HIGH TENSION CABLE BARRIER SYSTEM
(REV 2-5-25)

The following new Section is added:

SECTION 540
HIGH TENSION CABLE BARRIER SYSTEM

540-1 Description.

Furnish and install high tension cable barrier (HTCB) systems in accordance with the requirements of the Contract Documents, the Developmental Standard Plans, Index D540-001, and the manufacturer's recommendations. Use a system listed on the Department's Approved Product List (APL).

No Cost Savings Initiative Proposals for alternative barrier types will be accepted.

Use only one manufacturer's cable barrier system, of the same type end terminal and line post, for the entire Contract.

540-2 Materials.

Meet the following requirements:

Concrete for Foundation	Section 346
Concrete for Mow Strips	Section 347
Reinforcing Steel for Foundation	Section 415
Barrier Delineators	Section 994
HTCB System (cables, fittings, line posts, post sockets, and end terminals)	Section 968

540-2.1 Barrier Delineators:

540-2.1.1 Line Post Delineators: Provide retroreflective sheeting on every post or 50 feet, whichever is less. Use Type IV or XI sheeting meeting the requirements of Section 994 with a minimum surface area of 8 square inches. Place white sheeting on posts installed to the right of approaching traffic and yellow sheeting on posts installed to the left of approaching traffic. Install sheeting only on one side of the posts unless otherwise approved by the Engineer. The retroreflective sheeting may be applied directly to posts with visually unobstructed surfaces facing approaching traffic; otherwise, provide a post cap on which the reflective sheeting is affixed.

540-2.1.2 End Terminal Delineators: Provide a minimum of 120 square inches of Type IV or XI retroreflective sheeting meeting the requirements of Section 994, affixed to each of the gating end terminal posts. Place white sheeting on posts installed to the right of approaching traffic and yellow sheeting on posts installed to the left of approaching traffic. Install sheeting only on one side of the posts unless otherwise approved by the Engineer.

540-2.2 Concrete Reinforced Foundations: Use a Class IV (Drilled Shaft) concrete for line post foundations installed in wet conditions and all end terminal foundations. When authorized by the Engineer, other concrete mix designs may be considered for line post foundations constructed in a dry condition provided that the required design concrete strength is

met and the selected mix is adequately workable to allow for self-consolidation of the concrete inside the drilled holes.

540-3 Shop Drawings and Design Calculations.

540-3.1 Shop Drawings: Submit shop drawings in accordance with Section 5. As a minimum, include the following in the shop drawings covering each run of cable barrier:

1. General notes and construction specifications
2. Height of each cable in the system
3. Post length and height of each post with respect to the ground level
4. Post Spacing along entire length of system
5. Detailed drawings of all posts and hardware
6. Approximate turnbuckle and splice locations (station)
7. Overall length of the cable barrier segment, including end terminals
8. Cable barrier length, excluding end terminals
9. End terminal design, including length and location (station/offset)
10. Foundation dimensions and detailed steel reinforcement layout for all concrete foundations, including end terminal anchors, end terminal transition line posts, and standard line posts
11. Orientation and design of Barrier Delineators, including line post and end terminal

540-3.2 Design Calculations: Include design calculations signed and sealed by a Professional Engineer licensed in the State of Florida.

Provide two copies of the following design information:

1. The manufacturer's product brochure, construction specifications, installation manual, and maintenance manual
2. Contact information and qualifications/resume for manufacturer's technical representative
3. Design table including cable tension as a function of cable temperature
4. The NCHRP-350 or MASH FHWA eligibility letter for the proposed cable barrier system and end terminals
5. Blank sample of the proposed Cable Tension Log
6. The end terminal foundation design(s) prepared by the Contractor's Specialty Engineer
7. The line post foundation design(s) prepared by the Contractor's Specialty Engineer (required when geotechnical soil conditions do not meet standard criteria provided in 540-3.2).

540-4 Design Criteria.

540-4.1 End Terminal Foundations: Use only drilled shaft concrete foundations for all end terminal foundations. In addition to the following criteria, use the geotechnical information provided in the Plans and satisfy the requirements in the current edition of the FDOT Structures Design Guidelines (SDG) for end terminal foundation design:

Base the minimum design load for the end terminal to cable connections on the theoretical cumulative cable tension expected at zero degrees Fahrenheit.

Analyze the lateral deflection of the end terminal foundations using the P-Y Method.

Limit end terminal foundation lateral deflection to 1 inch at the proposed ground surface using a minimum factor of safety of 2.0.

Analyze the uplift resistance of the end terminal foundation using the Alpha or Beta Methods (see FHWA-NHI-10-016) and a minimum factor of safety of 2.0.

Design end terminal foundations using the geotechnical design information provided in the Plans, and/or the appropriate geotechnical information furnished by the Contractor, as required by the manufacturer.

