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**Recommended Design Criteria and Functional/Operating Guidelines for Overhead  
Bridge and Cantilever Structures and Placement of  
Grade Crossing Warning Devices**  
Revised 2025 (7 Pages)

**A. Purpose**

This Manual Part recommends design criteria and functional/operating guidelines for overhead bridge and cantilever structures and for bridge and cantilever mounted grade crossing warning devices.

**B. Warning Devices**

1. Flashing-light signal units shall conform to Manual Part 3.2.35 Recommended Design Criteria for Electric Light Unit for Grade Crossing Signals Including Light Emitting Arrays and Incandescent Lamps and shall be aligned conforming to Manual Part 3.3.5 Recommended Instructions for Aligning Grade Crossing Light Units.
2. The crossarm for suspended flashing-light signal units shall conform to Manual Part 3.2.50 Recommended Design Criteria for Crossarm for Suspended Flashing-Light Grade Crossing Warning Signal without Gate Assemblies or Manual Part 3.2.51 Recommended Design Criteria for Crossarm for Suspended Lights for Flashing-Light Grade Crossing Signal with Mast Mounted Gate, Assemblies.
3. The bell when used shall conform to Manual Part 3.2.60 Recommended Design Criteria for an Electro-mechanical Grade Crossing Bell or Manual Part 3.2.61 Recommended Design Criteria for an Electronic Grade Crossing Bell.
4. Cantilever span support assembly for the crossarm and associated suspended flashing light signal units shall conform to Manual Part 3.2.2 Recommended Design Criteria for Grade Crossing Warning Device, Flashing-Light Signal Assembly, Cantilever Span Assembly, and Gate Assembly.
5. The 90-degree grade crossing (crossbuck) sign shall conform to Manual Part 3.2.70 Recommended Design Criteria for 90 Degree Grade Crossing Sign, Extruded Aluminum Retroreflective Sheet Type for all Pipe Sizes, or Manual Part 3.2.71 Recommended Design Criteria for a 90 Degree Grade Crossing Sign to Meet Canadian Federal Government Requirements.
6. The number of tracks sign, when used, should conform to Manual Part 3.2.75 Recommended Design Criteria for Number of Tracks Sign, Aluminum, Retroreflective Sheet Type, Detail & Assembly, or Manual Part 3.2.76 Recommended Design Criteria for Number of Tracks Sign for Use in Canada, Aluminum Sheet, Retroreflective Sheet Type, Detail & Assembly.

7. Bridge and cantilever structural supports for the crossarm(s) and associated suspended electric light units shall conform to American Association of State Highway and Transportation Officials (AASHTO) 2008 Specification for Structural Supports for Highway Signs, Luminaries and Traffic Signals.

**C. C. General**

1. 1. When it is required for better visibility to approaching traffic, particularly multi-lane roadway approaches, cantilevered or bridge mounted flashing-light signal units may be used.
2. Overhead mounted flashing-light signal units are also suitable for two-lane roadways where additional emphasis is required. These locations may include high speed rural highways and high-volume two-lane roads or specific locations where distractions or obstructions indicate mast mounted flashing-light signal units are not readily visible to motorists.
3. Overhead mounted flashing-light signal units should be used at locations on two-lane roadways with surfaced shoulders which require the flashing-light signal units to be located greater than 10 ft (3.1 m) from the edge of the traveled way.
4. Overhead structures and supporting masts should have relatively clear and simple lines. Attention should be given to avoid the visual obstruction of or by other active traffic control devices in the vicinity of the grade crossing.
5. A minimum of one 90-degree grade crossing (crossbuck) sign shall be provided on each bridge and cantilever structure. Where only one is provided, it shall be located on the main support mast at the standard height above the roadway. Additional crossbuck signs may be provided on the bridge or cantilever overhead structure if so desired. Where an engineering study finds restricted sight distance or unfavorable geometry, crossbuck signs should be placed back-to-back or otherwise located so that two faces are displayed to that approach.
6. Other signs such as Number of Tracks should be located in conjunction with the crossbuck sign to conform to Manual Part 3.2.2 Recommended Design Criteria for a Grade Crossing Warning Device, Flashing Light Signal Assembly, Cantilever Span Assembly and Gate Assembly
7. The highway motorists' view of flashing-light signal units shall not be obstructed by signs or structural members.
8. Vertical clearances above the roadway crown shall not be less than 17 ft 0 inches (5.2 m) under full load conditions.

