

Investigation Report of Choshi Ohashi Bridge

June 2002
Mighty Corporation

1. Purpose of Field investigation

At the request of the Choshi Ohashi Bridge Section of the Chiba Prefecture Civil Engineering Office, the condition of the Choshi Ohashi Bridge was investigated because there appeared to be corrosion on the area coated with Mighty Coat CF-CP. Mighty Coat CF-CP was applied in 2001; the bridge was coated originally with Fluorine Resin in 1991.

Investigation Date: April 24, 2002
Investigator: Mr. Gotan, President of Mighty Corp.
Official Observers: Mr. Kiuchi Engineer of Chiba Prefecture
Mr. Uchiike, Section head of Miyaji Maintenance
Uemura, President of Keep-Earth Corp.

This report presents the field investigation results and recommendations for Choshi Ohashi Bridge.

2. Present Status of Choshi Ohashi Bridge

(a) Problematic application of a very thick Fluorine Resin coating on 1991

In 1991, a very thick Fluorine Resin paint was applied on the entire bridge structure, at a coating thickness of approximately 1 mm thickness. This coating resulted in the following issues:

Many cracks were observed on the Fluorine Resin coated surface. (see Photos1 and 2)

- 1) The adhesion between the Fluorine Resin coating and steel structure had been compromised, and when hammering lightly or applying light pressure to the surface, the coating flaked away. It was also easily peeled off in layers (see Photo 5)
- 2) After removing, it was clear that rainwater had penetrated into the gap between the Fluorine Resin coating and steel structure.
- 3) Due to the penetration of the moisture, the steel structure corroded. The

swelling caused by the corrosion further damaged the bonding plane, which allowed more moisture to penetrate, creating more corrosion, more expansion and so on in a vicious cycle.

- 4) The rainwater and rust which formed between the Fluorine Resin coating and the steel structure flowed down through the clearance between the coating and the structure, and accumulated at the connection points of the gusset plate and slope structure, which caused additional corrosion at this point (see Photo 4).

(b) Problematic areas of Mighty Coat CF-CP on flaking surfaces

Mighty Coat CF-CP was applied to the deteriorated and corroded areas coated with Fluorine Resin paint, without first removing the Fluorine Resin paint. A typical example is seen in Photo 7. Here, Mighty Coat CF-CP was not applied directly on the steel surface. Additionally, as shown in Photo 5, Mighty Coat CF-CP was applied across the entire steel structure's edge, where the Fluorine Resin layer was flaking, but was not removed prior to applying Mighty Coat CF-CP. Some existing cracks in these areas were not filled prior to applying, or corrected with the application of, Mighty Coat CF-CP, so rainwater was able to penetrate these openings. Typically, rust formed on the areas coated with Mighty Coat CF-CP as follows:

- 1) After coating Mighty Coat CF-CP, metal particulates accumulated in some areas where the surface was prepped with an electrical sander disc and not properly cleaned afterwards. The metal particulates corroded on the surface where Mighty Coat CF-CP had been applied; rust was easily removed by wiping with a cloth.
- 2) Rainwater penetrated cracks on the Fluorine Resin coating and reached the steel structure and the rust surfaced through the Mighty Coat CF-CP and/or Fluorine Resin coating layers. As the result, it appeared that the rust formed on the Mighty Coat CF-CP as seen in Photo 4.
- 3) Mighty Coat CF-CP was applied to the bolt heads, where corrosion was observed. This may have occurred due to a possible short supply of Mighty Coat CF-CP. The Fluorine Resin coating was not removed and Mighty Coat CF-CP was applied on top of the original Fluorine Resin coating. In addition, there were fissures in the Fluorine Resin coating which were not closed with Mighty Coat CF-CP. This was established when the Mighty Coat CF-CP was removed from the bolt head, as shown on Photo 6.
- 4) Mighty Coat CF-CP was applied to the top edge of steel plate. However, the cracks on the top side of the surface were not sufficiently closed. Rust formed in these areas and/or where the rainwater penetrated the cracks and

flowed to the lower edge of the structure and accumulated, as shown on Photo 3.

- 5) It appeared that rust also formed at the edge of gusset plate, as shown on Photo 4. Here, Mighty Coat CF-CP was applied without first removing the Fluorine Resin coating layer. Rust formed at the top edge of the gusset plate. As seen in Photo 4, the amount of Mighty Coat CF-CP was not sufficient. As a result, the red coloration of the Fluorine Resin coating was observed through the Mighty Coat CF-CP layer, which gave the appearance of corrosion on the surface of Mighty Coat CF-CP.
- 6) General observation indicates that Mighty Coat CF-CP was applied on the surface for corrosion prevention without consideration for the coating amount and without properly preparing the surface or removal of the heavy, flaking layer of existing corrosion.