Determine the steel reinforcement requirements for the end terminal foundations using AASHTO LRFD Bridge Design Specifications.

540-4.2 Line Post Foundations: Standard line post foundations provided by the manufacturer, for both saturated and non-saturated soil conditions, must be based on the following soil criteria which covers the majority of soil types in Florida:

Soil Classification	Cohesionless (Fine Sand)
Friction Angle	30 degrees
Unit Weight	112 pounds per cubic foot (unsaturated condition)
Effective Unit Weight	50 pounds per cubic foot (saturated condition)

Assume an extremely aggressive environmental classification for foundations.

When geotechnical information provided in the Plans does not meet the above soil conditions, submit a line post foundation design for approval by the Engineer. Design line post foundations so that the posts reach their plastic strength limit or fracture before the line post foundations deflect 1 inch. Reinforce all line post foundations to either resist external loads or temperature/shrinkage strains, whichever leads to the most reinforcement in accordance with AASHTO LRFD Bridge Design Specifications. Design the line post foundations using a minimum factor of safety of 1.5 against overturning using the Broms' method.

Line post foundations installed in conjunction with a concrete mow strip may rely on the increased lateral stiffness provided by the mow strip to reduce the foundation size requirements. Do not account for additional stiffness when miscellaneous asphalt mow strips are used.

The maximum allowable dynamic deflection of any system is 8 feet, and the maximum post spacing permitted is 16 feet (center of post to center of post). When specific deflection limits are included in the Plans, install line posts on a spacing that will provide the required deflection distance. Only use post spacing and dynamic deflections which have been included in the FHWA eligibility letter.

540-5 Manufacturer's Installation Representative.

Provide for a manufacturer's installation representative, under the direct employ of the manufacturer, to be on the jobsite prior to and during the initial work associated with the following milestones:

1. Cable barrier and foundation layout;
2. Installation of end terminal cable anchorage;
3. Installation of post sleeves;
4. Setting of initial line posts;
5. Installation of post hardware; and

6. Cable attachment and tensioning.

The manufacturer's representative must have a thorough knowledge of the cable barrier system being installed, and must have prior experience installing the cable barrier system selected for this project. The Engineer has the right to reject a manufacturer's representative if the representative fails to demonstrate thorough knowledge of the cable barrier system being installed, fails to submit proof of prior experience installing the cable barrier system, or fails to comply with the requirements of this specification. Provide a written letter from the manufacturer to the Engineer stating that the Contractor's installation process follows the requirements outlined in the manufacturer's installation manual and that the construction personnel has received adequate training for the installation and tensioning of the cable barrier system.

540-6 Construction Requirements.

540-6.1 General: Install the cable barrier system at the locations shown in the Plans or as directed by the Engineer. Notify the Engineer of any conflicts with existing utilities or other existing facilities at least two working days prior to any excavations.

Construct the end terminal anchor foundations in accordance with Section 455, as a Miscellaneous Structure Drilled Shaft. Place all reinforcement and line post sockets in accordance with the Shop Drawings.

Pour foundations in wet excavations using a tremie pipe or pump line following the requirements of Sections 400 and 455. Permanent casings/forms are not permitted. Allow the concrete to cure a minimum of seven days, or until 70% of the 28 day concrete compressive strength is attained, prior to setting the line posts and applying tension loads to the installed cable.

540-6.2 Layout and Preparation: Mark the location of the cable barrier system between beginning and ending points for each run. Complete all final grading in preparation for a concrete or asphalt mow strip. Install the mow strip flush with the adjacent grade.

540-6.3 Constructing Foundations, Setting Posts and End Terminals: Cast-in-place all foundations. Install end terminal foundations within one foot of their longitudinal plan locations. Install line post foundations within 2 feet of their longitudinal plan locations or as approved by the Engineer. However, do not exceed the maximum post spacing included in Standard Plans, Index D540-001 or as shown in the Plans. Ensure that the line post sockets and end terminal anchorage hardware do not deviate more than 6 inches in the transverse direction along the plan centerline of the cable barrier run, unless otherwise approved by the Engineer.

Construct concrete foundations to meet the dimensions specified in the Shop Drawings. If fill soils are required, compact in accordance with Section 120. Excavate line post and end terminal foundations with vertical sides in undisturbed or compacted soil. Dispose of any unsuitable or excess excavated material and install reinforcing steel in accordance with the design requirements. Place the concrete and install the line post sockets and end terminal hardware, ensuring the top of foundation is no more than 1 inch above or 1/2 inch below the line post foundations on the side adjacent to traffic. Place the line post sockets so that the top of the socket is no higher than 1 inch above its foundation on the nearest traffic side and such that the posts will be plumb and in line to provide an aesthetically pleasing line of sight of the cables. Furnish and install end terminals and associated hardware per manufacturer's specifications.

