



INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Design Memorandum No. 11-07 Technical Advisory

March 28, 2011

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

FROM: /s/ Richard L. VanCleave
Richard L. VanCleave
Manager, Office of Roadway Engineering Standards
Highway Design and Technical Support Division

SUBJECT: High-Tension Cable-Barrier System (CBS)

REVISES: *Indiana Design Manual Section 49-5.01(04)*

EFFECTIVE: May 11, 2011, Letting

The revised portions of *Manual* Section 49-5.01(04) are shown below. Revised Recurring Special Provision 627-R-546 is also attached herewith. An editable version appears on the Department website, at <http://www.in.gov/dot/div/contracts/standards/rsp/sep09/sec600.htm>.

Transverse Location in Median. The post offset from the edge of a median flat-ditch bottom should desirably be at least 8 ft or minimally within 1 ft of the ditch line as shown on revised Recurring Plan Detail 627-R-546d, attached herewith.

CBS Run Length. The recommended minimum run length is 1000 ft. For the desirable longest-run length, see Opening in CBS Run for Law-Enforcement or Emergency-Response Vehicle, below.

Clearance to Rigid Obstacle. The minimum lateral clearance to a rigid obstacle such as a bridge pier, sign support, utility pole, tree, etc., should be 10 ft.

Placing CBS Run in Vicinity of Another Barrier. If the side slopes are not steeper than 6:1 and another barrier is parallel to the roadway, the CBS run can be horizontally tapered at a 50:1 or flatter rate.

Placing CBS Run in Vicinity of Inlet or Dike. The horizontal transition should be at a taper rate of 50:1 or flatter.

CBS at Official Median Crossover. For a CBS run's termination at such a crossover, the CBS end terminal (end anchor) should be located preferably 3 to 5 ft beyond the points where the crossover radii are tangent with the edges of the adjacent travel lanes.

Changing Offset of CBS Run in a Median from Being Closer to One Roadway to Being Closer to the Opposing-Traffic Roadway. If a CBS run requires a change of lateral offset, the end anchors of the run should be overlapped for the minimum distance between the anchors in each direction as described below. The minimum overlap distance for the anchor located at the incoming end should be at least the runout length, L_R , used for calculating the guardrail length of need.

Opening in CBS Run for Law-Enforcement or Emergency-Response Vehicle. The desirable longest run should be 6,000 ft to allow for a vehicle crossover, although an ultimate maximum of 10,000 ft is allowed under certain site conditions.

The locations of such openings should be shown on the plans. The soil-stabilization method, if required, should be specified. Delineator posts with reflectors should be placed in a row to indicate that a crossover is available at the opening. See Recurring Plan Detail 627-R-546d for details.

RVC:ys:alu
Attachments

627-R-546 CABLE BARRIER SYSTEM

(Revised 03-21-11)

The Standard Specifications are revised as follows:

SECTION 627, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 627 – ~~BLANK~~CABLE BARRIER SYSTEM

627.01 Description

This work shall consist of furnishing and installing a high-tension cable barrier system in accordance with 105.03.

627.02 General Requirements

10 *The cable barrier system shall consist of 4 pre-stretched, individual wire ropes in tension between safety terminals and held in position by intermediate line posts. The system may incorporate single or multiple anchor foundations for the safety terminals to terminate the 4 wire ropes. The system shall be selected from the Department's list of approved Cable Barrier Systems. The Contractor shall use the selected system for the entire contract. The selected system shall be installed in accordance with the manufacturer's recommendations except as modified by these specifications.*

20 *The Department will make geotechnical information available for the approximate locations of the safety terminals and representative locations of the intermediate line posts. The Contractor shall be responsible for obtaining any additional geotechnical information required by the cable barrier system manufacturer to complete design of line post and safety terminal foundations or other components of the system.*

The Contractor shall provide the following to the Engineer a minimum of 14 days prior to installation of the system:

- (a) *A copy of the FHWA acceptance letter for the cable barrier system.*
- (b) *Two copies of the manufacturer's product brochure, specifications and installation and maintenance manuals.*
- 30 (c) *Four copies of erection drawings clearly depicting installation details, including safety terminals, terminal transitions, intermediate line posts and cables.*
- (d) *A copy of the design drawings and calculations for safety terminal and intermediate line post foundations for the soil conditions on the project. Design drawings and calculations shall be stamped by a professional engineer.*
- 40 (e) *Documentation that the Contractor's work force on the project has received training by the manufacturer in the proper installation of the system, including safety terminals, intermediate line posts, cables and tensioning of cables.*

Safety terminal foundations shall at a minimum be designed to resist movement in the soil due to system tensioning and impacts to the system at the NCHRP 350 test level specified. Design of the safety terminal foundations shall include a factor of safety of 1.5 for overturning and pullout.

50 *If all cables are to be anchored to a single foundation, the design of safety terminal foundations and cable connections shall be based on a minimum total equivalent horizontal static load of 50,000 lbf (222.4 kN) and the commensurate vertical component associated with the net cable angle from horizontal.*

If cables are to be anchored in multiple foundations, the design of safety terminal foundations and cable connections shall be based on a minimum equivalent horizontal static load of 15,000 lbf (66.7 kN) per cable and the commensurate vertical component associated with this force and each cable's angle from horizontal.

60 *All wire rope terminations shall be made with swaged type threaded terminals. Only 1 field-installed swaged terminal will be allowed per cable per run. All other swaged terminals shall be factory installed.*

Intermediate line post spacing shall be such that the maximum reported NCHRP crash test dynamic deflection is no greater than 10 ft (3 m), but in no case shall the post spacing be greater than 16 ft (4.9 m). Post spacing may be adjusted, as allowed by the manufacturer, to avoid conflicts with utilities, drainage structures, underdrain outlets and other permanent obstructions.

70 *Intermediate line posts shall be of a socket tube and post design where the socket is part of the line post foundation and line posts are inserted into the socket. Posts shall have a means of holding the wire ropes at the design height. The post and socket design shall include a means of excluding debris from entering the socket.*

Foundations for intermediate line post sockets shall be cast-in-place concrete a minimum of 3 ft 6 in. (1,070 mm) deep and a minimum of 14 in. (350 mm) in diameter centered about the socket. Concrete foundations shall be reinforced as recommended by the manufacturer, but in no case shall the reinforcement be less than shown in the plans.

80 *A minimum of 8 sq in. (5,000 mm²) of retroreflective sheeting shall be applied on the side facing approaching traffic of each line post in cable height transition sections and to every 4th intermediate line post in full height cable sections. The color of the sheeting shall match the color of the nearest adjacent traffic pavement marking.*

MATERIALS

627.03 Materials

Materials shall be in accordance with the following:

90 *Concrete, Class A.....702*
Reinforcing Bars910.01

Cables shall meet the manufacturer's specifications. In addition, cables shall be 3/4 in. (19 mm) 3 x 7 zinc-coated wire rope in accordance with AASHTO M 30-02 (2006) Type 1, Class A and shall have a minimum breaking strength of 39,000 lbf (173.5 kN). Wire rope shall be pre-stretched to exhibit a minimum modulus of elasticity of 11,805,000 psi (8,1393 Mpa).

