

Memorandum

Date: January 16, 2004

From: Bala Tharmabala
Manager, Bridge Office

To: Distribution List (Attached)

Re: **Bridge Office Design Bulletin**
Corrosion Protection Guidelines for Concrete Bridge Components

Definition of Terms (For the purpose of these Guidelines)

AADT (Average Annual Daily Traffic): means the total yearly traffic volume on a given road, in all lanes and both directions, divided by the number of days in the year.

Corrosion resistant materials: means stainless steel and high performance concrete.

Normal Concrete: means concrete of a minimum specified 28-day compressive strength up to 50 MPa and which does not include silica fume.

High Performance Concrete (HPC): means concrete with a minimum specified 28-day compressive strength of at least 50 MPa, which must include silica fume and may include other supplementary cementing materials, and having a rapid chloride permeability at 28 days of 1000 Coulombs or less.

Stainless Steel Reinforcing: means stainless steel reinforcing bars conforming to ASTM A276 and ASTM A955M, minimum Grade 420, Type 316 LN or Type 2205 Duplex. Stainless steel requirements for MTO work are to be found in Special Provisions 905S04 and 114S03, and the "Guidelines for the Inspection and Acceptance of Stainless Steel Reinforcement" * provides information regarding quality issues associated with stainless steel.

* "Guidelines for the Inspection and Acceptance of Stainless Steel Reinforcement", Ontario Ministry of Transportation. (Available from Concrete Section, Materials Engineering and Research Office, 1201 Wilson Ave., Downsview, ON M3M 1J8, Telephone 416 235 3705.)

Purpose

To assist designers on the use of premium corrosion resistant materials, specifically stainless steel reinforcement and high performance concrete, for construction of new Ministry bridges and rehabilitation of existing bridges.

Background

Currently Ministry allows the use stainless steel and high performance concrete as corrosion resistant materials in the salt splash zones of structures. To provide guidance to designers for their use on MTO projects the following guidelines have been developed. These guidelines replace all previous policy documents and memos dealing with this subject.

Although it is recognized that both stainless steel and high performance concrete have higher strengths than conventional materials, these guidelines only address the durability aspects of these materials.

The ministry will continue to review the performance of existing high performance concrete and stainless steel installations to date, review the experience of other jurisdictions and monitor costs and issues associated with construction contracts.

Other materials are under consideration at this time in MTO research activities, including stainless steel clad reinforcing bars, and bars made of steel alloys that may offer improved corrosion resistance. These may offer advantages over the current approach to corrosion protection, but their long-term performance has not been proven and they remain under assessment at this time.

All this information will provide input to the ministry's corrosion protection strategy, so that the policy can be refined. However, until a sufficient level of comfort is reached, with performance, availability and cost to consider broadening the use of premium corrosion protection materials, the guidelines described below will remain in place.

Recommendations

New Bridges

(I) Bridges Carrying Strategic Highways

Premium corrosion protection and durability enhancement will be specified for bridges carrying strategic highways.

For the purpose of applying these guidelines, strategic highways are defined as follows:

Highways carrying traffic volumes with an AADT $\geq 100,000$, and shown in bold in Fig.2.8.2. All structures between the highway limits shown are to be included. This map is based on highways carrying traffic volumes with an AADT $\geq 100,000$ for the year 2000 and will be updated when necessary.

For bridges carrying the above highways corrosion protection materials will be specified as follows:

- (i) Stainless steel will be used in areas of all bridge components where their surface is within the Splash Zone as defined in Table 1. On overpasses, overheads, and bridges that span roads, railways and waterways, where the application of de-icing chemicals is minimal, this requirement may be waived for piers and columns.

