

Section 810. PERMANENT TRAFFIC SIGNS AND SUPPORTS

810.01 Description. This work consists of furnishing, fabricating, and erecting traffic signs and supports. This work shall be according to the *Michigan Manual of Uniform Traffic Control Devices*, the *Michigan Standard Highway Signs Manual*, and the Department Sign Support Typical Plans.

A. Terminology.

Defect. Physical imperfection affecting function, performance, or durability of a sign or post. (dent, scratch, nick, blemish, mottle, dark spot, scuff, streak, warpage, sheeting lift.)

Patch. Small piece of reflective sheeting material used to cover a defect or imperfection on a sign surface.

Post Spacing. Center to center distance between posts.

Substrate. Material to which sheeting is applied (wood or aluminum).

Warpage. Deformation caused by bending or twisting in posts or substrate.

Wedge. Tapered object used to secure wood posts in sleeves.

810.02 Materials. Materials shall meet the following requirements.

Concrete, Grade P2, P1	601
Concrete, Grade S2	701
Curing Compounds	903
Steel Reinforcement	905
Structural Steel	906
Anchor Bolts and Nuts	908
Electrical Conduit	918
Permanent Traffic Sign and Support Materials	919

Concrete. Concrete for cantilever and truss sign support foundation shall be Grade P1 or S2. Concrete for all other sign support foundations shall be Grade P2.

Structural Steel. When structural steel is specified for either cantilevers or trusses, the structural steel plants shall be certified by the American Institute of Steel Construction for the category that applies to highway sign structures.

810.03 Construction.

Traffic signs and sign supports shall be constructed using the following methods. Before beginning all excavations or driving posts, the Contractor shall determine the location of all underground utilities in the vicinity. This work shall be conducted to avoid damaging all utilities as directed in section 107.

Place signs at the height shown in the sign support typical plans or as indicated on the plans.

Zinc coating on sign supports which has been damaged in transporting, handling, or erection shall be repaired by the Contractor without cost to the Department. The damaged area shall be repaired according to subsection 716.03.E.

A. Dimensional Information.

1. **Trusses and Cantilevers.** Steel cantilevers and steel trusses shall be fabricated per the sign support typical plans or as indicated in the plans.
2. **Steel Column Breakaways and Bridge Connections.** Fabrication will not be permitted to begin until the Contractor or fabricator has confirmed in the field that breakaway heights, bridge connection strut lengths, and all other dimensions necessary for fabrication are correct, final, and approved in writing by the Engineer.

B. Delineators.

1. **Installing Steel Posts.** Steel posts shall be driven into the ground by a method that will not bend the post or damage the top of the post. The post shall be plumb when ready to receive the reflector.
2. **Installing Flexible Delineator Posts.** The flexible delineator posts shall be installed complete with all required anchoring accessories by a method that will not bend or damage the post, according to the post manufacturer's directions. Sheeting damaged during installation shall be replaced by the Contractor at no cost to the Department. The flexible post shall be installed plumb with its reflective sheeting oriented perpendicular (or radial) to oncoming traffic.
3. **Reflectors.** For steel post delineators the fastener shall hold the reflectors firmly to the post. The proper hand or pneumatic blind rivet gun shall be used for the specific solid pin being used. After swaging the collar material into the annular grooves of the pin, a vandal resistant locked fastener shall be formed. The reflectors shall be mounted as shown on the standard plan. The reflective sheeting for the flexible delineator shall be applied to the flexible delineator post according to the manufacturer's specifications.

- C. Steel Post Sign Supports and Square Tubular Steel Sign Supports.** The posts shall be driven or embedded so the sign face and supports do not vary from plumb by more than 3/16 inch in 3 feet. The center to center distance between posts shall not vary by more than 2 percent.

When driving posts, a method shall be used which will not damage the top of the post.

- D. Wood Post Sign Supports.** Wood sign support posts shall be erected so that the sign face and supports do not vary from plumb by more than $\frac{3}{16}$ inch in 3 feet. The post ends with the most severe strength defects shall be at the top where the signs will be attached. Forms will not be required for the concrete, but the Contractor shall prevent the intrusion of earth within the limits of the excavation. The center to center distance between posts shall not vary by more than 3 percent.

- E. Installing Steel Posts Through Concrete.** When installing steel sign posts (including square tubular steel sign supports) or steel delineator posts through an existing concrete area a separate hole must be carefully drilled or sawcut through the concrete for each post. This post hole shall be a maximum of one inch wider in diameter than the largest cross-sectional dimension of the post to be installed. After completion of drilling or sawing, all concrete debris shall be removed and the immediate vicinity of the hole cleaned and dried to enable placement of silicone sealer after installation of the post. The galvanized steel post will be inserted through this hole and into the underlying material to a depth of 3 feet

8 inches measured from the top of concrete grade. The hole around the post shall be filled with a silicone sealer to facilitate future post replacement.

When installing in new concrete the Contractor is allowed the option of forming the hole prior to installing the new concrete.