3. Possible future action

During this investigation, only a portion of the areas where Mighty Coat CF-CP was applied were observed, so it is difficult to draw conclusions for the entire project based on these observations. However, based on the information gathered at those sites, the following recommendations for repair can be made.

It is clear that the Fluorine Resin coating layer had many cracks and did not adhere well to the surface of the steel structure, thereby causing the coating's failure in protecting and adhering to the steel surface. The rainwater infiltrated the cracks and got between the Fluorine Resin coating and steel surface and caused corrosion on the steel surface. As the surface corroded and the rust expanded, it caused additional issues by separating the Fluorine Resin coating layer from the steel surface.

The coating needs to be tightly bonded with the steel surface in order to maximize protection. The Fluorine Resin paint may not have any anti-corrosion abilities, but would protect from corrosion by blocking water penetration, if it is properly bonded to the steel surface. However, once cracks form, it will no longer form a protective barrier and act as an anti-corrosion layer. For reinforcement purposes, all of the flaking layer should be removed and then Mighty Coat CF-CP applied. Of course, if the Fluorine Resin coating has a good bond with the original steel surface and is not compromised, it does not need to be removed before applying Mighty Coat CF-CP.

In this case, the primary cause for corrosion appearing where Mighty Coat

CF-CP was applied was due to poor preparation of the surface and applying the Mighty Coat CF-CP directly on the Fluorine Resin coating layer. Mighty Coat CF-CP will prevent corrosion through its strong alkaline nature connecting directly with the steel surface. However, if it is applied on top of another layer which is flaking cracked or otherwise not perfectly sealed, rainwater will infiltrate the layers and Mighty Coat CF-CP will not provide protection. In the case of the Choshi Ohashi Bridge, the Fluorine Resin was applied so thickly that the difference in the thermal expansion between the steel and the Fluorine Resin was probably great enough to cause the Resin to crack.

In this investigation, the flaking layer shown in Photo 3 was so wide that it could not be removed due to a short supply of Mighty Coat CF-CP at the site. The repairs performed because of the damages caused by the reasons mentioned above were limited to small areas due to time limitations, but can be seen in Photo 5 (corroded area) and Photo 7 (repair).

In Photo 5, it is clear that rainwater infiltrated the area between the steel surface and the Fluorine Resin. To repair this, it was necessary to remove all of flaked Fluorine Resin coating and, after cleaning the steel surface, Mighty Coat CF-CP was applied to the clean surface. Depending on the schedule to replace the existing bridge, some type of anti-corrosion work will be necessary to preserve the structure for its remaining years. If Mighty Coat CF-CP is applied for anti-corrosion, the following points need to be considered.

The proper amount of Mighty Coat CF-CP, per the manufacturer's specifications, should be applied on the steel surface after removing the Fluorine Resin coating and thoroughly cleaning up the rust flakes. Mighty Coat CF-CP should not be painted over the flaking Fluorine Resin coating. If you paint it over the compromised Fluorine Resin coating, the steel surface will be continuously corroded by rainwater which will penetrate the imperfections in the Fluorine Resin layer. The following steps must be complied with.

- a) All flaking Fluorine Resin coating must be removed.
- b) Level 3 cleaning of floating and flaky corrosion should be completed after removing the layer.
- c) Remove the rust powder using a metallic brush or broom.
- d) Apply the proper amount of Mighty Coat CF-CP with a brush or roller, per the manufacturer's directions.

If the above steps cannot be carried out, the second choice would be to completely seal the cracks prior to applying Mighty Coat CF-CP; however, this is a temporary solution only.



Photo-1 Defective points of Fluorine Resin coating



Photo-2 Crack of Fluorine Resin coating



Photo-3 Removal of Fluorine Resin coating layer



Photo-4 Corrosion of gusset plate edge

Fluorine Resin coating

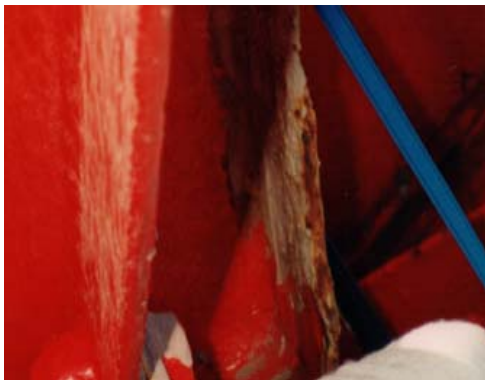


Photo-5 Corrosion under Fluorine Resin layer



Photo-6 Corrosion where bolt head was removed

Rust came up through the hole made by the shortage of Mighty Coat CF-CP



Photo-7 After repainting with Mighty Coat CF-CP