100 *Intermediate line posts shall meet the manufacturer's specifications. In addition, posts shall be zinc-coated steel meeting the requirements of ASTM A 36 and AASHTO M 111M / M 111-04 after fabrication.*

Swaged type threaded terminals, turnbuckles and anchor fittings shall meet the requirements of ANSI B1.13M and be zinc-coated in accordance with AASHTO M232-06 (M 232M) after fabrication and shall develop a minimum breaking strength of 36,800 lbf (160.1 kN). Turnbuckles may be either the open or closed body type and shall allow for a minimum of 6 in. (150 mm) of penetration from each end. Anchor fittings at the termination of each cable barrier run shall be of the same size and type used in connection to the turnbuckles.

110 *Concrete for safety terminal and intermediate line post foundations shall be Class A.*

Retroreflective sheeting shall be in accordance with AASHTO M 268 Type IV for adhesive sheeting.

A Type A certification in accordance with 916 shall be provided with each spool of wire rope cable prior to installation. The certification shall include the thickness of zinc coating, the minimum breaking strength, the modulus of elasticity and the force applied to pre-stretch the wire rope.

120 *A Type C certification in accordance with 916 shall be provided for intermediate line posts, threaded terminals, turnbuckles, anchor fittings and retroreflective sheeting prior to installation.*

CONSTRUCTION REQUIREMENTS

627.04 Construction

130 *All site work, including grading and placing of fill shall be completed and approved by the Engineer prior to installation of the cable barrier system.*

Installation of the cable barrier system shall be in accordance with the manufacturer's recommendations and these specifications.

The top of cast-in-place concrete safety terminal foundations and intermediate line post foundations shall be finished no lower than flush with final grade and no higher than 1 in. (25 mm) above final grade. Intermediate line post foundations shall be installed such that line posts will be plumb when installed in the socket. Safety terminal foundation concrete shall be cured for a minimum of 168 h in accordance with 702.22 prior to tensioning of wire ropes.

140

A D2 delineator with post shall be placed in accordance with 804 in front of each safety terminal foundation.

Turnbuckles and other fittings shall be placed so as not to interfere with each other or with the intermediate line posts.

150 *A manufacturer's representative shall be present during tensioning of the system. Tensioning shall be done in accordance with the manufacturer's specifications and using a tension chart provided by the manufacturer. The tension testing device shall be calibrated no more than 1 month prior to beginning tensioning and a copy of the calibration shall be provided to the Engineer. The temperature of the bottom wire rope shall be measured and recorded and used to determine the required tension values for the wire ropes from the manufacturer's chart. A copy of the chart shall be provided to the Engineer prior to tensioning.*

The Contractor shall maintain a tensioning log in a format acceptable to the Engineer to record, at a minimum, the following:

- 160
- (a) The date tensioning is performed*
 - (b) The ambient air temperature at the time of tensioning*
 - (c) The temperature of the bottom wire rope at the time of tensioning*
 - (d) The model and serial number of the tension testing device used*
 - (e) The location of each safety terminal in the run being tensioned*
 - (f) The location where tensioning is being performed*
 - (g) A diagram showing the number assigned to each of the 4 wire ropes*
 - (h) The wire rope number being tensioned*
 - (i) The maximum stress applied to each wire rope*
 - (j) The final stress applied to each wire rope*

170 *The tensioning log shall be signed by the person overseeing the tensioning and submitted to the Engineer upon completion of each day's tensioning.*

The tension in the cable barrier system shall be tested and retensioned as necessary no sooner than 15 days after initial tensioning. Retensioning shall be performed when the test indicates that tension is less than 90% of the manufacturer's recommended tension for the given cable temperature.

180 *A tensioning log for all runs retensioned shall be completed and signed by the person overseeing the tensioning and submitted to the Engineer upon completion of each day's retensioning.*

The Contractor shall provide for the manufacturer's representative to be on-site to instruct Department personnel in the proper installation and repair procedures for the system.

The Contractor shall repair any portion of a cable barrier system, including wire ropes, intermediate line posts, safety terminals, retroreflective sheeting and hardware that is damaged as a direct result of traffic during the life of the contract. Damage shall

190 *be repaired within 7 days of notification by the Engineer. Responsibility for repairs will be in accordance with 107.18.*

The Contractor may request final inspection and final acceptance of completed runs of cable barrier in accordance with 105.15(a).

The Contractor shall provide a spare parts package for the selected cable barrier system as defined below:

Qty	Description
200	_____ <i>Intermediate line posts and all associated hardware.</i>
	_____ <i>Intermediate line post sockets and all associated hardware.</i>
	_____ <i>Retroreflective sheeting.</i>
	_____ <i>Manufacturer's tools required to replace intermediate line posts.</i>
	_____ <i>Tension testing device as produced by or recommended by the manufacturer.</i>
210	_____ <i>Tensioning device as produced by or recommended by the manufacturer.</i>
	_____ <i>Complete set of manufacturer's installation and repair manuals.</i>

Prior to final acceptance of the contract, the spare parts package shall be delivered to a location within the District to be determined by the Engineer.

627.05 Method of Measurement

220 *Cable barrier system will be measured by the linear foot (meter) for the type specified, complete in place. Measurement will be made between the centers of the 2 safety terminal foundations at the extreme ends of each run.*

Safety terminals will be measured per each for the type specified, complete in place. One safety terminal will include all foundations and hardware necessary to anchor all 4 wire ropes at 1 end of a cable barrier run.

Safety terminal foundations, intermediate line posts, line post foundations, cable tensioning and retroreflective sheeting will not be measured separately for payment.

230 *D2 delineators will be measured in accordance with 804.06.*

Spare parts package will be measured per lump sum, complete and delivered to the Department.

627.06 Basis of Payment

Cable barrier system will be paid for at the contract unit price per linear foot (meter) for the type specified.

240 *Safety terminals will be paid for at the contract unit price per each for the type specified.*

D2 delineators will be paid in accordance with 804.07.

Spare parts package will be paid for at the contract unit price per lump sum.

