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ENGINEERING INSTRUCTION

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

SUBJECT: Bridge Design Manual;
Design Criteria For Bridges,
Protection of Substructure Concrete

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The following criteria shall be used to determine where steel reinforcing bars in concrete should be protected from chlorides.

RATIONALE

Much attention has been given to understanding the effects of chlorides on reinforced concrete and to developing measures to prevent the undesirable effects caused by the corrosion of reinforcing bars. The Department's major effort has been directed to bridge decks up to this time, but with increased understanding of the nature of the problem, it has become apparent that attention must also be given to the effect of chlorides on substructure concrete elements.

Substructure concrete is directly exposed to chlorides in the following ways:

1. salt water passing through bridge deck openings or bridge deck joints.
2. salt water running or dripping over deck fascias.
3. salt water splash resulting from moving vehicles.
4. immersion in seawater.
5. splashing of seawater.

The result of this exposure is the same as that which occurs in bridge decks. Spalling, delamination and cracking of concrete may be expected as a result of the corrosion of unprotected reinforcing bars. The elapsed time to the appearance of these problems in substructure concrete is normally greater than for a bridge deck because the exposure is generally less concentrated and traffic loads are not a factor. However, some substructure situations may be as severe as with a bridge deck, such as exposure to seawater, or a high concentration of chlorides in water passing through an open bridge deck joint.

Just as the cause and symptoms of the problem are the same as with bridge decks, the corrective measures are also the same. Epoxy coated reinforcing bars, increased concrete cover, and surface coatings are measures that can be taken to reduce or eliminate the corrosion problem. Because of the positive protection provided, the small extra cost and the confidence in the quality of the protection provided, this criteria statement will only consider the use of epoxy coated reinforcing bars. Epoxy protective coating for concrete has been effective in preventing the ingress of chlorides in concrete on backwalls, pier caps, and bearing seats. However, it is not as cost effective as epoxy coated reinforcing bars and extends the construction schedule for a structure. The protective coating is not required to protect properly air entrained concrete. In addition, the entrained air requirements for all classes of concrete have been increased by 1% to provide a greater degree of confidence that the minimum air contents will provide satisfactory protection against freeze-thaw damage. For this reason, the use of epoxy protective coating for concrete on these elements will be discontinued. The development of improved bridge joint sealing systems has also substantially reduced the potential for chloride laden water to reach these elements.

WARRANTS FOR PROTECTION OF REINFORCED CONCRETE SUBSTRUCTURE ELEMENTS DIRECTLY EXPOSED TO CHLORIDES

Reinforcing bars used in the faces of substructure concrete elements which are directly exposed to chlorides shall be epoxy coated to prevent corrosion of the steel. Sources of chlorides include roadway drainage and spray from traffic due to deicing salt, splash and spray from seawater, and immersion in seawater. The exposed reinforced concrete elements generally include abutments, backwalls, bridge seats, bearing pedestals, columns, cap beams, stems of solid piers, wingwalls and retaining walls.

POLICY

1. Epoxy Protective Coating for Concrete
   Section 559 - Protective Coatings For Concrete shall not be used on bridges designed and built under this policy. However, for bridges not built under this policy, Note 36 of Section 21.21 of the Standard Details For Highway Bridges shall apply where appropriate.

2. Elements Exposed to Roadway Drainage

The faces of substructure elements shall be considered directly exposed to roadway drainage and require epoxy coated reinforcing bars when they are located as follows:

a. under an open steel grating deck.
b. under any bridge joint.
c. under or adjacent to a bridge deck with an open bridge railing.

Footings are not directly exposed. However, any reinforcing bars extending from the footing into an exposed substructure element shall be epoxy coated.

The need for protecting the elements beneath open steel gratings and open bridge joints is obvious. Bridge joints with "watertight" seals should protect the substructure, however, "watertight" seals may leak after a few years of service. Protecting the substructure concrete against the problems caused by leaking joints assures a long service life of the element. Water running or dripping over the fascia of the bridge deck usually finds its way to the substructure element. It is very difficult to differentiate between elements or portions of elements which would be affected. Even if portions of elements could be identified, it would be a burden to construct the element with a mixture of plain and epoxy coated reinforcing bars. Therefore, all substructure elements, except footings, under a bridge deck with an open railing shall utilize epoxy coated reinforcing bars. This includes U-wingwalls.

Bridges with parapets keep the roadway drainage on the deck, therefore, the substructure does not require epoxy coated reinforcing bars due to roadway drainage over the fascias.

3. Elements Exposed to Salt Splash or Spray

The faces of substructure elements shall be considered directly exposed to salt splash or spray and require epoxy coated reinforcing bars when they are located as follows:

a. within 30 feet horizontally of the edge of the roadway pavement.
b. within 30 feet horizontally of the edge of seawater at mean high water. If the structure is located in a seawater area where large waves frequently exceed the mean high water level, the distance from the edge of seawater shall be increased to 100 feet.

The limits of seawater shall be all tidal waters of New York State, except those of the Hudson River and its tributaries north of the Newburgh-Beacon Bridge.

Footings are not directly exposed. However, any reinforcing bars extending from the footing into an exposed substructure element shall be epoxy coated.

Any element exposed to salt water splash shall generally have epoxy coated reinforcing bars throughout the element. However, if the element is tall, plain steel may be used beginning with the first splice at 15 feet or higher above the pavement or mean high water. In an area that has large waves frequently exceeding the mean high water level, the height shall be increased to 50 feet above mean high water.

4. Elements Immersed in Seawater
All substructure elements immersed in seawater shall utilize epoxy coated reinforcing bars. This includes reinforcing bars in footings. The limits of seawater shall be the same as those stated in 3. above.

The design guidelines described above are for general conditions and they will cover most bridges. Special cases will occur, such as intersecting roadways with multiple levels, where the designer will have to analyze the conditions and protect the substructure elements accordingly.

When epoxy coated reinforcing bars are used in substructure elements, those reinforcing bars to be coated shall be identified on appropriate plan sheets and in the bar list for the bridge.

Any questions regarding this policy may be referred to the Special Design Unit of the Structures Division.