- F. **Installing Wood Posts Through Concrete.** At locations where the installation of wood sign posts is through existing concrete, a separate hole for each post shall be drilled or saw cut through the concrete. This post hole shall be a minimum of 18 inches in diameter with the galvanized steel sleeve and wood post centered in the hole when installation is complete. After completion of drilling or sawing, all concrete debris shall be removed and the immediate vicinity of the hole cleaned before installation of the wood post foundation. When installing in new concrete the Contractor is allowed the option of forming the hole prior to installing the new concrete.
- G. **Sign Band.** Furnish and install bands to fasten single sign or route marker cluster bracket to the supports according to the sign support typical plans. The number of bands required for each installation is shown on the plans, or as directed by the Engineer.
- H. **Concrete Glare Screen and Concrete Median Barrier Connections.** Furnish and install sign supports on concrete glare screen or concrete median barrier according to the sign support typical plans.
- I. **Foundations for Steel Column Breakaway Sign Supports.** A hole shall be augured at the location shown in the plans.

Forms will not be required for the concrete, but the Contractor shall prevent the intrusion of earth within the limits of the excavation. The concrete shall be placed against the undisturbed soil in the augured hole according to subsection 706.03.H, except the use of tubular shells may be used in soils which will not support the augured hole. The stub column shall be held in position by means of a template for a minimum of 24 hours after placement of the concrete. The top elevation of the foundation shall be as shown in the sign support typical plans.

- J. **Foundations for Cantilever Sign Supports and Truss Sign Supports.** If the project or section is open to traffic before or during the construction of the foundations, the Contractor shall provide and maintain the proper temporary traffic control devices according to section 812, at each foundation until the foundation and backfilling operations are completed and guardrail, if indicated in the plans, has been installed.
 - 1. **Excavation.** Excavation for foundations shall be done according to subsection 206.03.A.
 - 2. **Forms.** Forms shall be constructed according to subsection 706.03.D. Forms may be omitted for footings or portions of foundations which are more than 6 inches below finished earth grade, provided soil conditions ensure no intrusion of earth within the neat lines of the foundation shown on the plans. The top elevation of the foundation shall be as shown in the sign support typical plans or as indicated in the plans.
 - 3. **Placing Steel Reinforcement.** Steel reinforcement shall be placed according to subsection 706.03.E.
 - 4. **Setting Anchor Bolts and Placing Concrete.** The anchor bolts shall be accurately positioned according to subsection 810.03.N.1. The concrete shall be placed and the

- seat struck off at the elevation shown on the plans, or as determined by the Engineer, and finished smooth and horizontal. The cantilever or truss sign support shall not be erected until the concrete has attained 70 percent of the anticipated minimum 28-day compressive strength, or until test beams have attained a flexural strength of 500 psi.
5. **Surface Finish.** Exposed surfaces shall be finished according to section 706.
 6. **Curing.** The concrete shall be cured by uniformly coating with a white membrane curing compound except during cold weather the concrete shall be protected according to subsection 706.03.N.
 7. **Backfilling.** Backfilling shall be done according to subsection 206.03.B. All backfill around the foundation shall be placed and compacted in layers not exceeding 9 inches in thickness and the backfill material and compaction method shall be as approved.

K. Drilled Piles for Cantilever Foundations.

1. **Drilled Pile Installation Plan.** The Contractor shall submit an installation plan at the preconstruction meeting for approval by the Engineer. The installation plan shall be sealed by a professional engineer licensed in the State of Michigan. This plan shall provide detailed information on the following.
 - a. Proposed equipment to be used including cranes, drills, augers, bailing buckets, final cleaning equipment, slurry pumps, tremies or concrete pumps, and casing.
 - b. Description of the overall construction sequence.
 - c. Shaft excavation methods including proposed methods of excavation through and supporting caving soil layers whether anticipated or unanticipated.
 - d. Methods to mix, circulate and desand slurry, if slurry is to be used.
 - e. Methods to clean the pile excavation.
 - f. Reinforcement placement including support and centering methods.
 - g. Concrete placement including procedures for free fall, tremie or pumping of concrete.
 - h. Other information shown in the plans or requested by the Engineer.

The Engineer will evaluate the drilled pile installation plan for conformance with the contract documents. Within 7 days after receipt of the plan, the Engineer will notify the Contractor of any additional information required and any changes necessary to meet the contract requirements. Any part of the plan that is unacceptable will be rejected and the Contractor will resubmit changes for re-evaluation. All procedural approvals given by the Engineer shall be subject to trial in the field and shall not relieve the Contractor of the responsibility to satisfactorily complete the work. The approval by the Engineer shall not be cause for extra compensation if the methods of construction or equipment do not provide a satisfactory drilled pile.

