I-240 CORROSION DETERIORATION CHARACTERISTIC OF STEEL BRIDGES

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1. INTRODUCTION: Corrosion deterioration of steel bridge is investigated. Emphasis is placed on the evaluation of the amount of corrosion of plate girder bridge which is calculated based on steel exposure test, paint life and corrosion ratio. The effect of corrosion to the strength of bridge is also evaluated.

2. CORROSION OF BRIDGE STRUCTURE: Fig.1 shows the model for estimation of corrosion depth. Corrosion will occur after the finishing of paint life. Paint life is estimated based on investigated data collected by Japan National Railway.[1] Fig.2 shows an example of distribution of paint life for lower flange exposed in rural environment.

Long-term corrosion of naked steel can be predicted by Eq. of Horikawa.[2]

$$Y = A X^B \exp(C/X) \quad (1)$$

where Y:expecting long-term corrosion, X:exposure time, A,B and C : constants. Here based on steel exposure test, regression Eqs. for predicting corrosion for exposure period of 1,2,3,4 and 5 years are obtained. Eq.2 shows an example of these Eqs. for 5 years exposure time.

$$Y = 5793+131.5X_1-111.4X_2+0.503X_3+55.9X_4+7.57X_5 \quad (2)$$

where Y: expecting corrosion depth for 5 years exposure time(10^{-4}mm), X_1:temperature(°C), X_2: humidity(%), X_3:precipitation(mm/year), X_4:SO_2 (10^{-3}ppm), X_5:sea-salt particle(10^{-4}g/cm^{2}year). Applying data of X_1,X_2,X_3,X_4 and X_5 into these regression Eqs., expecting corrosion depths for exposure period of 1,2,3,4 and 5 years are obtained. Applying the results into Eq.1, parameters A,B and C can be estimated.

Corrosion ratio is estimated based on data of 5 bridges. Corrosion of steel for middle part at

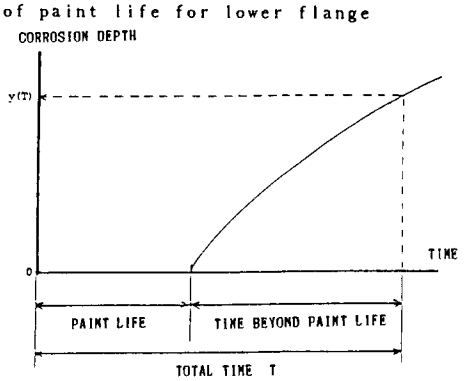

FIGURE 1 MODEL FOR ESTIMATION OF CORROSION DEPTH

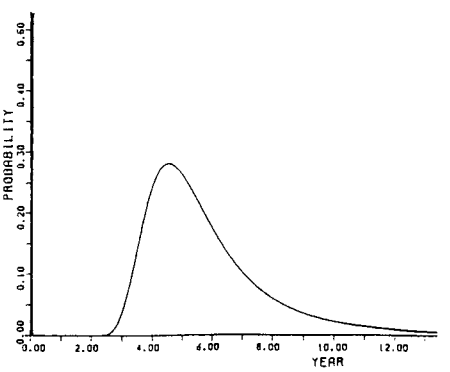

FIGURE 2 PROBABILITY DENSITY FUNCTION OF PAINT LIFE LOWER FLANGE, RURAL ENVIRONMENT

lower flange of external girder is considered to be the same as in exposure test. Fig.3 shows corrosion ratio for rural environment.

Based on these results, uniform and local corrosion are evaluated. Local corrosion is assumed to develop when average corrosion is 0.7 mm. Fig.4 shows the comparison of corrosion between estimated and measured values for lower flange exposed in certain rural environment.

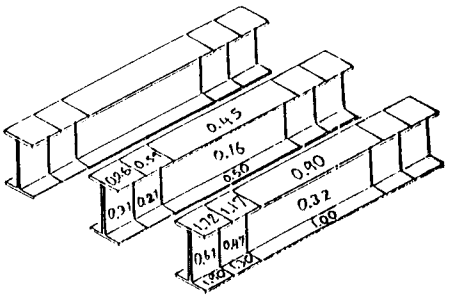

FIGURE 3 CORROSION RATIO, RURAL ENVIRONMENT

3.EFFECT OF CORROSION TO THE STRENGTH OF BRIDGE Stress ratio is the comparison of bending stress values between original materials and corroded materials. This value is used to measure the effect of corrosion to the strength of bridge. Fig.5 shows the girder section used in estimation. Results of estimation are shown in Fig.6.

4. CONCLUSION: Stress ratio was introduced as a performance index to evaluate the effect of corrosion to the strength of bridge. Corrosion of plate girder bridge was evaluated based on paint life, steel exposure test and corrosion ratio.

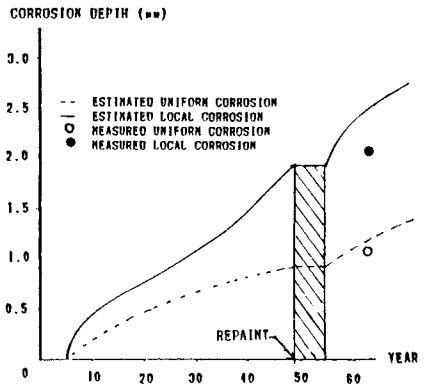

FIGURE 4 COMPARISON OF CORROSION BETWEEN ESTIMATED VALUES AND MEASURED VALUES (RURAL, LOWER FLANGE)

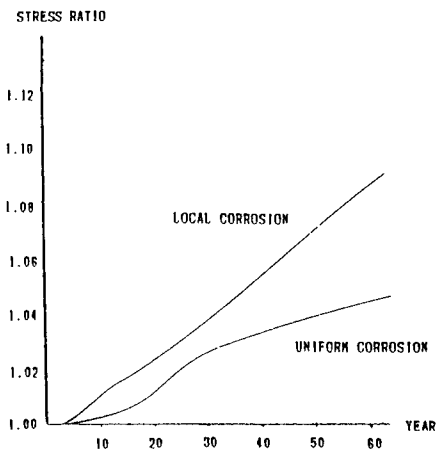

FIGURE 6 ESTIMATED STRESS RATIO AS A FUNCTION OF TIME RURAL ENVIRONMENT

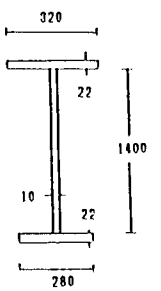

FIGURE 5 REPRESENTATIVE CROSS-SECTION OF GIRDER FOR ESTIMATING STRESS RATIO

5. REFERENCES:

1) Sato,Y.and Hashimoto,T.:Investigation on the corrosion of steel bridges and the method of maintenance painting; Railway Technical Research, Report No.392, Feb.,1947

2) Horikawa et al: Kakushu kinzoku zairyo oyobi boseihimaku no taiki fushoku ni kan suru kenkyu(No.5); Corrosion Eng.,Vol.16,1967,153-158