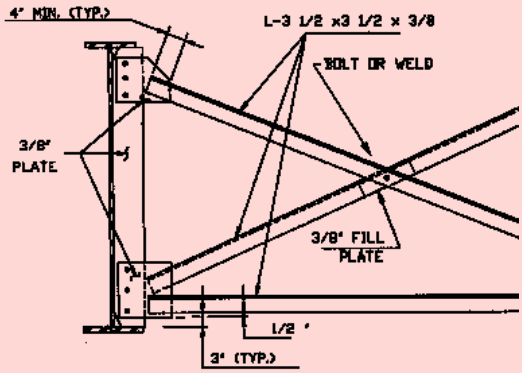

BRIDGE CROSSINGS

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Practical Information For The Bridge Industry

TIPS TO INSURE THE SUCCESSFUL USE OF WEATHERING STEEL FOR HIGHWAY BRIDGES

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ASSESSING PERFORMANCE: As ASTM A588 (or ASTM A709 Gr. 50W) weathers, it develops a tight patina on the surface that protects the steel from future corrosion. During development of this protective patina, "flakes" of rust, which can be easily brushed off, form on the surface. Unfortunately, some engineers have interpreted this as excessive section loss and therefore have decided to paint the bridge to prevent it from continuing. In reality, the flaking on the surface of weathering steel is a necessary part of the formation of the protective surface. The actual loss of thickness during the formation of this patina could only be measured with very sensitive equipment since the "loss" is in the order of a few mils at the greatest. And because rolling tolerances result in a greater thickness than required by design, even after many years in service a weathering steel bridge will usually have a greater thickness than originally specified.

When excessive section loss does actually occur, it is very obvious and is in the form of "laminar" rusting of the surface. This occurs primarily under the all-too-common leaking bridge joints when deicing chemicals are used on the roadway above. Wherever laminar rusting is observed, it is imperative to locate the source of the corroding water, and if possible, seal it off. If it is not possible, then spot coating of the affected area may be necessary (see painting tips below).

DETAILING: As with bridges built of any material, the performance of the structure is often controlled by the types of details used. Details for weathering steel bridges must be such that they will not trap water. If weathering steel remains wet more than 60% of the time—regardless of the cause of wetness—it will not perform as intended. Since it is virtually impossible to prevent debris (e.g. pigeon nests) from building up on horizontal bridge components, it is imperative that bridge inspectors brush off this debris during their biennial inspections. This simple act will prevent the debris from holding moisture in contact with the steel, thus insuring long-term performance.

MARINE ENVIRONMENT APPLICATIONS: The FHWA Technical Advisory "Uncoated Weathering Steel in Structures" recommends the use of a "wet candle" test method to determine the level of airborne salts, with a limit above which the FHWA advises "caution". However, this test is very time consuming. A more practical approach is to evaluate performance of other types of steel structures in the general area of the proposed structures, and if excessive corrosion is not observed, then weathering steel will perform successfully. Since the mid-1970s, weathering steel has been performing well in applications literally within a few feet of bodies of salt water. Performance on these structures is more than adequate, and this performance level is expected to continue.

HIGH RAINFALL, HUMIDITY OR FOG: As with the performance of weathering steel when details trap water, if the environment is such that the steel will remain wet more than 60% of the time, then it will not perform as intended. An example of where the use of weathering steel is inappropriate is in the northwest U.S., where rainfall approaches 200" per year. However, in areas subjected to annual rainfall of even as much as 100" per year—and in areas with high humidity—structures with uncoated weathering steel are providing excellent performance even after many years in service.

BRIDGE JOINTS: Regardless of the type of material used in the superstructure, a main cause of structure deterioration is the poor performance of bridge joints. The FHWA, in its Technical Advisory, recommends use of "jointless" bridges wherever possible as a cure to this ever present problem. Weathering steel used in conjunction with jointless bridge design has performed excellently. Integral and semi-integral abutments, in addition to just extending the deck slab over the abutment backwall, are ways to achieve the benefits of jointless bridges. Further guidance and details are available from the American Iron and Steel Institute ("Performance of Weathering Steel in Highway Bridges—A Third Phase Report" contact: AISI at 202/452-7100). Where joints must be used, properly detailed troughs under all types of

bridge joints must be used to insure long-term protection.

STAINING OF SUBSTRUCTURES: When weathering steel is directly exposed to rainfall—either temporarily during construction or permanently due to bridge detailing—concrete elements below will be stained by the rust colored water that runs off.

This problem is prevented during construction by simple and inexpensive techniques that include wrapping the substructure units with plastic until the deck slab is placed, precoating the concrete surfaces with a sealer, or requiring the stains to be removed by blast cleaning after construction. For areas where the steel is permanently exposed, detailing of the tops of the substructure to channel the staining water into "grooves" in the concrete surface has been used successfully. This provides a "streaked" appearance that actually enhances the otherwise rather bland color of the concrete wall. Should staining occur that needs to be removed, there are commercial products available that are very successful in removing the stains. Another, and possibly the most cost-effective solution, is to use weathering steel "forms". If the form also serves as the concrete reinforcement, substantial economies can result. Of course, the steel must be coated where it penetrates into the ground.

FATIGUE CRACKING: State-of-the-art designs of steel structures, including those built with weathering steel, should be immune from the fatigue cracking that is prevalent on older structures that were built before a full understanding of the problem emerged. However, sometimes a detail that is fatigue-sensitive still shows up on a newer bridge. Therefore, inspectors have to be continually vigilant to insure that fatigue cracks are discovered before they reach the point at which unstable crack growth can occur. Fatigue cracks in weathering steel are readily apparent because they exude an "orange dust" that contrasts with the deep brown color of the steel itself. These cracks may even be more visible than ones that occur in painted structures.

PAINTING: The FHWA strongly recommends that the ends of beams and girders under bridge joints be painted for a minimum distance to protect against the certainty of joint leakage. The paint system used for weathering steel should be high quality paint as would be used for any other steel bridge. Where the painted surface is exposed to view, the color of the paint should match the color of the "weathered" steel (note that this color changes during the first two years of service as the protective patina on the steel forms). One recommended specification to achieve this is Federal Color #30045. In some instances, aesthetic needs require a painted bridge. To provide most of the cost benefits of weathering steel while still satisfying aesthetic requirements, only the fascia side of exterior girders need be painted. For structures built with joints, and for those built before the FHWA Technical Advisory was issued with its recommendation to paint the steel below the joint, it may be necessary to paint steel that has been contaminated with the salt water coming through the joint. Recommended paint systems for this application are included in the FHWA Research Report RD-92-055 "Maintenance Coating of Weathering Steel: Field Evaluation and Guidelines".

Eagle Canyon Bridge in Utah

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