A PAINT SYSTEM FOR THE BENJAMIN HARRISON BRIDGE

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RECOMMENDATION FOR PAINTING THE BENJAMIN HARRISON BRIDGE

It is the belief of the authors that for a corrosive environment such as the one that surrounds the Benjamin Harrison Bridge the following paint system will give optimum protection:

1. Surface preparation — near white blast clean surface in accordance with specification SSPC-SP10.

2. Primer — at least 2.5 mils (or more, if recommended by the manufacturer) of approved zinc-rich paint (example: SSPC-PS 12.00) should be applied.

3. Finish coat(s) — vinyl paints in accordance with specification SSPC-PS 4.00.

Mr. John Keane of the Steel Structures Painting Council, author of National Cooperative Highway Research Program Report 74, "Protective Coatings for Highway Structural Steel" recommended the following companies:

1. Koppers Company,

2. Ameron Industries, and

3. Carboline.

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INTRODUCTION

The Benjamin Harrison Bridge was constructed between 1964 and 1967 at a cost of over $5 million and was opened to traffic in 1967. It replaced the Jordan Point Ferry across the James River on Route 156 approximately two miles downstream from Hopewell. Route 156 is a connector route between Route 5 north of the river and Route 10 south of the river. The bridge, a vertical lift span type, consists essentially of three spans — two anchor spans and a lift span — plus a concrete approach trestle from each end. The overall length of the bridge is 4,463 feet and the width is 26 feet. The steel portion of the bridge is 1,074 feet in length, and with the lift machinery and towers has a maximum height above sea level of nearly 200 feet. In the fixed position (down) the bridge is 50 feet above mean high water over the shipping channel and in the lifted position the lift span is 145 feet above mean high water. Vehicular clearance on the truss itself is 16 feet. The bridge averages from 3 to 4 lifts in a 24 hour period and the average daily traffic (ADT) in 1970 was 2,240 vehicles.

The bridge is located close to several large chemical plants which produce a corrosive environment (see Figure 1).

STATEMENT OF PROBLEM

The paint system on a bridge, under normal conditions, should have a minimum life of ten years and it is desirable to have the paint last longer. The paint on the Benjamin Harrison Bridge is peeling (Figures 2, 3, and 4), and numerous rust spots (Figures 5, 6, and 7) are showing through after four years of service, and upon inspection it became obvious that the life expectancy of the paint will not be met.

The reasons for this seem to be twofold — (1) the structure is exposed to rather severe corrosive fumes from the nearby chemical plants (no special paint system was designed for this type of environment), and (2) the 1958 specification that the bridge was painted under appears not to give sufficient protection over a long period of time. Mr. J. A. Tavenner, district bridge engineer in the Richmond District, stated that he has had 35 bridges repainted on I-95 and I-85, several whose ages were from 6 to 8 years, that had been painted under the 1958 specification. It is his opinion that the number 10 exterior white paint used did not bond well with the other coats.

INVESTIGATION AND RECOMMENDATION

In order to find out what was causing the paint failure on the Benjamin Harrison Bridge, two trips to the bridge and surrounding area were made. These field inspections revealed that the west side of the bridge — the side facing the chemical plants — was noticeably more corroded than the east side. The prevailing wind is from the direction of the plants, and the difference in the extent of corrosion of the two sides of the bridge clearly indicates that the fumes being discharged by the chemical plants produce an accelerated failure of the paint.

The chemical plants are discharging chemical substances such as sulfur dioxide, nitrogen dioxide, and particulate sodium hydroxide, which can cause damage to paint. The corrosiveness of these substances is strengthened by the presence of moisture in the atmosphere; this fact is manifested in the more rapid corrosion of surface areas where rain water is trapped. The retained water provides excellent contact between the corrosive substances and the paint, leading to the rapid deterioration of the latter. Sulfur dioxide is partially oxidized in the atmosphere to sulfur trioxide, which then combines with moisture to form a mist of sulfuric acid that can directly attack the paint. Nitrogen dioxide attacks in the same manner. The mechanism of attack for sodium hydroxide proceeds by the reaction of sodium hydroxide with sulfuric acid to form a metallic salt — sodium sulfate. It has been proven that metallic salts damage paints.[1] For the type of environment that the Benjamin Harrison Bridge is exposed to the Steel Structures Painting Council (SSPC) recommends the following:

1. Surface preparation — near white blast cleaners of surface in accordance with their specification SSPC-SP10.

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(1) Stern, A. C., Air Pollution, Academic Press, New York, 1968, Volume 1, p. 635.