540-6.4 Mow Strip Installation: Install asphalt mow strips in accordance with Section 339. For concrete mow strips, prepare the foundation and treat the soil in accordance with Section 339 and install the mow strip concrete in accordance with 520-2 through 520-5.

540-6.5 Cable Installation: Install the cables in accordance with the manufacturer's specifications. Ensure the cables do not deviate more than 1 inch from the height shown in the Shop Drawings. Unless otherwise crash tested and recognized in a FHWA eligibility letter, position all turnbuckles so that there is no interference with posts or with one another. Stagger turnbuckles so that no more than two turnbuckles are located within a specific line post spacing.

540-6.6 Initial Cable Tensioning: Use certified, calibrated testing equipment specified by the manufacturer at the beginning of installation and throughout the project duration. Results from only one model of tension testing device will be accepted. Provide calibration certificates to the Engineer at least 7 days prior to cable installation indicating calibration of the instrument(s).

Upon completion of the cable barrier installation, provide two tension meter devices and any additional system-specific tools needed for the repair or resetting of the barrier, as required, to the Department. Provide new device(s) that are calibrated and in good working condition.

Systematically tension the cables in accordance with the manufacturer's specifications. Measure the temperature of each cable prior to tensioning and use this temperature to determine required tension values in the manufacturer's specifications.

After all cables in each run are tensioned, check that cable heights at each post are within the tolerances specified in the manufacturer's instructions.. If cables are not within the specified tolerances, check to see that the posts are seated in the sockets. When approved by the Engineer, secure posts which do not remain properly seated in the socket in accordance with the manufacturer's recommended positive means.

540-6.7 Final Testing and Re-tensioning: Test and re-tension, as necessary, each cable of each cable run to the manufacturer's specifications, between 14 and 21 days after initial tensioning. Re-tensioning will be required when the test reading is less than 90% of the manufacturer's recommended tension for the given material temperature. If readings are less than 90%, repeat the testing and re-tensioning procedure within one week prior to final acceptance of the project.

Prepare a tension log in a format acceptable to the Engineer to record, at a minimum, the following:

1. The ambient air temperature at the time of tensioning
2. The date tensioning is performed
3. The temperature of the bottom wire cable at the time of tensioning
4. The model and serial number of the tension testing device used
5. The location of each end terminal in the run being tensioned
6. The location where tensioning is being performed
7. A diagram showing the number assigned to each of the cables
8. The wire cable number being tensioned
9. The initial tension load in each cable
10. The final tension load applied to each cable
11. Any applicable installation notes
12. The name and signature of person conducting the tension testing

Provide tension logs for the initial, final and any intermediate re-tensioning. Submit two copies of each tension log to the Engineer. Deliver tension meter devices and additional system tools if required, to the Department prior to final acceptance.

No additional compensation will be provided for testing and re-tensioning the cable system.

540-6.8 Maintenance of Cable Barrier System: Maintain the cable barrier system until final acceptance in accordance with 5-11. Such maintenance includes, but not be limited to, repair of any portion of the cable barrier system including cables, intermediate line posts, end terminals, retro-reflective sheeting and other system hardware that is damaged during the life of the contract. Repair damage within 3 days of written notification by the Engineer.

540-7 Method of Measurement.

540-7.1 HTCB Length of Need Segment: The quantity of HTCB to be paid for will be the length, in feet, constructed, tested and accepted. Measurement will be made along the General HTCB Segment, as defined in Standard Plans, Index D540-001. The length of the End Terminal assemblies is not included in the payment length for the HTCB Length of Need Segment. This includes all pre-stretched wire cables, line posts, line post foundations, sockets and hardware required per the manufacture to install a functioning system. This also includes two calibrated tension meters and additional system tool(s) if required.

540-7.2 End Terminals: The quantity to be paid for will be the number of End Terminal assemblies constructed in place and accepted. This includes end terminal posts, post foundations, terminal distribution slab, and hardware required per the manufacturer for a complete and functioning end terminal system with the exception of the end terminal anchor foundations.

540-7.3 End Terminal Foundations: Price and payment will be full compensation for all miscellaneous structure drilled shafts, including the cost of concrete, reinforcing steel, labor, materials, equipment and all incidentals necessary to complete the drilled shafts included in the end terminal. Quantity shown in the Plans are for bid purposes only. The quantity to be paid will be based on the concrete end terminal anchor foundation dimensions approved on the Shop Drawings.

540-7.4 Mow Strip: Asphalt mow strips will be paid for under Miscellaneous Asphalt, Section 339. For concrete mow strips, price and payment will be full compensation, including the cost of concrete, labor, materials, equipment and all incidentals necessary to complete the mow strip.

540-8 Basis of Payment.

Price and payment will be full compensation for all materials and work specified in this Section, including all costs for tensioning, maintenance, and assistance from the manufacturer's representative.