Payment will be made under:

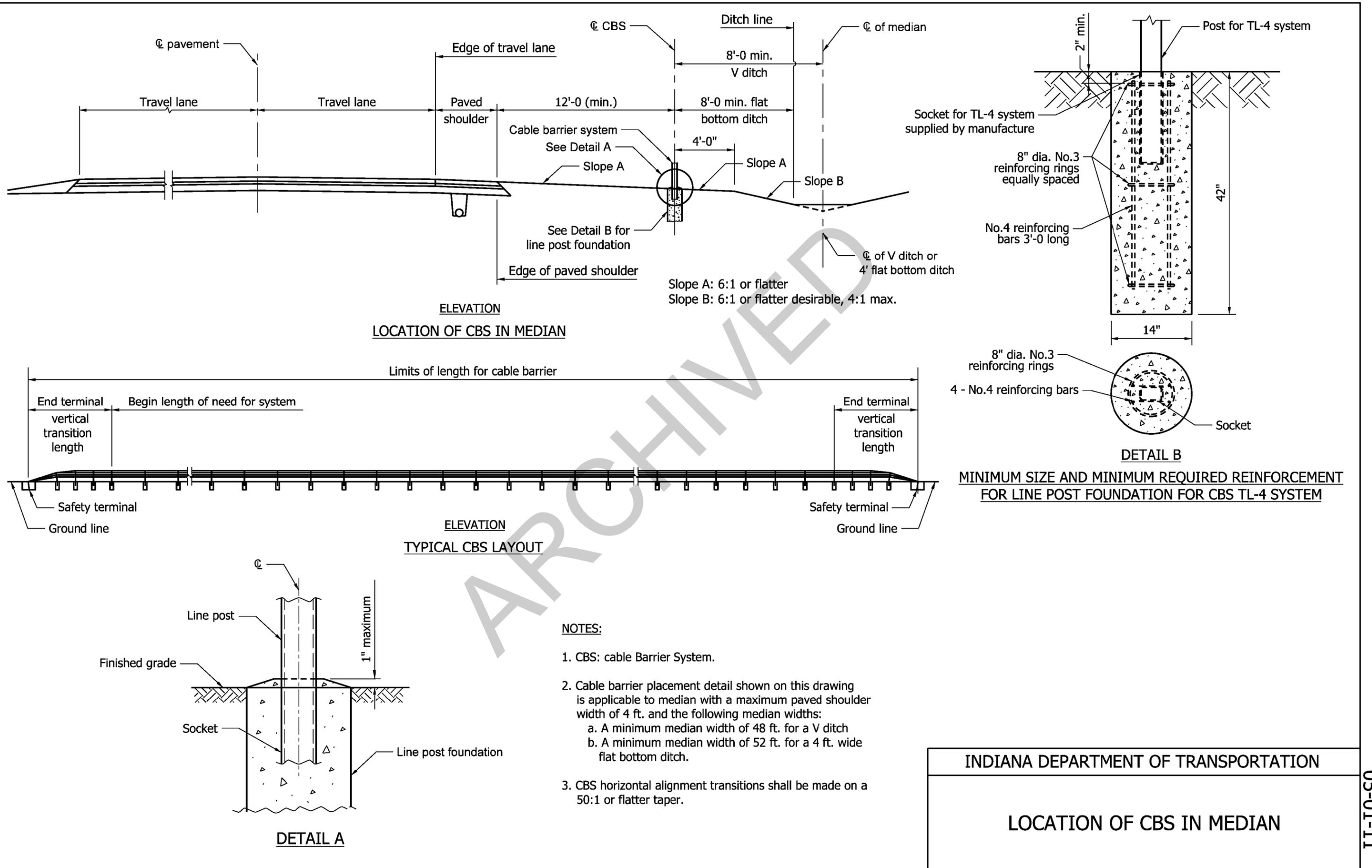
	<i>Pay Item</i>	<i>Pay Unit Symbol</i>
250	<i>Cable Barrier System, Type TL- _____ (test level)</i>	<i>LFT (m)</i>
	<i>Cable Barrier System, Type TL- _____, Spare Parts (test level)</i>	<i>LS</i>
	<i>Safety Terminal, Type TL- _____ (test level)</i>	<i>EACH</i>

260 *The cost of wire rope cables, intermediate line posts, line post foundations, cable tensioning, retroreflective sheeting and all equipment, parts and labor, including the cost of the manufacturer's representative, necessary to furnish and install the cable barrier system shall be included in the cost of the pay item for cable barrier system.*

The cost of safety terminal foundations, including reinforcing steel and all necessary cable anchor hardware, shall be included in the cost of the pay item for safety terminal.

270 *The cost of obtaining any necessary additional geotechnical information and the cost of designing the safety terminal foundations shall be included in the cost of the pay item for safety terminal.*

The cost of spare parts package shall include all costs necessary to deliver the spare parts to the designated location in the District.



NOTES:

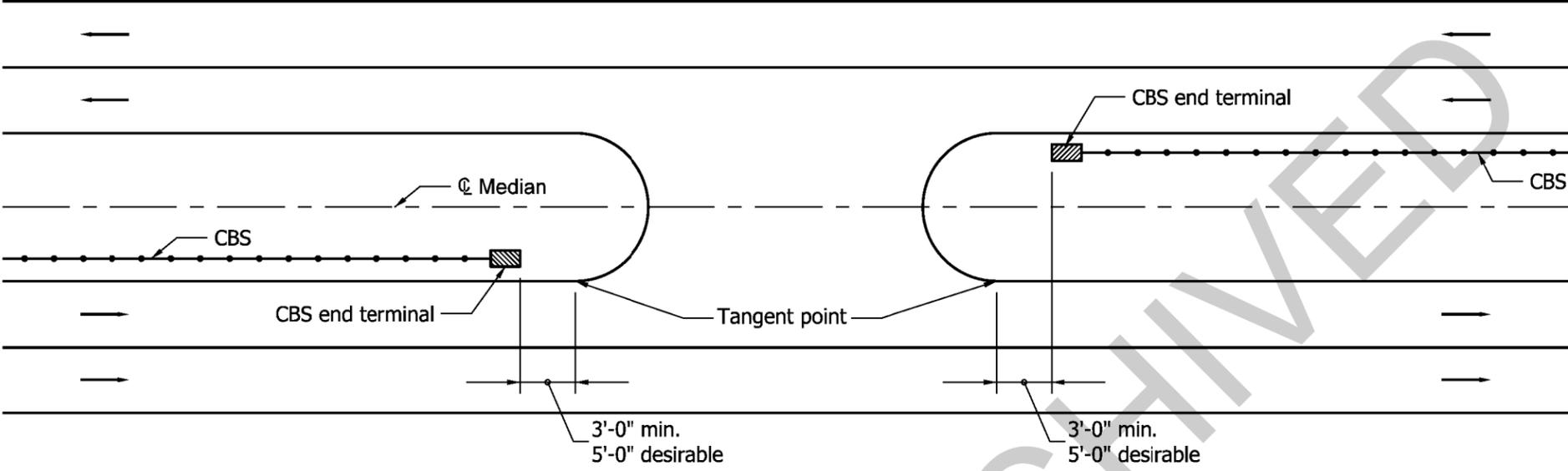
1. CBS: cable Barrier System.
2. Cable barrier placement detail shown on this drawing is applicable to median with a maximum paved shoulder width of 4 ft. and the following median widths:
 - a. A minimum median width of 48 ft. for a V ditch
 - b. A minimum median width of 52 ft. for a 4 ft. wide flat bottom ditch.
3. CBS horizontal alignment transitions shall be made on a 50:1 or flatter taper.