2. Primer — at least 2.5 mils (or more, if recommended by the manufacturer) of approved zinc-rich paint (example: SSPC-PS 12.00) should be applied.

3. Finish coats — vinyl paints in accordance with specification SSPC-PS 4.00.

This paint system corresponds to the system of proprietary products recommended by the Highway Department's Materials Division. However, because policy encourages the procurement of materials and the performance of work on an open competitive basis, it is believed preferable to stipulate paint systems with adequate specifications such as those of the Steel Structures Painting Council.

Although expensive, blast cleaning is the best surface preparation. In areas where a paint life of 5 years or less is being obtained, blast cleaning can be justified economically since it gives a longer paint life and greater uniformity. It gives such good performance that in this country about one-fifth of the states require blast cleaning and another one-fifth are considering it.

Zinc-rich paints are the one new type most frequently used in corrosive environments. They provide tough protection to steel by virtue of galvanization. There are two principal types of zinc-rich coating systems — organic and inorganic; the former require better surface cleanliness and are generally less resistant to solvents and chemicals. There is a wide variation — from excellent to mediocre — in the quality of protection obtainable from the numerous zinc-rich products now available. For this reason, it is important to follow the requirements stated in SSPC-PS 12.00.

Vinyl paint is the best topcoat for chemical environments. In a survey conducted by an independent consultant, it was found that vinyl paint systems had far more case histories of long paint life than any other system.[2] In selecting a vinyl paint for finish coating over a zinc-rich paint, one must be aware of the danger of a potential incompatibility between the two systems. Therefore, no combination should be used without the manufacturer's recommendation. The instructions of the manufacturer should be carefully followed, especially in regard to film thickness, since paint film thickness and uniformity correlate directly with performance.

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(2)Keane, John D., "Protective Coatings for Highway Structural Steel," National Cooperative Highway Research Program Report No. 74, Highway Research Board, Washington, D. C., 64 pp.

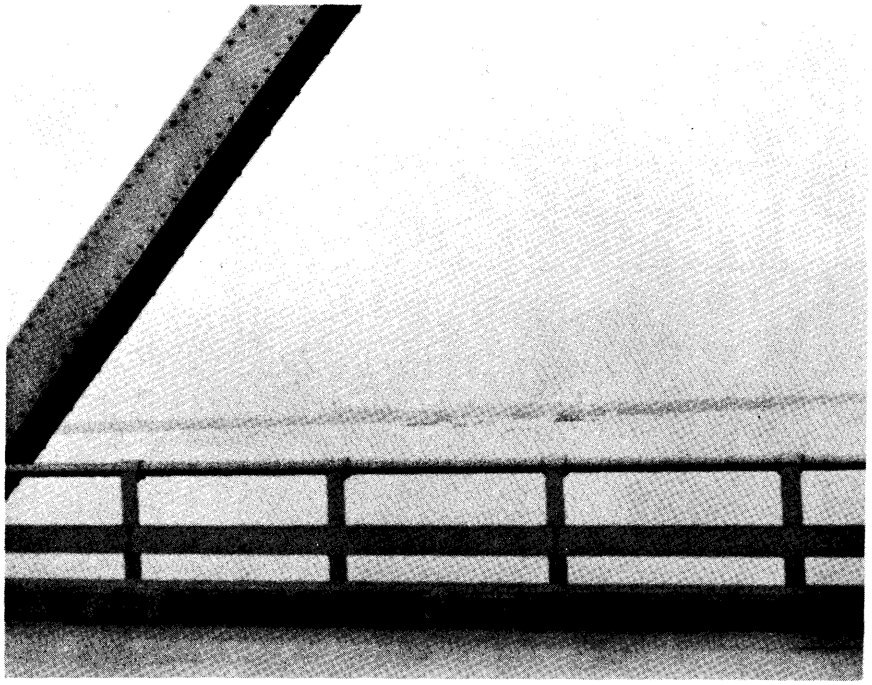

Figure 1. Chemical plants as seen from bridge.