Payment will be made under:

Item No. 904-540-	HTCB Length of Need Segment - per foot.
Item No. 904-540-	End Terminal - per each.
Item No. 904-540-	End Terminal Foundation (Misc. Drilled Shaft) - per cubic yard.
Item No. 904-540-	Concrete Mow Strip - per foot.

HIGH TENSION CABLE BARRIER- MATERIALS
(REV 2-5-25)

The following new Section is added:

SECTION 968

CABLE BARRIER SYSTEMS

968-1 High Tension Cable Barrier (HTCB) Systems.

968-1.1 General: A HTCB system will include the cables, fittings, line posts, post sockets, and end terminals.

The system must meet the test requirements of the National Cooperative Highway Research Program (NCHRP) Report 350 or the AASHTO Manual for Assessing Safety Hardware (MASH), 2009 or later, for Test Level 4 (TL-4) roadside barriers. Any system used must have an FHWA eligibility letter showing conformance with these test requirements.

The HTCB system must be of the four-cable type, capable of roadside or median installation. Any system used must have a minimum top cable height of 33 inches and maximum bottom cable height of 21 inches, as measured from the ground at a post.

968-1.2 Approved Product List: Manufacturers seeking evaluation of their product for the Approved Product List (APL) must submit an application in accordance with Section 6 and provide documentation showing the product is in conformance with this section.

968-2 Cable.

All cables are to be 3/4-inch (minimum) diameter, 3 x 7, pre-stretched steel wire rope galvanized in accordance with AASHTO M30/ASTM A741, Type 1, Class A coating. Provide cable with a minimum breaking strength of 39,000 pounds. Unless otherwise approved by the FHWA eligibility letter, the maximum cable length is 1,000 feet.

Furnish wire cable that has been factory pre-stretched with a minimum load equal to 0.5 times the tensile strength of the cable to minimize future strain relaxation of the cable. Provide a Certificate of Quality from the wire cable manufacturer with each cable spool specifying the breaking strength, modulus of elasticity after pre-stretching, force used to stretch the wire cable, and the date(s) of the stretching and testing.

968-3 Fittings.

Provide fittings, including cable end terminals and turnbuckles, with a minimum diameter of 3/4-inch and a minimum tensile yield strength of 36,800 pounds. Furnish fittings that are either galvanized in accordance with ASTM A153 after threading, or made of stainless steel. Use fittings of the same size and thread within a run (all cables between end anchor foundations) of cable barrier. Provide documentation from the manufacturer certifying that all fitting types have been tested and meet the minimum tensile yield strength. Include in the documentation the tensile yield strength and test date(s) of each fitting type.

968-3.1 Threaded Cable Studs: Cable studs may be a swaged or closed-type wedge lock. Swaged fittings may be shop or field swaged. Provide an engagement depth of the cable into the terminal equivalent to or greater than the depth of the yield strength test. A threaded-end socket is required for all closed-type wedge lock terminals to secure the wedge by compression.

968-3.2 Turnbuckles: One end each of the turnbuckle must be threaded righthand and the other left-hand. Turnbuckles must be of the solid or closed body type with two holes to determine cable stud thread penetration. Provide an equivalent, or greater, thread penetration depth to that of the yield strength tested turnbuckle.

968-3.3 End Terminal Cable Anchor Fittings: Furnish anchor fittings for the termination end of each cable run. Use only fittings of the same size and type installed as part of the NCHRP 350 or MASH crash tested system. Provide anchor connections for each of the four cables of the system at the end terminal. Do not terminate any combination of the cables to the end terminal with a common cable. Provide end terminal cable anchor fittings capable of release and reuse.

968-4 Line Posts and Sockets.

Furnish steel posts that meet the manufacturer's specifications and which are consistent with the post sizes and shapes specified in the FHWA eligibility letter. Furnish steel posts and sleeves meeting the requirements of ASTM A36 or A499, galvanized after fabrication to ASTM A123. In addition, provide for the following requirements:

1. 16 feet maximum post spacing;
2. Posts with a means of holding the cables at the design height;
3. Posts that are socketed in a steel sleeve encased in a reinforced concrete foundation;
4. Set post sockets in the plan center (plus or minus 1 inch) of the concrete foundations; and,
5. Provide an excluder cap profiled to fit tightly around the post to prevent debris from entering the post socket.

968-5 End Terminals.

Furnish end terminals of the size and shape determined by the manufacturer or Specialty Engineer, whichever is more stringent. Use only end terminals with a FHWA eligibility letter meeting the requirements of NCHRP 350 or MASH TL-4 criteria.

968-5.1 Gating End Terminals: Provide end terminal anchor foundations of the dimensions recommended by the manufacturer or Specialty Engineer, whichever is more stringent and sufficient to prevent movement in the soil after tensioning the cables. Follow the Design Criteria in Section 540-3 for end terminal foundations.