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Autor(en): **Konishi, Ichiro / Okumura, Toshie / Susei, Shuzo**

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Maintenance-free Bridges

ICHIRO KONISHI
Professor Emeritus
Kyoto University
Kyoto, Japan

TOSHIE OKUMURA
Professor Emeritus
University of Tokyo
Tokyo, Japan

SHUZO SUSEI
Manager
Technical Institute
Kawasaki Heavy Inds.
Kobe, Japan

KAZUHIKO YOSHIDA
Manager
Kobe Shipyard & Engine Works
Mitsubishi Heavy Inds.
Kobe, Japan

1. INTRODUCTION

In the future subject for the construction of steel bridges, we shall consider as one of the most important problems, the maintenance-free-method to minimize the repainting cost for steel bridges. The Hanshin Expressway Public Corporation has been studying the standard of non painting use in atmospheric corrosion resisting steel. In this paper, we will describe the outline of experimental bridge which was recently built by the Hanshin Expressway Public Corporation.

2. OUTLINE OF THE BRIDGE

Name of bridge	.....	off ramp of Dejima in Osaka bay route
Type of bridge	.....	three span continuous, non-composite, I-section plate girder
Length of bridge	.....	31 + 36 + 31 = 98 m
Width of bridge	.....	7.500 m
Weight of bridge	.....	approximately 118 tons

3. SPECIFICATION OF MATERIAL AND TEST RESULT

Table-1 shows the Japanese standard specification for the atmospheric corrosion resisting steels. These steels are not specified to use with no painting system. The Technical Committee of the Hanshin Expressway Public Corporation has recommended a tentative standard for the atmospheric corrosion resisting steels without painting, which are shown as Table-2.

TABLE I CHEMICAL COMPOSITION (JIS G 3114)

Classification	Symbol	Chemical Composition (%)							
		C	Si	Mn	P	S	Cu	Cr	Others
Class 1	SMA 41 A·B·C	0.20 max	0.35 max	1.40 max	0.040 max	0.040 max	0.20 to 0.60	0.20 to 0.65	–
Class 2	SMA 50 A·B·C	0.19 max	0.75 max	1.40 max	0.040 max	0.040 max	0.20 to 0.70	0.30 to 1.20	One or more elements among Mo, Nb, Ni, Ti, V and Zr shall be added.
Class 3	SMA 58	0.19 max	0.75 max	1.40 max	0.040 max	0.040 max	0.20 to 0.70	0.30 to 1.20	One or more elements among Mo, Nb, Ni, Ti, V and Zr shall be added.

Remark: Alloy element other than those in the above table may be added as required.

TABLE 2 CHEMICAL COMPOSITION
(HANSHIN EXPRESSWAY PUBLIC CORPORATION TENTATIVE STANDARD)

Group	Symbol	CHEMICAL COMPOSITION (%)						
		C	Si	Mn	P	S	Cu	Cr
High Cu, Cr Group	H-SMA 41	0.19 max	0.15 to 0.35	1.40 max	0.035 max	0.035 max	0.25 to 0.50	0.40 to 0.70
	H-SMA 50	0.19 max	0.25 to 0.75	1.40 max	0.035 max	0.035 max	0.25 to 0.50	0.40 to 0.70
Low C, High Cu, Cr, P Group	H-SMA 41P	0.08 max	0.15 to 0.50	0.50 to 1.40	0.07 to 0.15	0.035 max	0.25 to 0.50	0.30 to 0.70
	H-SMA 50P	0.08 max	0.15 to 0.50	0.50 to 1.80	0.07 to 0.15	0.035 max	0.25 to 0.50	0.30 to 0.70

Remark: One or more elements among Mo, Nb, Ni, Ti, V and Zr shall be added.

Comparing these two tables, we can find that the capability of resisting to atmospheric corrosion is strengthened by means of increasing the contents of [Si], [Cr] and [Cu].

On the other hand, [Cu] and [Cr] decrease the weldability of steels. To solve this problem, Japanese five big steel makers proposed new type of steels by means of decreasing the contents of [C] as shown by Fig-1.