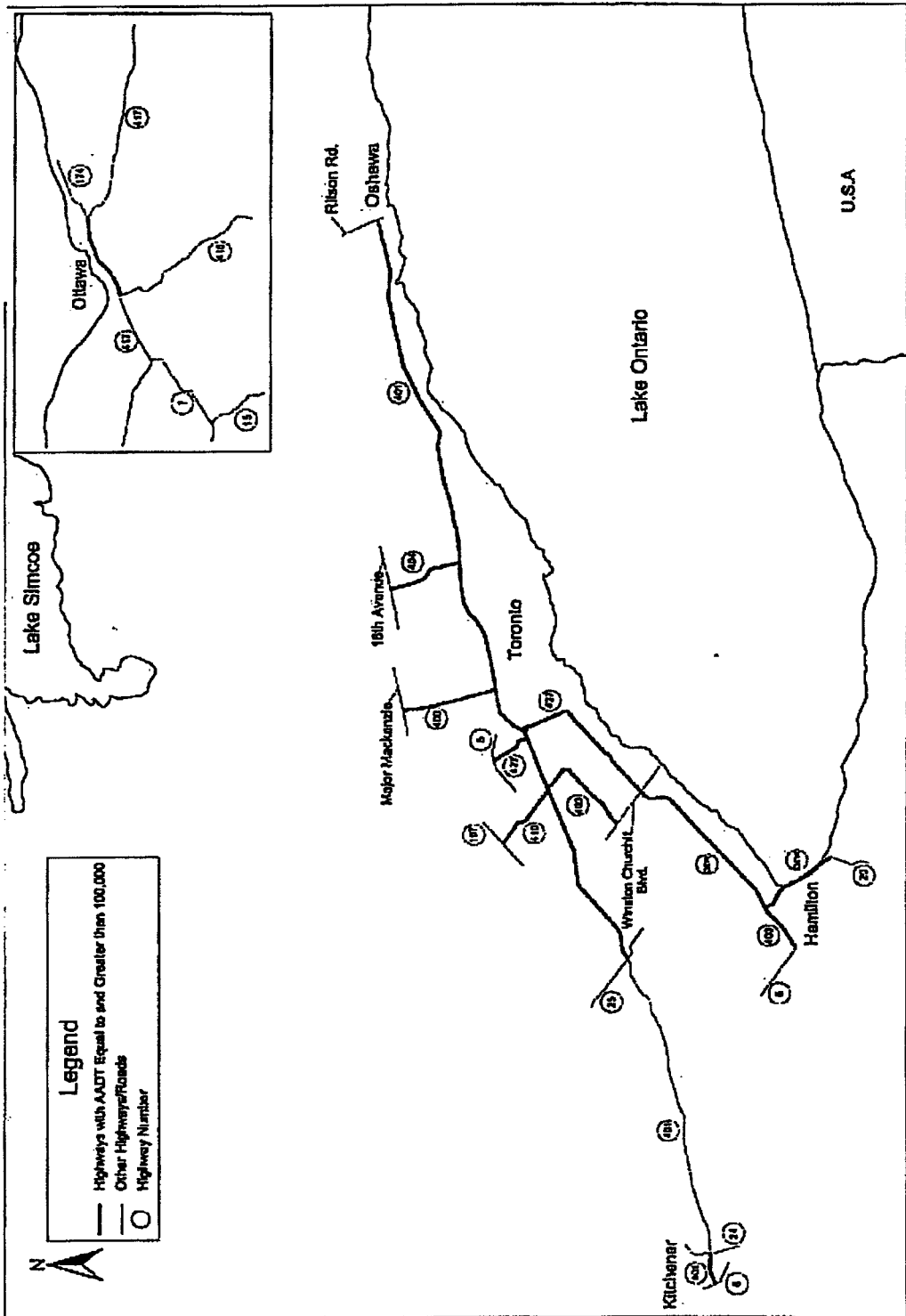


Figure 1: Location of Highways with AADT Equal to and Greater than 100,000 Based on Traffic Figures For the Year 2000

- (ii) For waterproofed decks and all other components not covered in Table 1 epoxy coated steel and black steel will be used as specified in the Structural Manual (Section 12.) If there is regional interest in using stainless steel in bridge decks, the Region would have to demonstrate that the additional costs of using stainless steel is justified.

High performance concrete (HPC) may be specified for all bridge components except for

- Footings

Post-tensioned bridges unless approved by the Ministry

Prestressed precast concrete girders with 28 day design strength less than or equal to 50 Mpa

All concrete decks shall be protected by an asphalt and waterproofing system.

Table 1: Component Surfaces Within Splash Zone

• Top and side surfaces of barrier walls and parapet walls
• Top and side surfaces of sidewalks, medians and curbs
• Top surfaces of expansion joint end dams
• Surfaces of columns within 10 m horizontally and 5 m vertically of an existing or future roadway measured from the edge of the nearest travelled lane. Pier caps are exempt from this requirement except as detailed below.
• Side and end surfaces of pier shafts within 10 m horizontally and 5 m vertically of an existing or future roadway measured from the edge of the nearest travelled lane
• Bearing seats and sides of pier shafts and columns, including pier caps, below expansion joints within 5 m measured vertically from the bearing seat.
• Top and side surfaces of bases for pole and sign structures that are attached to bridges

(II) All Other Bridges

For these bridges the guidelines are as follows:

- (i) Stainless steel reinforcing will be used in areas of all bridge components where their surface is within the Splash Zone as defined in Table 1 except as follows:

The superstructure components of bridges carrying traffic volumes with an AADT of ≤ 2000

- On overpasses, overheads, and bridges that span roads, railways and waterways,

where the application of de-icing chemicals is minimal, this requirement may be waived for piers and columns

- (ii) For all components, including decks, where stainless steel is not used, black steel and epoxy-coated steel is to be used as specified in the Structural Manual (Section 12.)

For these bridges normal concrete is to be used. Where considered appropriate by the Regions high performance concrete (HPC) may be specified for all bridge components except for the following:

Footings

Post-tensioned bridges unless approved by the Ministry

- Prestressed precast concrete girders with 28 day design strength less than or equal to 50 Mpa

All concrete decks shall be protected by an asphalt and waterproofing system.

Bridges for Rehabilitation

In general, the use of premium corrosion protection treatments, as described above, shall be followed in bridge rehabilitation when the remaining life of the bridge is equal to and greater than 35 years. For less than 35 years, normal concrete, black and epoxy coated steel shall be used as specified in the Structural Manual.

Additional Guidelines for Rehabilitation

In addition to the requirements described above, the following policies should be followed with respect to the application of premium corrosion protection systems in rehabilitated concrete bridges:

Concrete patch repairs: Conventional concrete or proprietary patching materials should be used in patch repairs, depending on the size and dimensions of the repair area. High performance concrete is not to be used in patch repairs, regardless of the remaining life of the bridge or its exposure condition.

Overlays: Two low permeability overlay options are available, silica fume concrete and latex-modified concrete, as outlined in the Structure Rehabilitation Manual. There is no "high performance concrete" overlay option available in current MTO specifications and this should not be specified. The current strength specification for silica fume concrete overlay is 40Mpa compressive strength at 28 days. Conventional concrete remains an option for overlays.

Widening of bridge, infill sections, replacement of outer deck edges: Bridge widening, infill sections, or partial replacements should not use premium corrosion protection systems, where there is no value in extending the life of the new section beyond that of the existing bridge. If the widened portion of the bridge is to remain in place for a longer time than the original bridge, use of stainless steel or HPC systems should be considered as per policy for new bridges.