in accordance with 910.07 or geogrid. The ground reinforcement supplied shall be the same type as that used with the pullout test and shall be consistent throughout the contract work.~~

Backfill material used in the modular block wall volume shall be structure backfill, type 3, in accordance with 211. Where ground reinforcement is required, nominal size aggregate No. 30 shall not be used. The size of the structure backfill selected for use in the reinforced area of the modular block volume shall remain the same

for that wall's volume. If ACBF or coarse aggregate No. 8 are used, and soil, B borrow, structural backfill, or coarse aggregate No. 53 are to be placed above the ACBF or coarse aggregate No. 8, a single layer of geotextile shall be placed on top of the ACBF or coarse aggregate No. 8 in accordance with 616.11. A type C certification in accordance with 916 for the geotextile materials shall be furnished to the Engineer prior to use.

~~*Where ground reinforcement is required, nominal size aggregate No. 30 shall not be used, and the angle of internal friction, φ, shall be a minimum of 34° when tested under consolidated drained conditions in accordance with AASHTO T 236 or T 297. Testing for ϕ shall be performed on the portion that passes the No. 8 (2.36 mm) sieve, using a sample of the material compacted to 95% in accordance with AASHTO T 99, methods C, or D. Testing for ϕ will not be required if 80% or more of the material is retained on or above the No. 4 (4.75 mm) sieve.*~~ *If ground reinforcement is required, it shall be either steel in accordance with 910.07 or geogrid. The ground reinforcement supplied shall be the same type as that used with the pullout test and shall be consistent throughout the contract work. If the ground reinforcement is steel, structure backfill shall be in accordance with the backfill requirements for ~~MSE~~retaining walls~~s~~ systems contained in 211.03.1.*

~~*If ground reinforcement is used, a type A certification in accordance with 916 for the above additional testing of the structure backfill shall be furnished to the Engineer. An approved geotechnical laboratory shall perform the tests. One copy of all test results performed by the Contractor, which are necessary to demonstrate compliance with the specifications, shall also be furnished to the Office of Geotechnical Services.*~~

~~*If ACBF or coarse aggregate No. 8 are used, and soil, B borrow, structural backfill, or coarse aggregate No. 53 are to be placed above the ACBF or coarse aggregate No. 8, a single layer of geotextile shall be placed on top of the ACBF or coarse aggregate No. 8 in accordance with 616.11. A type C certification in accordance with 916 for the geotextile materials shall be furnished to the Engineer prior to use.*~~

(a) Concrete Modular Block Wall Units

Concrete modular block retaining wall units shall be in accordance with ASTM C 1372, except for the modifications below, and shall have a minimum compressive strength of 4,000 psi at 28 days. Modular block wall units utilizing type I or II cement will be considered acceptable for placement in the wall when 7-day strengths exceed 3,500 psi. The modular block wall unit's compressive strength shall be considered acceptable regardless of curing age when compressive test results indicate that the compressive strength is in accordance with the requirements stated above.

Retarding agents, accelerating agents, coloring pigments, or additives containing chloride shall not be used without approval.

1. Testing and Inspection

REVISION TO SPECIAL PROVISIONS

732-R-310 MODULAR CONCRETE BLOCK RETAINING WALL

a. Material properties shall be in accordance with the requirements of 732.05 in lieu of Section 4.

b. Table 1, "Strength and Absorption Requirements", shall be modified to require that the average compressive strength, when sampled and tested in accordance with ASTM C 140, of a three CMU compressive strength sample shall be 4,000 psi with no individual unit less than 3,500 psi. Maximum absorption shall be 6%.

c. Freeze-thaw durability testing shall be completed in accordance with Section 8.3 by a laboratory approved by the Department. Test results on all mix designs used in the manufacture of modular blocks shall have been completed in accordance with ASTM C 1372. If a change to the mix design, such as proportioning or material source, is desired, the modified mix design shall be retested for freeze-thaw. A type A certification in accordance with 916 for the freeze-thaw durability testing shall be submitted to the Engineer prior to use of the blocks.

d. Sampling and testing of the manufacturer's production lots will be conducted by the Engineer in accordance with ASTM C 140. If the compressive strength test result does not meet the requirements of 732.05(a), the production lot units may not be used. The manufacturer may resample the same production lot in the presence of the Engineer for retesting. The Engineer will test the additional samples in accordance with ASTM C 140. If the retested samples meet the requirements of 732.05(a), the production lot may be used. If the retested samples do not meet the requirements of 732.05(a), all the units from the production lot may not be used.

2. Rejection

Units shall be subject to rejection due to failure to be in accordance with the requirements specified above. In addition, the following defects may be sufficient cause for rejection.

a. Defects which indicate imperfect molding.

b. Defects which indicate honeycombed or open texture concrete.

c. Defects in the physical characteristics of the concrete, such as broken or chipped concrete, or color variations, or dunnage marks on the front face due to excessive form oil or other reasons.

REVISION TO SPECIAL PROVISIONS

732-R-310 MODULAR CONCRETE BLOCK RETAINING WALL

The Engineer will determine whether spalled, honeycombed, chipped, or otherwise defective concrete shall be repaired or be cause for rejection. Repair of concrete, if permitted, shall be completed in a satisfactory manner. Repair to concrete surfaces, which are to be exposed to view after completion of construction shall be subject to approval.

3. Marking

The date of manufacture, the production lot number, and the place mark shall be clearly scribed on the rear face of each unit or on each shipping pallet.

4. Handling, Storage, and Shipping

All modular block wall units shall be handled, stored, and shipped so as to eliminate the danger of chipping, cracks, fractures, and excessive bending stresses.

(b) Blank

CONSTRUCTION REQUIREMENTS

732.06 General Requirements

The wall supplier representative shall provide technical instruction, guidance in preconstruction activities including the preconstruction conference, and on-site technical assistance to the Contractor during construction.

732.07 Foundation Preparation

The foundation for the modular block wall shall be graded level for the width shown on the plans. Foundation preparation shall otherwise be in accordance with 731.07.

At each foundation level, an aggregate leveling pad shall be provided as shown on the plans.

732.08 Retaining Wall Excavation

Excavation shall be in accordance with 731.08.

732.09 Wall Erection

Modular block wall units shall be stored to minimize contact with the ground or being covered by standing water. Modular block wall units having face discoloration shall not be used.

The Contractor shall perform the necessary work to verify that the foundation is at the correct elevation, that the wall is constructed to the correct alignment, and that the work is in accordance with the specified tolerances.

Modular block wall units shall be placed in successive horizontal lifts in the sequence shown on the plans as backfill placement proceeds. As backfill material is

placed behind the units, the units shall be maintained in vertical position. Horizontal alignment tolerances shall not exceed 3/4 in. when measured with a 10 ft straightedge. Alignment shall be checked at each layer of modular block wall units after the backfill behind the modular block wall units has been compacted, and the results shall be recorded. Checking of alignments and tolerances shall include verifying that the modular block wall units are plumb over the entire height of the wall.

Ground reinforcement shall be placed normal to the face of the wall, unless otherwise shown on the plans and shall be constructed in accordance with 214.04.

732.10 Backfill Placement

Backfill placement shall follow erection of each course of modular block wall units. All sheeting and bracing shall be removed as the backfilling progresses. Backfill shall be placed so as to avoid damage or disturbance to the wall materials or misalignment of the modular block wall units. All material for backfill shall be subject to approval and shall be free from large or frozen lumps, wood, or other undesirable material. Wall materials that become damaged or disturbed during backfill placement shall be removed and replaced or corrected as directed. All misalignment or distortion of the modular block wall units due to placement of backfill outside the limits described herein shall be corrected as directed.

The work shall also include backfilling beyond the theoretical length of the ground reinforcement in accordance with the details shown on the plans and the disposal of surplus of unsuitable excavated materials as permitted.

Backfill placement and compaction shall otherwise be in accordance with 731.11.

732.11 Method of Measurement

The measurement of concrete modular block wall units with or without ground reinforcement and wall erection will be based on the square foot area contained within the neat line limits of the wall envelope shown on the plans and not that of the wall system supplier.

Common excavation will be measured by the cubic yard in accordance with 203.27(a) to the neat lines shown on the plans. Structure backfill and B borrow will be measured in accordance with 211.09. Unsuitable foundation materials, if found, will be measured in accordance with 211.09. Coarse aggregate No. 8 used as drainage fill will be measured by the cubic yard based on the theoretical volume to the neat lines as shown on the plans. Clearing and grubbing, compacted aggregate No. 53, and ground reinforcement will not be measured. Geotextile materials will not be measured. Drainage of the backfill including piping and geotextile materials used in the drainage system will not be measured.

732.12 Stockpiled Modular Block Units

REVISION TO SPECIAL PROVISIONS

732-R-310 MODULAR CONCRETE BLOCK RETAINING WALL

Partial payment may be made for block wall units stockpiled on the project site or at the Contractor's approved storage location. Partial payment will include the delivered cost of the units, as verified by invoices that include freight charges. The Contractor shall furnish the invoices. The partial payment will not exceed 75% of the contract unit price for modular block wall with or without ground reinforcement. Prior to authorizing partial payment, the Engineer will verify that the units are in accordance with 732.05(a).

732.13 Basis of Payment

The accepted quantities of modular block wall units with or without ground reinforcement will be paid for at the contract unit price per square foot. Erection of modular block wall units will be paid for by the square foot. Common excavation will be paid for in accordance with 203.28. Structure backfill and B borrow will be paid for in accordance with 211.10. Unsuitable foundation materials will be paid for in accordance with 211.10. The accepted quantities of coarse aggregate No. 8 used as drainage fill will be paid for as aggregate for drainage fill at the contract unit price per cubic yard, complete in place.

Payment will be made under:

Pay Item	***Pay Unit Symbol***
Aggregate for Drainage Fill	*CYS*
Modular Block Wall Erection	*SFT*
Modular Block Wall with Ground Reinforcement	*SFT*
Modular Block Wall	*SFT*

The cost of designing the wall system, services including the testing laboratory, certified testing personnel, and the testing and inspection of modular block wall units shall be included in the cost of the pay items of this section.

The cost of materials, ground reinforcement if required, fasteners, cutting or altering the ground reinforcement at the site, repair or replacement of units damaged or removed due to backfill placement, compressive-strength retesting if required, retesting or replacing failed block units, and incidentals shall be included in the cost of the pay items of this section.

The cost of all labor and materials required for preparing the wall foundation, clearing and grubbing, compacted aggregate No. 53, coarse aggregate No. 8 placed outside the neat lines as shown on the plans, replacement materials damaged during backfill placement if required, and erecting the modular block units shall be included in the cost of wall erection.

The cost of all labor and materials for geotextiles shall be included in the cost of the pay items of this section.

COMMENTS AND ACTION

732-R-310 MODULAR CONCRETE BLOCK RETAINING WALLS

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: NONE Recurring Special Provision affected: 732-R-310 MODULAR CONCRETE BLOCK RETAINING WALL Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Ms. Phillips
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: When MSE walls were a RSP, it contained language to allow the Department to make partial payment for stockpiled concrete face panels and ground reinforcement. When this provision was incorporated into the Standard Specifications, this section was omitted, with the belief that stockpiled material payment was already covered under section 111. There has been inconsistent stockpile material payment for these items.

PROPOSED SOLUTION: Incorporate a paragraph into the 111 section to more clearly define the partial payment for stockpile materials for MSE concrete face panels and ground reinforcement.

APPLICABLE STANDARD SPECIFICATIONS: 111

APPLICABLE STANDARD DRAWINGS: No

APPLICABLE DESIGN MANUAL SECTION: None

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

PAY ITEMS AFFECTED: No new items should need to be created.

Submitted By: Elizabeth Phillips

Title: Manager, Office Standards and Policy

Organization: Bridges

Phone Number: 232-6775

Date: January 23, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Ad hoc committee of Elizabeth Phillips and Jim Reilman

REVISION TO STANDARD SPECIFICATIONS

SECTION 111 – STOCKPILED MATERIALS
111.09 ADDITIONAL REQUIREMENTS
111.10 METHOD OF MEASUREMENTS
111.11 BASIS OF PAYMENT

The Standard Specifications are revised as follows:

SECTION 111, AFTER LINE 97, DELETE AND INSERT AS FOLLOWS:

111.09 Stockpiled MSE Concrete Face Panels and Ground Reinforcement

Partial payment for MSE concrete face panels and ground reinforcement as stockpiled material will be the delivered cost of the concrete face panels and ground reinforcement, including freight, as verified by invoices furnished by the Contractor. Partial payment will not exceed 75% of the contract unit price for concrete face panels. Concrete face panels and ground reinforcement shall be stored within the project limits or at an approved storage location. Prior to authorizing partial payment, verification will be obtained that the concrete face panels are in accordance with 901.10 and the ground reinforcement is in accordance with 910.07(b).

111.~~09~~*10* Additional Requirements

Partial payment will not be allowed on an estimate for materials of less than $10,000 in value.

The Department may consider partial payment for stockpiled materials having a value of over $25,000. Partial payment will be the delivered cost verified by invoices, except it will not exceed 50% of the contract unit price.

All materials when so paid for under this requirement will become the property of the Department in the event of default on the part of the Contractor. The Department may use, or cause to be used, such materials in the construction of the work provided for in the contract.

Although payment may have been made for materials, the Contractor shall be responsible for loss or damage to the materials. Such materials shall be replaced with no additional payment.

Approval of partial payment for stockpiled materials will not constitute final acceptance of such materials for use in completing the work. Structural steel members and pavement reinforcement may be subjected to additional inspection and testing prior to final acceptance and incorporation into the work. All other stockpiled pay items will be subjected to additional inspection and testing prior to final acceptance and incorporation into the work.

Partial payments for stockpiled materials that are a portion of the pay item will be deducted from estimates due the Contractor as the material is incorporated in the work.

111.~~10~~*11* Method of Measurement

REVISION TO STANDARD SPECIFICATIONS

SECTION 111 – STOCKPILED MATERIALS
111.09 ADDITIONAL REQUIREMENTS
111.10 METHOD OF MEASUREMENTS
111.11 BASIS OF PAYMENT

No measurement will be made. However, the amount will be substantially verified before authorization for payment.

111.~~11~~*12* Basis of Payment

Stockpiled materials which are authorized for payment in accordance with the requirements herein will be paid for in accordance with 111.03, 111.04, 111.05, 111.06, 111.07, 111.08, ~~and~~ 111.09*, and 111.10*.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
Stockpiled Material, _____ (type of material)	LFT~~(m)~~
	EACH
	CYS~~(m3)~~
	SYS~~(m2)~~
	TON~~(Mg)~~
	LBS~~(kg)~~
Structural Steel	LS
Structural Members, Concrete	LS
Structural Expansion Joint, _____ (type)	LFT~~(m)~~

COMMENTS AND ACTION

SECTION 111 – STOCKPILED MATERIALS

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 111 pg 115 and 116. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Ms. Phillips
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS
REVISION TO STANDARD DRAWINGS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Use of leveling concrete with precast coping atop MSE walls is not clear on current standard drawings.

PROPOSED SOLUTION: Add notes clarifying use of leveling concrete to Standard Drawing 731-MSEW-01. No changes are proposed for the remaining drawings in the 731-MSEW series. No changes are proposed to the related Standard Specification 731 or active Recurring Special Provision 731-R-597. Leveling concrete will continue to be considered an "incidental" wall material and should be included in the cost of Face Panels, Concrete per 731.13.

APPLICABLE STANDARD SPECIFICATIONS: 731

APPLICABLE STANDARD DRAWINGS: 731-MSEW-01

APPLICABLE DESIGN MANUAL SECTION: none

APPLICABLE SECTION OF GIFE: none

APPLICABLE RECURRING SPECIAL PROVISIONS: 731-R-597

PAY ITEMS AFFECTED: none

Submitted By: Elizabeth Phillips

Title: Manager, Office of Standards and Policy

Organization: INDOT

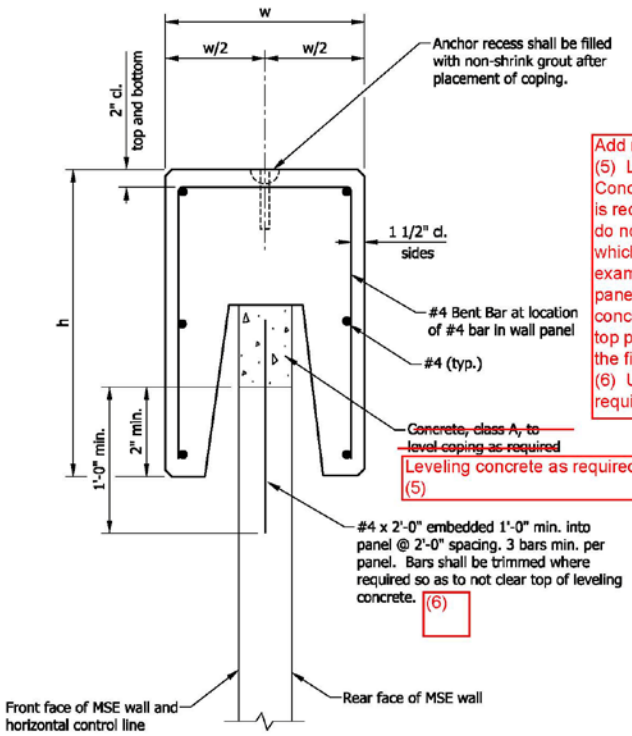
Phone Number: 232-6775

Date: January 22, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: INDOT Wall Committee

REVISION TO STANDARD DRAWINGS

731-MSEW-01 MSE WALL PRECAST CONCRETE COPING (WITH MARKUPS)

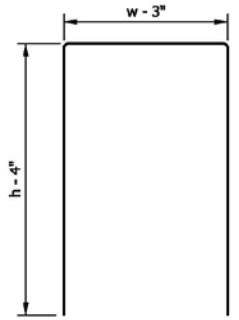


TYPICAL SECTION

Add notes:
(5) Leveling concrete shall be Concrete, Class A. Leveling concrete is required when adjacent top panels do not provide a continuous surface on which to place the precast coping, for example stepped panels or rectangular panels on a sloping grade. Leveling concrete is not required when custom top panels provide a surface parallel to the finished grade.
(6) Use only when leveling concrete required.

NOTES

1. Precast coping unit length shall be 10'-0".
2. Reinforcing bars' size, length, and spacing shall be determined by the manufacturer.
3. All chamfered edges shall be 3/4".
4. See Standard Drawing E 703-BRST-01 for reinforcing-bar bending details and notes.



#4 BENT BAR

INDIANA DEPARTMENT OF TRANSPORTATION

MSE WALL
PRECAST CONCRETE COPING

SEPTEMBER 2012

STANDARD DRAWING NO. E 731-MSEW-01

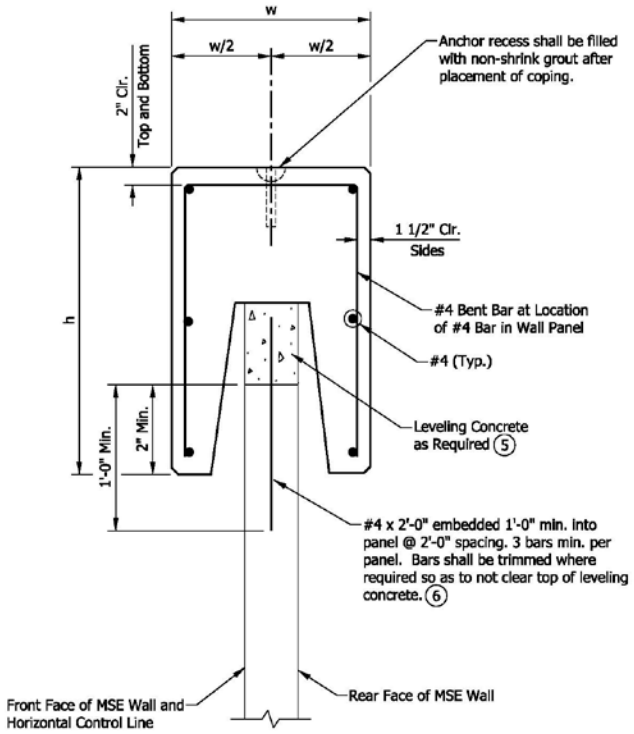
RICHARD L. VanCLEAVE REGISTERED No. 9750 STATE OF INDIANA PROFESSIONAL ENGINEER

/s/ Richard L. Van Cleave 09/04/12
SUPERVISOR, ROADWAY STANDARDS DATE

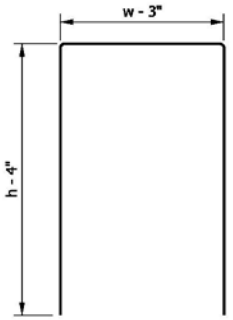
/s/ Mark A. Miller 09/04/12
CHIEF ENGINEER DATE

REVISION TO STANDARD DRAWINGS

731-MSEW-01 MSE WALL CAST-IN-PLACE CONCRETE COPING (DRAFT)



TYPICAL SECTION



#4 BENT BAR

NOTES

1. Precast coping unit length shall be 10'-0".
2. Reinforcing bars' size, length, and spacing shall be determined by the manufacturer.
3. All chamfered edges shall be 3/4".
4. See Standard Drawing E 703-BRST-01 for reinforcing-bar bending details and notes.

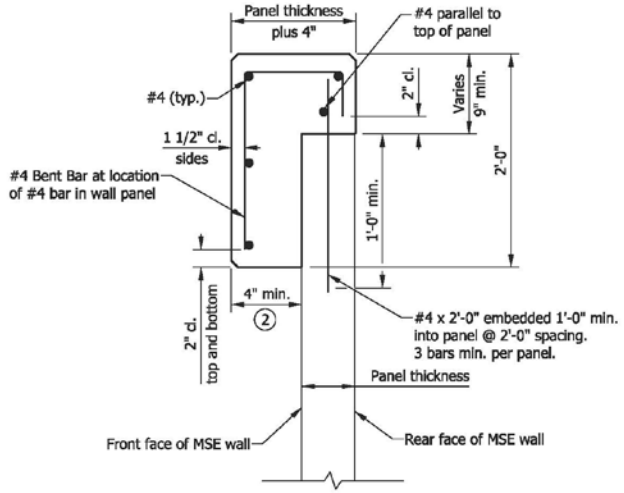
(5) Leveling concrete shall be Concrete, Class A. Leveling concrete is required when adjacent top panels do not provide a continuous surface on which to place the precast coping, e.g., stepped panels or rectangular panels on a sloping grade. Leveling concrete is not required when custom top panels provide a surface parallel to the finished grade.

(6) Use only when leveling concrete is required.

INDIANA DEPARTMENT OF TRANSPORTATION	
MSE WALL PRECAST CONCRETE COPING SEPTEMBER 2013	
STANDARD DRAWING NO. E 731-MSEW-01	
	STANDARDS ENGINEER DATE CHIEF ENGINEER DATE

REVISION TO STANDARD DRAWINGS

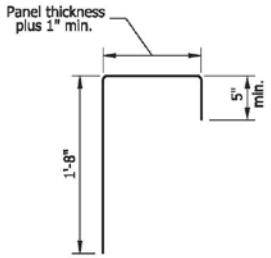
BACKUP 01. 731-MSEW-02 MSE WALL CAST-IN-PLACE CONCRETE COPING (FOR REFERENCE)



TYPICAL SECTION

NOTES

1. Coping joints shall coincide approximately with the panel joints. Reinforcing bars' ends shall be 2" short of near side of each joint.
2. The front face of a cast-in-place coping shall match the front face of a precast coping where used in conjunction.
3. All chamfered edges shall be 3/4".
4. See Standard Drawing E 703-BRST-01 for reinforcing-bar bending details and notes.