2. **General Methods and Equipment.** The Contractor shall perform the excavations required for the drilled pile through whatever materials are encountered, to the dimensions and elevations shown in the plans or otherwise required by the contract documents. The Contractor's methods and equipment shall be suitable for the intended purpose and materials encountered. Drilled piles shall be constructed to the

dimensions shown on the plans or as described herein. One of the following methods will generally be used to produce sound, durable concrete foundations free of defects. The Contractor shall select a method on the basis of its suitability to the site conditions and approval by the Engineer.

- a. **Dry Construction Method.** This method shall be used only at sites where the groundwater table is low, seepage is not a problem, and the soil profile is sufficiently stable to support the sides and bottom of the excavation. The dry method consists of drilling the excavation, removing accumulated water and loose material from the excavation, and placing the drilled pile reinforcing steel and concrete in a dry excavation.
- b. **Wet Construction Method.** This method shall be used at sites where a dry excavation can not be maintained for placement of the concrete. This method consists of using water or mineral slurry to maintain stability of caving soils while advancing the excavation to final depth, placing the reinforcing cage, and concreting the drilled excavation. This procedure may involve desanding and cleaning the slurry; final cleaning of the excavation by means of bailing bucket, air lift, submersible pump or other approved devices; and placing the concrete with a tremie tube or concrete pump beginning at the pile bottom. Temporary surface casing shall be provided to aid drilled pile alignment and position, and to prevent sloughing of the top of the excavation unless the Contractor demonstrates to the satisfaction of the Engineer that the surface casing is not required.
- c. **Dry Temporary Casing Method.** This method shall be where caving soils occur but a relatively dry and stable excavation can be maintained with the use of casing. This method consists of first installing a temporary casing through the caving soils to either the bottom of pile elevation if dry soil, or to a relatively impermeable strata if ground water is encountered. Excess water and soil are then removed from within the casing. The casing and excavation may be advanced simultaneously; however, drilling outside the casing will not be permitted through caving soil layers. The bottom of the excavation must remain relatively dry and stable long enough to allow placement of the reinforcing steel and concrete. The casings are withdrawn while the concrete is in a workable state. Before the casing is withdrawn, the level of fresh concrete in the casing shall be at such a point that all fluids trapped behind the casing are displaced upward.
- d. **Wet Temporary Casing Method.** This method shall be used where caving soils occur and a dry excavation cannot be maintained. The soil profile is relatively permeable and the groundwater elevation is above the required bottom of pile elevation. The bottom stability will likely be compromised if any attempt is made to dewater the completed excavation. This method consists of first installing the casing through the caving soils to the required bottom of pile elevation, then drilling the excavation to the required dimensions. The casing and excavation may be advanced simultaneously; however, drilling outside the casing will not be permitted through caving soil layers. A positive pressure differential must be maintained between the fluid level in the excavation and the groundwater elevation during drilling, excavation and clean out. Reinforcing steel is placed and concrete is either pumped or tremied to the bottom of the excavation. Water inside the casing is displaced by the concrete and no pumping is permitted. This method may involve

drilling slurry. Final cleaning of the excavation may require the use of a bailing bucket, air lift, or other approved device. Before and during withdrawal of the casing, the level of fresh concrete in the casing shall be at such a point that all fluid trapped behind the casing is displaced upward without contaminating or displacing the shaft concrete.

3. **Casings.** Casings shall be metal, smooth, watertight, and of sufficient strength to withstand handling, installation and the pressure of both concrete and the surrounding earth materials. The inside diameter of casing shall not be less than the specified size of the pile. All casings, except those approved for the permanent casing, shall be removed from the excavation.

Temporary casings shall be removed while the concrete remains workable. Generally the removal of temporary casing shall not be started until concrete placement in the shaft is completed. Casing extraction shall be at a slow, uniform rate with the pull in line with the shaft axis. Application of eccentric forces which induce undesirable moments in the shaft will not be permitted. Fixtures to aid in the removal of the temporary casing shall be attached to the top of the casings.

When vibratory extractors are used for the casing removal on cantilever foundations requiring two shafts, both shafts will be poured simultaneously and the casing removed while the concrete is in a workable state.

4. **Slurry.** When slurry is employed in the drilling process, the Contractor shall submit the slurry properties and construction procedures for approval of the Engineer.
5. **Excavation Inspection.** The Contractor shall provide equipment for checking the dimensions and alignment of each permanent drilled pile. The dimensions and alignment shall be determined by the Contractor under the direction of the Engineer. The alignment and dimensions may be checked by any of the following methods as necessary.
 - a. Check the dimensions and alignment of drilled pile excavations using reference stakes and plumb bob.
 - b. Check the dimensions and alignment of casing when inserted in the excavation.
 - c. Insert a casing in pile excavations temporarily.
 - d. Insert a rigid rod assembly with several 90 degrees offsets equal to the pile diameter into the pile excavation.

The depth of the pile during drilling shall generally be referenced to appropriate marks on the kelly bar or other approved methods. Final drilled pile depths shall be measured with a suitable weighted tape or other approved methods after final cleaning.