9. If one pair of cantilever flashing-light signal units would be visible to drivers in all approaching lanes, except the right lane which affords a view of the mast mounted flashing-light signal units, other flashing-light signal units are not required on the cantilever arm. Overhead flashing-light signal units for each approaching lane are not required, however, their need should be determined by a traffic engineering study. In addition to the flashing-light signal units cantilevered over the roadways, flashing-light signal units should usually be placed on the supporting mast.
10. Back mounted flashing-light signal units should be provided on overhead structures near the center of the roadway for the opposite approaching traffic. Additional back mounted flashing-light signal units are optional on the overhead structure. Consideration should be given to providing back mounted flashing-light signal units on the support mast for visual indication to pedestrians, as required.
11. Electro-mechanical bells, when used, should be mounted on the supporting mast of the overhead structure with the face of the gong parallel to the roadway. Electronic bells, when used, should be mounted on the supporting mast of the overhead structure so that the sound is directed parallel to the roadway.
12. Service Ladders
  - a. Walkout Type Cantilever and Bridge Structures Service ladder should be either permanently attached to the supporting mast or provisions made to securely attach a detachable type ladder to the mast to gain access to the maintenance walkway.
  - b. Rotatable and Non-Rotatable Cantilevers Detachable service ladder should be provided and provisions made to securely attach it to the mast. Ladder should be equipped with hooks or other suitable safety devices at the top to securely attach it to the overhead structure to permit direct servicing of sign(s), flashing-light signal units and bell. Ladder should be equipped with hinged type feet designed to prevent sinking and subsequent tipping under a 300 lb (136 kg) live load when attached to the cantilever and shall be of sufficient length to allow a 15 degree vertical incline with the feet resting on the ground.
  - c. Step surfaces of all ladders shall have skid resistant surfaces.
  - d. A locking device shall be provided for all detachable type ladders to prevent unauthorized removal.
  - e. All ladders, both fixed and detachable, shall be equipped with locked-in-place anti-climb guards to prevent unauthorized access to the overhead structure.

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- f. Steps on all ladders shall be a minimum of 16 inches (40.6 cm) wide (total usable, inside width of the step).
13. Maintenance walkways and handrails on overhead structures shall extend from the supporting mast to a point which will provide safe access to all arm mounted flashing-light signal units. Handrails shall not obstruct the motorist's view of the signs and flashing-light signal units. The manufacturer's name and structure model number, live load limits of the structure and the maximum length of cantilever arm that can be safely supported should be clearly shown in an obvious location on the support mast. Footways shall have skid proof surfaces a minimum width of 15 inches (38 cm) and shall be of open design to allow drainage. All cantilevered or bridge mounted flashing-light signal units, handholds, and crossarm mounted junction boxes shall be readily accessible from the footway.
14. Mast bases of cantilever and bridge structure shall not be of the break-away type.
15. Minimum 4 inch x 8 inch (10.2 cm x 20.3 cm) handholes should be provided in the mast if internally mounted terminals are used. Where externally mounted junction boxes are used, a 2 inch x 4 inch (5.1 cm x 10.2 cm) hole should be provided for wire entry from the mast to the junction box. Optional handholes may be advisable at the junction of the overhead structure and the mast to assist in the installation or replacement of the internal wiring.
16. The supporting foundation(s) should be designed so that underground signal cabling can enter the interior of the mast(s). All handholes, when not in use, should be covered by weatherproof covers.
17. Bridge and cantilever structure should be provided with 4 inch (10.2 cm) inside diameter vertical masts or struts for mounted crossarm and flashing-light signal units. Proper clearance of other structure components shall be provided to permit proper adjustment and maintenance of the flashing-light signal units.
18. All supporting structures shall be properly sealed to prevent ingress of water and air-ventilated to prevent condensation collecting in the interior.
19. All internal surfaces of structures in areas where individual wires or multi-conductor cable may be required to run shall be free of sharp corners and obstructions to avoid possible damage to wire or cable. Protective grommets should be used in all openings where required.
20. Rotatable or non-rotatable cantilevers may be used at locations where extensive arm length is not required and walkway access is not considered necessary. Rotatable cantilevers shall be rotatable 165 degrees in either
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direction with provision for locking in normal service position and in maintenance positions. The live load capacity for rotatable and non-rotatable (non-walkout) type structures shall be 250 lb (113.4 kg) when applied at the outer end of the cantilevered arm.