#4 BENT BAR

INDIANA DEPARTMENT OF TRANSPORTATION

MSE WALL
CAST-IN-PLACE CONCRETE COPING

SEPTEMBER 2012

STANDARD DRAWING NO. E 731-MSEW-02

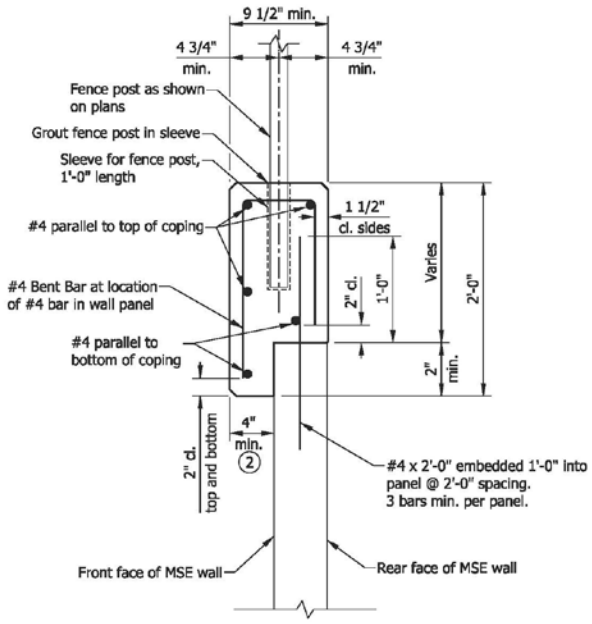
RICHARD L. VanCLEAVE REGISTERED No. 9750 STATE OF INDIANA PROFESSIONAL ENGINEER

/s/ Richard L. VanCleave 09/04/12
SUPERVISOR, ROADWAY STANDARDS DATE

/s/ Mark A. Miller 09/04/12
CHIEF ENGINEER DATE

REVISION TO STANDARD DRAWINGS

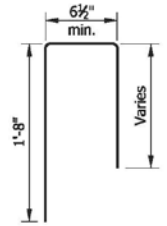
BACKUP 02. 731-MSEW-03 MSE WALL CAST-IN-PLACE CONCRETE COPING WITH PEDESTRIAN FENCE (FOR REFERENCE)



TYPICAL SECTION

NOTES

1. Coping joints shall coincide approximately with the panel joints. Reinforcing bars' ends shall be 2" short of near side of each joint.
2. The front face of a cast-in-place coping shall match the front face of a precast coping where used in conjunction.
3. All chamfered edges shall be 3/4".
4. See Standard Drawing E 703-BRST-01 for reinforcing-bar bending details and notes.



#4 BENT BAR

INDIANA DEPARTMENT OF TRANSPORTATION

MSE WALL
CAST-IN-PLACE CONCRETE COPING
WITH PEDESTRIAN FENCE
SEPTEMBER 2012

STANDARD DRAWING NO. E 731-MSEW-03

RICHARD L. VanCLEAVE REGISTERED No. 9750 STATE OF INDIANA PROFESSIONAL ENGINEER

/s/ Richard L. Van Cleave 09/04/12
SUPERVISOR, ROADWAY STANDARDS DATE

/s/ Mark A. Miller 09/04/12
CHIEF ENGINEER DATE

COMMENTS AND ACTION

731-MSEW-01 MSE WALL PRECAST CONCRETE COPING

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: NONE Recurring Special Provision affected: NONE Standard Sheets affected: 731-MSEW-01 MSE WALL PRECAST CONCRETE COPING Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Mr. Pankow
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: There have been situations arise on some contracts where multiple PDA tests have been required which exceeded the number of PDA tests the Department budgeted for.

PROPOSED SOLUTION: Incorporate the proposed changes into the 701 section which puts the responsibility for additional PDA testing on the Contractor if the reason for the additional PDA testing is the result of Contractor actions.

APPLICABLE STANDARD SPECIFICATIONS: 701

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: None

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

PAY ITEMS AFFECTED: None

Submitted By: Greg Pankow

Title: State Construction Engineer

Organization: INDOT

Phone Number: 232-5502

Date: January 24, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Ad hoc committee consisting of Jim Reilman and Mir Zaheer.

REVISION TO STANDARD SPECIFICATIONS

SECTION 701 – DRIVING PILING
701.05(b) DYNAMIC PILE LOAD TEST
701.15 BASIS OF PAYMENT

The Standard Specifications are revised as follows:

SECTION 701, BEGIN LINE 385, INSERT AS FOLLOWS:

(b) Dynamic Pile Load Test

Dynamic monitoring will be performed for the purpose of obtaining the nominal driving resistance, pile driving stresses, pile integrity, and pile driving system performance. *The Department will make arrangements and provide for PDA testing for the number of PDA tests show in the Schedule of Pay Items. Once pile driving operations have commenced, additional PDA testing required by the Engineer resulting from Contractor actions such as but not limited to a Contractor-requested change in the piling type or size, changing the pile hammer, or due to inefficient operation of the approved pile hammer, shall be arranged by the Contractor.* Dynamic monitoring will be conducted by PDA in accordance with ASTM D 4945. PDA will be performed on the first pile driven. The length of the pile used in the dynamic pile load test shall be a minimum of 10 ft ~~(3 m)~~ greater than the estimated length of production piles in order to provide for variation in soil conditions. The Contractor shall assist the Department in obtaining dynamic measurements with the PDA during initial pile driving and during pile restrikes. If a static load test is required, the dynamic pile load test shall be performed on the same pile as the pile used in the static load test. The restrike for the dynamic pile load test on a static load test pile shall be performed within 48 h of completion of the static load test. If the contract is a local public agency contract, the Contractor shall perform the pile driving analysis in accordance with ASTM D 4945.

SECTION 701, BEGIN LINE 957, INSERT AS FOLLOWS:

No additional payment will be made if the Contractor elects to furnish and drive thicker walled pipe piles than specified.

An increase in the size of a pile cap to satisfy edge distance clearance requirements, when approved, shall be at no additional cost to the Department.

Once pile driving operations have commenced and additional PDA testing is required by the Engineer resulting from Contractor actions, all costs associated with the additional PDA testing shall be the responsibility of the Contractor.

If the method for driving the piles is specified as 701.05(b) and the contract is a local public agency contract, the Contractor shall include the cost of acquiring the PDA consultant in the cost of the Dynamic Pile Load Test.

The cost of mobilization and demobilization for pile driving operations shall be included in the cost of mobilization and demobilization in accordance with 110.04.

The cost to control sediment in water from jetting operations shall be included in the cost of the piling.

COMMENTS AND ACTION

701.05(b) DYNAMIC PILE LOAD TEST
701.15 BASIS OF PAYMENT

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 701.05(b) pg 469; 711.15 pg 482. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By _____ Addition or _____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Mr. Pankow
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED:1. There has been confusion regarding application of loads to and acceptance of new concrete. Also, there are several minor changes necessary to 702.

2. The improper installation of stay-in-place (SIP) metal deck forms can cause cracking. Limiting the projection of the form support above the top flange to 1/2 inch is considered adequate to reduce the likelihood cracks. Figures 404-2B and -2C illustrate the connection of SIP forms and instructs the designer to detail the connection on the plans. Because the engineer of record is not responsible for the design for the SIP forms, the plans are not the appropriate place for this information.

PROPOSED SOLUTION: Incorporate the proposed changes into the 702 section and to amend section 702.13 (e) 2. to limit the projection of the form support to a maximum of 1/2 in. above the top flange. Revise the Design Manual to refer to Figures 404-2B and -2C as typical connections and delete the requirement to detail the connection on the plans.

APPLICABLE STANDARD SPECIFICATIONS: 702

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: 404-2.03

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

PAY ITEMS AFFECTED: None

Submitted By: Greg Pankow

Title: State Construction Engineer

Organization: INDOT

Phone Number: 232-5502

Date: January 24, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Ad hoc committee consisting of Mike Nelson, Jim Reilman, and Tony Zander.

REVISION TO STANDARD SPECIFICATIONS

SECTION 702 – STRUCTURAL CONCRETE
702.05 PROPORTIONING
702.07 MIXING
702.11 COLD WEATHER CONCRETE
702.13 FORMS
702.14 FALSEWORK AND CENTERING
702.15(e) POLYCHLOROPENE JOINT MEMBRANE
702.21 FINISHING CONCRETE SURFACES
702.22 CURING CONCRETE
702.24 APPLICATION OF LOADS TO AND ACCEPTANCE OF NEW CONCRETE
702.25 FIELD DRILLED HOLES IN CONCRETE
702.28 BASIS OF PAYMENT

(Note: Proposed changes shown highlighted gray.)

The Standard Specifications are revised as follows:

SECTION 702, BEGIN LINE 107, DELETE AND INSERT AS FOLLOWS:

When fly ash or ground granulated blast furnace slag is used, an acceptable concrete mix design shall be submitted. Fly ash or ground granulated blast furnace slag and all other material sources proposed for portland cement concrete mix designs shall be furnished at least 15 days prior to the initiation of work. Prior to use, it shall be demonstrated by trial batch that the concrete mix design will produce concrete complying with all requirements. A concrete mix design will not be considered approved until this trial batch demonstration is successfully completed, including flexural strength data. The required *minimum* 550 psi ~~(3,800 kPa)~~ flexural strength shall be obtained at an age consistent with the contract work schedule, but not to exceed 28 days.

SECTION 702, BEGIN LINE 141, DELETE AND INSERT AS FOLLOWS:

Portland cement concrete with fly ash or ground granulated blast furnace slag which does not consistently comply with Department concrete requirements ~~due to the presence of the fly ash or ground granulated blast furnace slag~~ will be grounds for rejection of its further use. In the event of such a rejection of further use, all unsatisfactory work shall be corrected with no additional payment and the contract shall be completed using portland cement without fly ash *or ground granulated blast furnace slag*.

SECTION 702, BEGIN LINE 263, INSERT AS FOLLOWS:

702.07 Mixing

Concrete may be mixed at the site of construction, at a central point, or wholly or in part in truck mixers. Retempering concrete by adding water or by other means will not be permitted after initial set. When concrete is delivered in transit mixers, additional water may be added occasionally to increase the slump, if permitted, and additional mixing shall be performed as directed and all operations completed within the time limits in accordance with 702.09(c). The amount of water added shall be determined accurately and noted on the batch ticket. Such addition of water will not be permitted as a continuing operation. The total of all water included in the mix shall not exceed the maximum in accordance with 702.02.

REVISION TO STANDARD SPECIFICATIONS

SECTION 702 – STRUCTURAL CONCRETE
702.05 PROPORTIONING
702.07 MIXING
702.11 COLD WEATHER CONCRETE
702.13 FORMS
702.14 FALSEWORK AND CENTERING
702.15(e) POLYCHLOROPENE JOINT MEMBRANE
702.21 FINISHING CONCRETE SURFACES
702.22 CURING CONCRETE
702.24 APPLICATION OF LOADS TO AND ACCEPTANCE OF NEW CONCRETE
702.25 FIELD DRILLED HOLES IN CONCRETE
702.28 BASIS OF PAYMENT

Concrete that is not within the specified slump limits at time of placement shall not be used. Except as required in 702.05 for class C concrete, a water reducing admixture, type A, or a water reducing and retarding admixture, type D, may be used in the concrete. Chemical admixtures type B, type C, and type E will be permitted only with prior written permission. *Chemical admixtures type F and type G shall not be used.*

SECTION 702, BEGIN LINE 501, DELETE AND INSERT AS FOLLOWS:

702.11 Cold Weather Concrete

When it is necessary to place concrete at or below an atmospheric temperature of 35°F ~~(2°C)~~, or whenever it is determined that the temperature may fall below 35°F ~~(2°C)~~ within the curing period, the water, aggregates, or both shall be heated and suitable enclosures and heating devices provided. Cold weather concrete shall be placed at the risk of the Contractor and shall be removed and replaced with no additional payment if it becomes frozen or otherwise damaged.

When aggregates or water ~~must be~~*are* heated, the *resulting* concrete shall have a temperature of at least 50°F ~~(10°C)~~ and not more than 80°F ~~(27°C)~~ at the time of placing. Heating equipment or methods which alter or prevent the entrainment of the required amount of air in the concrete shall not be used. The equipment shall be capable of heating the materials uniformly. Neither aggregates nor water used for mixing shall be heated to a temperature exceeding 150°F ~~(66°C)~~. *When aggregates or water are heated to 100°F, they shall be combined first in the mixer before cement is added.* The maximum temperature of concrete produced with heated aggregates shall be 90°F ~~(32°C)~~. Materials containing frost or lumps of frozen material shall not be used. ~~When either aggregates or water are heated to 100°F (38°C), they shall be combined 1st in the mixer before cement is added.~~

Stockpiled aggregates may be heated by the use of dry heat or steam. Aggregates shall not be heated directly by gas or oil flame or on sheet metal over fire. However, a drier ~~in accordance with 409.02(a)~~ may be used if approved.

When aggregates are heated in bins, steam-coil *heating,* ~~or~~ water-coil heating, or other methods which are not detrimental to the aggregates may be used. The use of salt or other chemicals to accelerate hardening of the concrete will not be permitted unless approved in writing.

REVISION TO STANDARD SPECIFICATIONS

SECTION 702 – STRUCTURAL CONCRETE
702.05 PROPORTIONING
702.07 MIXING
702.11 COLD WEATHER CONCRETE
702.13 FORMS
702.14 FALSEWORK AND CENTERING
702.15(e) POLYCHLOROPENE JOINT MEMBRANE
702.21 FINISHING CONCRETE SURFACES
702.22 CURING CONCRETE
702.24 APPLICATION OF LOADS TO AND ACCEPTANCE OF NEW CONCRETE
702.25 FIELD DRILLED HOLES IN CONCRETE
702.28 BASIS OF PAYMENT

Immediately after a pour is completed, the freshly poured concrete and forms shall be covered so as to form a *complete* protective enclosure *around the element being poured. If the element is a bridge deck, the enclosure shall encompass the top, bottom, and all sides.* ~~and t~~*T*he air ~~in~~*within* the *entire* enclosure ~~kept~~ *shall be maintained* at a temperature above 50°F ~~(10°C)~~ for ~~at least~~*a minimum of* 144 h for bridge decks, the top surface of reinforced concrete slab bridges, and for ~~at least~~*a minimum of* 72 h for all other concrete. If for any reason this *minimum* temperature is not maintained, the heating period shall be extended. When dry heat is used, means shall be provided to maintain adequate moisture in the air within the enclosure.

All necessary measures shall be taken during protective heating to keep the heating equipment in continuous operation and to ensure maintenance of the proper temperature around *all sides, top and bottom of* the concrete. Adequate fire protection shall be provided where heating is in progress and such protection shall be accessible at all times.

SECTION 702, BEGIN LINE 668, DELETE AND INSERT AS FOLLOWS:

The form support shall not protrude into the deck more than 1/2 in. above the beam or girder top flange nor shall it interfere with the required deck thickness.

Form supports at steel beam or girder bridges shall be placed in direct contact with the top flange of the beam or girder and shall be adjusted to maintain the required deck thickness. If straps are used on the top flanges, the straps shall be No. 8 gage ~~(4.2 mm)~~ thick, fit tight, and shall not be galvanized. ~~Welding of form supports to flanges of non-weldable grades of steel and to steel flanges subject to tensile stresses shall not be permitted~~*Form supports shall not be welded to flanges of non-weldable grades of steel or to steel flanges subject to tensile stresses*.

Form supports at prestressed concrete I-beam, ~~and~~*prestressed concrete spread* box beam, *and prestressed concrete bulb-T beam* bridges shall be placed in direct contact with the sides of the box or edge of the I-beam *or bulb-T beam* flange and shall be adjusted to maintain the required deck thickness. The form supports may be attached to steel inserts cast into the top of the box, ~~or~~ I-beam, *or bulb-T beam,* straps extending across the top of the flange, hangers mechanically attached to reinforcing bars extending from the top flange, or by other approved methods. If straps are used across the top flange, they shall be No. 8 gage ~~(4.2 mm)~~ thick, fit tight, and shall not be galvanized. ~~Welding of attachments directly to beam reinforcement shall not be~~

REVISION TO STANDARD SPECIFICATIONS

SECTION 702 – STRUCTURAL CONCRETE
702.05 PROPORTIONING
702.07 MIXING
702.11 COLD WEATHER CONCRETE
702.13 FORMS
702.14 FALSEWORK AND CENTERING
702.15(e) POLYCHLOROPENE JOINT MEMBRANE
702.21 FINISHING CONCRETE SURFACES
702.22 CURING CONCRETE
702.24 APPLICATION OF LOADS TO AND ACCEPTANCE OF NEW CONCRETE
702.25 FIELD DRILLED HOLES IN CONCRETE
702.28 BASIS OF PAYMENT

~~permitted~~*Attachments shall not be welded directly to beam reinforcement*. In addition, the use of recesses cast into the beam to serve as a form support shall not be permitted.

All permanently exposed form metal, where the galvanized coating has been damaged, shall be thoroughly and satisfactorily cleaned, wire brushed, and painted with 2 coats of zinc oxide-zinc dust primer in accordance with Federal Specification ~~TT~~*MIL*-P-~~641(d)~~*2441*, type II, with no color added. Minor heat discoloration in areas of welds need not be touched up.

Concrete shall be placed in accordance with 702.20. Particular emphasis should be placed on proper vibration of the concrete to avoid honeycombs and voids, especially at construction joints, expansion joints, attachment hardware, and valleys and ends of form sheets. Pouring sequences, procedures, and mixes shall be ~~approved~~*submitted for approval*.

SECTION 702, BEGIN LINE 800, DELETE AND INSERT AS FOLLOWS:

702.14 Falsework and Centering

Detailed working drawings for falsework and arch centering shall be submitted in accordance with 105.02. Since the quality of the lumber is not known and because of the uncertainty of computing nailed joints, no responsibility will be assumed by the Department for the strength of falsework and centering.

Working drawings for falsework shall include details for support of interior bent caps, hammerhead piers, and the portion of the bridge floor and coping beyond fascia girders or beams if the overhang is 18 in.~~ (460 mm)~~, or more, or if a finishing machine, concrete spreader, or other equipment is to be supported by the overhang.

The scheme of falsework for work on a span over active railroad tracks shall provide a *minimum* horizontal clearance of ~~not less than~~ ~~8~~*13* ft ~~(2.4 m)~~ from the centerline of *the nearest tangent* track *or 14 ft from the centerline of the nearest track on a horizontal curve* and a *minimum vertical* clearance ~~height~~ of ~~not less than~~ 22 ft~~ (6.7 m)~~ from the top of the *highest* track rail *unless different clearance values are approved by the railroad*.

SECTION 702, BEGIN LINE 976, DELETE AND INSERT AS FOLLOWS:

(e) Polychloroprene Joint Membrane

REVISION TO STANDARD SPECIFICATIONS

SECTION 702 – STRUCTURAL CONCRETE
702.05 PROPORTIONING
702.07 MIXING
702.11 COLD WEATHER CONCRETE
702.13 FORMS
702.14 FALSEWORK AND CENTERING
702.15(e) POLYCHLOROPENE JOINT MEMBRANE
702.21 FINISHING CONCRETE SURFACES
702.22 CURING CONCRETE
702.24 APPLICATION OF LOADS TO AND ACCEPTANCE OF NEW CONCRETE
702.25 FIELD DRILLED HOLES IN CONCRETE
702.28 BASIS OF PAYMENT

Polychloroprene joint membrane used for semi-integral end bents shall be secured to the concrete with an adhesive. The polychloroprene joint membrane shall be centered vertically on the joint, *and shall have no gaps*. Any field joint in the polychloroprene membrane shall be lapped a minimum of 12 in. ~~(300 mm)~~.

SECTION 702, BEGIN LINE 1168, DELETE AND INSERT AS FOLLOWS:

702.21 Finishing Concrete Surfaces

Unless otherwise authorized, the surface of the concrete shall be finished immediately after form removal. Only the minimum amount of covering necessary to allow finishing operations to be carried on shall be removed at one time. Subject to approval, metal ties may be left in the concrete for the purpose of supporting or bracing subsequent work. Such ties shall be in accordance with 702.13(b) and shall be of a type which uses a cone and rod as both spreader and tie. Before final acceptance of the work, the cones shall be removed and the cavities filled, in accordance with 702.13(b).

All concrete surfaces shall be given a finish immediately following the removal of any forms.

~~The concrete surfaces of pier and bent caps, the front face of mudwalls, and any other concrete surfaces specified shall be sealed. The material used for sealing shall be in accordance with 709. It shall be applied so as to obtain a finished film thickness of at least 10 mils (250 µm). Mixing, surface preparation, and method of application shall be in accordance with the manufacturer's recommendations. However, the surfaces to be sealed shall be prepared in accordance with 709 prior to applying the sealer.~~

At the time of the removal of forms, the concrete surface shall be scraped to remove all fins and irregular projections. The surface shall then be power ground to smooth all joints and chamfers.

After grinding is completed, a paste of grout shall be applied to the concrete surface with a sponge float to fill all air holes and small irregularities. The paste grout shall be 6 parts of pre-mix mortar mix for masonry and 1 part white portland cement in accordance with ASTM C 150, ~~T~~*t*ype 1.

After the paste grout takes its initial set, the surface of the concrete shall be scraped with a steel drywall knife to remove the paste from the surface.

REVISION TO STANDARD SPECIFICATIONS

SECTION 702 – STRUCTURAL CONCRETE
702.05 PROPORTIONING
702.07 MIXING
702.11 COLD WEATHER CONCRETE
702.13 FORMS
702.14 FALSEWORK AND CENTERING
702.15(e) POLYCHLOROPENE JOINT MEMBRANE
702.21 FINISHING CONCRETE SURFACES
702.22 CURING CONCRETE
702.24 APPLICATION OF LOADS TO AND ACCEPTANCE OF NEW CONCRETE
702.25 FIELD DRILLED HOLES IN CONCRETE
702.28 BASIS OF PAYMENT

The concrete surfaces of pier and bent caps, the front face of mudwalls, and any other concrete surfaces specified shall be sealed. The material used for sealing shall be in accordance with 709. It shall be applied so as to obtain a finished film thickness of at least 10 mils. Mixing, surface preparation, and method of application shall be in accordance with the manufacturer's recommendations. However, the surfaces to be sealed shall be prepared in accordance with 709 prior to applying the sealer.

702.22 Curing Concrete

Concrete in bridge decks or the top surface of reinforced concrete slab bridges shall be cured continuously for ~~at least~~*a minimum of* 168 h commencing immediately after the surface is able to support the protective covering without deformation. *Curing time for bridge decks and the top surface of reinforced concrete slab bridges are not controlled by beam tests and the cure time shall not be reduced.* Curing of patches or small full depth deck replacement areas on existing bridge decks that are to be overlaid, may be controlled by test beams in accordance with 702.24(a).

Unless otherwise specified or permitted, all other concrete shall be cured for at least 96 h commencing immediately after the surface is able to support the protective covering without deformation. If portland-pozzolan cement, type IP or IP-A, or fly ash is used, the concrete shall be cured for at least 120 h. *Curing shall continue until the flexural strength stated in 702.13(h) has been attained.*

Membrane forming curing compound may be used in lieu of protective covering curing methods. Where it has been determined that a surface treatment is to be used, the membrane forming curing compound shall not be used.

The curing of surfaces to be waterproofed may be discontinued when waterproofing is started.

~~If field operations are controlled by beam tests, the curing time, except for bridge decks and the top surface of reinforced concrete slab bridges, shall be in accordance with 702.13(h).~~

If further precautions are necessary to ensure strength, they shall be taken as directed.

(a) Protective Covering Curing Methods

REVISION TO STANDARD SPECIFICATIONS

SECTION 702 – STRUCTURAL CONCRETE
702.05 PROPORTIONING
702.07 MIXING
702.11 COLD WEATHER CONCRETE
702.13 FORMS
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702.15(e) POLYCHLOROPENE JOINT MEMBRANE
702.21 FINISHING CONCRETE SURFACES
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702.25 FIELD DRILLED HOLES IN CONCRETE
702.28 BASIS OF PAYMENT

1. Water Curing Method

Surfaces to be cured shall be protected by covering with cotton mats, burlap, or other satisfactory protective material and shall be kept continuously and thoroughly wet during the curing period. The protective covering shall be suitably anchored to keep the protective materials in place during the curing period. Curbs, walls, handrails, copings, and other surfaces requiring a finish in accordance with 702.21 may have the covering temporarily removed for finishing, but the covering shall be restored as soon as possible.

~~(b)~~*2.* Membrane Forming Curing Compound

All surfaces shall be given the required surface finish prior to application of the curing compound. During the finishing period, the concrete shall be protected by the water *curing* method ~~of curing~~.