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LOCATION OF CBS IN MEDIAN

NOTES

- 1. CBS: cable Barrier System.
- 2. For location of CBS, see sheet 1 of 9.



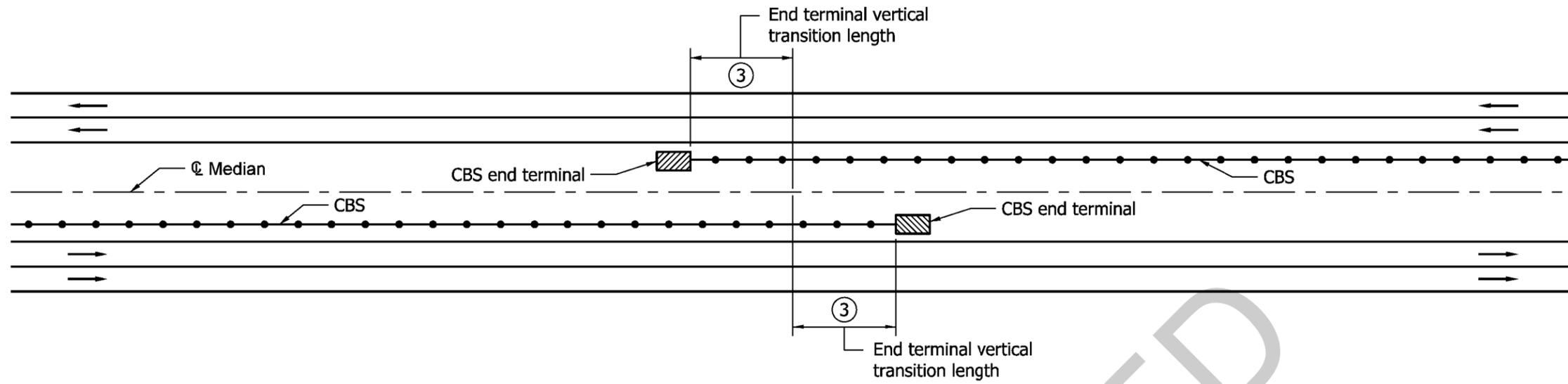
LOCATION OF CBS END TERMINAL AT MEDIAN CROSSOVER

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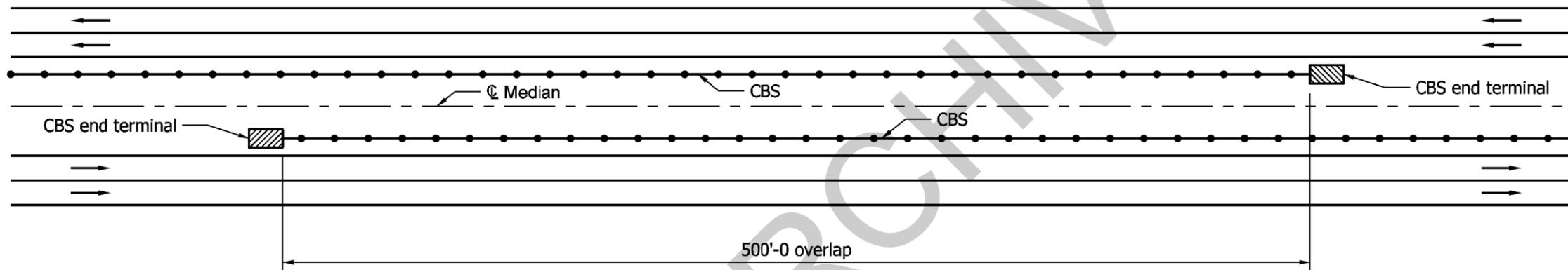
INDIANA DEPARTMENT OF TRANSPORTATION

LOCATION OF CBS END TERMINAL
AT MEDIAN CROSSOVER

05-01-11



CHANGING LOCATION OF CBS TRAFFIC SIDE TO OPPOSITE SIDE OF MEDIAN (DESIRABLE)



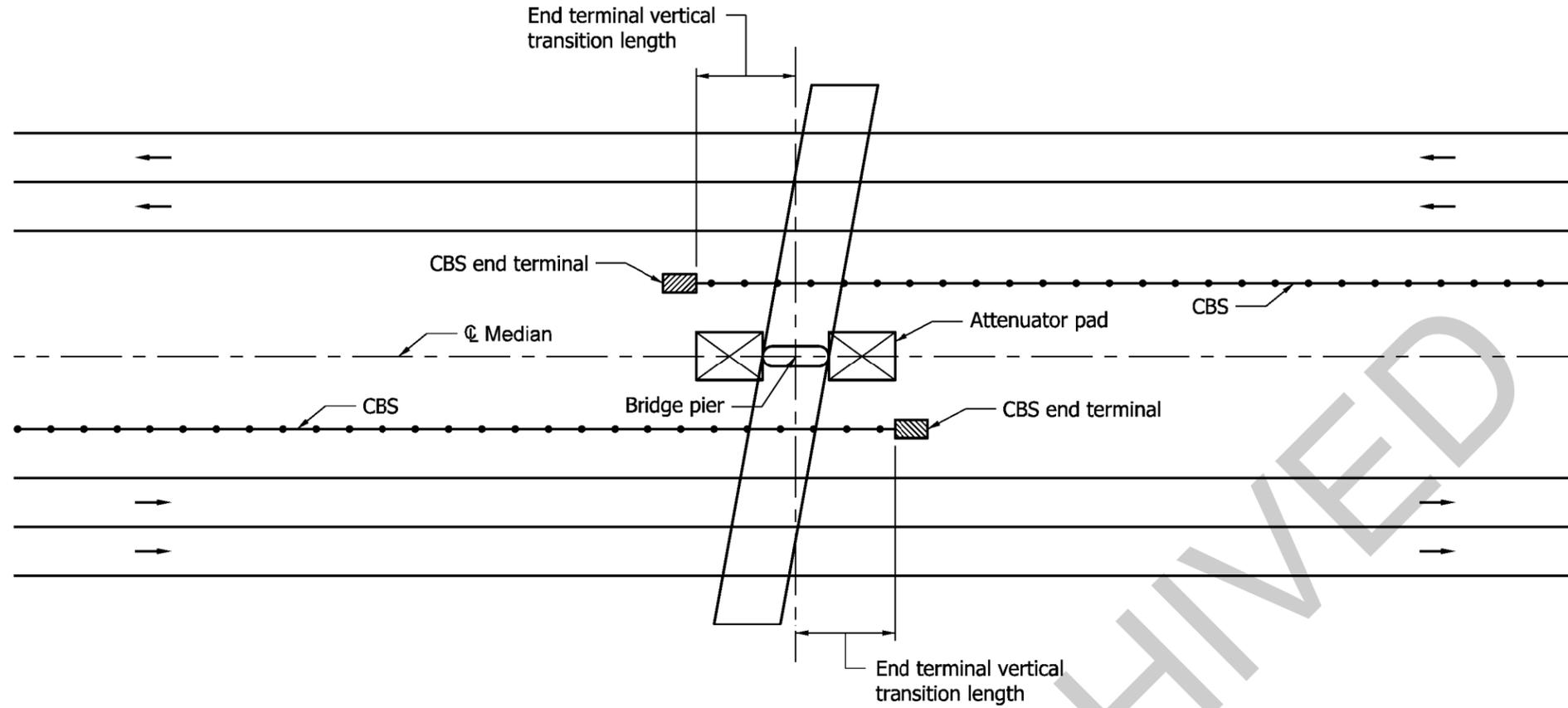
CHANGING LOCATION OF CBS TRAFFIC SIDE TO OPPOSITE SIDE OF MEDIAN TO NEAR TRAFFIC SIDE