The Contractor's cleaning operation shall be adjusted so that at least 50 percent of the base of each shaft has less than ½ inch of sediment. Debris at any point on the base of the shaft shall not exceed 1½ inch. Shaft excavation cleanliness will be determined by the Engineer by visual inspection for dry excavations, or other methods deemed appropriate by the Engineer for wet excavations.

6. **Concrete Placement.** Concrete shall be poured immediately after the reinforcing steel is placed. Concrete placement shall be continuous to the top elevation of the drilled

pile. Concrete placement shall continue after the excavation is full until good quality concrete is evident at the top of the drilled pile. Concrete shall be placed through a tremie tube or concrete pump using approved methods.

The elapsed time from the beginning of concrete placement in the drilled pile to the completion of the placement shall not exceed 2 hours. Retarding plasticizer in the concrete mix shall be adjusted for the conditions encountered on the job so that concrete remains in a workable plastic state throughout the 2-hour placement limit. Temporary casings shall be removed with the 2 hour placement.

7. **Tremies.** Tremies used to place concrete shall consist of a tube of sufficient length to meet the requirements below. The tremie shall not contain aluminum parts which will come into contact with the concrete. The Contractor may use concrete pumps in lieu of tremies for concrete placement when approved by the Engineer. All pump lines shall have a minimum 4-inch diameter and shall be constructed with watertight joints.

The tremie used for a dry excavation shall consist of a tube of either one piece construction or sections which can be added and removed. Concrete may be placed through either a hopper at the top of the tube or side opening as the tremie is retrieved during concrete placement. The tremie shall be supported so the free fall of the concrete is less than 5 feet at all times. If concrete placement causes the pile excavation to cave or slough, the Contractor shall reduce the height of free fall and/or reduce the rate of concrete flow into the excavation.

The tremie used for wet excavation concrete placement shall be watertight. The discharge end of the tremie shall be constructed to permit the free flow of concrete during placement operations. The length and weight of tremie shall be sufficient to extend to the bottom of the excavation. The discharge end shall be entirely immersed in concrete at all times after starting the flow of concrete. The flow of concrete shall be continuous and under positive pressure at all times to prevent water or slurry intrusion into the tremie concrete or tube.

- L. **Cantilever Sign Supports.** Cantilever sign supports shall be transported and handled in a manner so not to damage the members. The sign supports shall be erected according to the following sequence.
1. Bottom leveling nuts and washers shall be placed on all the anchor bolts. These nuts shall initially be placed $\frac{1}{4}$ inch above the concrete foundation. The nuts shall be brought level with the highest nut above the foundation. Clearance between the concrete foundation and the bottom leveling nuts shall not exceed one inch.
 2. The column only, without the arm brackets attached, shall be placed on the leveled bottom nuts and washers.
 3. Beeswax or the equivalent shall be applied to all top nut bearing faces and the top nut internal threads prior to placement on the anchor bolt. The two top nuts perpendicular and the two top nuts parallel to the sign face (in its final position) shall be placed on the anchor bolts, along with their corresponding washers, and loosely snug tightened.
 4. The column base plate shall be leveled by adjusting only the nuts perpendicular and parallel to the sign face (in its final position).

5. Remaining top nuts and washers shall be placed on the anchor bolts and loosely snug tightened.
6. All bottom nuts and top nuts shall now be tightened according to subsection 810.03.N.2.
7. Place the assembled arm bracket, without the sign, on the erected column. All bolts shall be tightened according to the turn-of-the-nut method in subsection 707.03.D.7.c. All nuts and bolts loosened or removed after being fully tightened shall not be reused. Retightening previously tightened bolts that have been loosened by the tightening of adjacent bolts will not be considered as reused.
8. Place the sign panel on the erected arm bracket. The holes in the aluminum mounting supports, which receive the sign panel mounting U-bolts, shall be field drilled in locations such that the sign panel is horizontal in its final position.
9. Anchor bolt nuts connecting the column base to the concrete foundation shall be checked for tightness according to subsection 810.03.N.2.e. Field welding will not be permitted unless approved by the Engineer.

M. **Truss Sign Supports.** During transportation of truss sign support to the project site, two 4 by 4 inch wood timbers shall be placed tightly against each other on the truck bed at each end of the truss section a maximum of 2 inches from the flanges of the truss box. A nylon sling, or equivalent, as approved by the Engineer, shall be used to tie down each end of the truss box to the truck bed. The contractor has the option of tying the top, bottom or both cords of the truss box to the truck bed. No other part of the truss box shall be tied to another object. The contractor shall be responsible for securing and delivering the truss to the project site.

At the project site, the transported truss sign support shall be stored on a level surface away from traffic. Four by four inch wood timbers shall be provided at each end and the midspan of each truss sign support section.

Nylon slings, or equivalent, as approved by the Engineer, providing at least a two-point pickup and wrapping the entire cross section, will be required for handling the truss, truss sections, and end supports. Lifting by chains or by internal truss members is prohibited.

Bearing surfaces shall be in full contact in the relaxed position prior to tightening the flange bolts.