The curing compound shall be mixed thoroughly within 1 h before use. The rate of application shall be as approved, with a minimum spreading rate per application of 1 gal. ~~(3.8 L)~~ of liquid coating for 150 sq ft ~~(14 m^2)~~ of concrete surface. All concrete cured by this method shall receive 2 applications of the curing compound. The 1st coat shall be applied immediately after stripping of forms and acceptance of the concrete finish. If the surface is dry, the concrete shall be wetted with water and the curing compound applied just as the surface film of water disappears. The second application shall be applied after the 1st application has set. During curing operations all unsprayed surfaces shall be kept wet with water.

The coating shall be protected against marring for at least 10 days after application. All coatings marred or otherwise disturbed shall be given an additional coating. If the surface coating is continuously subjected to injury, immediate application of water curing may be required. If the use of a curing compound results in a streaked or blotchy appearance, the method shall be stopped and water curing applied until the cause of the defective appearance is corrected.

(~~c~~*b*) Curing-Sealing Materials

Curing-sealing materials may be used in lieu of protective covering curing methods when surface seal is required. These materials may only be used on concrete surfaces that are not subjected to vehicular wear and that have been formed using the slip form method. Curing-sealing material shall not be applied to cast-in-place concrete.

REVISION TO STANDARD SPECIFICATIONS

SECTION 702 – STRUCTURAL CONCRETE
702.05 PROPORTIONING
702.07 MIXING
702.11 COLD WEATHER CONCRETE
702.13 FORMS
702.14 FALSEWORK AND CENTERING
702.15(e) POLYCHLOROPENE JOINT MEMBRANE
702.21 FINISHING CONCRETE SURFACES
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702.24 APPLICATION OF LOADS TO AND ACCEPTANCE OF NEW CONCRETE
702.25 FIELD DRILLED HOLES IN CONCRETE
702.28 BASIS OF PAYMENT

When curing-sealing materials are used for curing concrete, surface seal will not be required.

The curing-sealing material shall be mixed in accordance with the manufacturer's instructions prior to application. The rate of application shall be as specified in the list of approved Curing-Sealing Materials. All concrete cured-sealed by this method shall receive 2 applications of the curing-sealing compound. The 1st coat shall be spray applied after the finished surface has been achieved. The 2nd coat shall be applied while the 1st coat is still tacky.

The use of curing-sealing material shall be discontinued if plastic shrinkage cracks occur that cannot be corrected by decreasing the application rate. The concrete shall then be cured and surface sealed in accordance with 702.22(a)*1* and 709, respectively.

~~Polychloroprene used for a semi-integral end bent shall be secured to the concrete with an adhesive. The polychloroprene sheeting shall be centered vertically on the joint, and shall have no gaps. Joints in the sheeting material shall be lapped a minimum of 12 in. (300 mm).~~

The coating shall be protected against damage after application. All coatings that have been disturbed shall be given an additional coating. If the surface coating is continuously subjected to injury, immediate application of curing in accordance with 702.22(a)*1* may be required. The concrete shall then be surfaced sealed in accordance with 709.

SECTION 702, BEGIN LINE 1324, DELETE AND INSERT AS FOLLOWS:

702.24 Application of Loads to and Acceptance of New Concrete

Except as otherwise hereinafter provided, application of loads to new concrete shall be in accordance with the following:

(a) Equipment or traffic will not be permitted on structures until *test beams representing* all concrete required to carry live loads ~~has been poured for at least 15 days or~~*have attained* a flexural strength of 550 psi ~~(3,800 kPa)~~ for ~~3rd~~*third*-point loading ~~has been attained~~.

REVISION TO STANDARD SPECIFICATIONS

SECTION 702 – STRUCTURAL CONCRETE
702.05 PROPORTIONING
702.07 MIXING
702.11 COLD WEATHER CONCRETE
702.13 FORMS
702.14 FALSEWORK AND CENTERING
702.15(e) POLYCHLOROPENE JOINT MEMBRANE
702.21 FINISHING CONCRETE SURFACES
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702.25 FIELD DRILLED HOLES IN CONCRETE
702.28 BASIS OF PAYMENT

(b) Unbalanced backfill will not be permitted until *test beams representing* the concrete required to resist it ~~is at least 10 days old or~~*have attained* a flexural strength of 440 psi ~~(3,030 kPa)~~ for ~~3rd~~ *third*-point loading ~~has been attained~~. The unbalanced height shall not exceed 10 ft ~~(3 m)~~ until *test beams representing* the concrete ~~is at least 15 days old or~~*have attained* a flexural strength of 480 psi ~~(3,310 kPa)~~ for ~~3rd~~ *third*-point loading ~~has been attained~~.

(c) The dead weight of steel or precast concrete superstructure shall not be placed on concrete until *test beams representing* the concrete ~~is at least 5 days old, or longer as directed, or~~*have attained* a flexural strength of 400 psi ~~(2,760 kPa)~~ for ~~3rd~~ *third*-point loading ~~has been attained~~. A dead load shall not be placed on hammer-head piers until *test beams representing* the concrete ~~is 15 days old or until test beams attain~~*have attained* a flexural strength of at least 480 psi ~~(3,310 kPa)~~ for ~~3rd~~ *third*-point loading. The concrete floor, if to be placed thereon, shall not be poured until *test beams representing* the concrete supporting the superstructure ~~is at least 10 days old or until test beams attain~~*have attained* a flexural strength of at least 440 psi ~~(3,030 kPa)~~ for ~~3rd~~ *third*-point loading.

(d) ~~C~~*Test beams representing c*oncrete anchoring inserts to support falsework shall ~~be in place 15 days or the test beams shall~~ attain a flexural strength of ~~at least~~*a minimum of* 480 psi ~~(3,310 kPa)~~ for third-point loading, before a dead load of concrete is applied.

~~For concrete poured during March, April, October, November, or at any other time between April and October when the average temperature is less than 50°F (10°C), the above periods shall be increased 20%. For concrete placed during December, January, and February, the above periods shall be increased 40%. When test beams indicate the required flexural strength, the required time periods may be reduced. If at the expiration of the specified periods test beams do not indicate the required flexural strength, the periods shall be lengthened until the required strength is attained. If portland-pozzolan cement, type IP or IP-A, fly ash, or ground granulated blast furnace slag used as an additive is incorporated into the concrete, the specified periods shall not apply and the application of loads shall be controlled by beam tests.~~ No time extension will be considered for delays due to ~~additional~~ time necessary to attain specified strengths.

REVISION TO STANDARD SPECIFICATIONS

SECTION 702 – STRUCTURAL CONCRETE
702.05 PROPORTIONING
702.07 MIXING
702.11 COLD WEATHER CONCRETE
702.13 FORMS
702.14 FALSEWORK AND CENTERING
702.15(e) POLYCHLOROPENE JOINT MEMBRANE
702.21 FINISHING CONCRETE SURFACES
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702.24 APPLICATION OF LOADS TO AND ACCEPTANCE OF NEW CONCRETE
702.25 FIELD DRILLED HOLES IN CONCRETE
702.28 BASIS OF PAYMENT

SECTION 702, BEGIN LINE 1395, DELETE AND INSERT AS FOLLOWS:

702.25 Field Drilled Holes in Concrete

This work shall consist of field drilling holes of the diameter and length shown on the plans or as directed.

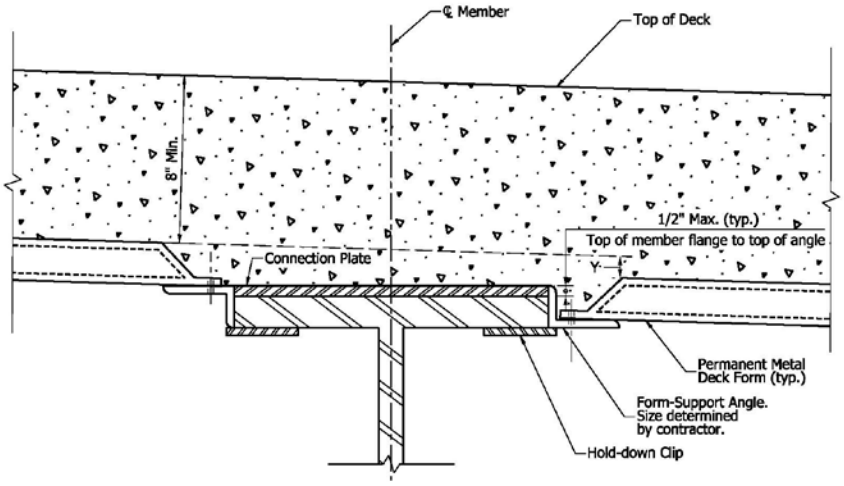
When vertical holes are to be drilled into the top of a concrete bridge deck, a minimum clearance of 2 in. ~~(50 mm)~~ shall be maintained between the bottoms of holes and bottom of slab. When vertical holes are to be drilled over a steel beam flange, the holes may be extended to the top of the beam flange. When vertical holes are to be drilled over a concrete I-beam, concrete box beam, *concrete bulb-T beam*, or concrete girder, the depths of the holes shall be as shown on the plans. If breakout occurs on the bottom of slab during the drilling process, the work shall be stopped, the breakout shall be repaired as directed, and an approved alternate drilling method shall be used to prevent breakout.

SECTION 702, BEGIN LINE 1487, DELETE AS FOLLOWS:

If the Contractor elects to increase the cement content as allowed herein ~~for its advantage~~, no additional compensation will be made.

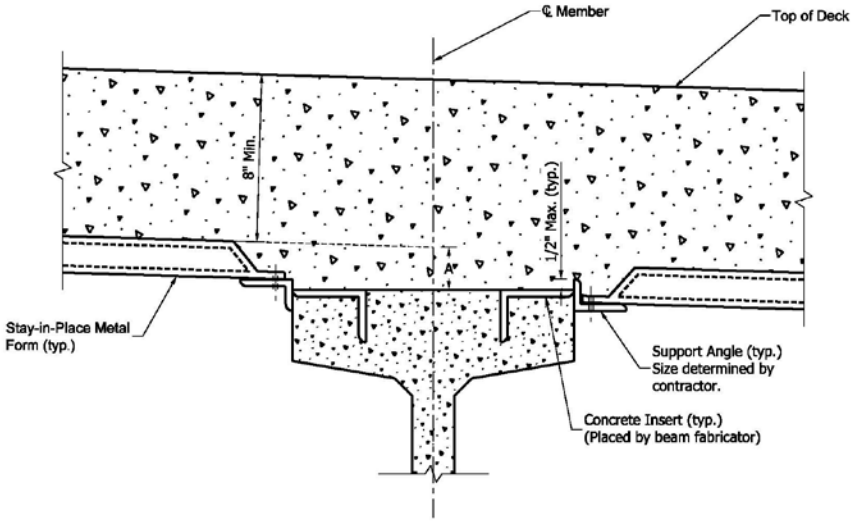
REVISION TO STANDARD SPECIFICATIONS

BACKUP 01. IDM, FIGURES 404-2B and 404-2C



FILLET TREATMENT FOR
STRUCTURAL-STEEL MEMBER

Figure 404-2B



FILLET TREATMENT FOR
PRESTRESSED-CONCRETE MEMBER

Figure 404-2C

COMMENTS AND ACTION

702.05 PROPORTIONING
702.07 MIXING
702.11 COLD WEATHER CONCRETE
702.13 FORMS
702.14 FALSEWORK AND CENTERING
702.15(e) POLYCHLOROPENE JOINT MEMBRANE
702.21 FINISHING CONCRETE SURFACES
702.22 CURING CONCRETE
702.24 APPLICATION OF LOADS TO AND ACCEPTANCE OF NEW CONCRETE
702.25 FIELD DRILLED HOLES IN CONCRETE
702.28 BASIS OF PAYMENT

Motion: Second: Ayes: Nays:	Action: ____ Passed as Submitted ____ Passed as Revised ____ Withdrawn
Standard Specifications Sections affected: 702.05 pg 484, 485; 702.07 pg 488; 702.11 pg 493, 494; 702.13 pg 497; 702.14 pg 500; 702.15(e) pg 503, 504; 702.21 pg 508; 702.22 pg 508, 509, 510; 702.24 pg 511' 512; 702.25 pg 513; 702.24 pg 515. Recurring Special Provision affected: 730-B-157 QUALITY CONTROL/QUALITY ASSURANCE, QC/QA, SUPERSTRUCTURE CONCRETE Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	____ 2014 Standard Specifications Book ____ Revise Pay Items List ____ Create RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? ____

Mr. Pankow
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: It has become necessary to be able to ensure that the buy America policy is implemented on contracts prior to construction.

PROPOSED SOLUTION: Revise the Buy America portion of the Standard Specifications section 106.01(c), and the Buy America Certification form in 916.03(a).

APPLICABLE STANDARD SPECIFICATIONS: 106.01 (c), 916.03 (a)

APPLICABLE STANDARD DRAWINGS: N/A

APPLICABLE DESIGN MANUAL SECTION: N/A

APPLICABLE SECTION OF GIFE: N/A

APPLICABLE RECURRING SPECIAL PROVISIONS: N/A

PAY ITEMS AFFECTED: N/A

Submitted By: Greg Pankow

Title: State Construction Engineer

Organization: INDOT

Phone Number: 317-232-5502

Date: 2/21/2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Mark Miller, Greg Pankow, Ron Walker, District Construction

REVISION TO STANDARD SPECIFICATIONS

SECTION 106 – CONTROL OF MATERIALS
106.01(c) BUY AMERICA REQUIREMENTS

The Standard Specifications are revised as follows:

SECTION 106, BEGIN LINE 81, INSERT AS FOLLOWS:

(c) Buy America Requirement

All contracts, whether financed entirely or partially with State or Federal funds, shall comply with IC 5-16-8 and the 23CFR 635.410.

Except for pig iron and processed, pelletized, and reduced iron ore, steel shall be made in the United States by the open hearth, basic oxygen, electric furnace, Bessemer, or other steel making process. Except for pig iron and processed, pelletized, and reduced iron ore, all steel and cast iron materials and products permanently incorporated in the contract shall be manufactured in the United States. Manufactured products include those which are rolled, formed, shaped, drawn extruded, forged, cast, or fabricated. The United States includes all territories, continental and insular, subject to the jurisdiction of the United States of America.

Except for pig iron and processed, pelletized, and reduced iron ore, no steel or cast iron products produced in the United States may be modified in a foreign country and still comply with the Buy America Requirement.

A Buy America Certification shall be submitted *for each product or shipment of material and received prior to being incorporated in the contract* in accordance with 916.02(g) and 916.03(a).

COMMENTS AND ACTION

106.01(c) BUY AMERICA REQUIREMENTS

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 106.01(c) pg 57. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Ms. Gottschalk
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Due to adding underdrains for MSE walls in 718, a pay item reference in 706 is no longer necessary. Also, a sentence in 706 after the list of pay items repeats information presented in the 105.03 section.

PROPOSED SOLUTION: Delete the unnecessary pay item.

APPLICABLE STANDARD SPECIFICATIONS: 706

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: None

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

PAY ITEMS AFFECTED: None

Submitted By: Shelly Gottschalk

Title: Manager, Construction Technical Support

Organization: INDOT

Phone Number: 232-7758

Date: January 17, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: None

REVISION TO STANDARD SPECIFICATIONS

SECTION 706 – BRIDGE RAILINGS
706.07 BASIS OF PAYMENT

The Standard Specifications are revised as follows:

SECTION 706, BEGIN LINE 127, DELETE AS FOLLOWS:

706.07 Basis of Payment

The accepted quantities of concrete railing will be paid for at the contract price per linear foot ~~(meter)~~ or cubic yard ~~(cubic meter)~~, for railing, concrete, of the type specified. Steel railing will be paid for at the contract unit price per linear foot ~~(meter)~~ of the type specified. Concrete bridge railing transitions will be paid for at the contract unit price per each for the type specified. Reinforced concrete moment slabs will be paid for at the contract unit price per square yard ~~(square meter)~~ for the thickness specified, complete in place. Underdrains for MSE walls placed under moment slabs will be paid for in accordance with 718.10. Type D-1 contraction joints will be paid for in accordance with 503.08. Reinforcing bars for concrete railings and concrete bridge railing transitions will be paid for in accordance with 703.08. Barrier delineator will be paid for in accordance with 602.06.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
~~Coarse Aggregate, No. 8~~	~~CYS (m3)~~
Concrete Bridge Railing Transition, ____ type	EACH
Railing, Steel ____ type	LFT ~~(m)~~
Railing, Concrete ____ type	LFT ~~(m)~~ CYS ~~(m3)~~
Reinforced Concrete Moment Slab, ____ thickness	SYS ~~(m2)~~

The cost of painting, washers, rivets, welding, anchor bolts, and necessary incidentals shall be included in the cost of the pay items in this section.

~~Concrete railing which the Engineer has ordered removed and replaced in accordance with 706.03 shall be with no additional payment.~~

The cost of the epoxy coated reinforcing bars and tie bars in the moment slab shall be included in the cost of the reinforced concrete moment slab.

The cost of all labor and materials required to provide for the monolithic concrete coping with moment slabs shall be included in the cost of the moment slab.

The cost of furnishing and placing all materials not specified as pay items shall be included in the cost of the pay items in this section.

COMMENTS AND ACTION

706.07 BASIS OF PAYMENT

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 706.07 pg 527 and 528. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y___N___ By ____ Addition or ____ Revision Received FHWA Approval? _____

Ms. Gottschalk
Date: 02/21/13

STANDARD, SPECIAL PROVISIONS AND DRAWINGS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Section 709 and 909.10 contain inconsistent language when referring to an approved list.

PROPOSED SOLUTION: Make the language in both 709 and 909.10 consistent and change the name of the approved list.

APPLICABLE STANDARD SPECIFICATIONS: 709 & 909.10

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: None

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

PAY ITEMS AFFECTED: None

Submitted By: Shelly Gottschalk

Title: Manager, Construction Technical Support

Organization: INDOT

Phone Number: 232-7758

Date: January 24, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Ad hoc committee consisting of Jim Reilman, Todd Tracy, and Tony Zander.

REVISION TO STANDARD SPECIFICATIONS

SECTION 709 – PORTLAND CEMENT CONCRETE SEALERS
709.02 MATERIALS
709.04(c) OTHER PORTLAND CEMENT CONCRETE SEALERS
709.05(c) OTHER PORTLAND CEMENT CONCRETE SEALERS
709.5(d) CLEAR SEALERS
SECTION 909 – PAINT AND LIQUID EPOXY
909.10 PROPRIETARY PCC SEALERS

The Standard Specifications are revised as follows:

SECTION 709, BEGIN LINE 10, DELETE AND INSERT AS FOLLOWS:

709.02 Materials

Materials shall be in accordance with the following:

Epoxy Penetrating Sealers 909.09
~~Other Portland Cement Concrete~~*Non-Epoxy PCC* Sealers.....909.10

SECTION 709, BEGIN LINE 42, DELETE AND INSERT AS FOLLOWS:

(c) ~~Other Portland Cement Concrete~~*Non-Epoxy PCC* Sealers

The concrete to be sealed shall be cured as stated on the list of approved ~~Other~~*Non-Epoxy* Portland Cement Concrete Sealers prior to sealer application.

SECTION 709, BEGIN LINE 104, DELETE AND INSERT AS FOLLOWS:

(c) ~~Other Portland Cement Concrete~~*Non-Epoxy PCC* Sealers

The sealer chosen for use shall be applied at the application rate specified on the list of approved ~~Other~~*Non-Epoxy* Portland Cement Concrete Sealers. The sealer shall be applied without dilution or alteration. Sealers, which are applied by spraying shall be sprayed onto the concrete surface using low pressure spray equipment with a sufficient number of passes to achieve the minimum application rate and a uniform coverage. The low pressure spray apparatus shall have a 15 psi ~~(105 kPa)~~ maximum nozzle pressure with a course fan spray, such as a garden, form oil, horticulture, or other low pressure sprayer. The spray equipment tanks, and hoses shall be thoroughly clean, free of foreign matter, oil, residue, and water prior to use. Sealers shall be selected from the Department's list of approved ~~Other~~*Non-Epoxy* Portland Cement Concrete Sealers and shall be spread to achieve uniform coverage. If roller spreading is required, a clean new roller shall be used for each application sequence. If brooming is specified, a clean, stiff-bristled broom shall be used to spread and work the sealer into the concrete surface.

(d) Clear Sealers

Clear sealers shall be used on all vertical wall surfaces such as concrete bridge railing, barrier wall, exterior concrete bridge beams, etc., when sealing is specified for these items. ~~The epoxy penetrating sealers are not clear sealers.~~ Clear sealers will be those identified on the list of approved ~~Other~~*Non-Epoxy* Portland Cement Concrete Sealers. *Epoxy penetrating sealers are not clear sealers.*

REVISION TO STANDARD SPECIFICATIONS

SECTION 709 – PORTLAND CEMENT CONCRETE SEALERS
709.02 MATERIALS
709.04(c) OTHER PORTLAND CEMENT CONCRETE SEALERS
709.05(c) OTHER PORTLAND CEMENT CONCRETE SEALERS
709.5(d) CLEAR SEALERS
SECTION 909 – PAINT AND LIQUID EPOXY
909.10 PROPRIETARY PCC SEALERS

SECTION 909, BEGIN LINE 613, DELETE AND INSERT AS FOLLOWS:

909.10 ~~Proprietary~~ *Non-Epoxy* PCC Sealers

~~Proprietary~~*Non-epoxy* PCC sealers shall be selected from the Department's list of approved ~~Other~~*Non-Epoxy Portland Cement* Concrete Sealers. A ~~proprietary~~*non-epoxy* PCC sealer may be added to the approved list by completing the requirements in accordance with ITM 806, ~~Approved List~~ Procedure C.

(a) Properties

The ~~proprietary~~*non-epoxy* PCC sealer shall be in accordance with NCHRP 244, Series IV, Southern Climate Weathering Test and possess the following properties.

Property	Requirement
Reduction of Chloride Ion Content	90% of the Control
Active Ingredients, Minimum	
Silane Based	20%
Siloxane Based	15%
Others	10%

(b) Test Report

The testing shall be performed by a recognized laboratory in accordance with ITM 806.

The ~~proprietary~~*non-epoxy* PCC sealers shall be delivered to the jobsite in unopened containers with the manufacturer's numbered seal intact.

COMMENTS AND ACTION

709.02 MATERIALS
709.04(c) OTHER PORTLAND CEMENT CONCRETE SEALERS
709.05(c) OTHER PORTLAND CEMENT CONCRETE SEALERS
709.5(d) CLEAR SEALERS
909.10 PROPRIETARY PCC SEALERS

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 709.02 pg 544, 545, 546, 547; 909.10 pg 870. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Ms. Gottschalk
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISION AND STANDARD DRAWINGS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Pipe support brackets are not explicitly addressed in the bridge deck drain system specification.

PROPOSED SOLUTION: Add language that elaborates on what is included in the bridge deck drain system lump sum pay item in sections 715.02 (n) and 715.14 .

APPLICABLE STANDARD SPECIFICATIONS: 715

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: None

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

PAY ITEMS AFFECTED: None

Submitted By: Shelly Gottschalk

Title: Manager, Construction Technical Support

Organization: INDOT

Phone Number: 232-7758

Date: January 28 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: None

REVISION TO STANDARD SPECIFICATIONS

SECTION 715 – PIPE CULVERTS, AND STORM AND SANITARY SEWERS
715.02(n) BRIDGE DECK DRAIN SYSTEM
715.14 BASIS OF PAYMENT

The Standard Specifications are revised as follows:

SECTION 715, BEGIN LINE 182, INSERT AS FOLLOWS:

(n) Bridge Deck Drain System

Pipe and fittings used in an enclosed bridge deck drainage system shall be cast iron soil pipe in accordance with 908.10 or reinforced thermosetting resin pipe in accordance with 907.28. *The need for pipe support brackets and their spacing or location shall be determined by the pipe manufacturer. Pipe support brackets and all hardware shall be galvanized in accordance with ASTM A 153, class D or AASHTO M 298, class 40, type I. A type C certification in accordance with 916 shall be provided for the pipe brackets.*

SECTION 715, BEGIN LINE 624, INSERT AS FOLLOWS:

The cost of reinforcing bars, straps, and hook bolts used in anchors shall be included in the cost of the concrete anchor. The cost of the toe plate anchor and galvanized bolts required for pipe end sections and safety metal end sections shall be included in the cost of the pay items. The cost of pipe support brackets and all hardware used to attach the roadway drain casting extension pipe to the drain casting and the pipe support bracket to the structural member and to the drain extension pipe shall be included in the cost of the pay items. *The cost of the pipe, all necessary fittings, pipe support brackets, all incidental hardware, design costs, and all other costs to provide the bridge deck drain system shown in the plans shall be included in the lump sum cost of the bridge deck drain system.* The cost of concrete backfill for slotted drain pipe and slotted vane drain pipe shall be included in the cost of the pay items.