NOTES

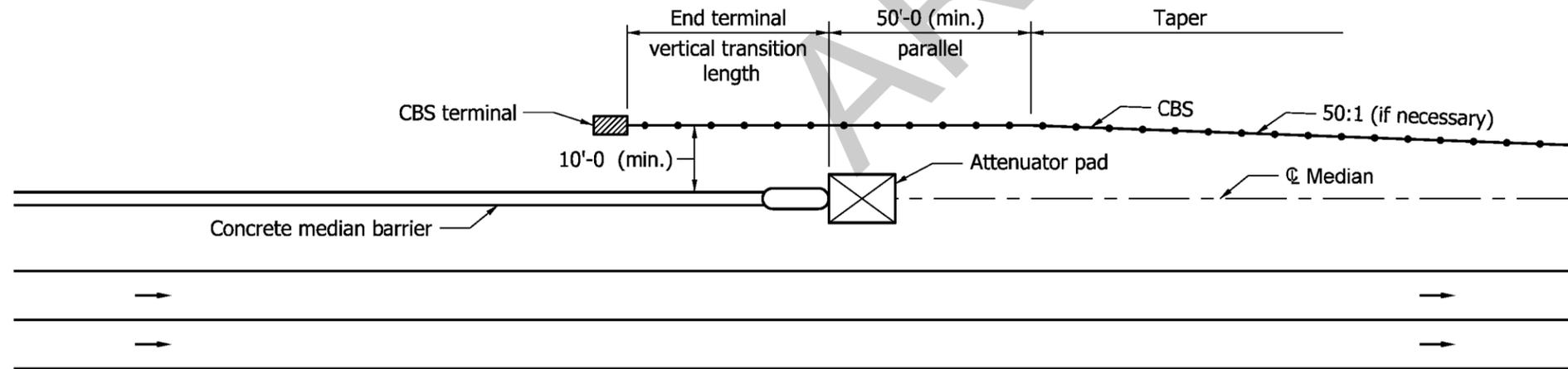
1. CBS: cable Barrier System.
2. For location of CBS, see sheet 1 of 9.
- ③ This distance shall be 0 ft when specified on plan where there is no access point within 10,000 ft for emergency crossover.

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CHANGING LOCATION OF CBS TRAFFIC SIDE TO OPPOSITE SIDE OF MEDIAN



CBS AT MEDIAN BRIDGE PIER WITH ATTENUATOR



CBS AT CONCRETE MEDIAN BARRIER WITH ATTENUATOR

NOTES

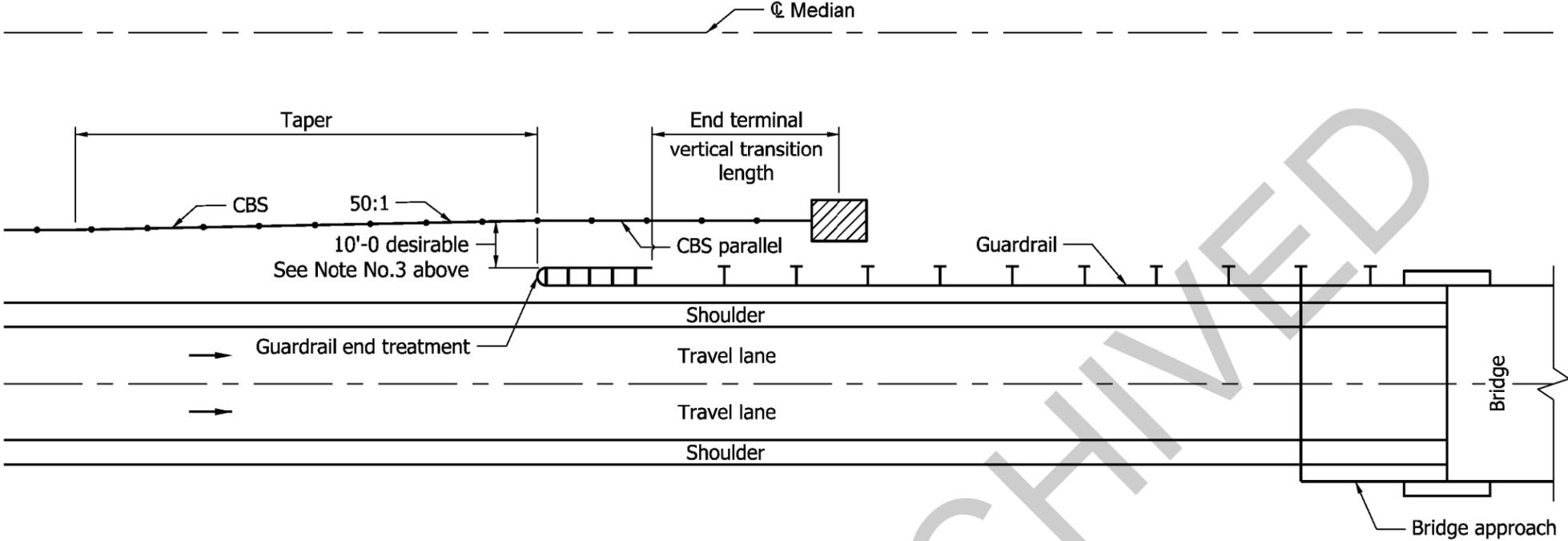
1. CBS: cable Barrier System.
2. For location of CBS, see sheet 1 of 9.

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CBS AT MEDIAN BRIDGE PIER

Notes:

- 1. CBS: Cable Barrier System.
- 2. For location of CBS, see sheet 1 of 9.
- 3. Adjust as necessary to maintain 8'-0" minimum from ditch as shown on sheet 1 of 9.