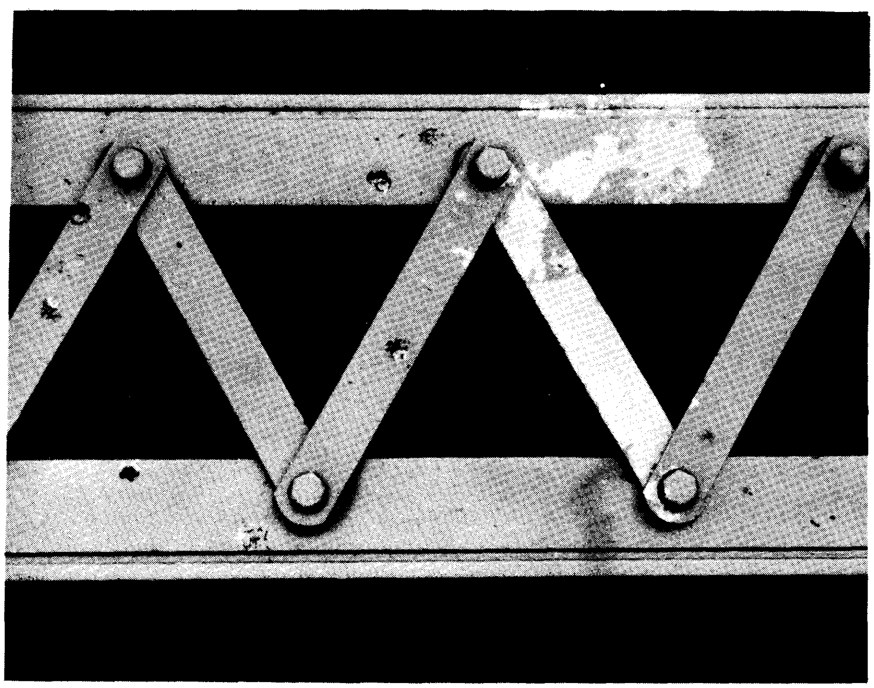

Figure 2. Paint peeling from bridge beam.

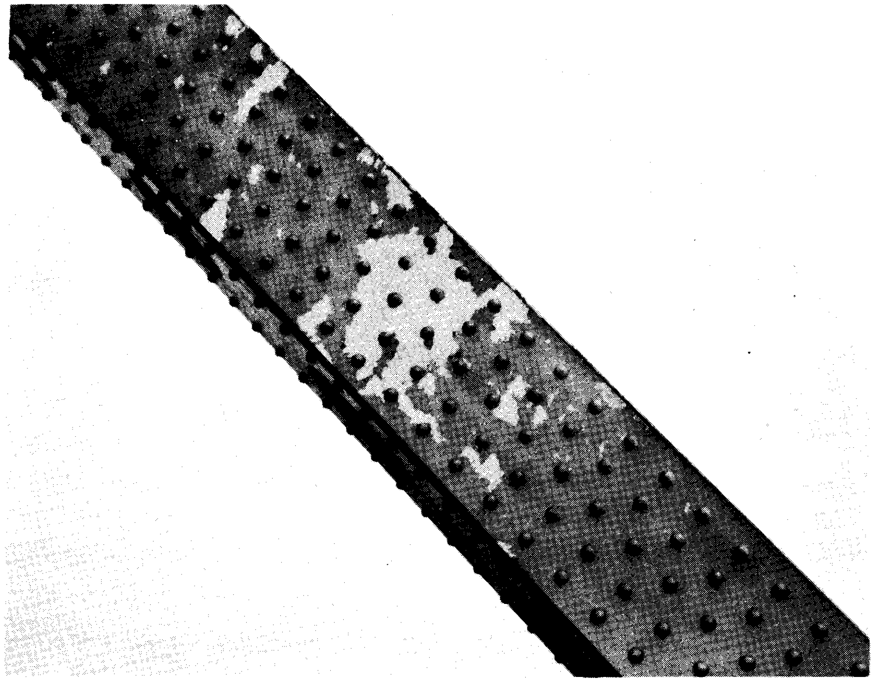

Figure 3. Paint peeling from bridge beam.