COMMENTS AND ACTION

715.02(n) BRIDGE DECK DRAIN SYSTEM
715.14 BASIS OF PAYMENT

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 715.02 pg 601; 715.14 pg 611. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Ms. Gottschalk
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISION AND STANDARD DRAWINGS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Section 915.03, wood piles, is a repetition of a reference in 701.02.

PROPOSED SOLUTION: Delete the 915.03 text. Renumber the 915.03.1 section to be 915.03 and make other necessary reference adjustments throughout the book (ie. where 915.03.1 is referenced, change it to 915.03).

APPLICABLE STANDARD SPECIFICATIONS: 915.03

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: None

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

PAY ITEMS AFFECTED: None

Submitted By: Shelly Gottschalk

Title: Manager, Construction Technical Support

Organization: INDOT

Phone Number: 232-7758

Date: January 17, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: None

REVISION TO STANDARD SPECIFICATIONS

SECTION 915 –BRIDGE PILES AND BEARINGS
913.03 WOOD PILES
915.03.1 PILE SHOES

The Standard Specifications are revised as follows:

SECTION 910, BEGIN LINE 193, DELETE AS FOLLOWS:

~~**915.03 Wood Piles**~~

~~Wood piles shall be in accordance with 911.01(e) or 911.02(c) as specified.~~

915.03~~.1~~ Pile Shoes

Steel H pile shoes furnished shall be covered by a type C certification in accordance with 916. Pile shoes shall be cast-in-one-piece steel in accordance with ASTM A 148 Grade 80-50 ~~(grade 550-345~~) and shall be fastened to the piles by welding in accordance with the manufacturer's recommendations. They shall have sufficient flange and continuous web vertical back-ups to assure proper alignment and fitting to the pile. Either the pile shoe or the outside of each flange of the pile shall be beveled 45°. E70XX welding rods shall be used. All welds shall be made in the flat position and the welder shall be qualified in accordance with 711.32.

Timber pile shoes furnished shall be covered by a type C certification in accordance with 916. Pile shoes shall be cast-in-one-piece steel in accordance with ASTM A 27 Grade 65-35 ~~(450-240)~~ Class 2 or Grade 70-36 ~~(485-250)~~ Class 2 and shall be fastened to the piles in accordance with the manufacturer's recommendations.

The soil or rock bearing surfaces of the shoes shall be sloped downward towards the web a minimum of 15° but not to exceed 45° to the horizontal under the flanges. The sloped surfaces of the shoes shall terminate so as to form a flat surface not exceeding 1/3 of the flange width. The surfaces may have individual or continuous cutting teeth.

COMMENTS AND ACTION

913.03 WOOD PILES
915.03.1 PILE SHOES

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 701.02 pg 461; 915.03 pg 939; 915.03.1 pg 940. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book _____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ _____ Revise RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ Standard Drawing Effective _____ _____ Create RPD (No. _____) Effective _____ Letting _____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By _____ Addition or _____ Revision Frequency Manual Update Req'd? Y___N___ By _____ Addition or _____ Revision Received FHWA Approval? _____

Mr. Pankow
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: The 108 working restrictions during certain holiday periods provision was enacted in May 2011. At that time there was uncertainty whether it should go into the next spec book or remain a provision. Based on comments received from the districts, minor revisions are proposed to the provision.

PROPOSED SOLUTION: Incorporate the proposed changes into the 108-C-585 RSP. Also, incorporate the new 108-C-585 into the next spec book.

APPLICABLE STANDARD SPECIFICATIONS: None

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: None

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: 108-C-585

PAY ITEMS AFFECTED: None

Submitted By: Greg Pankow

Title: State Construction Engineer

Organization: INDOT

Phone Number: 232-5502

Date: January 28, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Ad hoc committee consisting of several district construction folks and Jim Reilman.

REVISION TO SPECIFICATIONS, SPECIAL PROVISIONS

108-C-585 WORKING RESTRICTIONS DURING CERTAIN HOLIDAY PERIODS

(Note: proposed changes shown highlighted gray.)

108-C-585 WORKING RESTRICTIONS DURING CERTAIN HOLIDAY PERIODS

(Adopted 05-19-11)

The Standard Specifications are revised as follows:

SECTION 108, AFTER LINE 333, DELETE AND INSERT AS FOLLOWS:

Contractors will not be permitted to work during the following holiday periods unless prior written approval is received from the Engineer. All deliveries and traffic coming from suppliers shall cease during the Department-ordered suspensions of work listed below. No time extensions to closure periods, intermediate completion dates, or contract completion dates will be granted for suspending work during these holiday periods.

(a) New Year's Day. If New Year's Day falls on a Sunday, work shall be suspended from noon December 31 until ~~sunrise~~7:00 am local time January 3. If New Year's Day falls on a Monday through Saturday, work shall be suspended from noon December 31 until ~~sunrise~~7:00 am local time January 2.

(b) Good Friday. Work shall be suspended from noon on Good Friday until ~~sunrise~~7:00 am local time Monday, the day after Easter Sunday.

(c) Memorial Day. Work shall be suspended from noon the Friday before Memorial Day until ~~sunrise~~7:00 am local time Tuesday, the day after Memorial Day.

(d) Independence Day. If Independence Day falls on a:

Sunday - Work shall be suspended from noon Friday, July 2, until ~~sunrise~~7:00 am local time Tuesday, July 6.

Monday - Work shall be suspended from noon Friday, July 1, until ~~sunrise~~7:00 am local time Tuesday, July 5.

Tuesday - Work shall be suspended from noon Friday, June 30, until ~~sunrise~~7:00 am local time Wednesday, July 5.

Wednesday - Work shall be suspended from sunset on Tuesday, July 3, until ~~sunrise~~7:00 am local time Thursday, July 5.

Thursday - Work shall be suspended from noon Wednesday, July 3, until ~~sunrise~~7:00 am local time Monday, July 8.

REVISION TO SPECIFICATIONS, SPECIAL PROVISIONS

108-C-585 WORKING RESTRICTIONS DURING CERTAIN HOLIDAY PERIODS

Friday - Work shall be suspended from noon Thursday, July 3, until ~~sunrise~~7:00 am local time Monday, July 7.

Saturday - Work shall be suspended from noon Thursday, July 2, until ~~sunrise~~7:00 am local time Monday, July 6.

(e) Labor Day. Work shall be suspended from noon the Friday before Labor Day until ~~sunrise~~7:00 am local time Tuesday, the day after Labor Day.

(f) Thanksgiving Day. Work shall be suspended from noon the Wednesday before Thanksgiving Day until ~~sunrise~~7:00 am local time the Monday after Thanksgiving Day.

(g) Christmas Day. Work shall be suspended from noon December 24 until ~~sunrise~~7:00 am local time December 27.

If prior written approval is received from the Engineer which permits a Contractor to work on one or more of the days shown in the holiday periods listed above, all affected intermediate and contract completion dates will subsequently be shortened by the number of days approved to work during the requested holiday period.

The Department may order the suspension of work, either wholly or in part, for a period of time for certain holidays *not already specified herein.* For such orders~~, if the contract suspension is not stated in the contract documents,~~ the contract completion time will be adjusted as follows:

COMMENTS AND ACTION

108-C-585 WORKING RESTRICTIONS DURING CERTAIN HOLIDAY PERIODS

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 108.08 pg 84. Recurring Special Provision affected: 108-C-585 WORKING RESTRICTIONS DURING CERTAIN HOLIDAY PERIODS. Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List ____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Mr. Buening
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISIONS AND DRAWINGS
REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: To date, I have heard of underseal material migrating upwards on three active contracts to include the US-40 project west of Greenfield. Standard Specification section 612 states:

1. The pumping holes are typically made by drilling a uniform diameter hole (612.04).
2. Wood plugs are to be used (612.05) and their use has been verified by multiple responses from District Construction personnel.
3. The wood plugs are supposed to be oversized by 1/16" (612.05) and driven to refusal at least 3" into the pavement (612.05).

We know the undersealing operations have/are occurring before milling operations. We know the historical material used has been UA-III but recent projects have been using UA-II (less viscous) due to reported supply issues with UA-III. The UA-II material can be 4 times more ductile and approximately 1.5 times softer at higher temperatures than the UA-III. I believe milling the pavement after the drilled holes are plugged is the primary cause for the observed problem; the secondary cause is the UA-II material.

The current specification in 612 does not account for the milling operation.

PROPOSED SOLUTION: Provide an option to use cement grout as well as removing UA-II material from use. UA-III material can be obtained from three different sources as confirmed by Rieth-Riley. Require longer wooden dowels in addition to an inspection of all wood plugs upon completion of milling and before overlaying with HMA pavement. Damaged or loose plugs should be replaced.

APPLICABLE STANDARD SPECIFICATIONS: 612

APPLICABLE STANDARD DRAWINGS:

APPLICABLE DESIGN MANUAL SECTION:

APPLICABLE SECTION OF GIFE:

APPLICABLE RECURRING SPECIAL PROVISIONS:

PAY ITEMS AFFECTED: Asphalt Material for Underseal

Submitted By: Michael Prather for Mike Buening
Title: Area Pavement Engineer
Phone Number: 234-8250
Date: 01/07/13

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Ad-Hoc committee comprised of Michael Buening, Jeff James, Tommy Nantung and Alan Selner of Rieth-Riley.

REVISION TO STANDARD SPECIFICATIONS

SECTION 612 – UNDERSEALING

The Standard Specifications are revised as follows:

SECTION 612, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 612 – UNDERSEALING

612.01 Description

This work shall consist of *drilling holes and* furnishing and pumping an asphalt *or cement grout* material under cement concrete pavement in accordance with 105.03.

MATERIALS

612.02 Materials

Asphalt material shall be in accordance with the following:

Utility asphalt, ~~UA-II or~~ UA-III ~~shall be in accordance with~~ .....902.01(d)

Cement grout materials shall be in accordance with the following:

Admixtures.....912.03
Fly Ash 901.02
Portland Cement .....901.01(b)
Water.....913.01

612.03 Cement Grout Mix Design

The mix design for cement grout shall consist of 1 part by volume of Portland cement and 3 parts by volume of fly ash. Water shall be added to achieve required fluidity and admixtures shall be added as needed to obtain required grout characteristics.

Fluidity of the grout when measured by a flow cone in accordance with ASTM C 939 shall have a time of efflux between 9 and 15 seconds.

The mix design shall specify the materials and sources and be submitted for approval to the Engineer. Test results shall show 1, 3, and 7-day compressive strengths, flow cone time, shrinkage and expansion observed and time of initial set. The 7-day compressive strength shall be at least 600 psi as measured in accordance with AASHTO T 106.

CONSTRUCTION REQUIREMENTS

612.04 Weather Limitations

Undersealing shall not be performed when pavement surface temperatures are below 40°F, or when the subgrade or subbase is frozen. If proper undersealing cannot be achieved due to excessive temperatures or direct sunlight, work shall be performed at night.

REVISION TO STANDARD SPECIFICATIONS

SECTION 612 – UNDERSEALING

612.~~03~~*05* Shoulders

All holes, low areas, or displaced areas in the shoulders immediately adjacent to the pavement edge shall be filled with loam, clay, or other approved material and compacted to the elevation of the pavement. Such areas, including all other shoulder areas immediately adjacent to the pavement edge, shall be compacted with a roller or another approved method.

612.~~04~~*06* Drilled Holes

Where the existing pavement has transverse joints, holes not to exceed 1.5 in. ~~(38 mm)~~ in diameter shall be drilled on the centerlines of the pavement lane to be treated. Such holes, unless otherwise directed, shall be located longitudinally between transverse joints or cracks at approximately 30 to 36 in. ~~(750 to 900 mm)~~ from the joints or cracks. Intermediate holes, if necessary, shall be spaced as directed.

If the existing pavement does not have transverse joints, holes not to exceed 1.5 in. ~~(38 mm)~~ in diameter shall, unless otherwise permitted or directed, be located on the centerline of the pavement lane to be treated and be spaced as directed.

An approved method shall be used to prevent the drill from entering the subgrade after penetrating the pavement. Automatic stops on mechanical equipment and marked drill bits on hand operated jackhammers may be approved subject to satisfactory operation.

Just prior to pumping operations, the surface of the pavement around each hole for an area of at least 1/2 the width of the lane being treated shall be thoroughly sprinkled with water to prevent the undersealing material from adhering to the pavement surface.

612.~~05~~*07* Pumping ~~Asphalt~~

All storage tanks, pipes, retorts, booster tanks, and distributors used for storing or handling the materials shall be kept clean and in good operating condition at all times so there is no contamination of the materials.

Where undersealing operations are being performed under traffic, necessary signs, barricades, watchers, and flaggers shall be used to maintain 1 lane of traffic in the immediate vicinity of pumping operations. Traffic may be permitted to use the pumped areas upon removal of the original plugs and after the hardwood plugs are driven.

When directed, certain portions may be required to be undersealed a 2nd time. The number of holes involved in this 2nd undersealing shall not exceed 5% of the number of holes indicated in the Schedule of Pay Items.

(a) Asphalt Material

~~After the above procedure is complete, t~~*T*he asphalt shall ~~then~~ be pumped through the *drilled* holes and under the pavement with an approved type of self-propelled pressure distributor, the pressure to be as directed. A metallic hose shall connect the asphalt tank

through an asphalt pump to a 1 in. ~~(25 mm)~~ nozzle and a return metallic hose shall connect the nozzle to the asphalt distributor tank.

The nozzle shall be equipped with a 3-way valve ~~so designed~~ that *permits* the asphalt ~~may~~ *to* circulate back to the distributor tank when pumping operations are not in progress. The nozzle shall be inserted in the hole, driven to a snug fit, and pumping of the asphalt continued until the undersealing is complete, or to such other amount as directed. In case of an existing asphalt resurface on concrete, holes shall be drilled through the resurface and the underlying concrete and the nozzle shall be of sufficient length that it can be driven to a snug fit into the concrete without the upper part of the nozzle being below the elevation of the existing asphalt resurface. ~~Upon completion of the pumping operation, the nozzle shall be removed and a wood plug driven into the hole without an excessive back flow of asphalt material. After the material has hardened, the plug shall be removed and a hardwood plug at least 3 in. (75 mm) long and a minimum of 1/16 in. (2 mm) larger than the diameter of the drilled hole shall be driven flush with the surface of the concrete pavement. All material extruded during the pumping operations shall be immediately cleaned from the pavement surface and removed from the limits of the contract within a period of 24 h.~~

~~Where undersealing operations are being performed under traffic, necessary signs, barricades, watchers, and flaggers shall be used to maintain 1 lane traffic in the immediate vicinity of pumping operations. Traffic may be permitted to use the pumped areas upon removal of the original plugs and after the hardwood plugs are driven.~~

~~All storage tanks, pipes, retorts, booster tanks, and distributors used for storing or handling the asphalt materials shall be kept clean and in good operating condition at all times so there is no contamination of the materials.~~

The asphalt shall not be heated above 500°F ~~(260°C)~~ at any time and, when pumped under the pavement, the temperature shall be no less than 350°F ~~(177°C)~~. All material heated beyond 500°F ~~(260°C)~~ shall be rejected.

~~No material shall be applied on a frozen subgrade nor when the atmospheric temperature is 40°F (4°C) or lower and falling. The asphalt shall be placed only when general weather conditions are suitable.~~

~~When directed, certain portions may be required to be undersealed a 2nd time. The number of holes involved in this 2nd undersealing shall not exceed 5% of the number of holes indicated in the Schedule of Pay Items.~~

(b) Cement Grout Material

The cement grout shall be produced by a grout plant consisting of a positive displacement cement injection pump and a high speed colloidal mixing machine. The colloidal mixing machine shall operate between 800 and 2,000 rpm, creating a high shearing action and subsequent pressure release to make a homogeneous mixture.

The cement grout shall be pumped through the drilled holes and under the pavement with an expanding rubber packer or hose on a nozzle connected to the discharge of the grout pump.

The nozzle shall be inserted in the hole, driven to a snug fit, and pumping of the cement grout continued until the undersealing is complete, or to such other amount as directed. In case of an existing asphalt resurface on concrete, holes shall be drilled through the resurface and the underlying concrete and the nozzle shall be of sufficient length that it can be driven to a snug fit into the concrete without the upper part of the nozzle being below the elevation of the existing asphalt resurface.

(c) Wood Plugs

Upon completion of the pumping operation, the nozzle shall be removed and a wood plug driven into the hole. After the pumped material has hardened, the original plug shall be removed and a 4 in. or longer hardwood plug a minimum of 1/16 in. larger than the diameter of the drilled hole shall be driven flush with the surface of the pavement. All material extruded during the pumping operations shall be immediately cleaned from the pavement surface and removed from the limits of the contract within a period of 24 h.

The hardwood plugs shall be inspected after any milling operation in the case where a resurface exists on the concrete. Damaged or missing plugs shall be replaced prior to overlaying with a new surface.

612.~~06~~*08* Method of Measurement

Asphalt material will be measured by the ton~~ (megagram)~~. ~~Drilled holes for underseal will be measured per each hole drilled.~~

Cement grout material will be measured by the ton. The weight will be determined by multiplying the number of 94 lb bags of Portland cement used in the cement grout material by 94 lb and converting the product to the equivalent number of tons.

Drilled holes for underseal will be measured per each hole drilled.

612.~~07~~*09* Basis of Payment

This work will be paid for at the contract unit price per ton~~ (megagram)~~ for ~~asphalt~~ material for underseal. Drilled holes for underseal will be paid for at the contract unit price per each, complete in place.

Additional holes and materials required for a 2nd undersealing operation will be paid for at the contract unit prices for the quantities involved.

Payment will be made under:

REVISION TO STANDARD SPECIFICATIONS

SECTION 612 – UNDERSEALING

Pay Item	Pay Unit Symbol
~~Asphalt~~ Material for Underseal	TON ~~(Mg)~~
Drilled Hole for Underseal	EACH

The cost of shoulder material, wood and hardwood plugs, and necessary incidentals shall be included in the cost of the pay items.

REVISION TO SPECIAL PROVISIONS

SECTION 612 - UNDERSEALING

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 305.02 pg 222; 507 pg 346 and 347; 612 pg 393 thru 395. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: _____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By _____ Addition or _____ Revision Frequency Manual Update Req'd? Y__N__ By _____ Addition or _____ Revision Received FHWA Approval? _____

SPECIFICATION, SPECIAL PROVISION AND STANDARD DRAWINGS

REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Currently, Standard Specification section 628.02 only requires the Contractor to provide a printer capable of printing letter and legal sized documents. Field personnel would greatly benefit from being able to print out ledger sized documents, making plan sheets more legible.

Also, feedback from District field personnel indicates that radios are no longer commonly used on construction projects. There is also a growing need to provide more useful and beneficial tools in the field with regard to communication and sharing of data.

PROPOSED SOLUTION: Revise 628 to include ledger size printing capabilities. Remove radios from the list of pay items and from the Standard Specifications. Revise the cell phone requirements to include a sufficient digital camera, e-mail and internet access, along with video capture capability when specified. This revision will provide useful and beneficial tools in the field while maintaining a budget conscious approach to business.

APPLICABLE STANDARD SPECIFICATIONS: 628.02 (e) 2, 628.04, 628.05, 628.06

APPLICABLE STANDARD DRAWINGS: N/A

APPLICABLE DESIGN MANUAL SECTION: N/A

APPLICABLE SECTION OF GIFE: N/A

APPLICABLE RECURRING SPECIAL PROVISIONS: N/A

PAY ITEMS AFFECTED: Cellular Telephone/Radio Service, Cellular Telephone/Radio, Radio Only Service, Radio.

Submitted By: Michelle M. Gottschalk, PE

Title: Director, Construction Technical Support

Organization: INDOT

Phone Number: 317-232-7758

Date: January 24, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Michelle Gottschalk, Jeffrey James, Greg Pankow, Brad Minnick, Scott Trammell, Mark Miller

REVISION TO STANDARD SPECIFICATIONS

SECTION 628 – FIELD OFFICE, FIELD LABORATORY, COMPUTER SYSTEMS, OFFICE MACHINES AND COMMUNICATIONS
628.02(e)2 PRINTER
628.04 CELLULAR TELEPHONES/RADIOS
628.05 METHOD OF MEASUREMENT
628.06 BASIS OF PAYMENT

The Standard Specifications are revised as follows:

SECTION 628, BEGIN LINE 314, DELETE AND INSERT AS FOLLOWS:

2. Printer

The printer shall be a laser printer compatible with the computer system provided by the Contractor for use by the Department in the field office. The printer shall be capable of printing single-sided, black and white letter, ~~and~~ legal *and ledger* US paper size documents at a rate of 20 pages per minute and capable of automatic duplex printing. *More than 1 printer may be used to meet this requirement.*

SECTION 628, BEGIN LINE 422, DELETE AND INSERT AS FOLLOWS:

628.04 Cellular Telephones~~/Radios~~

The Contractor shall provide ~~radio or~~ cellular telephone~~/radio~~ equipment and services, as specified below, for use by the Department on the contract.

~~Each radio or cellular telephone/radio unit shall be capable of 2-way radio communication with all other units provided under this contract.~~ Each ~~radio or~~ cellular telephone~~/radio~~ unit shall have a service coverage area that includes the project limits. Each ~~radio or~~ cellular telephone~~/radio~~ unit shall include a belt clip system, a 120v AC charger, and a 12v DC mobile charger.

All equipment shall be covered by normal manufacturer's warranties. All ~~radio or~~ cellular telephone~~/radio~~ units and associated equipment will remain the property of the Contractor and will be returned to the Contractor upon completion of the contract.

~~The Contractor shall provide the following services for each radio or cellular telephone/radio unit.~~

Cellular telephone units shall meet the following minimum requirements:

(a) ~~Radio Service~~*Type A*

~~Radio service shall include the following:~~

1. ~~unlimited direct connect radio service;~~*internet ready device with minimum 3.5 in. display, measured diagonally;*
2. ~~no cellular telephone service.~~*cellular telephone anytime minutes per month as shown in the Schedule of Pay Items;*
3. *unlimited nights and weekends service;*
4. *voice mail and caller ID;*
5. *protective case to prevent damage to the unit;*
6. *rear facing camera with a minimum 4 MP resolution;*
7. *minimum 720p video capture;*

REVISION TO STANDARD SPECIFICATIONS

SECTION 628 – FIELD OFFICE, FIELD LABORATORY, COMPUTER SYSTEMS, OFFICE MACHINES AND COMMUNICATIONS
628.02(e)2 PRINTER
628.04 CELLULAR TELEPHONES/RADIOS
628.05 METHOD OF MEASUREMENT
628.06 BASIS OF PAYMENT

8. 2GB or higher data plan per unit;
9. internal memory of 8GB or higher;
10. USB port for computer connection.

(b) ~~Cellular Telephone/Radio Service~~*Type B*
~~Cellular telephone/radio service shall include the following:~~

1. cellular telephone anytime minutes per month as shown in the ~~s~~*S*chedule of ~~p~~*P*ay ~~i~~*I*tems;
2. unlimited nights and weekends service;
3. ~~unlimited direct connect radio service~~*voice mail and caller ID*;
4. built-in camera with a minimum 3.2 MP resolution.

The Department will be responsible for damage ~~and/~~or loss of the units beyond that covered by normal manufacturer's warranties, while in use by the Department. The Contractor shall provide replacement cellular telephone~~/radio~~ units, batteries, chargers, ~~etc~~*and equipment* within 1 business day of notification of need for the item.

The Contractor shall not enter into any agreement with any service provider or purchase any ~~radio or~~ cellular telephone~~/radio~~ units for use by the Department until authorized by the Engineer. The Engineer will notify the Contractor a minimum of 10 business days prior to the need for the units.