**D. Design Criteria**

1. The American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications (2008) for Structural Supports for Highway Signs, Luminaries and Traffic Signals, LTS5, should be used as the basis of design where applicable to railroad requirements.
2. Loading:
  - a. Dead Load - Reference 2008 AASHTO, Section 3, Paragraph 3.5. The dead load shall include the weight of flashing light signal units, all other grade crossing warning devices, masts, signs, horizontal and vertical supporting structure including appurtenances.
  - b. Live Load - Reference 2008 AASHTO, Section 3, Paragraph 3.6. All cantilever and bridge structures, including walkways and service platforms, shall be designed to support a single load of 500 lb (226.8 kg), 250 lb (113.4 kg) for non-walkout, distributed over a distance of 2 ft (61 cm) and in the case of cantilevers, that shall mean at the outermost end of the arm.
  - c. Ice Load - Reference 2008 AASHTO, Section 3, Paragraph 3.7 shall be considered to be 3 lb/ft<sup>2</sup> (1.4 kg/ft<sup>2</sup>) applied around the surfaces of the structural vertical and horizontal supports flashing-light signal units and walkways, but on only one face surface of signs.
  - d. Wind loads - Reference 2008 AASHTO, Section 3, Paragraph 3.8 shall be considered to be the force due to wind pressure on the horizontal and vertical supports, flashing-light signal units, signs and walkways with application as derived from the Wind Pressure Formula of AASHTO 2008 Specification, Section 3, Paragraph 3.8.1. The wind loading for cantilever and bridge structures shall be based upon a velocity of 120 mi/h. If local wind speeds exceed 120 mi/h, the higher value shall be used. A wind importance factor of 1.0 representing a 50-year life span shall be used.
  - e. Group loads - Reference 2008 AASHTO Section 3.4
    - (a) The following group loads shall be used for calculating deflections:
 

Group I	Direct result of dead load.
Group II	Direct result of dead load plus wind.

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Group III	Direct result of dead load plus ice plus $\frac{1}{2}$ wind.
Group IV	Direct result of dead load plus live load.

3. Deflections
  - a. Horizontal deflection – Result of Group II load Maximum horizontal deflection shall not exceed 3 degrees, 15 minutes. This angle shall be computed as the ARCTAN of arm tip deflection divided by the arm length.
  - b. Dead load camber shall be equal to the result of Group I.
  - c. Vertical deflection – Maximum vertical deflection for Group III and IV shall not exceed 1/60th of the arm length (L/60)<sup>1</sup> beyond dead load camber. The lowest part of the arm shall not fall below the minimum height requirements.
4. Material Specification - Reference 2008 AASHTO, Section 6 High strength to weight ratio corrosion-resistant extruded and cast aluminum alloys should be used throughout in the fabrication of all structural components, walkways, mast, ladders, signs, junction boxes, platforms and handhole covers. <sup>2</sup>
5. Fabrication
  - a. Welding - Reference 2008 AASHTO, Section 6, Paragraph 6.9 All welding required should be performed by certified welders in strict conformance with the above mentioned AASHTO reference.
  - b. Assembly hardware should be either stainless steel or zinc plated dichromate dipped.
6. Anchor Bolts for Walkout Cantilever
  - a. Anchor bolts shall be made from steel and conform to the requirements of American Society for Testing and Materials (ASTM) A36/A36M-19 Standard Specification for Carbon Structural Steel.
  - b. Anchor bolts provided shall be a minimum of 1½ inches (3.8 cm) in diameter and a minimum of 54 inches (137.2 cm) in length for the 19 inch by 19 inch (48.3 cm x 48.3 cm) bolt spacing.

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<sup>1</sup> The L/60 ratio for vertical deflection was selected by committee members in 2016 after a detailed structural analysis of current aluminum structures being provided in the industry.

<sup>2</sup> R-D-4 - Hot dipped galvanized steel mast may be substituted for aluminum mast.

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- c. Anchor bolts shall be provided with a minimum of 6½ inches (16.5 cm) of galvanized thread above the top of the foundation.
  - d. Each anchor bolt should be provided with required nuts and washers.
  - e. Bolts, nuts and washers shall be hot dipped galvanized to meet the requirements of ASTM A123/A123M-17 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. All threads shall be chased after galvanizing.
7. Anchor Bolts for Non-Walkout Cantilevers and Bridge Structures
- a. Anchor bolts shall conform to the manufacturer's recommendations for specific size and type of structure being supplied.
8. Anchor Bolt Spacing
- a. Anchor bolt spacing for walkout cantilevers shall be on 19 inch by 19 inch (48.3 cm x 48.3 cm) bolt centers.
  - b. Anchor bolt spacing for non-walkout cantilevers and bridge structures shall conform to the manufacturer's recommendations for the specific size and type of structure being supplied.
9. Foundations
- Information in AASHTO 2008 Specification Section 13: Foundation Design and AREMA Manual Part 14.4.1 Recommended Design Criteria and Functional Guidelines for Signal Structure/Enclosure Foundations , should be considered.