The end supports shall be plumbed by the use of anchor bolt leveling nuts.

Field welding will not be permitted, unless approved by the Engineer.

At the time of erection, the truss shall be suitably loaded to prevent vibration. Loading may be accomplished by the installation of the permanent signs, blank sign panels, sand bags, or other means approved by the Engineer. The temporary loads shall be securely fastened and shall remain in place until the permanent signs are installed.

N. **Anchor Bolts for Cantilever and Truss Sign Supports, Light Standards, CMS Structures and CCTV Poles, Tower Lighting Units and Mast Signal Arm Poles.**

1. **Anchor Bolt Installation.** A steel template shall be used to accurately locate and hold the anchor bolts plumb and in proper alignment. This template shall be in place during placement of the concrete base and shall remain in place a minimum of 24 hours after the concrete placement has been completed. The support cage used to position the

anchor bolts within the foundation shall remain in the concrete foundation. Out-of-position anchor bolts and anchor bolts greater than 1:40 out-of-plumb are cause for rejection of the base. Bending of the anchor bolts to straighten or move into position, or alterations of the base shall not be permitted.

2. Anchor Bolt Tightening.

- a. All leveling nuts (bottom nuts) shall be brought to full bearing on the bottom of the base plate. The bottom of the leveling nuts must be kept as close to the concrete base as practical, and shall not be more than one inch above the top of the concrete base. Leveling nuts must be threaded onto the anchor bolt to provide at least ¼ inch projection of the bolt above the top nut when in its tightened position.
- b. Beeswax or equivalent shall be applied to the top nut bearing face and top nut internal threads prior to placement on the anchor bolt. Tighten all top nuts to a snug condition defined as the tightness attained by the full effort of a person using a wrench with a length equal to 14 times the diameter of the anchor bolt, except the minimum length shall be 18 inches. The full effort required to achieve a snug tight condition, shall be applied as close to the end of the wrench as possible. Pull firmly by leaning back and using full body weight (brace feet to prevent slipping) on the end of the wrench until the nut stops rotating. This snug tightening shall be accomplished in a minimum of two separate passes of tightening. The sequence of tightening in each pass shall be such that the opposite side nut, to the extent possible, shall be subsequently tightened until all the nuts in that pass have been snugged.

Snug tightness of both the top and leveling nuts shall be checked in the presence of Department personnel after the Contractor has completed nut snugging as described above, but prior to applying a hydraulic wrench. The Contractor's method of checking snug tightness of the nuts shall be approved by the Engineer. Snug tightness of the nuts (top and leveling) shall be checked by applying a torque to the nut within the range of the following values.

Bolt Diameter (in.)	Torque (ft lbs)	
	Min.	Max.
1	100	200
1¼	200	400
1½	300	600
1¾	400	600
2	500	700
2¼	700	900
2½	800	1000

- c. At this point, the top nut and leveling nut must be in full bearing on the base plate. If any gap exists between either nut (top or leveling) and the base plate, a beveled washer shall be added between the nut washer and the base plate to eliminate the gap. The washer shall be stainless steel Type 304, the same diameter as the hardened washer, and beveled as required to eliminate the gap between the nut and the base plate. All nuts shall be retightened according to steps (a) and (b)

above if beveled washers are added. All costs required to remove and re-erect the structure to install beveled stainless steel washers shall be at the Contractor's expense.

- d. Using a hydraulic wrench, rotate all top nuts an additional $\frac{1}{3}$ turn. The additional $\frac{1}{3}$ turn of the nuts shall be accomplished by tightening all the nuts in two separate passes of equal incremental turns (i.e., $\frac{1}{6}$ turn each pass). The sequence of nut tightening in each pass shall be such that the opposite side nut, to the extent possible, shall be subsequently tightened until all the nuts in that pass have been turned. There shall be no rotation of the leveling nut during top nut tightening.
- e. Tightness of the nuts shall be checked in the presence of Department personnel a minimum of 48 hours after the nuts have been rotated the additional $\frac{1}{3}$ turn. Tightness of the top nuts shall be checked by applying a torque to the nut according to the following values.

Bolt Diameter (in)	Torque (ft lbs)
	Min.
1	300
$1\frac{1}{4}$	630
$1\frac{1}{2}$	1120
$1\frac{3}{4}$	1820
2	2770
$2\frac{1}{4}$	4010
$2\frac{1}{2}$	5550

Bottom leveling nuts shall be in contact with the base prior to applying the torque.

After the anchor bolt nuts have been checked for tightness, the bolts shall be ultrasonically tested, and the nuts and washers tested for proper tightening by the Department before final acceptance. Ultrasonic testing and calibration procedures that will be used by the Department for final acceptance testing are available to the Contractor upon request. The Contractor must test ultrasonically to verify the absence of flaws prior to the erection stage. Reflectors found with an indication rating less than 15 decibels will be cause for rejection of the entire base installation. Replacement of the base installation shall be done at the Contractor's expense. If any nut or washer is found loose as a result of the above acceptance procedure, the Contractor shall tighten all nuts found loose according to steps (a) through (e) above. The Engineer shall determine the extent of removal, disassembly, and re-erection of the structure. If any nuts require tightening, after the initial installation, all costs required to remove and reinstall nuts and washers and, if necessary, to remove, disassemble, and re-erect the entire structure shall be at the Contractor's expense.

