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Artikel: Rehabilitation of prestressed concrete bridge deteriorated by salt (Japan)
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3. Rehabilitation of Prestressed Concrete Bridge Deteriorated by Salt (Japan)

All structures located on the coastline are likely to be subject to damage by blown salt.

Even the prestressed concrete structures conventionally said to be «maintenance-free» are damaged by blown salt and recently, rehabilitation works for maintenance of these structures have been started.

Two cases of rehabilitation for a prestressed concrete roadway bridge deteriorated by salt will be explained hereafter.

Case 1 Nadachi Bridge, Niigata

Owner: *Ministry of Construction*
Engineer & Contractor: *Kawada Construction*
Work's duration: *7 months*
Date of repair: *1982 – 1983*

The Nadachi bridge is a T shaped prestressed concrete simple girder bridge, completed in 1962. The bridge is 70 m long consisting of three 22.7 m span and has a 7.7 m road width.

According to inspection test carried out in 1982, cracks and stripping were discovered mainly along the longitudinal reinforcements of the main girder lower flange. Corrosion seepage from these cracks and stripping were noticed at many places. These are the typical characteristics of damages on most concrete structures in the area affected by blown salt.

In planning the work, the rehabilitation procedure was reviewed based upon the following two concepts:

a) the procedure should be capable of preventing further permeation of salt and moisture into the structure and of slowing down or restricting the rate of progress of damages to a minimum, and
b) the procedure should be capable of rehabilitating the deteriorated girder sections which have fallen off or cracked.

Based on the above, it was decided to coat anti-corrosive paints to the whole of this bridge to cope with a), and also to rehabilitate the deteriorated member sections to their original design dimensions by adjusting the surface evenness of girders and by repairing the member sections with resin mortar or resin concrete to cope with b).

In the actual rehabilitation procedure, the cracked concrete portions, portions with corrosion seepage and stripped portions (these areas have lost their strength and were acting only as loads on defected girders) were removed, then salt and debris stuck to the surface of steel members and concrete were removed by sandblasting . In addition, a modified epoxy resin paint was applied to the surface of steel reinforcements and cables, then the concrete that was lost was restored.

Epoxy resins were used for rehabilitating the concrete. Porous concrete surfaces and uneven portions were corrected by epoxy resin mortar mixed with sand; to make a good surface for paints. Epoxy resin prepacked concrete method was adopted for continuous or large sections that had fallen off. In this case formwork was attached and filled with dry aggregate and then epoxy resin grout was applied.

Upon completion of the rehabilitation of sections performed as stated above, an anti-corrosive paint was applied to prevent corrosive materials from penetrating.

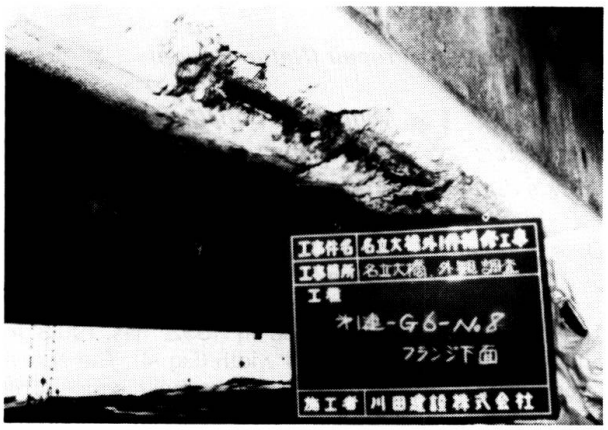

Fig. 1 Detoriation of flange (Nadachi Bridge)

Fig. 2 After repair (Nadachi Bridge)

In applying anti-corrosive paints to these concrete structures having the normal surfaces not treated with paint, there were many unknown points, and it was thought to be important to conduct a research on the suitable kinds of anti-corrosive paints. Thus, four kinds of paints shown in Table 1 were applied to the rehabilitated bridge. Generally, for a structure into which salt has already penetrated, the salinity will vary depending on the location of the portion to be painted, so that the effect of painted material varies by the location. Thus the effect at different places cannot be compared on the same basis. Therefore, concrete slabs painted with four different kinds of paints and unpainted concrete slabs were exposed below this bridge (Fig. 1 and 2).

Effect of these painted materials will be confirmed by examining the atmospheric exposure test samples several years later.

(Shoji Miyazaki)

flake glass epoxy paint			
No.	paint system	quantity (kg/m^2)	stage of work
1	epoxy primer	0.15	primer
2	epoxy putty	0.40	putty
3	flake glass mixed epoxy	0.90	2nd
4	flake glass mixed epoxy	0.90	3rd
5	urethane	0.15	4th
6	urethane	0.15	finish

glass cloth reinforced non solvent epoxy paint			
No.	paint system	quantity (kg/m^2)	stage of work
1	epoxy primer	0.15	primer
2	epoxy putty	0.40	putty
3	F.R.P. 1st	2.00	2nd
4	F.R.P. 2nd	1.00	3rd
5	urethane	0.15	4th
6	urethane	0.15	finish

flake glass vinylester paint			
No.	paint system	quantity (kg/m^2)	stage of work
1	epoxy primer	0.15	primer
2	flake glass filled vinylester resin putty	0.40	putty
3	flake glass filled vinylester resin 2nd	1.00	2nd
4	flake glass filled vinylester resin 3rd	1.00	3rd
5	urethane	0.15	4th
6	urethane	0.15	finish

soft type non solvent polybutadien paint			
No.	paint system	quantity (kg/m^2)	stage of work
1	epoxy primer	0.15	primer
2	epoxy putty	0.40	putty
3	polybutadien	0.80	2nd
4	polybutadien	0.70	3rd
5	urethane	0.15	4th
6	urethane	0.15	finish

Table 1 Paint list (Nadachi Bridge)

Case 2 Oyataroh Bridge, Miyazaki

Owner: *Ministry of Construction*
Contractor: *Fuji P.S. Concrete*
Sho-Bond Construction
Work's duration: *1 year*
Date of repair: *1985 – 1987*

The Oyataroh bridge is a T shaped prestressed concrete simple girder bridge, completed in 1975. The bridge is 116.9 m long consisting of four span and has a 10.0 m road width.

The inspection carried out in 1985 revealed damages typical of salt deterioration such as cracked concrete along the transverse reinforcement at the lower flange of main girders, concrete stripping and rust. Furthermore, inspection by breaking the concrete revealed that in some cases 2 cables were broken among the 12 cables that are used.

The same repair method was applied as for Nadachi bridge. Cracked or stripped concrete areas were removed, sandblasted, resin paint applied on steel and concrete restored to its original dimension with epoxy resin mortar by the prepacked concrete method. To repair broken cables, reinforcement methods by adding external cables were studied. Considering the present traffic and other conditions of this bridge, it was decided that the present strength is sufficient and that further reinforcement will not be needed.

The anti-corrosive paint applied is as follows: the first coat is epoxy resin primer; second, third and fourth coat is polybutadien resin paint; finish coat is polyurethane resin.

(Norio Morinaga)

Fig. 3 Crack at lower flange (Oyataroh Bridge)

Fig. 4 After repair (Oyataroh Bridge)