628.05 Method of Measurement

Field office and field laboratory will be measured by the month for the specified type. Partial months will be rounded up to the next 1/2 or whole month. The Department will provide 2 weeks advanced notice prior to when the facility will be vacated.

If a field laboratory is specified and is included in the same space as the field office, the field laboratory will not be measured for payment.

Additional field office computer system, mobile laptop computer system, mobile internet service, and cellular telephone~~/radio~~ service will be measured by the month for each system or service provided. Partial months will be rounded up to the next 1/2 or whole month. The Department will provide 2 weeks advanced notice prior to when mobile internet service and cellular telephone~~/radio~~ service will no longer be required.

628.06 Basis of Payment

Field office and field laboratory will be paid for at the contract unit price per month, complete in place until released.

REVISION TO STANDARD SPECIFICATIONS

SECTION 628 – FIELD OFFICE, FIELD LABORATORY, COMPUTER SYSTEMS, OFFICE MACHINES AND COMMUNICATIONS
628.02(e)2 PRINTER
628.04 CELLULAR TELEPHONES/RADIOS
628.05 METHOD OF MEASUREMENT
628.06 BASIS OF PAYMENT

Additional field office computer system, mobile laptop computer system and mobile internet service will be paid by the month for each system or service provided.

~~Radio and c~~*C*ellular telephone~~/radio~~ units will be paid for at the contract unit price per each *per each type specified*. ~~Radio and c~~*C*ellular telephone~~/radio~~ service will be paid for at the contract unit price per month per each phone. Monthly charges for cellular telephone minutes *and data* in excess of those specified in the contract will be paid for by the dollar amount for the invoiced price per each occurrence as cellular telephone~~/radio~~, additional charges.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
Cellular Telephone~~/Radio~~ Service, _____ anytime minutes	MOS
Cellular Telephone~~/Radio~~_____ *type*	EACH
Cellular Telephone, Additional Data	*DOL*
Cellular Telephone~~/Radio~~, Additional Minutes	DOL
Field Laboratory, _____ type	MOS
Field Office Computer System, Additional, _____ Each qty	MOS
Field Office, _____ type	MOS
Mobile Internet Service, _____ Each qty	MOS
Mobile Laptop Computer System, _____ Each qty	MOS
~~Radio Only Service~~	~~MOS~~
~~Radio~~	~~EACH~~

The cost of all heating, cooling, electrical service, telephone service and other miscellaneous utility bills required for the field office or field laboratory shall be included in the cost of the field office or the field laboratory.

If a field office smaller than the specified type is approved by the Engineer, a new unit price will be established for the smaller field office. The new unit price will be equal to the original contract unit price multiplied by the smaller floor area and divided by the specified floor area.

REVISION TO STANDARD SPECIFICATIONS

SECTION 628 – FIELD OFFICE, FIELD LABORATORY, COMPUTER SYSTEMS, OFFICE MACHINES AND COMMUNICATIONS
628.02(e)2 PRINTER
628.04 CELLULAR TELEPHONES/RADIOS
628.05 METHOD OF MEASUREMENT
628.06 BASIS OF PAYMENT

If a temporary field office is provided in accordance with 628.02, payment will be 65% of the unit price during the time the temporary field office is in use by the Department.

The cost of all materials and labor necessary to setup, secure, maintain and remove the field office, including all required equipment and supplies and any material required to provide parking, shall be included in the cost of the field office.

All costs necessary to provide the field office computer system, including the required software, manuals, peripherals and related equipment, technical support and miscellaneous computer requirements shall be included in the cost of the field office.

All costs necessary to establish, install and maintain field office internet service, including any required hardware, software, fees, monthly charges, setup, installation and technical support shall be included in the cost of the field office.

All costs necessary to provide the copier, printer, document scanner and fax machine, including setup, installation, all required connections to computer systems, technical support and miscellaneous office machine requirements shall be included in the cost of the field office.

All costs necessary to establish and maintain a field office network when 1 or more additional field office computer systems are specified shall be included in the cost of the field office.

All cost necessary to provide an additional field office computer system, including the required software, manuals, peripherals and related equipment and technical support shall be included in the cost of the additional field office computer.

All costs necessary to provide the mobile laptop computer system, including the required software, manuals, peripherals and related equipment, technical support and miscellaneous computer requirements shall be included in the cost of the mobile laptop computer.

All costs necessary to establish, install and maintain mobile internet service, including required hardware, software, fees, monthly charges, setup, installation and technical support shall be included in the cost of mobile internet service.

The Contractor shall provide a copy of the detailed invoice from the service provider for each cellular telephone~~/radio or radio~~ unit each month.

COMMENTS AND ACTION

628.02(e)2 PRINTER
628.04 CELLULAR TELEPHONES/RADIOS
628.05 METHOD OF MEASUREMENT
628.06 BASIS OF PAYMENT

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 628.04 pg 456, 457, 458; 628.06 pg 458 and 459. Recurring Special Provision affected: 628-C-586 FIELD OFFICE COMPUTER EQUIPMENT Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS

REVISION TO SPECIAL PROVISION AND STANDARD DRAWINGS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: The 3312 Implemantation Subcommittee has identified Temporary Turbidity Curtains as a useful management practice for waterway protection. INDOT has limited experience using turbidity curtains and in the contracts they have been used have relied on a unique SP for the requirements for installation. This RSP will establish the specifications for the turbidity curtain.

PROPOSED SOLUTION: Adoption of the proposed RSP 205-C-xxxx and RPD E 205-TECX-xx

APPLICABLE STANDARD SPECIFICATIONS: 205

APPLICABLE STANDARD DRAWINGS: Proposed Recurring Plan Detail

APPLICABLE DESIGN MANUAL SECTION:

APPLICABLE SECTION OF GIFE: N/A

APPLICABLE RECURRING SPECIAL PROVISIONS: Proposed

PAY ITEMS AFFECTED: New pay item in this RSP

Submitted By: Michelle Gottschalk

Title: Construction Technical Support Manager

Organization: INDOT

Phone Number: 232-7758

Date: January 31, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Yes

REVISION TO SPECIAL PROVISION AND STANDARD DRAWINGS

PROPOSED NEW 205-C-XXX TEMPORARY TURBIDITY CURTAIN

205-C-XXX TEMPORARY TURBIDITY CURTAIN

Adopted (XX-XX-13)

Description

Turbidity curtains shall be implemented in accordance with 105.03.

Materials

Materials shall be in accordance with the following:

Curtain fabric material type: impermeable vinyl-nylon laminate.
Weight of fabric: 18 oz/sq yd.
Grab tensile strength: minimum 300 lbs, in accordance with ASTM D 4632.
Flotation: 6 in. diameter marine quality expanded polystyrene.
Net buoyancy: 13 lbs/ft.
Top load carrying components: fabric only.
Ballast: minimum 0.7 lbs/ft enclosed 1/4 in. galvanized chain.

The materials shall be a bright color and shall be installed and maintained per the manufacturer's recommendations.

Any deviation from the above material specifications is subject to approval by the Engineer.

The manufacturer's recommendations shall be followed with regard to shipping, handling, storage, installation, and protection from direct sunlight. The curtain material will be rejected if it has defects, tears, punctures, flaws, deterioration, or damage incurred during manufacturing, transportation, storage, or installation. Each roll shall be labeled or tagged to provide product identification.

Construction Requirements

The turbidity curtain shall be installed prior to any disturbance below the top of the channel bank, or as directed by the Engineer. Maximum water depth shall be as shown on the plans.

The Contractor shall inspect the curtain for sediment seepage plumes into the protected water. The Contractor shall repair and seal all tears, rips or openings which allow sediment to escape. The Contractor shall wait 48 hrs after site stabilization before removing the curtain. The Contractor shall minimize sediment re-suspension during curtain removal. Sediment that originated in the water body limits does not require removal. Damaged curtains shall be repaired prior to work continuing in the area.

Legible copies of all necessary current manufacturers' installation manuals shall be provided prior to installation. Required warning systems shall be in accordance with applicable local and federal laws and regulations. Seaming of the floating curtain shall be completed to develop the full strength of the product.

REVISION TO SPECIAL PROVISION AND STANDARD DRAWINGS

PROPOSED NEW 205-C-XXX TEMPORARY TURBIDITY CURTAIN

Method of Measurement

Turbidity curtains will be measured by the linear foot, installed.

Basis of Payment

Turbidity curtains will be paid at the contract unit price per linear foot.

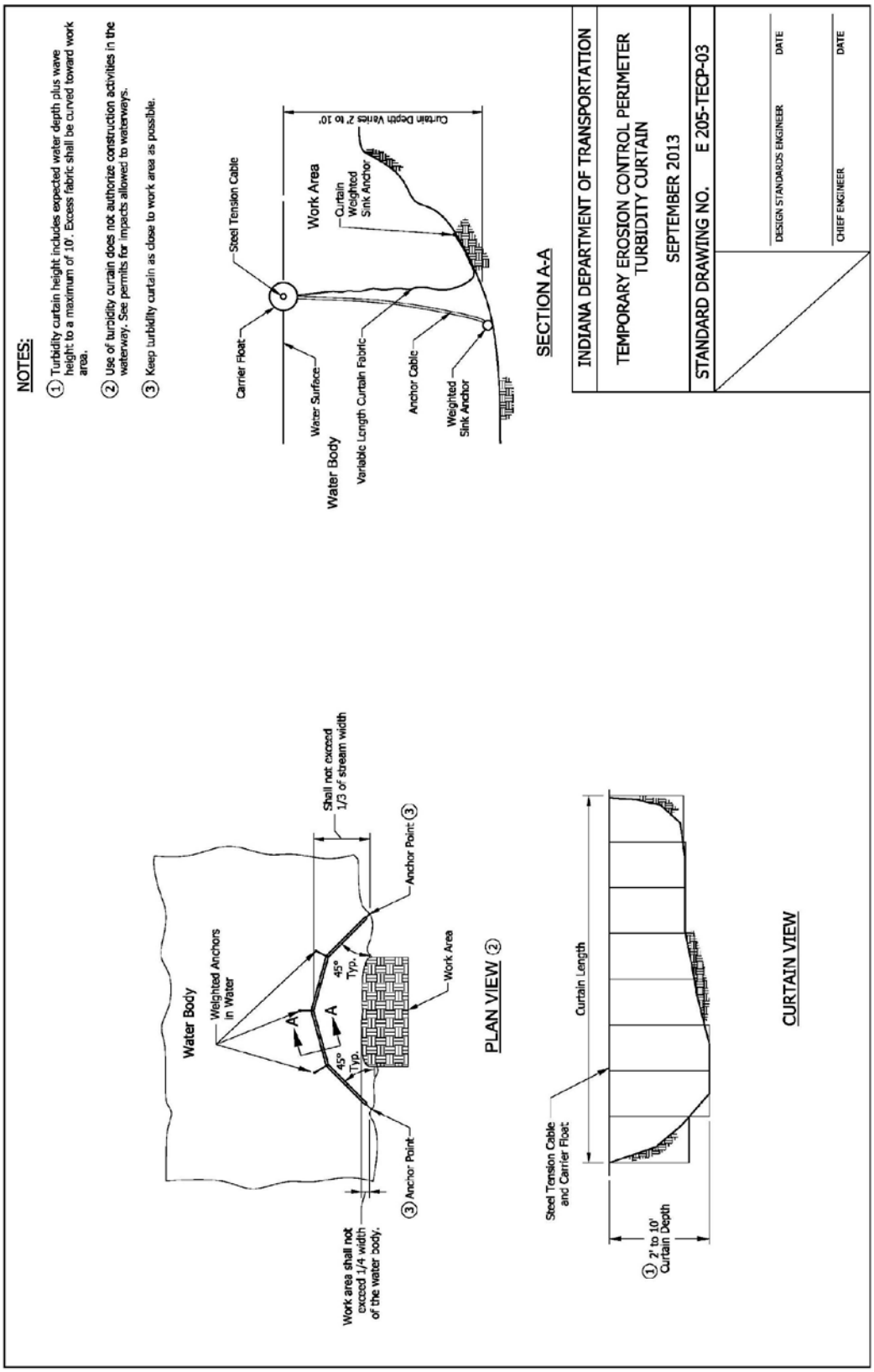
Payment will be made under:

Pay Item	**Pay Unit Symbol**
Temporary Turbidity Curtain	LFT

The cost of materials, installation, maintenance, and all other necessary incidentals shall be included in the cost of the pay item.

REVISION TO SPECIAL PROVISION AND STANDARD DRAWINGS

PROPOSED NEW 205-TEcP-03 TEMPORARY EROSION CONTROL TURBIDITY CURTAIN



COMMENTS AND ACTION

205-C-XXX TEMPORARY TURBIDITY CURTAIN
205-TECP-03 TEMPORARY EROSION CONTROL TURBIDITY CURTAIN

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: NONE Recurring Special Provision affected: PROPOSED NEW Standard Sheets affected: PROPOSED NEW Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By _____ Addition or _____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Ms. Gottschalk
Date: 02/21/13

SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS

REVISION TO SPECIAL PROVISION

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: It has been brought to our attention that the wording in RSP 108-C-192 requires that the erosion control supervisor, “shall perform all other tasks relating to the installation, maintenance, and removal …”. This wording requires the named individual to do all of the work personally and it places the person in an impossible situation and should be reworded.

PROPOSED SOLUTION: See proposed changes to RSP 108-C-192. The above wording is changed to "shall be responsible for the installation, maintenance, and removal …".

Also, an editorial change is included to change the wording 'designated individual' and 'such individual' to read 'erosion control supervisor'.

APPLICABLE STANDARD SPECIFICATIONS: 108 as modified by RSP 108-C-192

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: None

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: 108-C-192

PAY ITEMS AFFECTED: None

Submitted By: Michelle Gottschalk

Title: Construction Technical Support Manager

Organization: INDOT

Phone Number: 232-7758

Date: January 31, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Not Required

REVISION TO SPECIAL PROVISION
108-C-192 TEMPORARY EROSION CONTROL MEASURES

(Note: Proposed changes shown highlighted gray.
Basis for Use: Required for all contracts except mowing, herbicide, and traffic maintenance.)

108-C-192 TEMPORARY EROSION CONTROL MEASURES

(Revised 04-19-12)

The Standard Specifications are revised as follows:

SECTION 108, BEGIN LINE 107, DELETE AND INSERT AS FOLLOWS:

An amended Erosion Control Plan shall be submitted in accordance with 327 IAC 15-5 for those areas not included in the Department submittal ~~or~~ as necessary for changes initiated by the Contractor. Items to include consist of sequencing of operations, *stockpile sites, equipment storage sites, plant sites,* ~~borrow and disposal areas,~~ and haul roads as well as any revision to the Department's submittal. All appropriate erosion control items shall be in place prior to disturbing the project site. A copy of the amended plan shall be provided to the Engineer.

Borrow and disposal sites shall be in accordance with 203.08.

The Contractor shall submit the planned sequencing of erosion and sediment control measures to be used on the project to:

IDEM	*Indiana Dept. of Transportation*
Rule 5 Coordinator	*Senior Environmental Manager*
100 N. Senate Avenue	*Room N642*
Mail Code 65-42 Room 1255	*100 N. Senate Avenue*
Indianapolis, IN 46204	*Indianapolis, IN 46204*

Where required by 327 IAC 15-5, stockpile and storage sites will be permitted by an IDEM Notice of Intent, NOI. The Contractor shall submit either a new IDEM NOI or revise the original NOI for the project. A copy of the new or revised NOI shall be submitted to the Engineer prior to operations at a stockpile or storage site.

All information shall be submitted and approved prior to land disturbing activities.

The Contractor shall designate 1 or more of its employees *as an erosion control supervisor. The erosion control supervisor shall* ~~to~~ be responsible for the preparation, submittal, and ensuring receipt of the approval of the amended erosion control plan. ~~Such individual(s)~~*The erosion control supervisor* shall ~~also be responsible for~~ obtain~~ing~~ all other necessary permits including the wetland inspection and archaeological record check and field survey in accordance with 203.08, and for all environmental inspections. ~~Such individual(s)~~*The erosion control supervisor* shall ~~oversee~~ *be responsible for* the installation*, maintenance, and removal* of all erosion *and sediment* control measures and shall conduct ~~regular~~ *weekly and post-event* inspections ~~*and perform all other tasks*~~

REVISION TO SPECIAL PROVISION

108-C-192 TEMPORARY EROSION CONTROL MEASURES

~~*related to the installation, maintenance, and removal of erosion control measures.*~~ *The inspections shall be documented in the erosion and sediment control inspection report supplied in the Contract Information book, and available on the Department's website. The erosion control supervisor shall accompany personnel from IDEM or other governmental agencies, as required, during site visits by those agencies.* ~~and~~ *The erosion control supervisor shall be responsible for* completion of all *inspection* reports ~~in accordance with 205~~.

A minimum of 14 days prior to commencing work, the Contractor shall prepare and submit to the Engineer, for approval, an erosion control plan that includes, at a minimum, the following:

(a) Locations of all proposed soil stockpiles.

(b) Locations of all proposed equipment storage areas, fueling locations, construction trailers, batch plants, and designated concrete truck washout areas.

(c) Proposed construction sequence and phasing of erosion control measures.

(d) Location of all construction entrances where vehicles and equipment will enter and exit the site.

(e) Material handling and spill prevention plan, which shall include a list of expected materials that may be present on the site during construction operations, and a written description of how these materials will be handled to minimize the potential that the materials can enter the storm water runoff from the site.

(f) Statements that the erosion control measures for the project shall, at a minimum, be inspected on a weekly basis and within 24 h of every 1/2 in. rain event.

(g) Monitoring and maintenance plan for erosion control measures.

The erosion control plan shall be signed by the erosion control supervisor. The Engineer will submit the erosion control plan to the Department's Office of Environmental Services permit coordinator.

The name~~(s)~~ of the ~~designated individual(s)~~ *erosion control supervisor* shall be furnished to the Engineer at, or prior to, the preconstruction meeting. ~~Should~~*If* the designated individual~~(s)~~ need*s* to be replaced during the contract *time*, replacements shall be designated within 7 calendar days and notification shall be furnished *to* the Engineer.

REVISION TO SPECIAL PROVISION

108-C-192 TEMPORARY EROSION CONTROL MEASURES

Permanent erosion control measures shall be incorporated into the work at the earliest practicable time as the construction progresses to stabilize the site.

In order to minimize pollution to bodies of water, the practices and controls set out below shall be followed.

(a) When work areas are located in or adjacent to bodies of water, such areas shall be separated by a dike or other barrier to keep contained. Sediment disturbance of these bodies of waters shall be minimized during the construction and removal of such barriers.

(b) All waterways shall be cleared as soon as practicable of false-work, temporary piling, debris, or other obstructions placed during construction operations.

(c) Water from aggregate washing or other operations containing sediment shall be treated by filtration, a settling basin, or other means sufficient to reduce the sediment content.

(d) Pollutants such a fuels, lubricants, asphalt, sewage, wash water, or waste from concrete mixing operations, and other harmful materials shall not be discharged into existing bodies of water.

(e) All applicable regulations and statutes relating to the prevention and abatement of pollution shall be complied with in the performance of the contract.

SECTION 108, AFTER LINE 176, INSERT AS FOLLOWS:

The cost of preparation of the erosion control plan shall be included in the cost of the erosion and sediment control items.

COMMENTS AND ACTION

108-C-192 TEMPORARY EROSION CONTROL MEASURES

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 108.04 pg 79, 80. Recurring Special Provision affected: 108-C-192 TEMPORARY EROSION CONTROL MEASURES. Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Mr. Pankow
Date: 02/21/13

SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS

REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: There have been situations arise on some contracts where the pile hammer submitted just barely qualifies as having the minimum manufacturer's rated energy. These values assume the pile hammer is in optimum condition. In reality, the submitted hammer is not and thus its maximum energy output is not adequate to drive the piling.

PROPOSED SOLUTION: Incorporate the proposed changes into the 701 section which modifies the minimum pile hammer requirements when the dynamic formula is used.

APPLICABLE STANDARD SPECIFICATIONS: 701

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: None

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

PAY ITEMS AFFECTED: None

Submitted By: Greg Pankow

Title: State Construction Engineer

Organization: INDOT

Phone Number: 232-5502

Date: January 24, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Ad hoc committee consisting of Jim Reilman and Mir Zaheer.

REVISION TO STANDARD SPECIFICATIONS

SECTION 701 – DRIVEN PILING
701.04(a) APPROVAL OF PILE DRIVING EQUIPMENT

The Standard Specifications are revised as follows:

SECTION 701, BEGIN LINE 69, INSERT AS FOLLOWS:

If the method of pile driving approval is in accordance with the dynamic formula shown in 701.05(a), a wave equation analysis is not required. The alternate method will be used to determine if the pile driving equipment is acceptable for use. *To be considered for approval, the proposed driving system shall obtain the nominal driving resistance between the specified blow count range of 30 and 120 blows per foot.*

SECTION 701, BEGIN LINE 125, DELETE AND INSERT AS FOLLOWS:

2. Alternate Method

If the alternate method is used, the energy of the pile driving equipment shall be rated by the manufacturer at or above the appropriate minimum manufacturer's rated hammer energy for the corresponding nominal driving resistance as shown in the table below. *Also, the maximum manufacturer's rated energy shall be at least 25% greater than the minimum manufacturer's rated energy shown in the table.* The table below will be used as the basis of approval of pile driving equipment for the alternate method.

ALTERNATE METHOD
MINIMUM PILE HAMMER REQUIREMENTS

Nominal Driving Resistance		Minimum Manufacturer's Rated Energy	
~~tons~~*kips*	~~(kilonewtons)~~	ft·lbs	~~(joules)~~
≤ ~~90~~*180*	~~(≤ 800)~~	12,000	~~(16,500)~~
~~91 – 150~~*181 – 300*	~~(801 – 1,340)~~	21,000	~~(28,500)~~
~~151 – 210~~*301 – 415*	~~(1,341 – 1,870)~~	~~26,750~~*28,800*	~~(36,500)~~
~~211 – 270~~*416 – 540*	~~(1,871 – 2,400)~~	37,600	~~(51,000)~~
~~271 – 300~~*541 - 600*	~~(2,401 – 2,670)~~	42,000	~~(57,000)~~
> ~~300~~*600*	~~(> 2,670)~~	Wave Equation Analysis required	

The minimum rated energies do not account for losses and inefficiencies in the pile driving system. If the hammer selected cannot satisfy *all of* the *requirements*~~minimum criteria in the above table~~, a wave equation analysis shall be submitted by the Contractor for approval.

COMMENTS AND ACTION

SECTION 701 – DRIVEN PILING
701.04(a) APPROVAL OF PILE DRIVING EQUIPMENT

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 701.04 pg 462, 463 and 464. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book _____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ _____ Revise RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ Standard Drawing Effective _____ _____ Create RPD (No. _____) Effective _____ Letting _____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By _____ Addition or _____ Revision Frequency Manual Update Req'd? Y___N___ By _____ Addition or _____ Revision Received FHWA Approval? _____

Mr. Pankow
Date: 02/21/13

SPECIFICATIONS, SPECIAL PROVISION AND STANDARD DRAWINGS

REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: AISC is changing their certification levels for steel bridge fabricators.

PROPOSED SOLUTION: Incorporate the proposed changes into the 711 section which updates the certification levels required and provides information on which certifications will be allowed during the transition period.

APPLICABLE STANDARD SPECIFICATIONS: 619 & 711

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: None

APPLICABLE SECTION OF GIFE: None

APPLICABLE RECURRING SPECIAL PROVISIONS: None

PAY ITEMS AFFECTED: None

Submitted By: Greg Pankow

Title: State Construction Engineer

Organization: INDOT

Phone Number: 232-5502

Date: February 1, 2013

APPLICABLE SUB-COMMITTEE ENDORSEMENT: None

REVISION TO STANDARD SPECIFICATIONS

SECTION 619 – PAINTING BRIDGE STEEL
619.11 SHOP PAINTING
SECTION 711 – STEEL STRUCTURES
711.04 CERTIFICATION OF FABRICATORS

The Standard Specifications are revised as follows:

SECTION 619, BEGIN LINE 536, INSERT AS FOLLOWS:

619.11 Shop Painting

The shop performing the cleaning and painting of structural steel shall have a valid SSPC-QP 3 certification. Abrasive used for cleaning steel in the shop shall be an abrasive that produces an angular profile. The inorganic zinc primer coat shall be applied to all structural steel in the shop. The remaining 2 coats shall be applied in the field after final erection. A structural steel paint system in accordance with 619.09(a) shall be used. When shear connectors have been specified, the top of the top flange shall not be painted. Erection marks may be painted on zinc painted surfaces. Machine finished surfaces for sliding contact shall be coated with heavy grease as soon as practicable after being accepted, but before removal from the shop.