O. Bolt Replacement in Retained Bridge Mounted Sign Connections.

Bolts in concrete bridge beams and concrete deck fascia shall not be replaced. All other bolts from the bracket, sign, diaphragm and hanger to the sign connection shall be replaced.

All connection hardware shall be hot dipped galvanized and shall meet subsection 906.06.

All bolts, nuts, flat washers and lock washers used to connect the bolted bridge sign connection bracket to the bridge structure fascia beam shall be removed, one at a time, and replaced with new bolts, nuts, flat washers, and lock washers. The requirements in subsection 707.03.D.7 shall be followed, including turn-of-nut tightening method as specified in Table 707-4, when replacing these bolts.

- P. **Overhead Lane Assignment Structures.** Overhead lane assignment structures shall be in accordance with the sign support typical plans and the traffic signal contract typical construction plans. Upon installation of the foundations, steel poles, and steel cables the overhead lane assignment signs or other signs indicated in the plans shall be erected according to the following sequence.
1. Two angles shall be connected to each sign, one on the top and one on the bottom.
 2. The cable clamps, oval eye bolts, threaded rod, nuts, and washers shall be assembled on the top side of each sign.
 3. The signs are hung from the top cable with the bottom plate attached to the lower cable with cable clamps.
- Q. **Signs.** All completed signs shall be reasonably free from defects in materials and workmanship. Reflectorized sign faces shall be reasonably smooth and free from dents, wrinkles and other defects. They shall exhibit uniform color and brightness over the entire background surface and shall not appear mottled, streaked, or stained when inspected. The sign shall be free of warpage or other deformation. Signs having improper font and/or legend layout shall be subject to adjustment as determined by the Engineer. Signs with unacceptable wrinkles shall be replaced.

Patches will be allowed under the following conditions. A maximum of three patches may be permitted per sign. The patch material shall be of the same material used to fabricate the sign. A maximum of 2 percent of the signs fabricated per job may contain a patch. For projects with 100 signs or less, the maximum number of signs with patches allowed will be determined by the Engineer. Patches shall extend $\frac{9}{16}$ inch beyond the outer edges of the defect. The maximum patch size will be determined by the Engineer.

The Contractor shall place a date sticker on the back of all signs at the time of installation. Date stickers shall be supplied by the Engineer to the Contractor at the preconstruction meeting.

Signs delivered for use on a project shall be stored as recommended by the reflective sheeting manufacturer. The Contractor shall replace or repair, at the Contractor's expense, any sign that is damaged, discolored, or defaced during fabrication, transportation, storage, or erection. Signs shall be positioned on and fastened to the support. Bolts in contact with reflective sheeting shall be tightened by methods recommended by the reflective sheeting manufacturer. Nylon washers are considered part of the attaching hardware. All signs, once erected, shall be clean and free of any substance which would hide or otherwise obscure any portion of the sign face.

Signs erected along a roadway opened to traffic and having a message not immediately applicable, shall have all of the sign message covered until such time as the message is applicable. Signs shall be covered according to subsection 812.03.F.2.

On any project or section of a project open to traffic where existing signs are being replaced by a new sign or signs, the Contractor shall remove each sign being replaced at the same time the new sign becomes visible to the motorists. The signs and supports that have been replaced shall be removed from the right-of-way within seven days and as specified in subsection 810.03.S. All overhead signs shall remain in place until the new signs are installed. All existing signs not shown on the plans shall be retained unless directed otherwise by the Engineer.

Signs shall not be installed behind any obstructions. Vegetation obstructing signs shall be pruned. Pruning will not be paid for separately.

Packaging and protective material used in protecting sign panels shall be completely removed and the Contractor shall perform cleaning of exposed sign face according to manufacturer's specification. Any excess material, shall be removed and disposed of properly. If sign construction operations have disturbed the site, leveling and repair may be necessary to ensure the effectiveness and neat appearance of the work. This work shall be done at the Contractor's expense.

The following tolerances shall be allowed in the installation of signs and supports.

Extra Holes. Maximum allowed - two per sign; extra holes shall be patched on both front and back sign surfaces. Material used to patch extra holes in signs shall be of the same reflectivity, color, and age of the reflective sheeting used to fabricate the signs. These patches shall be applied per the sheeting manufacturer's recommendations.

Offset. Offset distance shall be within 2 feet of the location shown on the plans or in the sign support typical plans but no closer to the edge of the traveled roadway.

Bottom Height. Rural \pm 6 inches; urban + 6 inches, - 0 inches.