CBS INCOMING END OF BRIDGE IN MEDIAN

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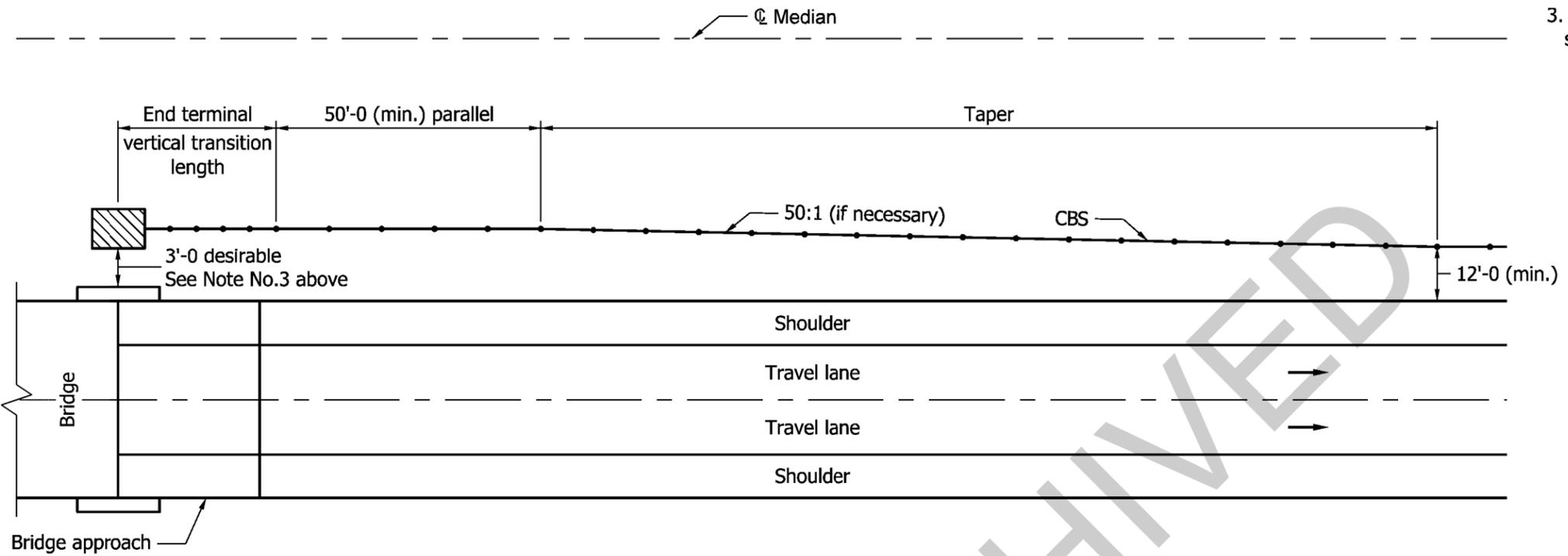
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INDIANA DEPARTMENT OF TRANSPORTATION
CBS INCOMING END OF BRIDGE IN MEDIAN

05-01-11

Notes:

- 1. CBS: Cable Barrier System.
- 2. For location of CBS, see sheet 1 of 9.
- 3. Adjust as necessary to maintain 8'-0" minimum from ditch as shown on sheet 1 of 9.