SECTION 711, BEGIN LINE 53, DELETE AND INSERT AS FOLLOWS:

711.04 Certification of Fabricators

(a) General Information

If the fabrication of secondary structural steel members and other miscellaneous structural steel components, such as but not limited to diaphragms, bearing assemblies, and miscellaneous plates does not involve any welding or heating of the steel, the fabrication facility that is fabricating these components will not be required to be AISC certified as described in this section.

Prior to approval for fabrication, the results of the latest AISC certification review shall be made available to the Engineer to determine if items critical to successful fabrication meet the needs of the specific work.

The fabricator shall be certified from the start of the fabrication process, through and including the shop assembly in accordance with 711.44. If the certification lapses during the course of the project, the fabricator shall have plans to maintain certification or complete the fabrication process before the expiration of his certification. Failure of the fabricator to maintain his certification during the fabrication shall result in a 10% reduction in the bid price for structural steel.

Approval of the fabricator shall be requested in writing prior to ordering structural steel. A valid certification with annual endorsement must be submitted with the request.

(b) Contract Letting Date on or After July 1, 2014

The fabricator of structural steel furnished under this section shall be certified in accordance with the American Institute of Steel Construction, AISC, Certification Program for Steel Bridge Fabricators – Standard for Steel Bridges, to the certification

REVISION TO STANDARD SPECIFICATIONS

SECTION 619 – PAINTING BRIDGE STEEL
619.11 SHOP PAINTING
SECTION 711 – STEEL STRUCTURES
711.04 CERTIFICATION OF FABRICATORS

category commensurate with the work to be fabricated. Fabricators producing fracture-critical members, intermediate bridges, or advanced bridges, shall also meet the applicable supplemental requirements of the certification program. For shop painting the Department will only accept an SSPC-QP 3 certification. It shall be the fabricator's responsibility to maintain a valid certification and annual endorsements thereto.

1. Simple Bridges

Fabricators of main load-carrying components for simple span bridges or bridges that do not have welded or bolted splices shall, as a minimum, be certified under the simple bridges category.

2. Intermediate Bridges

Fabricators of main load-carrying components for the following types of structures shall, as a minimum, be certified under the intermediate bridges category.

a. rolled beam bridge with field or shop splices, either straight or with a radius greater than 500 ft,
b. a built-up I-shaped plate girder bridge with constant web depth, with or without splices, either straight or with a radius greater than 500 ft,
c. a built-up I-shaped plate girder with variable web depth, either straight or with a radius greater than 1000 ft,
d. a truss with a length of 200 ft or less that is entirely or substantially pre-assembled at the certified facility and shipped in no more than three subassemblies.

3. Advanced Bridges

Fabricators of main load-carrying components for the following types of structures shall be certified under the advanced bridges category.

a. tub or trapezoidal box girders,
b. closed box girders,
c. large or non-preassembled trusses,
d. arches,
e. bascule bridges,
f. cable-supported bridges,
g. moveable bridges, and
h. bridges with a curve radius equal or tighter than that specified for the intermediate bridges category above.

(c) Contract Letting Date Before July 1, 2014

REVISION TO STANDARD SPECIFICATIONS

SECTION 619 – PAINTING BRIDGE STEEL
619.11 SHOP PAINTING
SECTION 711 – STEEL STRUCTURES
711.04 CERTIFICATION OF FABRICATORS

The fabricator of structural steel furnished under this section shall be certified in accordance with *either* the American Institute of Steel Construction, AISC, certification program *described herein or the AISC Certification Program for Steel Bridge Fabricators – Standard for Steel Bridges described in 711.04(b). For shop painting, the Department will accept a current and valid sophisticated paint endorsement certification or an SSPC-QP 3 certification.* It shall be the fabricator's responsibility to maintain a valid certification and annual endorsements thereto.

Fabricators of main load-carrying components for multi-span bridges that have welded or bolted splices shall be certified under the AISC major steel bridges (CBR) category. Fabricators of fracture critical members shall be certified under the CBR category and shall have the fracture critical endorsement. Fabricators certified as CBR are also certified to fabricate simple and continuous rolled beam structures. Only fabricators meeting the above requirements shall be used to fabricate girders using high performance steel.

Fabricators of main load-carrying components for simple span bridges or bridges that do not have welded or bolted splices shall, as a minimum, be certified under the AISC simple steel bridges structures (SBR) category.

~~If the fabrication of secondary structural steel members and other miscellaneous structural steel components, such as but not limited to diaphragms, bearing assemblies, and miscellaneous plates does not involve any welding or heating of the steel, the fabrication facility that is fabricating these components will not be required to be AISC certified as described in this section.~~

~~Prior to approval for fabrication, the results of the latest AISC certification review shall be made available to the Engineer to determine if items critical to successful fabrication meet the needs of the specific work.~~

~~The fabricator shall be certified from the start of the fabrication process, through and including the shop assembly in accordance with 711.44. If the certification lapses during the course of the project, the fabricator shall have plans to maintain certification or complete the fabrication process before the expiration of his certification. Failure of the fabricator to maintain his certification during the fabrication shall result in a 10% reduction in the bid price for structural steel.~~

~~Approval of the fabricator shall be requested in writing prior to ordering structural steel. A valid certification with annual endorsement must be submitted with the request.~~

COMMENTS AND ACTION

619.11 SHOP PAINTING
711.04 CERTIFICATION OF FABRICATORS

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 619.11 pg 419; 711.04 pg 552, 553. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____

Mr. Boruff
Date: 02/21/13

SPECIFICATION, SPECIAL PROVISION AND STANDARD DRAWINGS

REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: The use of light source types (e.g. LED, plasma) other than High Pressure Sodium (HPS) for roadway and high mast luminaires is now viable and may result in reduced energy consumption. Design procedures are lacking to support consideration of these various light source types and to determine which is the most cost effective for a particular project. Additionally the standard specifications are based on HPS.

PROPOSED SOLUTION: Revise the Indiana Design Manual to require a cost analysis of the various light source types and develop a RSP that will supersede the relevant sections of the standards specifications

APPLICABLE STANDARD SPECIFICATIONS: 807.13; 807.18; 807.19; 920.01(d)

APPLICABLE STANDARD DRAWINGS:

APPLICABLE DESIGN MANUAL SECTION: Chapter 78-3.04; 78-5; 78-6; 78-7

APPLICABLE SECTION OF GIFE:

APPLICABLE RECURRING SPECIAL PROVISIONS:

PAY ITEMS AFFECTED: Roadway Luminaire, High Mast Luminaire

Submitted By: Dave Boruff

Title: Manager, Traffic Administration Section

Organization: INDOT

Phone Number: 317-234-7975

Date: 01/28/13

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Traffic Standards Subcommittee, Industry.

REVISION TO STANDARD SPECIFICATIONS

SECTION 807 – HIGHWAY ILLUMINATION
807.13 LUMINAIRE INSTALLATION
807.19 BASIS OF PAYMENT

The Standard Specifications are revised as follows:

SECTION 807, BEGIN LINE 526, DELETE AND INSERT AS FOLLOWS:

807.13 Luminaire ~~Installation~~

(a) Installation

Luminaire installation shall consist of the physical placing of the luminaire. Each installation shall include the furnishing and placing of the lamp *or Light Emitting Diode, LED, arrays* as designated. *Luminaires shall be compatible with other lighting materials as specified in 920.01. All the luminaries on a contract shall be the same technology and provided by one manufacturer.*

A luminaire identification sticker shall be provided on each luminaire and on the light pole or tower that supports the luminaire. The sticker shall be titled "LUMINAIRE" and contain the following information: light source type, manufacturer, model, wattage, and year of installation. The pole/tower sticker shall be attached underneath the light pole ID tag, shall face the roadway, and shall have 3/4 in. lettering, and be no greater than 8 in. by 8 in.

~~(a)~~ *1.* Roadway Luminaires

Each luminaire shall be leveled in both directions in the horizontal plane after the light standard has been erected and adjusted. Rotary adjustment of the mast arm and vertical adjustment of roadway luminaires to obtain an installed level position in both directions shall be accomplished by means of the bolted saddle arrangement used to attach the luminaires to the mast arm. Lamp socket positions may be shown on the plans by type of Illuminating Engineering Society of North American, ~~(~~IES~~)~~, light pattern. The specified lamp socket position, *or comparable arrangement of LEDs*, shall be used to obtain the desired light pattern delivery. Proper connections shall be made to provide ~~ballast~~ operation at the voltage being supplied. Replacements needed because of faulty or incorrect voltage connections shall be made with no additional payment.

~~(b)~~ *2.* Sign Luminaires

Connections in which plain and galvanized steel are in contact shall be protected such that aluminum surfaces shall receive 1 coat of zinc chromate primer. Steel surfaces shall receive 1 coat of inorganic zinc primer followed by 1 coat of aluminum paint. All paint shall be permitted to dry before assembly. Conduit fittings, if required, shall be watertight. Required conduit shall be either rigid or flexible as necessary. Conduit shall not be clamped to a sign panel.

Sign luminaires shall be mounted on overhead sign structures on 2 metal channels located at the extremity of the sign walkway support brackets. The distance between lighting unit support channels shall be 7 in. ~~(180 mm)~~. These channels shall be located in such a manner that they readily receive the mounting bolts from the rear of the sign

REVISION TO STANDARD SPECIFICATIONS

SECTION 807 – HIGHWAY ILLUMINATION
807.13 LUMINAIRE INSTALLATION
807.19 BASIS OF PAYMENT

luminaire. The installation of the sign luminaire shall consist of the physical placement of the luminaire on the channels.

Sign luminaires shall be connected to a phase conductor and a neutral conductor. The luminaires shall be alternately connected to opposite phase conductors to balance the load. The connections in the base of the sign structure shall be in accordance with 807.06. Conductor splicing shall be in junction boxes, in-ground handholes, inside handholes of sign structures, and circuit breaker enclosures.

~~(c)~~ *3.* Underpass Luminaires

Underpass luminaires shall be mounted on the vertical side surfaces of bridge bent structures or suspended by means of pendants supported by angle-iron struts or clips fastened to the structural beam members of the bridge. All parts of the pendent pipe assembly shall be hot-dipped galvanized after threads are cut. Silicone caulking compound shall be applied to the threads during assembly of the pendent. Underpass luminaires may require separately mounted ballasts which shall be installed in close proximity to the luminaires.

Underpass luminaires shall be connected to a phase conductor and a neutral conductor. The luminaires shall be alternately connected to opposite phase conductors to balance the load. Conductor splicing will only be allowed in junction boxes, in-ground handholes, and circuit breaker enclosures.

~~(d)~~ *4.* High Mast Luminaires

The aiming of the luminaires shall be as shown on the plans. When the aiming process is being done the luminaire shall be oriented to conform to its raised position and the ring properly tethered to prevent rotation during the aiming adjustment. The long axis of the luminaire shall be parallel to the aiming direction indicated on the plans.

(b) Warranty

A manufacturer's written warranty covering all components, except lamps, of the luminaire against defects in materials and workmanship for a minimum period of 5 years after installation shall be provided. The warranty shall stipulate that replacement luminaires or will be provided within 7 days after receipt of failed luminaire at no additional cost. Warranty documents shall give the manufacturers name, contact person, contact person telephone number and e-mail, and shall be submitted to the Engineer with the Type C Certification.

SECTION 807, BEGIN LINE 811, DELETE AND INSERT AS FOLLOWS:

Luminaire, High Mast, _____, _____ Watt .....EACH
light source type

Luminaire, Roadway, _____, _____ Watt .....EACH
light source type

REVISION TO STANDARD SPECIFICATIONS

SECTION 807 – HIGHWAY ILLUMINATION
807.13 LUMINAIRE INSTALLATION
807.19 BASIS OF PAYMENT

Multiple Compression Fitting, Non-Waterproofed.....EACH
Multiple Compression Fitting, Waterproofed.....EACH
Portable Tower Lighting Drive System.....EACH
Service Point, _____ (type).....EACH
Sign, Underpass, and Roadway Lighting Location Identification.....EACH
Wire, _____ (designation), No. _____ Copper, in _____ (housing), _____ _____ /C.....LFT ~~(m)~~

The cost of lamps, *LED arrays*, ballast, *drivers*, optical systems, weatherproof housings, ~~and~~ electrical connections, *and identification stickers* shall be included in the cost of luminaire.

The cost of the mast arm, J-support hook for pole circuit, handhole with cover, shoe base, transformer base or frangible coupling if required, installation on the foundation with the pole circuit, and luminaire installation shall be included in the cost of light pole.

The cost of the pole; lowering system including winch assembly, power cable, and support cable; concrete pad; luminaire ring; anchor bolts and nuts; lightning rod assembly; grounding system; and all incidental materials necessary to complete the installation shall be included in the cost of light pole, high mast.

The cost of excavation, concrete, sleeves for cable-duct, non-metal pipe, reinforcing bars, backfill, finish grading, and sodding shall be included in the cost of lighting foundation.

The cost of aerial distribution service, drops to sign structures branching off from the pole line extension, weatherheads and risers required to connect the line extension to the underground electrical distribution circuit, all anchorage guy wires, hardware, aerial cable, electrical connections, wood poles, and incidentals required to complete the pole line extension shall be included in the cost of cable, pole circuit.

The cost of snap-on covering in light pole base and waterproof covering in underground handhole shall be included in the cost of multiple compression fitting.

The cost of circuit breakers; breaker enclosures; conduit; flexible conduit; conduit fittings; grounding; weatherhead; aerial cable termination; and incidentals required from the last luminaire to the point of attachment by the utility, the bottom of the riser at the structure base, or the connector kits in the base of the sign supports shall be included in the cost of circuit installation.

The cost of maintaining highway illumination during the life of the contract shall be included in the cost of other pay items.

REVISION TO STANDARD SPECIFICATIONS

SECTION 920 – HIGHWAY ILLUMINATION MATERIALS
920.01(d) LUMINAIRES

The Standard Specifications are revised as follows:

SECTION 920, BEGIN ON LINE 509, DELETE AND INSERT AS FOLLOWS:

(d) Luminaires

1. General Requirements

Lamps supplied for luminaires shall be electrically compatible with the luminaires. Luminaires *that are not solid state* shall include the lamp ballast. The ballast shall be integrally built in and of the constant wattage regulator type of sufficient size to operate the designated lamp at the required voltage. ~~The ballast shall provide satisfactory lamp performance to 20°F (-7°C).~~ *The luminaire shall operate satisfactorily in temperatures from - 40°F to 122°F* with an input voltage variation of ± 10% of the rated operating voltage specified. *Luminaires shall be a single, self contained device, not requiring on-site assembly for installation.*

Luminaires shall include vandal shields when installed on an underpass or signs on bridge brackets and when otherwise specified. The vandal shield shall be made of a tough durable plastic, such as Lexan, mounted in a rugged galvanized steel or aluminum frame, and shall withstand severe impact without being damaged or allowing the refractor to be damaged. It shall be fastened securely to the luminaire so it cannot be removed from the outside and shall not interfere with the light distribution pattern. It shall protect the face of the refractor and if ventilation is necessary, the ventilating apertures shall be arranged so that they do not admit a probe of a diameter greater than 1/4 in. ~~(6 mm).~~

2. Roadway Lighting Luminaires

Roadway lighting luminaires shall have a precision-cast aluminum housing ~~and refractor holder~~ with weatherproof finish. They shall have a strong, easily operated, positive latch on the street side of the ~~refractor holder~~ *housing* and a hinge with a safety catch that prevents accidental unhinging on the house side of the refractor *or lens* holder. They shall include a slipfitter capable of adapting to a 2 in. ~~(50 mm)~~ mounting bracket *that is adjustable +/- 5° for leveling.* ~~an easily detachable highly specular aluminum reflector; and an easily adjustable socket in both horizontal and vertical directions capable of producing lighting patterns to meet all the requirements of the American Standard Practice for Roadway Lighting as sponsored by the Illumination Engineering Society and as shown on the plans. They shall have a high impact, heat-resistant, glass, prismatic refractor; and~~ *They shall* include gasketing that will completely seal out dust, moisture, and insects from the interior of the optical assembly *in accordance with IP 65* and retard the formation of an undesirable film from gaseous vapors on the interior of the optical assembly. *Internal components shall be adequately supported to withstand mechanical shock and vibration and shall be tested in accordance with ANSI C136.31, 2G loading or ANSI C136.31 3G for luminaires on bridges.*

Luminaire weight shall not exceed 53 lbs and its projected area shall not exceed 2.4 sq ft. Luminaires shall be either High Pressure Sodium, HPS, or utilize another light source.

REVISION TO STANDARD SPECIFICATIONS

SECTION 920 – HIGHWAY ILLUMINATION MATERIALS
920.01(d) LUMINAIRES

a. High Pressure Sodium

HPS luminaires shall have a high impact, heat-resistant, glass, prismatic refractor; a precision-cast, aluminum refractor holder with weatherproof finish, a detachable highly specular aluminum reflector; and an adjustable socket in both horizontal and vertical directions capable of producing lighting patterns to meet all the requirements of the American Standard Practice for Roadway Lighting as sponsored by the Illumination Engineering Society and as shown on the plans.

b. Other Light Source Types

Luminaires that utilize technologies other than HPS shall be compatible with the lighting materials specified in this section and in the plans. Luminaires, including primary fuse protection, surge protection devices, SPD, and other major components, shall be rated for a minimum operational life of 50,000 hours, and shall deliver a minimum of 70% of the initial rated lumens after 30,000 hours of operation. Luminaires shall exhibit a color temperature in the range of 4100K to 6500K. Luminaires shall be adjustable in the horizontal and vertical directions to meet the specified Illumination Engineering Society light distribution pattern. Refractors or lenses shall be scratch resistant and made from high impact, heat-resistant, glass or UV inhibited, high impact plastic. If utilized, reflectors shall be detachable and made of highly specular aluminum.

Solid State luminaires shall met the lumen output and chromaticity requirements of LM-79, LM-80, and ANSI C78.377 and include a SPD to protect the luminaire from damage and failure for transient voltage and currents as defined in ANSI/IEEE. The SPD shall conform to UL 1449, or UL 1283 as appropriate for the components used in design, and be tested per the procedure in ANSI/IEEE C62.41.2 definitions for standard and optional waveform for location category C-High. Luminaires shall comply with Title 47 CFR Part 15, Class A regarding electromagnetic interference. A passive thermal management system to dissipate the heat generated by operation shall be provided- fans or other mechanical cooling systems shall not be used. Drivers, LED arrays, and plasma emitters shall be replaceable without replacing the entire luminaire.

LEDs shall be connected so that the loss of one LED will not result in the loss of the entire luminaire. LED circuitry shall prevent flickering to the unaided eye at the voltage specified on the plans and the range indicated herein.

3. Sign Luminaires

~~Luminaires shall be 250W mercury vapor unless otherwise specified~~. Sign luminaires shall have the same requirements as roadway luminaires plus a shield that blocks the view of the refractor from an approaching motorist. This shall be accomplished by the design of the housing or by a shield fabricated from sheet aluminum, approximately 0.05 in. ~~(1.3 mm)~~ thick, and of sufficient size to be fastened onto the horizontal edge of the refractor holder with self tapping screws and placed between the refractor and approaching traffic.

REVISION TO STANDARD SPECIFICATIONS

SECTION 920 – HIGHWAY ILLUMINATION MATERIALS
920.01(d) LUMINAIRES

Aluminum and steel structural members for luminaire supports shall include aluminum conduit, conduit clamps, fittings, and stainless steel screws.

4. Underpass Luminaires

Underpass luminaires shall have the same requirements as roadway luminaires except they shall have vandal shields and the ballast shall meet the same requirements except it may be mounted separately near the luminaire as shown on the plans.

5. High Mast Luminaires

The luminaires shall be in accordance with the American Standard Practice or Roadway Lighting by the Illumination Engineering Society and shall produce lighting patterns as shown on the plans. The ~~lamp in the~~ high mast luminaire *lamp or light source* shall be supported at both ends with mechanical spring grips or other means to hold the lamp secure against vibration. ~~The~~ *Sockets* shall be mogul sized and porcelain enclosed. The luminaire housing shall be an enclosed aluminum unit with a ~~reflector and~~ borsillicate glass refractor *or lens.* It shall include gasketing that will completely seal out dust, moisture, and insects from the interior of the optical assembly and retard the formation of an undesirable film from gaseous vapors on the optical assembly. *High pressure sodium luminaires shall have an aluminum reflector. A high mast luminaire LED retrofit inserted into the existing housing may utilize a mechanical cooling system which is rated for a minimum operational life of 50,000 hrs. Otherwise high mast luminaires utilizing light sources other than HPS shall meet the requirements of 920.01(d)1 and 920.01(d)2.*

INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Design Memorandum No. xx-__
Technical Advisory

January 28, 2013 DRAFT

DESIGN MEMORANDUM No. xx-__
TECHNICAL ADVISORY

TO: **All Design, Operations, and District Personnel, and Consultants**

FROM: _____
David Boruff
Manager, Office of Traffic Administration
Traffic Engineering Division

SUBJECT: **Lighting Design Procedure**

REVISE: **Indiana Design Manual Section 78-3.04, 78-5, 78-6, and 78-7.**

EFFECTIVE: **To Be Determined**

Through this time INDOT has been using High Pressure Sodium roadway, high mast, and underpass luminaires. With developing technology other types of light sources (e.g. LED, plasma, induction) are now available and can provide acceptable light levels while reducing energy consumption. Due to varying photometric (light distribution) patterns, installation costs and maintenance schedules it is necessary for the designer to consider and compare various light source types to generate the optimal, most cost effective design Therefore, the subject Indiana Design Manual sections have been revised and two new worksheets, figures 78-5B and 78-5C, have been developed to facilitate the light source type selection process .

Please note that sections 807.13, 807.18, 807.19, and 920.01(d) of the INDOT Standard Specifications are being revised to compliment the use of light sources other than HPS as determined and specified by the designer.

78-3.04 Luminaire

A luminaire is defined as a complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute light. The following and the INDOT *Standard Specifications* provide the Department's criteria for luminaire hardware. Section 78-6.03 discusses the various light distributions for a luminaire. For additional information, the designer should contact the ~~Highway Operations Division's Office of Traffic Engineering~~ *Traffic Administration Manager, Technical Services Division* for the latest products and specifications.

78-3.04(01) Light Source

There are numerous light sources for highway lighting. However, there are only a few practical choices when considering availability, size, power requirements, and cost effectiveness. Only a high-intensity discharge light source should be used. The following provides information on the recommended light sources that may be used.

1. High-Pressure Sodium (HPS). Due to its excellent luminous efficiency, power usage, and long life, ~~HPS is the only light source that INDOT is using for each new installations of conventional or high mast lighting~~. The HPS lamp produces a soft, pinkish-yellow light by passing an electric current through a sodium-and-mercury vapor.

2. Low-Pressure Sodium (LPS). Low-pressure sodium is considered one of the most efficient light sources. Its disadvantage is that it requires long tubes and has poor color quality. INDOT does not allow the use of LPS in a State-controlled system. However, a local agency may consider the use of an LPS lighting source. The LPS lamp produces a yellow light by passing an electrical current through a sodium vapor.

3. Mercury Vapor (MV). Prior to the introduction of HPS, mercury vapor was the most commonly used light source. ~~A local agency may still install the MV light source for a new installation to match an existing installation. However, INDOT does not allow the use of MV for conventional or high mast lighting in a new installation. MV usage by INDOT is limited to overhead sign lighting. The mercury vapor lamp produces a bluish white light~~. *New installations of Mercury Vapor lamps are prohibited by the Energy Policy Act of 2005.*

4. Metal Halide (MH). A metal-halide lamp produces better color at higher efficiency than an MV lamp. However, life expectancy for an MH lamp is shorter than for HPS or MV. An MH lamp is also more sensitive to lamp orientation than another light source. The MH lamp is used for lighting a sports arena or major sports stadium, for high-mast lighting, or for lighting a

downtown area or park. Metal halide produces good color rendition. Light is produced by passing a current through a combination of metallic vapors.

