CORROSION DETERIORATION OF STEEL BRIDGES

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1. INTRODUCTION: The object of this study is to clarify corrosion deterioration characteristics of steel bridges. Because corrosion deterioration characteristics of bridge members are different depending on the parts of a bridge, therefore a survey of existing bridges is required in order to clarify the corrosion deterioration characteristics of all parts of a bridge.

2. CORROSION OF BRIDGE MEMBERS: First of all, qualitative data of corrosion of bridge members of 185 bridges are measured by means of rating number (RN). The RN used in this investigation is defined as follows:

RN	Meaning
A	Spot rust < 0.5 % of area or no rust
B	0.5 % ≤ Spot rust < 10 % of area
C	10 % ≤ Spot rust < 50 % of area
D	50 % ≤ Spot rust < 90 % of area
E	Spot rust ≥ 90 % of area or uniform corrosion over the surface
F	Initial local corrosion
G	Severe local corrosion (corrosion depth about 3 mm)
G'	very severe local corrosion (corrosion depth about 10 mm)

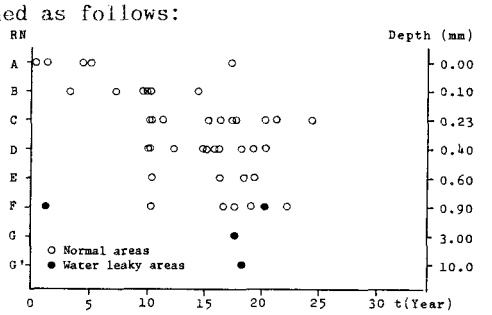

Fig.1 Qualitative data of corrosion
Middle span of external girder
Lower surface of lower flange
City environment

Based on this RN system, qualitative data of corrosion for 26 different parts of bridges are collected. Fig. 1 shows an example of the relationship between RN of steel corrosion and time after repainted. Vertical axis in the right-hand side of the figure represents the corresponding corrosion depth. Here, F represents the state of initial local corrosion that can be observed by eye, and corrosion depth of F should be greater than corrosion depth at the actual state of local corrosion that was reported as 0.7 mm [1]. Consequently, corrosion depth of 0.7 mm should fall between E and F. Based on this consideration, corresponding corrosion depth for RN of A to F are converted regarding to the fact that the degree of corrosion deterioration increases gradually from A to F.

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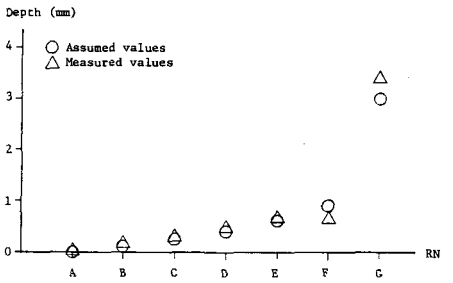
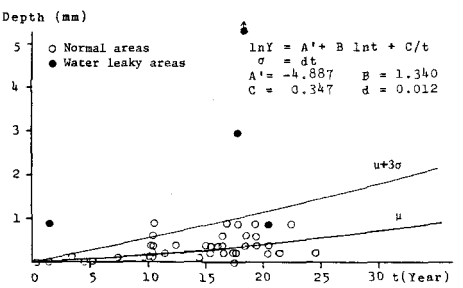
Next,plate thickness of 80 samples of corroded bridge members for each combination of RN (both sides of steel plate) are measured, and corrosion depth for each RN are determined. The results are shown in Fig.2. It is clearly shown that assumed values of corrosion depth accord well with measured values.



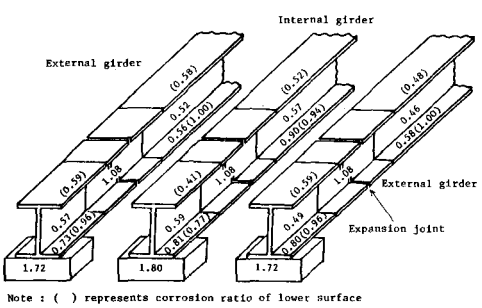
Fig。2 Corrosion depth for each RN of steel corrosion

Fig.3 is the replot of Fig.1. The relation between corrosion depth and exposure time is assumed as $Y = At^B \exp(C/t)$. Here, Y represents corrosion depth, t represents exposure time, A, B and C are constants. The scattering is assumed to increase proportionally to time. By the statistical analysis, predicting curves of corrosion depth are determined, and shown in the figure. Note that, the data of water leaky areas are not included in an analysis. From the results, corrosion ratios of bridge members are determined. Fig. 4 shows an example of the results. It is clearly seen that the most corrosive parts of bridges among 26 different parts are shoes of both internal girders and external girders.



Fig。3 Corrosion depth and time
after repainted
Middle span of external girder
Lower surface of lower flange
City environment

3. CONCLUSION:Corrosion deterioration of bridge members is different depending on the parts in the bridge. The comparative degree of corrosion deterioration can be concluded as follow:



Fig。4 Corrosion ratio for
normal areas
Marine environment

High rate in corrosion deterioration

Shoe	End of span	Internal girder
Expansion joint		
Lower flange		
Upper flange		
Web	Middle of span	External girder

Low rate in corrosion deterioration

4. REFERENCE: 1) E. Ito, Life estimation of corroded materials using the statistics of extremes, Proc. of the 41st Symp. on Corrosion Protection, 1976