

TECHNICAL MEMO

The Use of Weathering Steel for the Deh Cho Bridge

The structural steel truss of the Deh Cho Bridge consists of atmospheric corrosion resisting or “weathering” steel. This type of steel is currently used all over the world for bridge construction as the standard for steel bridges and has been the steel of choice for many owners and bridge designer for the past few decades.

The primary advantage of weathering steel is that the steel forms a durable, tightly adherent protective oxide coating, or “patina”, which prevents corrosion from occurring. Coating or painting of the steel is not required.

When subjected to normal atmospheric exposure, weathering steel does not require any routine maintenance to include cleaning, sandblasting or grinding to remove rust on the surface, at the joints or around bolts or connectors.

Weathering steel is calibrated, on a chemical level, to begin rusting immediately on the outside. The rust actually serves as a protective layer, keeping the alloys on the inside safe from corrosion. And interestingly enough, the rust is sort of like human skin; the layer protecting the surface develops and regenerates continuously when subjected to the influence of the weather."

The corrosion-retarding effect of the protective layer is produced by the particular distribution and concentration of alloying elements in it. The layer protecting the surface develops and regenerates continuously when subjected to the influence of the weather. In other words, the steel is allowed to form its own protective coating.

Owners and Designers use weathering steel for modern bridges due to a number of critical factors. These key factors include:

- **Durability.** With the oxide protective coating in place, design lives of the steel component of up to 120 years can be achieved. This is compared to alternative coatings which have a life to first maintenance of approximately 20 years. The Design Life of the Deh Cho Bridge is 75 years and a painted system would have required 4 coatings over the life of the structure significantly adding to the maintenance costs.
- **Faster fabrication time and easier handling resulting in lower costs.** Weathering steel only needs blast treatment before being transported. The fabrication time is shorted due to elimination of the paint shop process. Also, when handling coated steel special attention is needed to protect the surfaces. Extensive painting and touch up on site is avoided.

- **Lower maintenance cost.** Maintenance painting of the Deh Cho Bridge would be exorbitantly expensive and risky (for example environmental and safety risks with painting over the river). An estimated costing cost would be in the \$3-7m range depending on the type of coating and the application method.
- **Easy fabrication and detailing.** No additional design, detailing or fabrication costs are associated with using weathering steel. Compatible welding and bolting systems are available for weathering steels. Normal fabrication tools and workshops can be used.
- **Environmental benefits.** The use of chemical laden paints and blast cleaning, and the risk of exposing the environment to cleaning materials and waste products is eliminated.
- **Protective Coating.** Weathering steel is intended for and is more often used in a bare, uncoated and exposed conditions, However surface on which prolonged periods of moisture occur should be protected
- **Increased Safety.** Health and safety issue related to initial painting are avoided and the risk avoided with and the risk associated with future maintenance are minimised

Coating of weathering steel is required when the steel is exposed to abnormal conditions such as de-icing chemicals, constant water exposure or direct contact with soil or treated timber. Steel surfaces of the Deh Cho Bridge that the designer has determined may be exposed to such conditions have been coated, for example the ends of the trusses located at the expansion joints (in case the expansion joints leak). Areas of the steel pylon have also been coated to ensure the inspection of the cables is unhindered.

In the past ten years, the Department of Transportation has used weathering steel on a number of key bridges to include:

- Shale Creek Bridge;
- Kakisa River Bridge;
- Whitesand Creek Bridge; and
- Blackwater River Bridge along the Mackenzie Winter Road.

The Department will continue to use this system on its structures.

In summary, the use of any other steel combined with a coating system would have resulted in significantly higher initial and maintenance costs and the risk of structural failure due to inadequate maintenance would also have been far greater. The use of weathering steel for the Deh Cho Bridge is consistent with construction of new

bridges across Canada and the design has strictly been carried out to the Canadian Highway Bridge Design Code CAN/CSA-S6-06.

Further information regarding weathering steel can be found in the following links:

MITTAL USA;

<http://pc.arcelormittal.com/NA/plateinformation/documents/en/Inlandflats/ProductBrochure/ARCELORMITTAL%20WEATHERING%20STEEL.pdf>

Corus, (TATA); UK

http://resource.npl.co.uk/docs/science_technology/materials/life_management_of_materials/publications/online_guides/pdf/weathering_steel_bridges.pdf