5. *Light Emitting Diode (LED). LEDs are arranged in clusters which are attached to a panel. Various designs utilize different LED types. Heat sinks are provided for heat dissipation to improve the luminaires service life. Light is directly emitted from the lens, so reflectors are not required, resulting in the light being delivered more efficiently than the HPS type and also resulting in less light pollution. LEDs are energy efficient, have a long life, and produce a "truer" color of light. Due to the manner in which light is emitted the arrays must be carefully arranged to provide sufficient light distribution and yet be energy efficient.*

   LED retrofits are available for existing high mast luminaires. LED arrays are attached to a plate which is fit into the existing housing. Luminaire dimensions may be needed for the design of the attachment pending the manufacturer's specific design. Properly arranged LED arrays can provide energy efficient, effective light distribution.

6. *Plasma. Plasma lamps generate light by exciting gas with radio frequency power. They have no electrodes which reduces maintenance requirements. They are highly efficient and generate a truer color light than HPS.*

7. *Induction Lighting. Magnetic induction lamps also contain no electrodes resulting in an extended service life. The power used to generate light is transferred from outside the lamp to inside via electromagnetic fields. Induction lamps are also efficient light generators compared to HPS lamps.*

78-3.04(02) Optical System

The optical system consists of a light source, *usually* a reflector, and usually a refractor. The following discusses the optical system of a luminaire.

1. Light Source. Section 78-3.04(01) discusses the recommended high-intensity light sources that ~~should be considered~~ *may be used*.

2. Reflector. The reflector is used in optical control to change the direction of the light rays. Its purpose is to take that portion of light emitted by the lamp that otherwise would be lost or poorly utilized, and to redirect it to a more desirable distribution pattern. A reflector is designed to work either alone or with a refractor. Reflectors can be classified into two types, specular or diffuse. A specular reflector is made from a glossy material that provides a mirror-like surface. A diffuse reflector is used where the intent is to spread the light over a wider area.

3. Refractor. The refractor is another means in optical control to change the direction of the light. A refractor is made of a transparent, clear material, usually high-strength glass or plastic. Plastic is used in a high-vandalism area. However, plastic may yellow over time due to heat and ultraviolet exposure. The refractor, through its prismatic construction, controls and redirects both the light emitted by the lamp and the light reflected off the reflector. It can also be used to control the brightness of the lamp source.

78-3.04(03) *Regulation of Input Voltage*/Ballast

Each luminaire must *operate with an input voltage variation of ±10% of the rated operating voltage specified, with most technologies this is done by* ~~include~~ a built-in ballast. A ballast is used to regulate the voltage to the lamp to ensure that the lamp is operating within its design parameters. It also provides the proper open-circuit voltage to start the lamp. INDOT uses the auto-regulator type ballast. ~~with an input voltage variation of ±10% of the rated operating voltage specified~~. Figure 78-5A, Lamp Data, provides the approximate expected operating wattage for a ballast based on the lamp wattage.

78-3.04(04) Housing Unit

Luminaire housing requirements are dependent upon the application type. When selecting a luminaire housing, the designer should consider the following.

1. Roadway-Lighting Luminaire. A roadway-lighting-luminaire housing or specular reflector holder is made of aluminum with a weatherproof finish. The housing unit should allow access from the street side and allow for adjustments to the light. The luminaire should also have a high-impact, heat-resistant, glass *or plastic,* prismatic refractor. The unit should be sealed to ensure that dust, moisture, and insects will not be able to enter the inside of the luminaire.

2. Sign Luminaire. A sign luminaire requires the same housing as a roadway-lighting luminaire, except that it should also provide a durable, plastic, vandal-resistant shield and an aluminum shield that blocks the view of the refractor from an approaching motorist. The unit is attached to the sign walkway as shown on the INDOT *Standard Drawings.* The mounting attachment is adjustable to allow for directing the light onto the sign.

3. Underpass Luminaire. An underpass luminaire requires the same housing as a roadway lighting luminaire, except that it should also provide a durable, plastic, vandal-resistant shield. The ballast may be placed as shown on the INDOT *Standard Drawings.* An underpass luminaire may be attached to the vertical-side surface of a bridge bent structure, or may be suspended by the use of a pendant.

4. High-Mast Luminaire. A high-mast luminaire is an enclosed aluminum unit with a reflector and a borosilicate glass refractor. The unit should be sealed to ensure that dust, moisture, or insects will not be able to enter the inside of the luminaire. The luminaire is attached to the mast ring. The mounting attachment is adjustable to allow for directing the light.

78-5.0 DESIGN PROCEDURE

The following provides guidelines on the lighting-design procedure used by INDOT. For additional design information, the designer should also review the references listed in Section 78-1.01. Lighting-system design *should consider various light sources* and may require several iterations *for each type of light source* to produce an acceptable design. After the first run, if the design criteria are not satisfied the designer will need to change the initial parameters (e.g., pole spacing, mounting height, *light source*, and luminaire wattage/*lamp lumen output*) and recheck the design to determine if it then satisfies the criteria. This process is repeated until the design is optimized and all criteria are satisfied.

As part of the scope of work on certain project the designer may be given specific parameters for the lighting system, e.g. tower or conventional, pole height, luminaire type to supplement or supersede the guidance provided in this section.

78-5.01 Computerized Design

To determine an acceptable lighting system requires numerous iterations using numerous variables. The chance for error in manually solving its equations is high. Therefore, the designer should use one of the commercial computer software packages that are available. Each software package requires the same input and performs the same calculations. However, the method of input may vary significantly. With the proliferation of software programs, the user should first determine which programs are currently acceptable to INDOT. The Department is using the PC-based program ILLUM$, developed by General Electric, for its lighting calculations. ILLUM$ is used to generate templates for design and to check lighting levels and uniformity. For a lighting design prepared by a consultant, it should provide the Production Management Division's Traffic Review Team with the design data inputs and reports.

78-5.02 Design Process

Lighting may be designed under four different scenarios. The following provides the procedural steps in designing a lighting system *for each.*

78-5.02(01) Spot Lighting (new)

REVISION TO STANDARD SPECIFICATIONS

BACKUP 01. DESIGN MEMORANDUM (DRAFT)

Spot lighting comprises no more than one or two lights at an intersection or other particular spot along the roadway where it is deemed necessary to identify that roadway feature at nighttime.

In this circumstance AASHTO design criteria need not be applied so it is not necessary for the designer to perform a light level computations.

The design should be done as follows:

1. *Coordinate with the utility company to determine the availability of electric service and to identify the location of the service point. Re-imbursement costs to the utility company should be identified in a special provision and the cost incorporated into the bid estimate.*

2. *Develop a plan sheet for the location. The plan sheet should include the roadway geometry, the location of the service point (indicating the voltage being supplied), location of the pole(s), the orientation of the luminaire(s), the light source type and luminaire wattage, as well as any underground wiring, conduit, handholes, cable duct markers that are needed.*

78-5.02(02) Luminaire Replacement or Partial Modernizations

This type of project involves the replacement of luminaires on existing poles. Other equipment may also be replaced.

The design should be done as follows:

1. *<u>Assemble Information.</u> Obtain a plan of the existing lighting system*

2. *<u>Plan Verification</u>. Verify that the geometrics and lighting system are accurately detailed on the existing plan sheet*

3. *<u>Confirm Scope</u>. Confirm what elements in the system are to be modernized. This should be coordinated with the District Traffic Office.*

4. *<u>Select Design Criteria</u> Select the appropriate AASHTO design criteria- see 78-6.02. based on the type of roadway.*

5. *<u>Select Light Source Type</u> Select the optimal light source type and wattage to satisfy the design criteria in a cost effective manner. Because calculations by computer are relatively quick and easy, the designer should try a number of alternative light source types even if the first design satisfies the criteria as more than one alternative may be satisfactory. Typically systems with 40-ft height poles will typically utilize a luminaire that provides approximately 28,000 or 50,000 lumens of initial light output in a M-S-Type II, III or Type IV*

IES distribution classification- see Figure 78-6D for information on the IES classification system.

At minimum the alternatives should include one HPS, one LED, one Plasma, and one Induction model- other light source types may also be considered. Only luminaire types/models that have an accessible IES light distribution file can be used For a list of manufacturer's that have approached INDOT about use of their luminaires go to Y:\TrafficManagement\Luminaire Manufacturers.

Design optimization should include an analysis for the purpose of minimizing service costs. The lowest service cost per year alternative should be selected. The service cost is defined as:

Service Cost per Year =Annual Energy Cost + Annual Routine Luminaire Maintenance Costs Installation Cost/Warranty Period

Where:

Annual Energy Costs are the total luminaire wattage of the system x hours per year operated x cost of electricity

Hours operated per year will be defined as 4380

Cost per kWh can be estimated at $0.08 (the electric provider or district may have a more location specific unit cost)

Maintenance Cost for HPS should be based on re-lamping the entire system every 3 years. Currently lamp cost is estimated at $60 per lamp- or $20 per luminaire per year. Confer with manufacturer for routine maintenance costs of the alternative technology being considered.

Recent bid history as obtained on INDOT website should be used to estimate the cost of HPS luminaires. Cost of luminaires utilizing alternative light sources should be obtained from the manufacturer

Warranty period is defined as 5 years or the warranty period as stipulated by the manufacturer, whichever is greater.

See Figure 78-5B, Service Costs Analysis for Luminaire Modernization, for the worksheet that should be used to perform this computation. A worksheet should be completed for each alternative considered and placed in the project file. If the service cost analysis does not yield a clear choice, other factors such as the light color or district preferences should be weighed into the decision making on the type of light source.

6. *Electric Design. Once the luminaire model is selected, the designer will need to determine the voltage drop for the system. Section 78-6.07 provides information on how to determine the voltage drop for the lighting system. If the most cost effective model results in too much voltage drop the designer may either check the voltage drop of the second most cost effective design for use or may try additional luminaire models.*

7. *Prepare Plans. The plan sheet should indicate the average illumination level and uniformity ratio and should show the location of the existing equipment being reused and indicate what is being replaced or added. Equipment includes the service point (indicating voltage being supplied), pole(s), the orientation of the luminaire(s), underground wiring, conduit, handholes, and cable duct markers. The light source type. luminaire wattage, and the IES file type used will be given on the plans with a note that the distribution pattern of the actual luminaire to be supplied will be equivalent (e.g. luminaire shall provide a light distribution equivalent to IES distribution type GE 452918.IES). This distribution pattern is based on how a specific luminaire model distributes light (how it is designed) and also corresponds to the lumen output and power draw of the fixture. The luminaire table, service point amp table, and the lighting ID numbers should also be included in the plans,*

8. *Utility Notification. If there is a change in service location or an increase in the power requires the designer needs to coordinate with the electric provider. Re-imbursement costs to the utility company should be identified in a special provision and the cost incorporated into the bid estimate.*

78-5.02(03) New Lighting System or Full Modernizations

This procedure should followed when designing a new system or when modernizing and the existing poles and foundations will not be reused

1. Assemble Information. Assemble all necessary information. This includes the following:

   a. contact the Traffic Review Team for the current design policies and procedures applicable to the project, sample plans, schedules, pay quantities, and example calculations;

   b. gather roadway and bridge plans including plan and profile sheets and details sheets (e.g., those for overhead signs);

   c. determine existing and expected utility locations;

   d. discuss special considerations with the road or bridge designer

e. conduct field reviews; and

f. if a local-agency project, hold discussions with local officials.

2. Determine Classifications. Determine the roadway classification and environmental conditions. If not already included in the project report, this information can be obtained from the Environmental Policy Team. The roadway classifications, for lighting purposes, are defined in Section 78-6.01.

3. Select Design Criteria. Based on the above information, the designer will select the pertinent design methodology (see Section 78-4.0) and the appropriate criteria based on the classification selected in Step 2; see Section 78-6.02. For an INDOT-route lighting project, only the illuminance design methodology should be used.

4. Select Optimum Design *and Light Source Type* . Because recalculations by computer are relatively quick and easy, the designer should try several alternatives even if one design satisfies the criteria. There is often more than one satisfactory alternative.

At minimum the alternatives should include one HPS, one LED, one Plasma, and one Induction model- other light source types may also be considered. Only luminaire types/models that have a published IES light distribution can be used. For a list of manufacturer's that have approached INDOT about use of their luminaires go to Y:\TrafficManagement\Luminaire Manufacturers.

Design Optimization should include an analysis for the purpose of minimizing service costs. The lowest service cost per year alternative should be selected. The service cost is defined as:

Service Cost per Year =[Annual Energy Cost + Annual Routine Luminaire Maintenance Costs + Installation Costs]/Warranty Period

Where:

Annual Energy Costs are the total luminaire wattage of the system x hours per year operated x cost of electricity

Hours operated per year will be defined as 4380

Cost per kWh can be estimated at $0.08 (the electric provider or district may have a more location specific unit cost)

Maintenance Cost for HPS should be based on re-lamping the entire system every 3 years. Currently lamp cost is estimated at $60 per lamp- or $20 per luminaire per year. Confer with manufacturer for routine maintenance costs of the alternative technology being considered.

Installation Cost should include poles and foundations as well as the luminaires. Recent bid history as obtained on INDOT website should be used. Cost of luminaires utilizing other light sources should be obtained from the manufacturer

Warranty period is defined as 5 years or the warranty period as stipulated by the manufacturer, whichever is greater.

See Figure 78-5C, Service Costs Analysis for New or Fully Modernized Lighting, for the worksheet that should be used to perform this computation. A worksheet should be completed for each alternative considered and placed in the project file. If the service cost analysis does not yield a clear choice other factors, such as the light color or district preferences, should be weighed into the decision making on the type o flight source.

a. Select ~~Equipment~~ *Light Output Characteristics*. In the preliminary design, the designer will need to make some initial assumptions regarding the ~~equipment composition~~ light output. This includes mounting height, pole setback distance, light source, mast-arm length, *light source type*, lamp wattage, etc. INDOT's practice is to use either a *30 ft, 35 ft, or* 40-ft height pole ~~with HPS lamps of 250 W or 400 W~~ *with a luminaire that provides approximately 28,000 or 50,000 lumens of initial light output in a M-S-Type II, III or Type IV IES distribution classification- see Figure 78-6D for information on the IES classification system.* ~~Figure 78-5A, Lamp Data, provides the information on lighting levels for various HPS, LPS and Metal Halide~~. See Sections 78-3.0 and 78-6.03 for additional details. ~~on equipment selection~~. ~~After selecting the luminaire equipment, the designer will also need to obtain the photometric data sheet from the manufacturer for the luminaire selected.~~

Normally mounting heights and mast arm lengths will be uniform through the project limits. If the project ties into adjacent lighting systems consideration should be given to matching these considerations.

b. Select Layout Arrangement. Section 78-6.04 provides information on the commonly used lighting arrangements. The selection of the appropriate layout design depends upon local site conditions and the engineer's judgment. Section 78-6.05 provides the roadside safety considerations in selecting the lighting arrangements. Section 78-6.06 provides other layout considerations.

c. Luminaire Spacing. For an INDOT-route lighting project, use the illuminance methodology to determine the appropriate luminaire spacing. This step is conducted by the computer. ~~For hand calculation, Equation 78-5.1 should be used. Sections 78-1.02 and 78-6.03 define the variables used in the equation.~~

~~$S = \frac{(LL)(CU)(LLD)(LDD)}{(W)(E_h)}$ (Equation 78-5.1)~~

~~Where: S = Luminaire Spacing (ft)~~
~~LL = Initial Lamp Lumens~~
~~CU = Coefficient of Utilization~~
~~LLD = Lamp Lumen Depreciation Factor~~
~~LDD = Lamp Dirt Depreciation Factor~~
~~E_h = Average Maintained Level of Illumination (ft-cd)~~
~~W = Width of Lighted Roadway (ft)~~

d. Check Uniformity. Once the spacing has been determined, the designer should check the uniformity of light distribution and compare this to the criteria selected in Step 3. Use Equation 78-5.2 to determine the uniformity ratio. Section 78-7.0 provides an example for calculating the uniformity ratio.

5. Electric Design. Once the *type*. number, size, and location of the luminaires are determined, the designer will need to determine the ~~appropriate~~ electric voltage drop for the system. Section 78-6.07 provides information on how to determine the voltage drop for the lighting system.

6. INDOT Pre-Design Approval. For a consultant-designed project, the consultant should *submit the service cost analysis worksheets and* discuss the optimum alternatives with the Traffic Review Team prior to preparing the plans in order to expedite project development. Upon approval from INDOT, FHWA if necessary, and the local utility company, the final development of the plans may proceed.

7. Prepare Plans. Once the final design has been selected, the lighting designer will prepare and submit to the Traffic Review Team the plan sheets, , quantities, cost estimate, voltage drop calculations, circuit schematic layouts, and special provisions that are required for review. *The light source type, luminaire wattage, luminaire table, service point amp table, and the lighting ID numbers should be included on the plans Additionally the IES file type used in the design will be given on the plans with a note that the distribution pattern of the actual luminaire to be supplied will be equivalent (e.g. luminaire shall provide a light distribution equivalent to IES distribution type GE 452918.IES).*

78-5.02(04) Design-Build Projects

The following provides the procedural steps in designing a lighting system as part of a roadway design-build project. The design-build team will:

REVISION TO STANDARD SPECIFICATIONS

BACKUP 01. DESIGN MEMORANDUM (DRAFT)

1. Assemble Information. Assemble all necessary information. This includes the following:

a. contact the Traffic Review Team for the current design policies and procedures applicable to the project, sample plans, schedules, pay quantities, and example calculations;

b. gather roadway and bridge plans including plan and profile sheets and details sheets (e.g., those for overhead signs);

c. determine existing and expected utility locations;

d. discuss special considerations with the road or bridge designer;

e. conduct field reviews; and

f. if a local-agency project, hold discussions with local officials.

2. Determine Classifications. Determine the roadway classification and environmental conditions. If not already included in the project report, this information can be obtained from the Environmental Policy Team. The roadway classifications, for lighting purposes, are defined in Section 78-6.01.

3. Select Design Criteria. Based on the above information, the designer will select the pertinent design methodology (see Section 78-4.0) and the appropriate criteria based on the classification selected in Step 2; see Section 78-6.02. For an INDOT-route lighting project, only the illuminance design methodology should be used.

4. Select Equipment. In the preliminary design, the designer will need to make some initial assumptions regarding the equipment composition. This includes mounting height, pole setback distance, mast-arm length, light source type, luminaire wattage, photometric distribution pattern (INDOT typically uses M-S-Type II, III, or IV), and initial lumen output (typically 28,000 or 50,000,. See Sections 78-3.0 and 78-6.03 for additional details on equipment selection.

Normally mounting heights and mast arm lengths will be uniform through the project limits. If the project ties into adjacent lighting systems consideration should be given to matching these considerations.

At minimum the alternatives should include one HPS, one LED, one Plasma, and one Induction model- other light source types may also be considered. Only luminaire types/models that have an accessible IES light distribution file can be used For a list of manufacturer's that have approached INDOT about use of their luminaires go to Y:\TrafficManagement\Luminaire Manufacturers.

REVISION TO STANDARD SPECIFICATIONS

BACKUP 01. DESIGN MEMORANDUM (DRAFT)

5. Select Layout Arrangement. Section 78-6.04 provides information on the commonly used lighting arrangements. The selection of the appropriate layout design depends upon local site conditions and the engineer's judgment. Section 78-6.05 provides the roadside safety considerations in selecting the lighting arrangements. Section 78-6.06 provides other layout considerations.

6. Luminaire Spacing. For an INDOT-route lighting project, use the illuminance methodology to determine the appropriate luminaire spacing. This step is conducted by the computer.

Normally for tangent alignment where roadway width is constant, spacing will be uniform through the project limits. If the project ties into adjacent lighting systems consideration should be given to matching the spacing.

7. Check Uniformity. Once the spacing has been determined, the designer should check the uniformity of light distribution and compare this to the criteria selected in Step 3. Use Equation 78-5.2 to determine the uniformity ratio. Section 78-7.0 provides an example for calculating the uniformity ratio.

8. Select Optimum Design. Because recalculations by computer are relatively quick and easy, the designer should try several alternatives even if the first design satisfies the criteria. There is often more than one satisfactory alternative. Design Optimization should include an analysis for the purpose of minimizing service costs. The service cost is defined as:

Service Cost per Year =Annual Energy Cost + Annual Routine Luminaire Maintenance Costs + Installation Cost/Warranty Period

Where:

Annual Energy Costs are the total luminaire wattage of the system x hours per year operated x cost of electricity

Hours operated per year will be defined as 4380

Cost per kWh can be estimated at $0.08 (the electric provider or district may have a more location specific unit cost)

Maintenance Cost for HPS should be based on re-lamping the entire system every 3 years. Currently lamp cost is estimated at $60 per lamp- or $20 per luminaire per year. Confer with manufacturer for routine maintenance costs of the alternative technology being considered.

Estimated Cost of the system should include poles, foundations, wiring, conduit, handholes, service points as well as the luminaires. Recent bid history as obtained on

INDOT website should be used. Cost of alternative technology luminaires should be obtained from the manufacturer

Warranty period is defined as 5 years or the warranty period as stipulated by the manufacturer, whichever is greater.

See Figure 78-5C, Service Costs Analysis for New or Fully Modernized Lighting,, for the worksheet that should be used to perform this computation. A worksheet should be completed for each alternative considered and submitted with the plans. If the service cost analysis does not yield a clear choice other factors, such as the light color or district preferences, should be weighed into the decision making on the type o flight source.

9. Electric Design. Once the type, number, size, and location of the luminaires are determined, the designer will need to determine the appropriate electric voltage drop for the system. Section 78-6.07 provides information on how to determine the voltage drop for the lighting system. For light source types other than HPS, the design current (amperage) requirement should be obtained from the manufacturer.

10. Prepare Plans. Once the final design has been selected, the lighting designer will prepare and submit to the Traffic Review Team the plan sheets, design criteria, photometric files, service cost analysis worksheets, , luminaire shop drawing, quantities, cost estimate, voltage drop calculations, circuit schematic layouts for review. The plan sheet shall indicate the IES photometric distribution file number used in the design, the luminaire type and initial lumen output and should include the luminaire table, service point amp table, and the lighting ID numbers .

11. Plans submission. Plans should be submitted in accordance with the project witness and hold point schedule.

78-6.0 DESIGN CONSIDERATIONS

Minimum Maintained Illumination Value
Uniformity Ratio = Average Maintained Illumination Value (Equation 78-5.2)

In designing a lighting system, there are many elements or factors the designer must consider. To help the designer in this process, the IES has standardized many of these elements. However, not all elements are appropriate. In addition to the following, Figure 78-6A, INDOT Lighting Design Parameters, provides guidance regarding the design values used for a lighting design.

78-6.01 Roadway Classification

In selecting the appropriate design criteria, the designer must determine the highway's functional classification (Section 78-5.02, Step 2). The following definitions are used to define roadway classification for highway-lighting purposes only.

1. Freeway. A divided major roadway with full control of access and with no crossings at grade. This definition applies to a toll or non-toll road. An Interstate highway is a freeway.

2. Expressway. A divided major roadway for through-traffic with partial control of access and with interchanges at major crossroads. An expressway for noncommercial traffic within a park or park-like area is considered a parkway.

3. Arterial. That part of the roadway system which serves as the principal network for through-traffic flow. Such a route connects areas of principal traffic generation and important rural highways entering a city. For an INDOT project, use the city-street design criteria.

4. Collector. This is a distributor or collector roadway servicing traffic between an arterial and local roadway. This is used for traffic movements within a residential, commercial or industrial area. For an INDOT project, use the city-street design criteria.

5. Local Road. This is used for direct access to residential, commercial, industrial, or other abutting property. It does not include a road which carries through traffic. A long local road will be divided into short sections by collectors. For an INDOT project, use the city street design criteria.

