Leadership in Sustainable Infrastructure
*Leadership en Infrastructures Durables*

**Case Study**

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# RECENT DEVELOPMENT AND TRIAL OF CORROSION RESISTANT STRUCTURAL STEEL FOR BRIDGES IN ONTARIO

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## 1 Background

### 1.1 Use of uncoated weathering steel in Ontario

The use of uncoated weathering steel for highway bridges in Ontario started in the late 1960's and became the standard material for steel girder bridges for the ministry. Except underneath expansion joints where the weathering steel girders will be coated for a distance of 3m from the ends, the rest of the uncoated girders were believed to be maintenance free throughout their design life. However, by early 2000's, it has been observed that uncoated weathering steel is not performing well at certain locations, including the soffit of box girders over traffic and field splices of plate girders over rivers. The premature corrosion of weathering steel in these applications has led to major maintenance efforts and could pose a safety concern if sheets of corrosion product fall onto traffic below. There is therefore a need to identify a more corrosion resistant steel for highway bridges in order to minimize the maintenance effort, but the new steel should preferably have similar mechanical properties compared with the standard weathering steel, and could be fabricated by local fabricators using current technology.

### 1.2 Development of new corrosion resistant steel

MTO has engaged the steel industry, CISC, and Surface Science Western since 2008 through a ministry and industry funded research project to develop the chemistry of a new corrosion resistant steel; ingots of several compositions were cast at CANMET and plates rolled from them were subjected to cyclic salt spray at the ministry's laboratory, including the one with 5% Cr which shows promising results. At the same time, the ASTM A1010 steel with 12% Cr has been identified as a viable alternative based on the two bridges that the Oregon DOT has constructed and based on MTO's previous laboratory evaluation.

### 1.3 Target improvement in corrosion resistance

For box girders over highways, the goal is to develop a new composition that is 2.5 to 3 times better than the standard weathering steel such that any maintenance work cycle would be lengthened to 15 years; currently the corrosion product has to be scaled from the underside of these girders every 2 to 5 years. After being subjected to the salt spray cycles, the steel specimens were evaluated for weight gain, weight loss, impedance and corrosion potential.

## 2 Laboratory evaluation results

The composition with 5% Cr has shown promising results with an improved corrosion resistance about 2 to 2.5 times that of the standard weathering steel. On the other hand, the A1010 steel has shown much better performance with a corrosion resistance over 10 times better than the standard weathering steel.

## 3 Trial projects using the A1010 steel

The ministry implemented the following two trial projects using A1010 steel:

- Hwy 401/Speed River in 2015 using plate girders over a waterway with low clearance
- Hwy 19 over Hwy 401 using box girders in 2016

Since there is no existing CWB prequalified welding procedure for A1010 steel, the ministry engaged a consultant and MAJIC which is a federal government funded research organization for metal connections to develop welding procedures in advance of the contracts in order to avoid any complications during contract. Both bridges are still under construction.

## 4 Discussions and conclusions

This case study provides a comparison of the laboratory test results of A1010, 5% Cr, and the standard weathering steel. Lessons learned from the development of the welding procedure and fabrication of the A1010 steel is also shared. Finally, based on the cost premium of the A1010 steel in the two MTO contracts, a life-cycle cost comparison is made between the use of A1010 steel versus coated weathering steel.

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