Sign Location. Prior approval of the Engineer must be obtained for location changes for regulatory, gore and no passing zone signs.

Placement of advance warning signs may vary by \pm 10 feet. In no case shall the advance warning sign distance be less than the minimum distance set forth in the *Michigan Manual of Uniform Traffic Control Devices*.

Placement of all other signs may vary \pm 20 feet.

Gaps. Gaps between plywood sheets shall not exceed $1/16$ inch.

Unacceptable Wrinkles. Signs with the following wrinkles shall be replaced.

1. A wrinkle that ends at an outside edge of the sign.
2. A wrinkle that exceeds 3 inches in length.
3. A wrinkle that has split or the sheeting is damaged.

Wedges. The upper dimension for wedges shall be $3/4$ to 1 inch.

- R. **Installing Department Supplied Sign.** The Contractor shall be responsible for transporting the sign supplied by the Department from a site specified on the plans, to the project site. The Contractor shall confirm with the Department contact, as specified in the plans, a minimum of 72 hours prior to pick up of the sign.

S. **Removal of Signs and Sign Supports.** The Contractor shall use the same methods in removing cantilever and truss sign supports as required for erecting the supports. All Type I signs, cantilevers, trusses, column breakaways, bridge connections, and all attaching or fastening hardware, unless otherwise noted in the plans, are the property of the Department and shall be carefully removed, hauled, and stockpiled at an off-site location specified in the plans. The Contractor shall confirm with the Department contact, as specified on the plans, a minimum of 72 hours prior to delivery of these salvaged items. All remaining signs, supports, and attaching or fastening hardware for these items are the property of the Contractor.

Sign supports that are to be removed or replaced shall be pulled, not cut off. If the Engineer determines the post or column can not be pulled, the post or column shall be cut off a minimum of 12 inches below grade and the hole filled.

Bridge connections welded to steel beams shall be removed by flame cutting, leaving a 1½ inch projection from the web. The projection shall be ground flush to the surface of the web to a maximum surface roughness of 6.4 µm root mean square (rms). The ground surface shall be coated with an approved zinc-rich primer.

When trusses or cantilevers are removed, the truss box or cantilever arms shall be separated without damage during the time of removal. No scratches, scorches, or nicks will be allowed. The truss box or cantilever arms shall be removed before the end supports are removed, unless otherwise approved by the Engineer.

The Contractor shall use the method for storing and handling described in subsection 810.03.Q for signs, which are indicated on the plans, to be removed and erected as salvaged.

T. **Removal of Sign Support Foundations.** Foundations shall be removed to a depth of 12 inches below the ground surface and backfilled according to subsection 204.03.C. If the Engineer requires additional removal, it will be paid for as Removing Masonry and Concrete Structures if the contract contains the item; if the contract does not contain such an item, it will be paid for as extra work. Concrete and other unsuitable material removed shall be disposed of according to subsection 205.03.P. The area from which foundations were removed shall be restored by adding topsoil, seeding, and mulch according to subsection 816.03.

U. **Erection of Salvaged Sign Supports and Signs.** The same methods required for transporting, storing, and erecting new sign supports and signs shall be exercised in transporting, storing, and erecting salvaged supports and salvaged signs such that their condition after completion of the work will be the same as prior to removal.

810.04 Measurement and Payment.

Contract Item (Pay Item)	Pay Unit
Delineator, Reflector	Each
Post, Delineator	Each
Post, Flexible, Delineator	Each
Delineator, Reflective Sheeting, ___ inch by ___ inch, (<u>color</u>)	Each
Post, Steel, ___ pound	Foot
Post, Wood, ___ inch by ___ inch	Foot
Post, Wood, ___ inch by ___ inch, Direct Embedment	Foot

Post Hole Through Conc for Wood Post	Each
Post Hole Through Conc for Steel Post	Each
Band, Sign	Each
Glare Screen Connection, Conc	Each
Median Barrier Connection, Conc	Each
Fdn, Column Breakaway, ___ inch by ___inch	Each
Fdn, Cantilever, Type ___	Each
Fdn, Truss, Type ___	Each
Column, Breakaway ___ inch by ___ inch	Each
Cantilever, Type ___	Each
Truss, Type __, ___ foot	Each
Sign, Type ___	Square Foot
Bridge Sign Connection, Conc, Type ___	Each
Bridge Sign Connection, Steel, Type ___	Each
Bridge Sign Connection, Bolt Replacement	Each
Overhead Lane Assignment Structure	Each
Installing MDOT Supplied Sign, Type ___	Each
Sign, Type __, Rem	Each
Fdn, Wood Support, Rem	Each
Fdn, Column Breakaway, Rem	Each
Fdn, Cantilever, Rem	Each
Fdn, Truss, Rem	Each
Cantilever, Rem	Each
Truss, Rem	Each
Bridge Sign Connection, Type __, Rem	Each
Transporting Salv MDOT Materials	Lump Sum
Cantilever, Type __, Erect, Salv	Each
Truss, ___ foot, Type __, Erect, Salv	Each
Sign, Type __, Erect, Salv	Each

The pay items listed include all costs for furnishing, fabricating and installing the item. Providing dimensional information will be included in the payment for the item being fabricated.