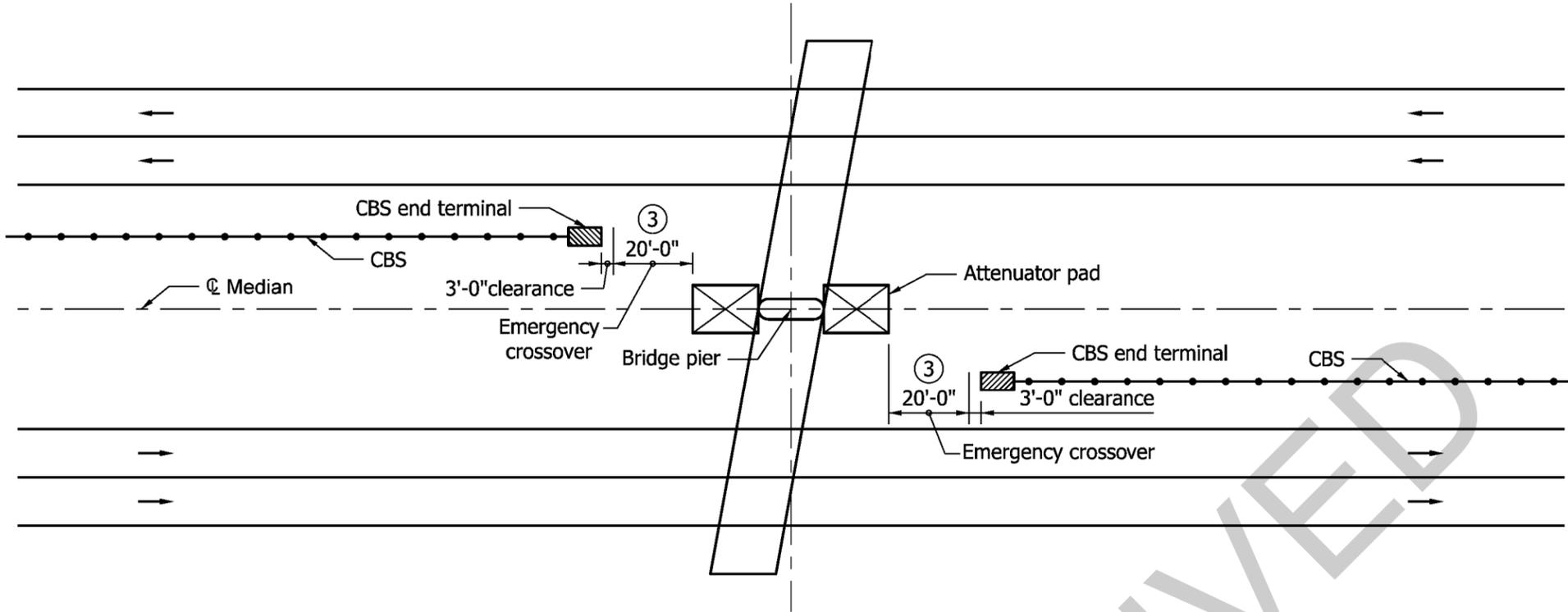


CBS OUTGOING END OF BRIDGE IN MEDIAN

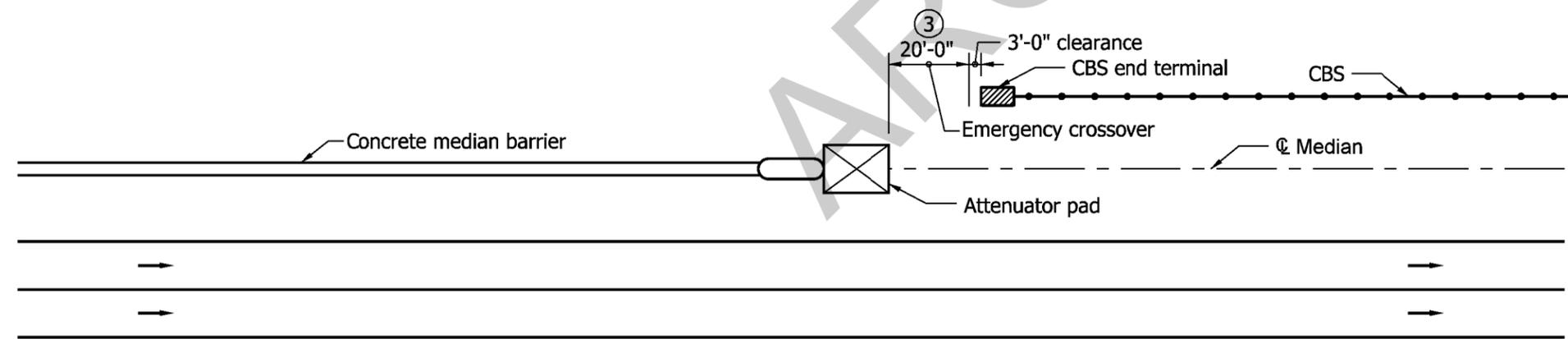
E 627-R-546d 6 of 9

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CBS OUTGOING END OF BRIDGE IN MEDIAN

05-01-11



CBS AT MEDIAN BRIDGE PIER WITH ATTENUATOR



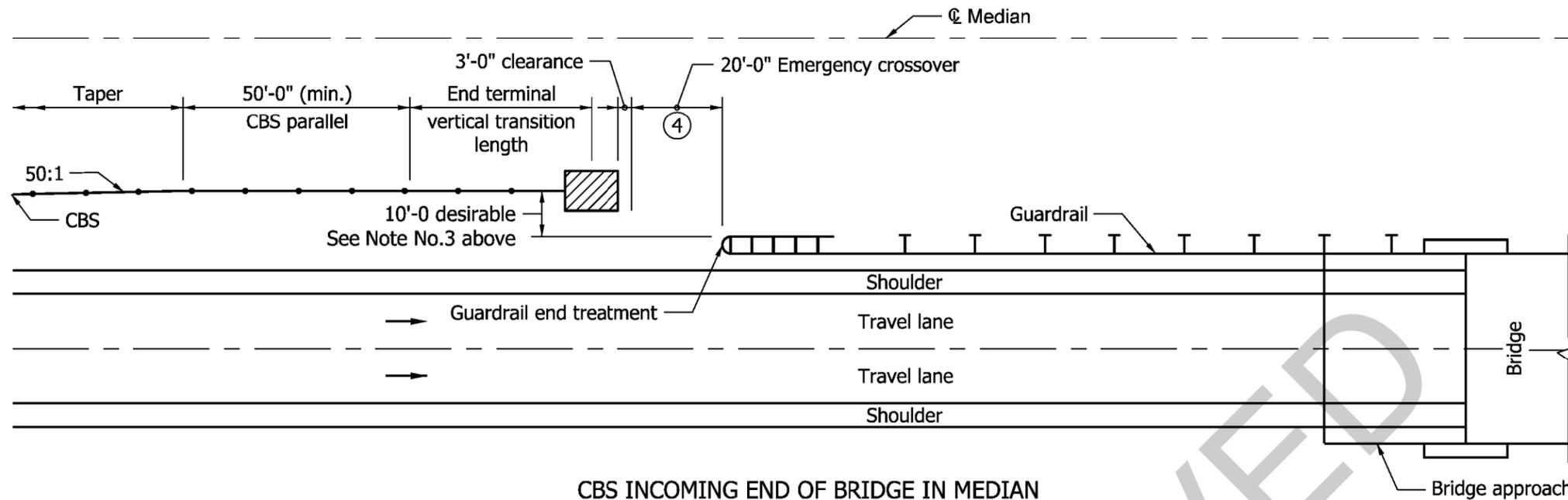
CBS AT CONCRETE MEDIAN BARRIER WITH ATTENUATOR

Notes:

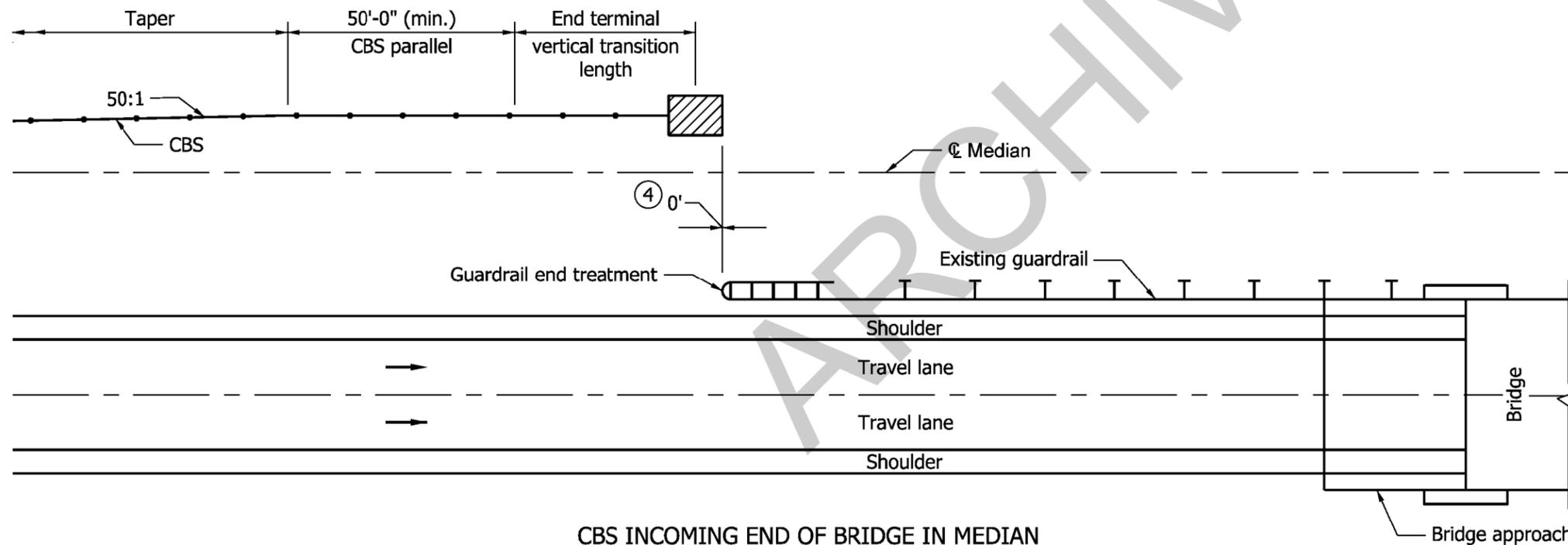
- 1. CBS: Cable Barrier System.
- 2. For location of CBS, See sheet 1 of 9.
- ③ See plans for location of emergency crossover and soil stabilization requirement.