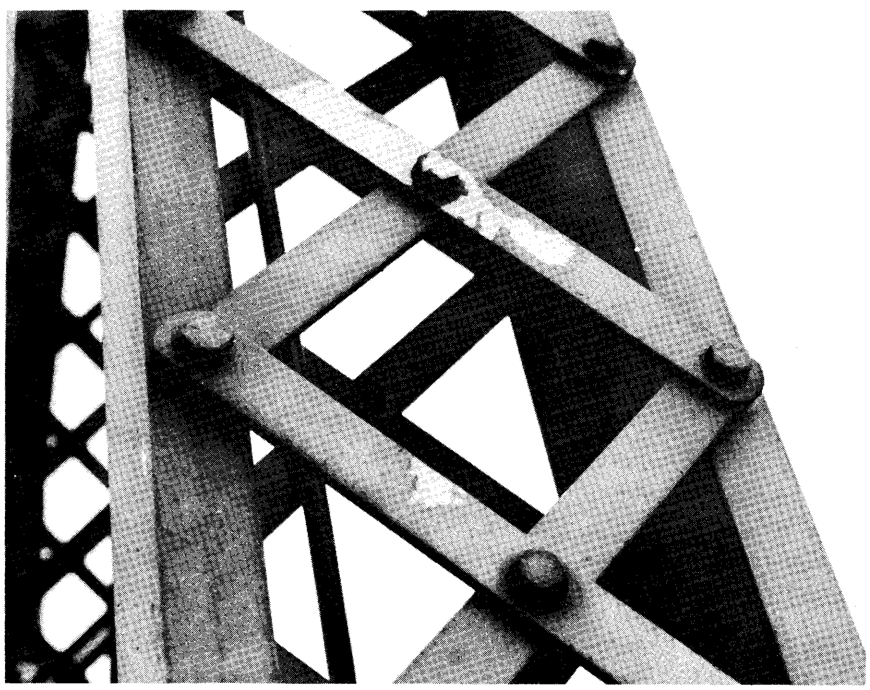

Figure 4. Paint peeling from bridge beam.

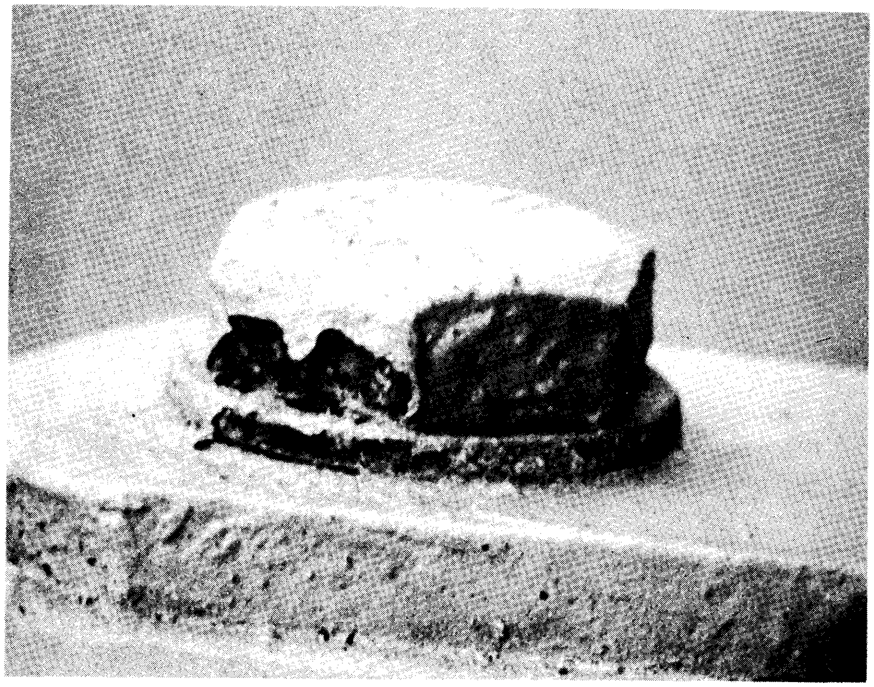

Figure 5. Rust action on bolt.

