INSPECTION AND MAINTENANCE GUIDELINES FOR SELF-WEATHERING STEEL RECREATION BRIDGES

Recreation bridges fabricated from self-weathering steel are relatively low maintenance, have enhanced atmospheric corrosion resistance, and are not usually susceptible to fatigue. Below are general guidelines for steel bridge inspection that may apply dependent on individual circumstances.

The bridge should be inspected by personnel qualified in bridge inspection at a frequency determined by the owner based on the location, environment and intended use of the bridge. Bridges under warranty shall be regularly inspected according to the National Bridge Inspection Standards for the warranty to remain in effect.

Physical Examination

All safety features including handrail, rubrail, safety rail, etc. shall be in place and functional.

If the bridge contains field bolted splice connections, all bolts shall be visually inspected for loosened or missing hardware.

De-icing salts and any other corrosive chemicals should not be applied to self-weathering steel bridges. Self-weathering steel exposed to corrosive chemicals should be properly cleaned or blasted.

The bridge shall be free of debris, soil deposits and overgrown vegetation, see section on Corrosion.

Foundations shall be reviewed for scour, settlement and general soundness. The bridge bearings shall be functional as shown in the design plans and with appropriate hardware in place.

It is important for analysis purposes that the members reported in the plans or inspection report correspond properly with the members actually used on the bridge. If incorrect member sizes are used, then any analysis of the safety of the bridge is worthless. Therefore, the inspector should measure the bridge members to verify that the sizes recorded in the plans or inspection report are accurate. For a new bridge, this function would be performed in the shop.

Corrosion

The most recognizable type of steel deterioration is corrosion, or rust. Corrosion results in the loss of member material. This partial loss of cross section due to corrosion is known as section loss. Bridge inspectors should be familiar with corrosion since section loss can lead to a substantial reduction in member capacity. Self-weathering steel is intended to rust and form a protective coating from the rust and is very durable under normal atmospheric conditions. However, rust can propagate adversely affecting self-weathering steel's performance under the following conditions:

- Environmental corrosion - primarily affects metal in contact with soil or water and is caused by formation of a corrosion cell due to deicing salt concentrations, moisture content, oxygen content, and accumulated foreign matter such as roadway debris and bird droppings.
- Stray current corrosion - caused by electric railways, railway signal systems, cathodic protection systems for pipelines or foundation pilings, DC industrial generators, DC welding equipment, central power stations, and large substations.
- Bacteriological corrosion - organisms found in swamps, bogs, heavy clay, stagnant waters, and contaminated waters can contribute to corrosion of metals.
- Stress corrosion - occurs when tensile forces expose an increased portion of the metal at the grain boundaries, leading to corrosion and ultimately cracking.
- Fretting corrosion - takes place on closely fitted parts which are under vibration, such as machinery and metal fittings, and can be identified by pitting and a red deposit at the interface.

Fatigue Cracking

Fatigue cracks develop in bridge structures due to repeated loadings. Since this type of cracking can lead to sudden and catastrophic failure, the bridge inspector should be able to identify fatigue cracks.

Some factors leading to the development of fatigue cracks are:

- Frequency of repeated loading
- Age or load history of the bridge
- Magnitude of stress range
- Type of detail
- Quality of the fabricated detail
- Material fracture toughness (base metal and weld metal)
- Quality of welds

There are two basic types of bending in bridge members: in-plane and out-of-plane. When in-plane bending occurs, the cross section of the member resists the load according to the design and undergoes nominal elastic deformation. Out-of-plane bending implies that the cross section of the member is loaded in a plane other than that for which it was designed and undergoes significant elastic deformation or distortion. More correctly, out-of-plane bending should be referred to as out-of-plane distortion. Out-of-plane distortion is common in beam webs where transverse members connect and can lead to fatigue cracking.

Overloads

Overloads are loads which exceed that for which the member or structure was designed.

Steel is elastic (i.e., it returns to its original shape when a load is removed) up to a certain point, known as the yield point. After this point is reached, steel will deform or elongate and remain in this condition even after the load has been removed. This type of deformation is called plastic deformation.

Plastic deformations due to overload conditions may be encountered in both tension and compression members. The symptoms in tension members are:

- Elongation
- Decrease in cross section, commonly called "necking down"

The symptoms in compression members are:

- Buckling in the form of a single bow
- Buckling in the form of a double bow or "S" type, usually occurring where the section under compression is pinned or braced at the center point.

An overload situation can lead not only to plastic deformation, but also to complete failure of the member. This occurs when a tension member breaks or when a compression member exhibits gross buckling distortion at the point of failure.

Vehicular Damage

Members of a bridge which are within reach of a moving vehicle are subject to damage by impact. Indications of vehicular damage include dislocated and distorted members.
Some common signs of distress include:

- Bent or damaged members - determine the type of damage (e.g., collision, overload, or fire), measure the variance from proper alignment, and check for cracks, tears, and gouges near the damaged location.
- Corrosion - since rust continually flakes off of a member, the severity of corrosion can not always be determined based simply on the amount of rust; therefore, corroded members must be examined by physical as well as visual means.
- Fatigue cracks - fatigue cracks are common at certain locations on a bridge, and certain inspection procedures should be followed when fatigue cracks are observed.
- Other stress-related cracks - determine the length, size, and location of the crack.

Timber Decking

The primary locations for timber deck inspection include:

- Areas exposed to traffic - examine for wear, weathering, and impact damage.
- Bearing and shear areas where the timber deck contacts the supporting floor system - inspect for crushing, decay, and fastener deficiencies.
- Tension areas between the support points - investigate for flexure damage, such as splitting, sagging, and cracks.
- Deck surface - check for decay, particularly in areas exposed to drainage.
- Outside edges of deck - inspect for decay.

The inspection of timber decks for deterioration and decay is primarily a visual activity. All surfaces of the deck planks should receive a close visual inspection.

However, physical examinations must also be used for suspect areas. The most common physical inspection techniques for timber include sounding and probing, drilling, core sampling, and electrical testing. An inspection hammer should be used initially to evaluate the subsurface condition of the planks and the tightness of the fasteners. In suspect areas, probing can be used to reveal decayed planks using a pick test or penetration test. If the deck planks are over 2 inches thick, suspect planks should be drilled to determine the extent of decay.

Concrete Decking

Reinforced concrete decks should be checked for excessive cracking, deterioration or wear. In the extreme case, the slab reinforcing may also be deteriorated.

Steel corrugated form decking is used to aid in the placement of the concrete. The steel forms should be inspected for excessive rust and/or damage. The steel forms are typically non-structural, but deterioration may be indication of, or the start of, related problems with the structure.

Excerpts obtained from FHWA Bridge Inspector's Training Manual, 1990