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CBS AT MEDIAN BRIDGE PIER
EMERGENCY CROSSOVER



**CBS INCOMING END OF BRIDGE IN MEDIAN
CBS AND GUARDRAIL ON SAME SIDE OF MEDIAN**



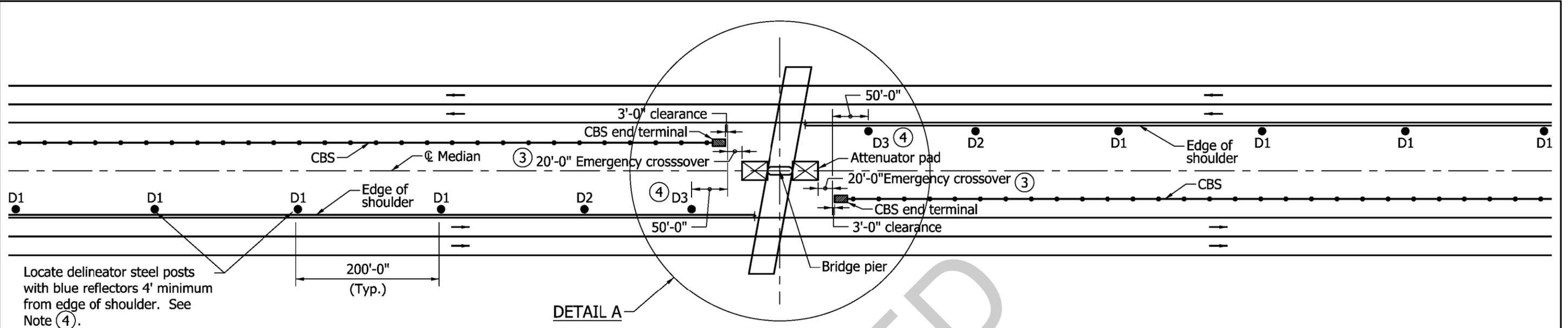
**CBS INCOMING END OF BRIDGE IN MEDIAN
CBS AND GUARDRAIL ON OPPOSITE SIDES OF MEDIAN**

Notes:

1. CBS: Cable Barrier System.
2. For location of CBS, see sheet 1 of 9.
3. Adjust as necessary to maintain 8'-0" minimum from ditch as shown on sheet 1 of 9.
- ④ See plans for location of emergency crossover and soil stabilization requirement.

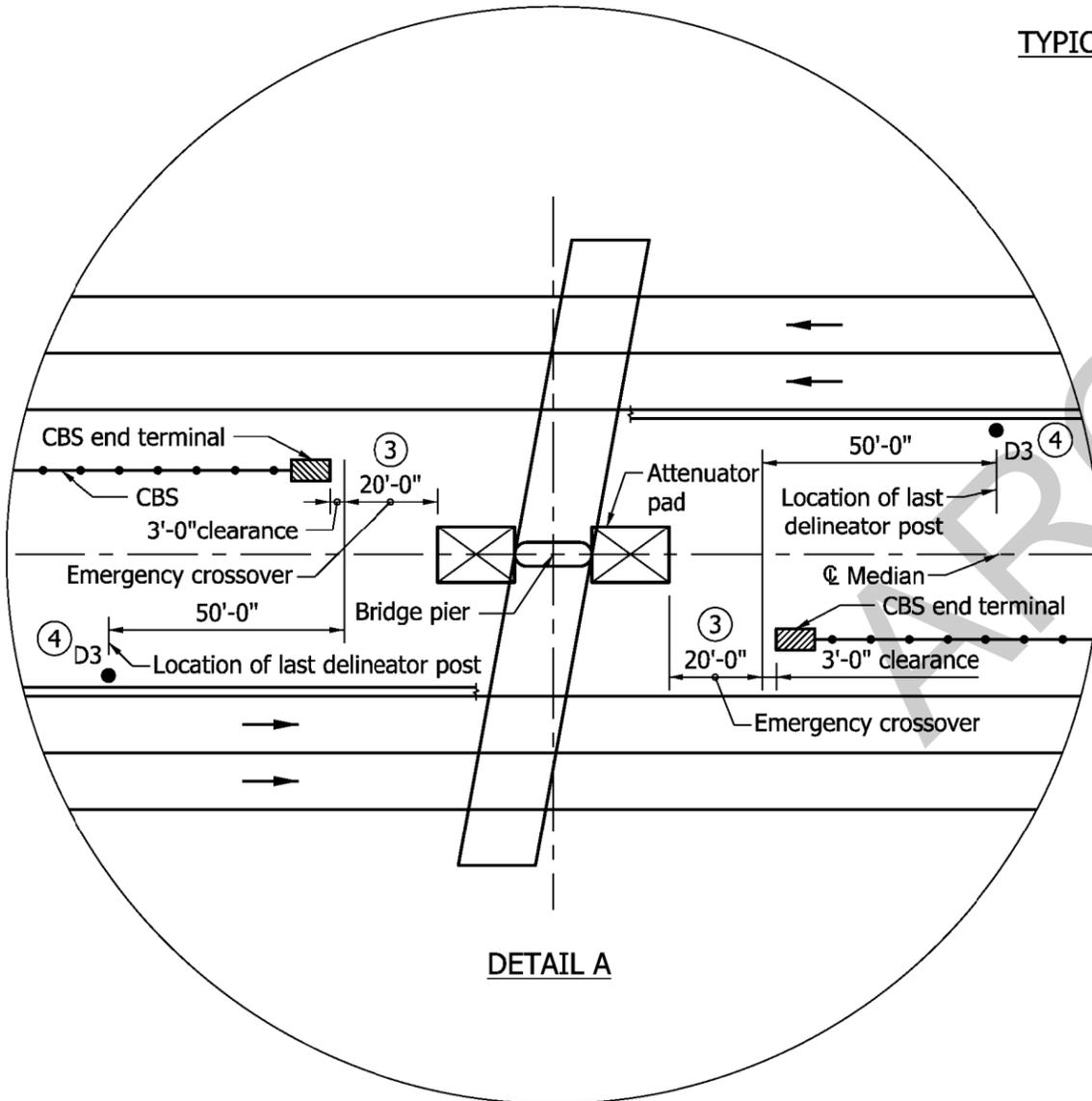
INDIANA DEPARTMENT OF TRANSPORTATION

**CBS INCOMING END OF BRIDGE IN MEDIAN
EMERGENCY CROSSOVER**



DETAIL A

TYPICAL DETAIL FOR DELINEATOR POSTS AT EMERGENCY CROSSOVER



DETAIL A

Notes:

- 1. CBS: Cable Barrier System.
- 2. For location of CBS, See sheet 1 of 9.
- ③ Location of emergency crossover when specified on plans.
- ④ Delineator post D3 with reflectors blue at top, white in the middle and blue at bottom.

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TYPICAL DETAIL FOR DELINEATOR POSTS AT EMERGENCY CROSSOVER