A. Sign Posts.

1. **Post, Steel** or **Post, Wood** sign supports will be measured to the nearest commercial length required to meet contract requirements. No payment will be allowed for the portion of posts installed to a depth in excess of that required by the plans unless specifically authorized by the Engineer.
2. The Contractor may use square tubular steel sign supports as an alternate to 3 pound steel posts. The work for square tubular steel sign supports will be measured and paid for at the contract unit price for **Post, Steel, 3 pound**. This includes furnishing the sign post, anchor sleeve, anchor post, associated hardware, and labor for erecting and installing.
3. Payment for **Post, Wood** includes all costs to furnish and install wood post sign supports of the nominal dimensions specified set in a sleeve in concrete.
4. Payment for **Post Hole Through Conc for Steel Post** or **Post Hole Through Conc for Wood Post** includes drilling or saw cutting a hole in existing concrete, silicone

- sealer, cleaning the site, and replacing damaged concrete. When installing in new concrete the optional method of forming, including materials and labor will be included in the item **Post Hole Through Conc for Steel Post** or **Post Hole Through Conc for Wood Post**.
- B. Payment for foundations includes all costs for constructing the foundations for sign support including the use of tubular shells. The completed work for construction of drilled piles for cantilever foundations will be measured and paid for at the contract unit price for **Fdn, Cantilever, Type __** .
- C. **Bridge Sign Connections.**
1. Payment for **Bridge Sign Connection** includes locating connections and constructing the sign support.
 2. Payment for **Bridge Sign Connection, Bolt Replacement** includes all bolted bridge connections, including diaphragms and hangers on steel bridges, which are to be retained, and includes materials, labor, and equipment necessary for removal and replacement of each bolt and associated hardware. The old bolts and hardware removed shall become the property of the Department.
- D. Payment for **Overhead Lane Assignment Structure** includes furnishing all labor, materials, and equipment necessary for the installation of the structures. Payment will also include all work associated with installation of the signs.
- E. **Signs.** In determining the area of sign faces, no deduction will be made for corner radii or mounting holes. The computed area will be the smallest circumscribing rectangle except triangular signs will be computed as the area of the circumscribing triangle. The pay item **Sign, Type __** includes all attaching devices and hardware (including H-brackets) and labor to fabricate and erect.
- For plywood (Type II) signs, all costs incurred for workmanship, repair, and sealing of plywood edges as stated in subsection 919.02.B.2, shall be included in the unit bid price of the sign as fabricated and no additional compensation shall be allowed.
- Prior to final acceptance, traffic sign installations which are accepted, approved for use, in use by traffic, and are damaged by other than the Contractor's personnel or equipment, shall be replaced or repaired as directed by the Engineer. Replaced items will be paid for at the contract unit price unless the elapsed time interval between the initial installation and the replacement installation is such that the Contractor can justify a price adjustment according to subsection 103.03. Repaired items will be paid for as extra work.
- F. Cost incurred in the certification of structural steel plants shall be the responsibility of the Contractor/Fabricator and no additional compensation shall be allowed. Claims by the Contractor/Fabricator for delays and inconvenience will not be considered.
- G. Payment for **Installing MDOT Supplied Sign** includes the labor and equipment necessary loading of the sign at the site specified in the plans, transportation, all sign mounting hardware and installation.
- H. **Removal of Signs and Foundations.**
1. **Sign, Type __ , Rem** includes the removal of the sign from the support and stacking by shape and size. Payment for **Sign, Type __ , Rem** will also include removal of

- support(s), sign bands, concrete glare screen connection, or concrete median barrier connection, and all attaching or fastening hardware except that removal of cantilever supports, or truss supports will be paid for separately as **Cantilever, Rem** and **Truss, Rem**.
2. If the contract does not include **Bridge Connection, Type** __ , **Rem**, this work is included in **Sign, Type** __ , **Rem**.
 3. Payment for foundation construction or removal items includes topsoil, seeding, and mulch and the work required to restore the area.
- I. Payment for **Transporting Salv MDOT Materials** includes the labor and equipment necessary for loading, transporting, unloading, and neatly stacking the salvaged materials at the off-site location specified in the plans or as directed by the Engineer.
 - J. Payment for **Cantilever, Erect, Salv** and **Truss, Erect, Salv** includes the labor, materials, and equipment necessary for loading, transporting, unloading, storing, and erecting the salvaged sign support on a new or existing foundation as specified in the plans.
 - K. Payment for **Sign, Erect, Salv** includes the labor, materials, and equipment necessary for storing after removal and erecting the salvaged sign on a new sign support, salvaged sign support, or existing sign support as indicated in the plans. The pay item for **Sign, Erect, Salv** includes all attaching devices, hardware (including the brackets), and labor to fabricate and erect.