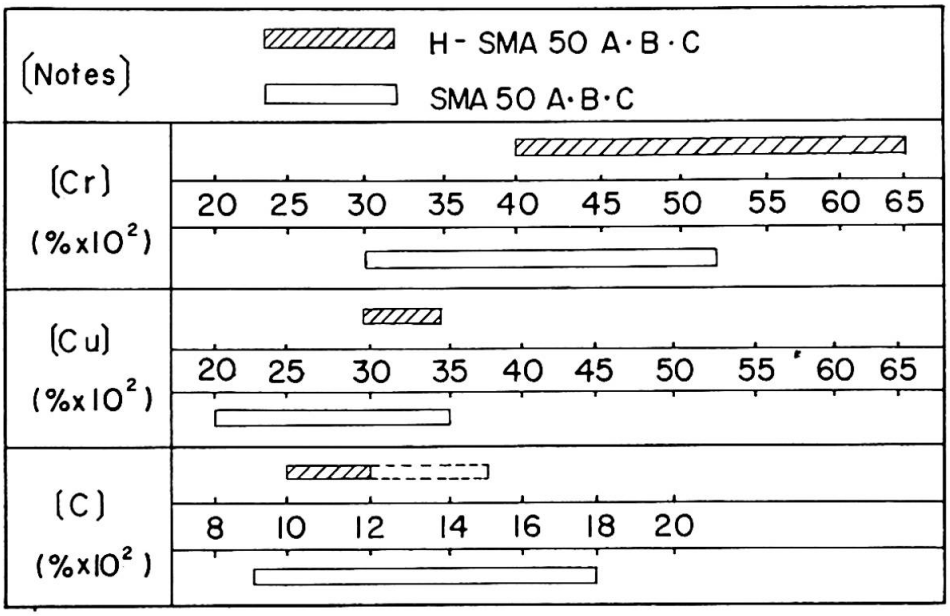

FIG.1 TEST RESULT OF CHEMICAL ANALYSIS (COMPARISON: H-SMA50, SMA50)

This steel has the same weldability and mechanical properties as weldable steel SM50, which has no anticorrosion contents of [Cu] or [Cr] as shown in Table-3 and Fig-2. Thus, a new low carbon type anticorrosion steel with good weldability has been established as the recommended material specification for the maintenance-free bridge.

TABLE 3 COMPARISON OF Ceq. AND Pcm VALUE.

Tensile strength level	Symbol	Ceq.(%) (ave)	Pcm(%) (ave)
41 to 52 (kg/mm²)	SM 41	0.299	0.196
	Special A·C·R·S	0.355	0.209
	H-SMA 41	0.358	0.184
50 to 62 (kg/mm²)	SM 50	0.410	0.247
	Special A·C·R·S	0.443	0.259
	H-SMA50	0.433	0.239

A·C·R·S: Atmospheric Corrosion Reseiting Steel

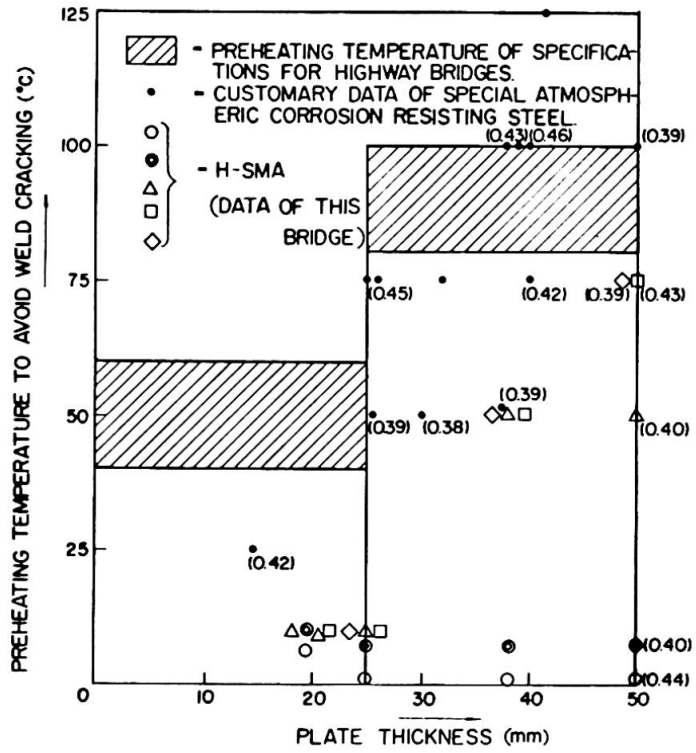

FIG.2 Y-SLIT CRACKING TEST RESULTS
(HT50, SHIELD METAL-ARC WELDING.)

4. SURFACE TREATMENT OF STEELS

One of the method to solve the initial rust problem is the chemical surface treatment to form the protective rust by the coating system shown below, and is sometimes applied in Japan.

1st stage ..... phosphate surface treatment

2nd stage ..... resin type coating (porous film)

Though this method has a weak point of its higher initial cost, but it is expected to be one of the answer for the initial rust problem.
The Hanshin Expressway Public Corporation decided to apply the method of chemical surface treatment to the half of area in the experimental bridge, and in the future, some conclusion will be obtained which of two is better, unpainted part or chemical surface treated part.

5. RESULT OF EXPERIMENTAL BRIDGE

Through the fabrication of experimental bridge, standard specification for the atmospheric corrosion resisting steels with good weldability has been established. The capability of the resisting corrosion will be tested during the later fifteen years both for the unpainted and phosphate treated parts. In the future, we expect the maintenance-free steel bridge from the technical data of the experimental bridge.