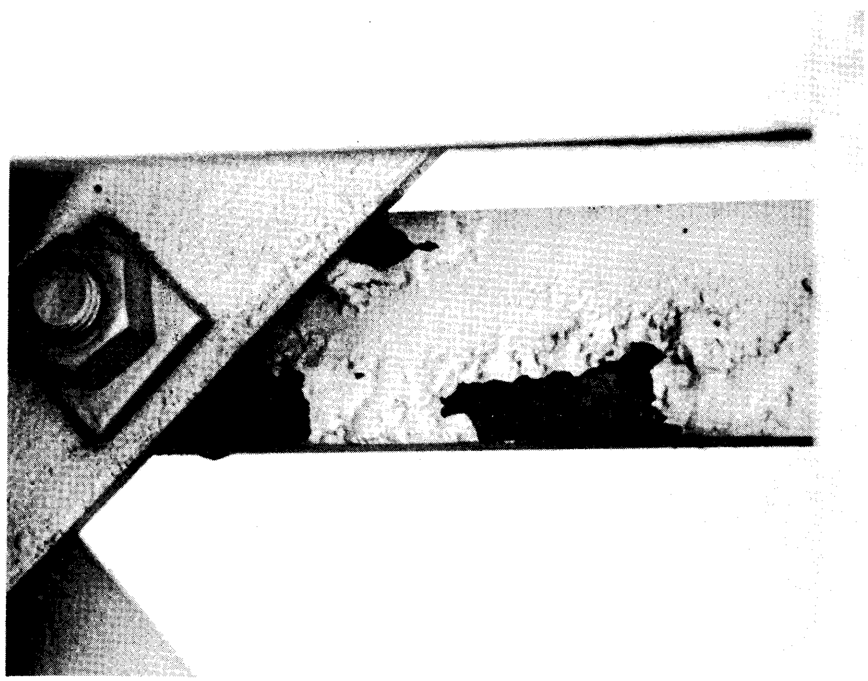

Figure 6. Rust action on beam.

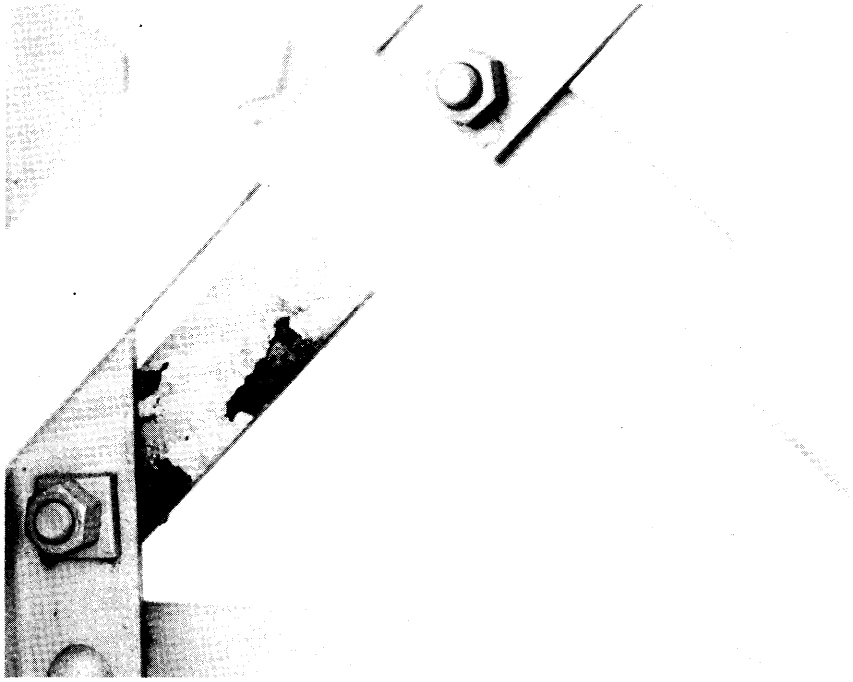

Figure 7. Rust action on beam.