6. Sidewalk. A paved or otherwise improved area for pedestrian use, located within the public-street right of way which also includes the roadway for vehicular traffic.

7 Pedestrian Walkway. A public walk for pedestrian traffic not necessarily within the right of way for a vehicular-traffic roadway. This includes a skywalk or pedestrian overpass, sub walk or pedestrian tunnel, walkway providing access to a park or block interior, or mid-block street crossing.

8. Isolated Interchange. A grade-separated roadway crossing which is not part of a continuously lighted system, with one or more ramp connections with the crossroad.

9. Isolated Intersection. The area where two or more non-continuously lighted roadways join or cross at the same level. This area includes the roadway and roadside facilities for traffic movement in that area. One type of isolated intersection is the channelized intersection in which traffic is directed into definite paths by means of islands with raised curbs.

10. Bikeway. A road, street, path, or way that is specifically designated as being open to bicycle travel, regardless of whether such facility is designed for the exclusive use of bicyclists or will be shared with other transportation modes.

a. Type A: Designated Bicycle Lane. A portion of roadway or shoulder which has been designated for use by bicyclists. It is distinguished from the portion of the roadway for motor-vehicle traffic with a paint stripe, curb, or other similar device.

b. Type B: Bicycle Path. A separate trail or path from which motor vehicles are prohibited and which is for the exclusive use of bicyclists or the shared use of bicyclists and pedestrians. Where such a trail or path forms a part of a highway, it is separated from the roadway for motor-vehicle traffic with an open space or barrier.

78-6.02 Design Criteria

The lighting criteria vary according to the design methodology, highway classification, area classification, and pavement type. The following provide AASHTO and INDOT lighting design criteria.

1. Figure 78-6B provides the recommended INDOT roadway-illuminance-design criteria

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2. The AASHTO *An Informational Guide for Roadway Lighting* provides the recommended illuminance-design criteria for a pedestrian walkway, bikeway path, or local-agency project.

78-6.03 Equipment Considerations

Figure 78-6C, Luminaire Geometry, illustrates the common terms used in defining and designing luminaires (e.g., mounting height, overhang, rotation). The following discusses other equipment considerations for design.

78-6.03(01) Light Distribution

In determining the lighting-design layout, the designer must know the expected light distribution for the luminaire. The designer may obtain photometric data from luminaire manufacturers. The proper distribution of light from the luminaire is a major factor in the design of efficient lighting.

Figure 78-6D, Luminaire Classification System, provides three IES classifications for luminaire light distributions: width, spacing, and glare control. Figure 78-6E, Guide for Luminaire Lateral Light Type and Placement, provides additional guidance on the selection of luminaires based on these classifications. Figure 78-6F, Plan View for Luminaire Coverage, illustrates a plan view of a roadway which has been modified to present a series of Longitudinal Roadway Lines (LRL) and Transverse Roadway Lines

(TRL) and how these distribution factors are interrelated to each other. The following briefly describes these classifications.

1. Vertical Light Distribution. Vertical light distribution can be short, medium, or long. The selection of a vertical light distribution is dependent upon the mounting height and light source. Pavement brightness is increased if the vertical light angle is increased. The following defines the vertical-light distribution types.

   a. Short Distribution. The maximum luminous intensity strikes the roadway surface between 1 and 2.25 mounting heights from the luminaire. The theoretical maximum spacing is 4.5 mounting heights.

   b. Medium Distribution. The maximum luminous intensity is between 2.25 and 3.75 mounting heights from the luminaire. The theoretical maximum spacing is 7.5 mounting heights. This is the most commonly-used distribution type.

   c. Long Distribution. The maximum luminous intensity is between 3.75 and 6.0 mounting heights from the luminaire. The theoretical maximum spacing is 12 mounting heights.

2. Lateral Light Distribution. The IES has developed the lateral light distributions which are provided in Figure 78-6F. The following provides information on the placement for lateral light distribution.

   a. Type I. The luminaire is placed in the center of the street or area where lighting is required. It produces a long, narrow, oval-shaped lighted area. Some types of high-mast lighting are also considered a modified form of Type I.

   b. Type I, 4-Way. The luminaire is placed in the center of the intersection and distributes the light along the four legs of the intersection. This type applies to high-mast lighting.

   c. Type II. The luminaire is placed on the side of the street or edge of the area to be lighted. It produces a long, narrow, oval-shaped lighted area which is applicable to a narrow-width street.

   d. Type II, 4-Way. The luminaire is placed at one corner of the intersection and distributes the light along the four legs of the intersection.

   e. Type III. The luminaire is placed on the side of the street or edge of area to be lighted. It produces an oval-shaped lighted area and is applicable to a medium width street.

f. Type IV. The luminaire is placed on the side of the street or edge of area to be lighted. It produces a wider, oval-shaped lighted area and is applicable to a wide street.

g. Type V. The luminaire is placed in the center of the street, intersection, or area where lighting is required. It produces a circular, lighted area. Type V can be applied to high-mast lighting.

3. Control of Distribution. As the vertical light angle increases, discomforting glare also increases. To distinguish the glare effects on the motorist from the light source, IES has defined the glare effects as follows.

a. Cutoff. This occurs where the luminaire's light distribution is less than 25,000 lm at an angle of 90 deg above nadir (vertical axis), and less than 100,000 lm at a vertical angle of 80 deg above nadir.

b. Semi-cutoff. This occurs where the luminaire's light distribution is less than 50,000 lm at an angle of 90 deg above nadir, and less than 200,000 lm at a vertical angle of 80 deg above nadir. This is the distribution used for lighting design.

c. Non-cutoff. This occurs where there is no limitation on the zone above the maximum luminous intensity.

78-6.03(02) Mounting Height

A higher wattage bulb allows the use of a higher mounting height, fewer luminaries, and fewer support poles, and still maintains the lighting quality. A higher mounting height tends to produce the most efficient design. For practical and aesthetic reasons, the mounting height should remain constant throughout the system. The manufacturer's photometric testing results are required to determine the appropriate adjustments for mounting height. *The mounting height should be at least 30 ft but no more than 50 ft; an even 5 ft increment should be selected.*

78-6.03(03) Coefficient of Utilization

The coefficient-of-utilization curve defines the percentage of bare lamp lumens that are required to light the desired surface. Figure 78-6G illustrates a sample coefficient-of-utilization curve.
The curve and the Isolux diagram are used to determine the amount of illumination to a given point on the pavement. The curve provides a value for the street side of the luminaire and the private-property side. If the luminaire is located over the roadway, the private-property-side value should also be used to determine the level of illumination. The manufacturer is required to provide these charts with its photometric testing results.

78-6.03(04) Light-Loss Factor (Maintenance Factor)

The efficiency of a luminaire is reduced over time. The designer must estimate this reduction to properly estimate the light available at the end of the lamp-maintenance life. The maintenance factor *for HPS lighting* may range from 0.50 to 0.90, with the optimum range from 0.65 to 0.75. Figure 78-6A, INDOT Lighting Design Parameters, provides the factors used for designing a lighting system.

The maintenance factor is the product of the following.

1. Lamp/*LED* Lumen Depreciation Factor (LLD). As the lamp progresses through its service life, the lumen output of the lamp decreases. The initial lamp lumen value is adjusted by means of a lumen depreciation factor to compensate for the anticipated lumen reduction. This ensures that a minimum level of illumination will be available at the end of the assumed lamp life, even though lamp lumen depreciation has occurred. This information should be provided by the manufacturer. *In general a* LLD factor of 0.90 should be used. ~~If deemed necessary, another value may only be used with approval from the Office of Traffic Engineering~~. *For a more precise value the designer may use the manufacturer's recommendations.*

2. Luminaire Dirt Depreciation Factor (LDD). Dirt on the exterior and interior of the luminaire, and to some extent on the lamp, reduces the amount of light reaching the roadway. Various degrees of dirt accumulation may be anticipated depending upon the area in which the luminaire is located. Industry; exhaust of vehicles, especially large diesel trucks; dust; etc., all combine to produce dirt accumulation on the luminaire. A higher mounting height, however, tends to reduce vehicle-related dirt accumulation. Information on the relationship between the area and the expected dirt accumulation is shown in Figure 78-6H. An LDD factor of 0.87 should be used. This is based on a moderately-dirty environment and three years' exposure time. If deemed necessary, another value may only be used with approval from the ~~Office of Traffic Engineering~~ *Traffic Administration Office.*

78-6.04 System Configuration

Figure 78-6 I, Lighting-System Configurations, illustrates the layout arrangements used. Figure 78-6 I also illustrates the recommended illuminance calculation points for the arrangements (Section 78-5.02, Step 7). INDOT does not place light standards in the median, as described below.

1. If no barrier is present, the light standards can be struck by traffic in both directions.

2. If a concrete barrier is present, the light standards are placed atop the barrier. A truck or bus hitting the barrier will lean substantially over the barrier and may strike the light standard.

3. Maintenance of the standards can be a safety concern for a maintenance crew situated in the median lane.

Figure 78-6J illustrates a layout for partial lighting of an interchange.

78-6.05 Roadside-Safety Considerations

The placement of a light standard should be such that it will not reduce roadside safety. However, the physical roadside conditions often dictate the light-standard location. The designer should consider such limitations in the design process. An overpass, sign structure, guardrail, roadway curvature, right-of-way limitation, gore clearance, proximity of another existing roadside obstacle, or the limitations of the lighting equipment are all factors that must be considered in design. The designer also must consider the roadway and area classification, design speed or posted speed limit, safety, aesthetics, economics, environmental impacts, etc., while accounting for the physical limitations.

There should be adequate right of way, driveway control, or utility clearance to allow the placement of the proposed light standards according to the safety requirements. Otherwise, additional right of way, driveway control, or utility relocations will be required. The designer should consider the following when determining the location of light poles relative to roadside safety.

1. Breakaway. A conventional light pole placed within the clear zone or the obstruction-free zone will be provided with a breakaway device except at a location with a sidewalk. In addition, the designer should consider the following.

   a. Pedestrians. A pole should not be mounted on a breakaway device in an area, including a rest area, where pedestrian traffic exists or is expected.

   b. Support. The maximum projection of the portion of a breakaway lighting support that remains after the unit has been struck is 4 in. (see Figure 78-6K, Breakaway Support Stub Clearance Diagram).

   c. Breakaway Device. Each breakaway device should be in accordance with the applicable AASHTO requirements for structural supports. It may be one that has been approved for use as a breakaway device; see Section 78-3.0.

   d. Wiring. Each pole that requires a breakaway device should be served by underground wiring and should be designed with breakaway connections.

2. Grading. A breakaway light standard, except one shielded by guardrail, should not be located where the opportunity exists for it to be struck more than 9 in. above the point

of vehicular bumper impact. Normal bumper height is 1'-6". To avoid a light standard being struck at an improper height, it should be placed as follows.

a. Fill Slope Flatter than 6:1. There are no restrictions on placement of the light standard nor is special grading required. A light standard should be placed 20 ft from the edge of the travel lane or 10 ft from the edge of shoulder.

b. Fill Slope of 5:1 or 6:1. The grading plan shown on the INDOT *Standard Drawings* should be followed. A light standard should be placed 20 ft from the edge of the travel lane or 10 ft from the edge of shoulder.

c. Fill Slope of 4:1 or Steeper. A light standard should be offset 3 ft from the edge of shoulder or 12 ft from the edge of the travel lane, whichever is greater. Grading should be provided as shown on Figure 78-6L, Light-Standard Treatment (Fill Slope of 4:1 or Steeper).

d. Cut Slope. The grading plan as shown on the INDOT *Standard Drawings* should be used to determine the placement of a light standard.

3. Gore Area. A pole should be located to provide adequate safety clearance in the gore area of an exit or entrance ramp, with a minimum of 50 ft (see Figure 78-6M, Pole Clearance for Ramp Gore).

4. Horizontal Curve. A pole should be placed on the inside of a sharp curve or loop.

5. Maintenance. In determining a pole location, the designer should consider the hazard which will be encountered while future maintenance is being performed on the lighting equipment.

6. Barrier. The placement of a light standard in conjunction with a roadside barrier should be as described in Section 49-5.0. In addition, the designer should consider the following.

a. Placement. A light standard should be placed behind the barrier.

b. Deflection. A pole behind guardrail should be offset by at least the deflection distance of the guardrail (see Section 49-5.01). This will allow the railing to deflect without hitting the pole. If this clearance distance is not available, such as in an extreme side-slope condition, or if the pole is located within the approach end of the railing, a breakaway device should be added. INDOT practice is to always use a breakaway device behind guardrail.

c. Concrete Median Barrier. A pole that is shielded by a rigid or non-yielding barrier will not require a breakaway device. However, INDOT practice is to always use a breakaway device behind a rigid or non-yielding barrier.

d. Impact Attenuator. A pole, either with or without a breakaway device, should be located such that it will not interfere with the functional operation of an impact attenuator or other safety breakaway device.

7. Protection Feature. A feature such as a curb, barrier, or other obstacle constructed primarily to protect a light pole, should not be used.

8. High-Mast Tower. An unprotected high-mast tower should be at least 75 ft from the nearest edge of the mainline or ramp travel lane. The minimum clear distance will be the roadway clear-zone width through the area where the high-mast lighting is located. Access for service vehicles should be provided for each high-mast tower or service pole.

9. Existing Installation. An existing breakaway light standard should be evaluated to determine if it is necessary to relocate it, re-grade around its base, or upgrade the breakaway mechanism to current criteria. The determination of the work necessary on an existing breakaway light standard involves a review of numerous variables. Therefore, this decision must be made by the Office of Traffic Engineering. If Federal-aid funds will be used for construction, the project is on the National Highway System, and it is not exempt from FHWA oversight, then the FHWA should also be consulted.

78-6.06 Other Considerations

The designer should review the following if designing of a lighting system.

1. Sign. A pole should be placed to minimize interference with the motorist's view of a highway sign. The luminaire brightness should not detract from the legibility of the sign at night.

2. Overhead Sign. An existing overhead sign's lights should be tied into the new lighting system's circuits.

3. Structure. A pole should be placed sufficiently far enough away from an overhead bridge or overhead sign structure so that the light from the luminaire will not cast distracting shadows on the roadway surface or produce unnecessary glare for the motorist.

4. Tree. A tree should be sufficiently pruned so that it do not cause shadows on the roadway surface or reduce the luminaire's efficiency. The luminaire should be designed with the proper height and mast-arm length to reflect the effect a tree will have on lighting distribution.

5. Retaining Wall. A pole may be located either on top of or behind a retaining wall. A pole mounted atop a retaining wall will require consideration in the retaining-wall design.

6. Median. Although not desirable, a pole may be placed in a median where the width of the median is adequate or if a barrier will be used. The median width should be equal to or greater than the pole's mounting height. Where used, twin poles should have the same mast-arm lengths on each side.

78-6.07 Voltage Drop Determination

A highway-lighting distribution circuit consists of two 240-V circuits provided by a multiple conductor armored cable. Power supply to the lighting system is 240/480 V, single phase, 60- cycle alternating current. The lights are alternately connected to each side of the four-wire circuit. Ground rods are provided at each light standard. Voltage drop should not be over 10% to the last light in the circuit. Figure 78-6N provides the design amperages for ~~various~~ typical HPS luminaires, *check with the manufacturer for other light source types*. Figure 78-6O provides resistances for various wire types. Equation 78-6.1 should be used to determine the voltage drop between two adjacent luminaires.

$E = IR$ (Equation 78-6.1)

Where:
E = voltage, or electric potential (volt)
I = current (ampere/mile)
R = resistance (ohm)

78-7.0 HIGH-MAST LIGHTING DESIGN [Rev. Jan. 2011]

The design of a high-mast lighting system consists of the same design procedures as discussed in
Section 78-5.02. The following should also be considered:

1. Lighting Source. ~~A 1000-W high pressure sodium~~ *A* light source *that provides approximately 130,000 lumens* should be used. The number of required luminaires should be determined based on the area to be lighted as shown in Figure 78-7A. *At a minimum the designer should consider one HPS and one LED model for determining the optimal design.*

2. Estimated Mounting Height. This can range from 100 to 200 ft. Once determined, it should be specified to the higher 5-ft increment. An EMH of 100 to 160 ft has proven to be the most practical. An EMH of 165 ft or greater requires more luminaires to maintain the illumination level. However, such an EMH allows for fewer towers and provides better uniformity. Use of such an EMH should be confirmed with the district traffic engineer.

3. Location. In determining the location for a tower, the plan view of the area should be reviewed to determine the more critical areas requiring lighting. In selecting the appropriate location for a tower, the following should be considered.

a. Critical Area. A tower should be located such that the highest localized level of illumination occurs within a critical-traffic area, e.g., freeway/ramp junction, ramp terminal, merge point.

b. Roadside Safety. A tower should be located a sufficient distance from the roadway so that the probability of a collision is virtually eliminated. It should not be placed at the end of a long tangent.

c. Sign. A tower should be located so that it is not within a motorist's direct line of sight to a highway sign.

4. Design. The methodologies for checking the adequacy of uniformity are the point-by point method and the template method. The point-by-point method checks illumination by using the manufacturer's Isolux diagram. The total illumination at a point is determined as the sum of the contributions of illumination from all luminaire assemblies within the effective range of the point. The template methodology uses isolux templates to determine the appropriate location for each tower. The templates may be moved to ensure that the minimum-maintained illumination is provided, and that the uniformity ratio has been satisfied. Section 78-8.0 provides an example of using the template methodology.

A retaining wall should be included with the concrete pad at the base of the tower if the surrounding ground's slope is steeper than 5:1. The height of the retaining wall should be determined from Figure 78-7B.

5. Foundation and Soil Test. After the final location of each tower is determined, a geotechnical investigation should be requested from the Office of Geotechnical Engineering. The standard foundation of 20-ft depth and 4-ft diameter should be specified for each tower with the soil properties as follows.

a. Soft Clay. Undrained shear strength of 750 lb/ft^2, density of 120 lb/ft^3, and strain of 0.01 at half the maximum stress for an undrained triaxial test. The soil should not include excess rock.

b. Sand. Angle of internal friction of 30 deg, density of 115 lb/ft^3, and modulus of subgrade reaction of 20 lb/in^3 . The soil should include a minimum of gravel or clay.

If a tower of 180 ft or higher is required where soil is sandy, a foundation of 22-ft depth and 4.5-ft diameter should be specified, and its details should be shown on the plans. The standard foundation has been designed with the

assumption that no groundwater is present. The Office of Geotechnical Engineering should be contacted if groundwater is present or if excess rock is present in clay soil.

For other soil conditions or properties, the Office of Geotechnical Engineering may recommend an alternate foundation. Such alternate foundation should be shown on the plans.

6. Information to be Shown on Plans. This includes the tower location, foundation details if not standard, estimated mounting height, retaining-wall height if applicable, *the light source type*, number of luminaires, *and the luminaire wattage*. *The IES file type used in the design will be given on the plans with a note that the distribution pattern of the actual luminaire to be supplied will be equivalent (e.g. luminaire shall provide a light distribution equivalent to IES distribution type GE 452918.IES). The plans should also include the luminaire table, service point amp table, and the lighting ID numbers.*

REVISION TO STANDARD SPECIFICATIONS

BACKUP 01. DESIGN MEMORANDUM (DRAFT)

Location: *Project Number:*

Light Source Type: *IES Light Distribution Type:*

Service Cost per year for luminaire modernization
= Annual Energy Cost + Annual Maintenance Cost + (Installation Cost/Warranty Period)

Annual Energy Cost
= [(no. of luminaires x wattage per luminaire x operational hours)÷1000] x unit cost of electricity

No. of Luminaires = (1)

Luminaire Wattage = (2)

Operational Hours = 4380

Unit Cost of Electricity = (3) *($0.08 per kWh or location specific rate)*

Annual Energy Cost = [((1) *x* (2) *x 4380) ÷ 1000] x* (3) *=* _____ (A)

Annual Maintenance Cost
= no. of luminaires x maintenance cost per luminaire

No. of Luminaires = (1)

Maintenance cost per luminaire,
for HPS (regardless of wattage) = $20 (4)
for other light source types = (5) *(per manufacturer's info)*

Annual Maintenance Cost = (1) *x* (4) or (5) *=* _____ (B)

Installation Costs
= no. of luminaires x furnish & install cost per luminaire

No. of Luminaires = (1)
furnish/install cost per luminaire = (6) *(for HPS use bid history)*

Warranty Period = (choose one) years (7)

Installation Cost = (1) *x* (6) *÷* (7) */=* _____ (C)

Service Cost per year = (A) *+* (B) *+* (C) *=* _____

SERVICE COST PER YEAR FOR LUMINAIRE REPLACEMENT OR PARTIAL MODERNIZATION
Figure 78-5B

REVISION TO STANDARD SPECIFICATIONS

BACKUP 01. DESIGN MEMORANDUM (DRAFT)

Location: *Project Number:*

System Configuration: *Pole Spacing:* *Mounting Height:*

Light Source Type: *IES Light Distribution Type:*

Service Cost per year for luminaire modernization
= Annual Energy Cost + Annual Maintenance Cost + (Installation Cost/Warranty or Service Period)

Annual Energy Cost
= [(no. of luminaires x wattage per luminaire x operational hours)÷1000] x unit cost of electricity

No. of Luminaires = *(1)*

Luminaire Wattage = *(2)*

Operational Hours = 4380

Unit Cost of Electricity = *(3)* *($0.08 per kWh or location specific rate)*

Annual Energy Cost = [(*(1)* *x* *(2)* *x 4380) ÷ 1000] x* *(3)* *= _____ (A)*

Annual Maintenance Cost
= no. of luminaires x maintenance cost per luminaire

No. of Luminaires = *(1)*

Maintenance cost per luminaire,
for HPS (regardless of wattage) = $20 *(4)*
for other light source types = *(5)* *(per manufacturer's info)*

Annual Maintenance Cost = *(1)* *x* *(4) or (5)* *= _____ (B)*

SERVICE COST PER YEAR FOR NEW OR FULLY MODERNIZED LIGHTING
Figure 78-5C

REVISION TO STANDARD SPECIFICATIONS

BACKUP 01. DESIGN MEMORANDUM (DRAFT)

Contd.

Installation Costs

= [Cost of Luminaires] ÷ Warranty Period +
[Cost of poles/foundations ÷ pole service life] +
+ [Cost of towers/foundations ÷ tower service life]

No. of luminaires = (1)
furnish/install cost per luminaire = (6) (per manufacturer for non-HPS)
Warranty Period = (choose one) years (7)

No. of poles foundations = (8)
furnish/install cost of pole = (9)
furnish/install cost of pole foundation = (10)
Pole Service Life = 20 years

No. of high mast towers foundations = (11)
furnish/install cost of tower = (12)
furnish/install cost of tower foundation = (13)
Tower Service Life = 40 years

Installation Cost =

[((1) x (6)) ÷ (7)] = (14)

+ [((8) x ((9) + (10))) ÷ 20] = (15)

+ [((11) x ((12) + (13))) ÷ 40] = (16)

/= (14) + (15) + (16) = (C)

Service Cost per year = (A) + (B) + (C) = _____

SERVICE COST PER YEAR FOR NEW OR FULLY MODERNIZED LIGHTING
Figure 78-5C

COMMENTS AND ACTION

807.13 LUMINAIRE INSTALLATION
807.19 BASIS OF PAYMENT
920.01(d) LUMINAIRES

Motion: Second: Ayes: Nays:	Action: _____ Passed as Submitted _____ Passed as Revised _____ Withdrawn
Standard Specifications Sections affected: 807.13 pg 759, 760; 807.19 pg 765; 902.01 pg 974, 975. Recurring Special Provision affected: NONE Standard Sheets affected: NONE Design Manual Sections affected: Chapter 78-3.04; 78-5; 78-6; 78-7 GIFE Sections cross-references: NONE	_____ 2014 Standard Specifications Book ____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ ____ Revise RSP (No.____) Effective ____ Letting RSP Sunset Date: ____ Standard Drawing Effective ____ ____ Create RPD (No. ____) Effective ____ Letting ____ Technical Advisory GIFE Update Req'd.? Y ___ N ___ By ____ Addition or ____ Revision Frequency Manual Update Req'd? Y__N__ By ____ Addition or ____ Revision Received FHWA Approval? _____