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Corrosivity evaluation for each structural part of steel deck truss bridge before and after dam construction

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ABSTRACT

Recently, severe corrosion damage in steel structural members has been reported for various structural members and details. In this study, corrosivity of each structural part in steel structure was examined to quantifiably investigate and identify the micro-corrosion environment of structural member depending on before and after dam construction. Thus, atmospheric exposure tests were carried out for 1 years before and after dam construction. Their corrosion depth and their surface figurations of corroded surface were evaluated using a laser focus measuring system. In addition, the corrosivity in corrosive environment with and without vegetation was characterized by the output of the Atmospheric Corrosion Monitor (ACM) sensor.

1. INTRODUCTION

Importance of maintenance in steel structures is emphasized according to increase of their service time. Repainting on steel bridges are usually applied every 10 to 13 years after examination of deteriorated paint thickness on steel surface of the steel member by visual inspection (Japan Road Association, 2005). However, recently, severe corrosion damage in steel structural members has been reported for various structural members and details, failures of plate girder bridges and truss members have been occurred according to increase of their service time under corrosion environmental effects in Japan. In a previous study about corrosion damages in steel structure, it has been usually conducted to verify their corrosion durability using measuring the corrosion loss. However, (Kainuma 2012) have suggested that the evaluation method for mean corrosion depth was used by thickness of corrosion product layer. In this study, atmospheric exposure tests on uncoated carbon steel plates were conducted, to examine the corrosivity of structural part and to obtain the micro-corrosion environment of structural member depending on before and after dam construction. In addition, the corrosivity in corrosive environment with and without

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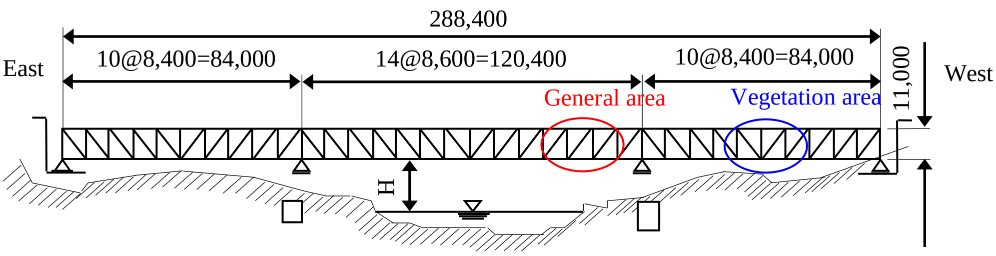
vegetation compared. It was chosen because their corrosivity were different and its effect on the corrosivity were examined.

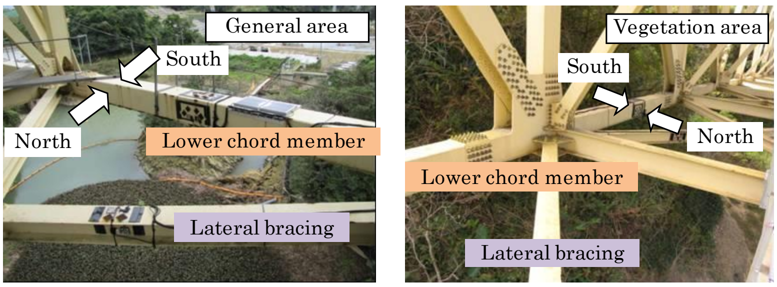
2. CORROSION ENVIRONMENT MONITORING AND EXPOSURE TEST

To examine the corrosivity and analysis of the affecting factors for corrosion in deck truss bridge depending on before and after dam construction, atmospheric exposure test was conducted in steel deck truss bridge on Okinawa Island, Japan (Latitude 26°47′N, Longitude 127° 93′E), which is about 1.5km from the coastline affecting by airborne sea salt, as shown in Fig. 1. Period of the exposure test was set to 1 year considering Japanese weather fluctuation throughout the four seasons. The specimens were manufactured according to Japanese Industrial Standard (JIS G 3106, 60×60× 3mm). In order to consider the various corrosion conditions based on the general, vegetation area and installation of steel structural members shown in Fig 2. Fig. 2 show the attaching positions for ACM sensors and test specimen, it is installed at in-outside of lower chord member. (Kainuma 2011, 2014) have evaluated on the corrosion depth by using ACM sensors.

Fig. 1 Before and after dam construction

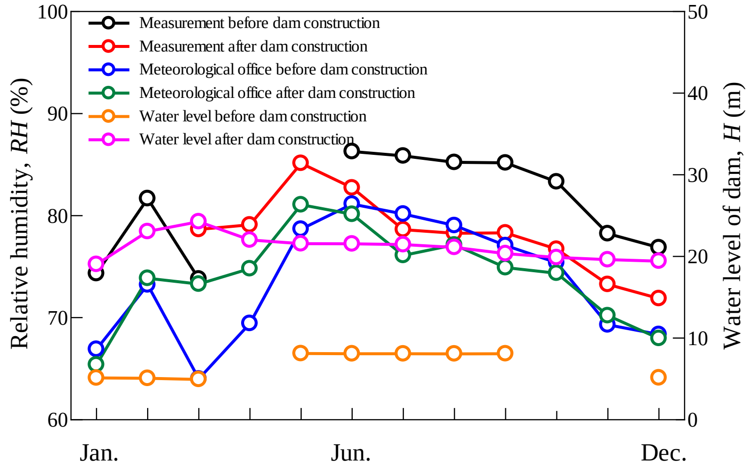


(a) Dimension of steel deck truss bridge (unit: mm)

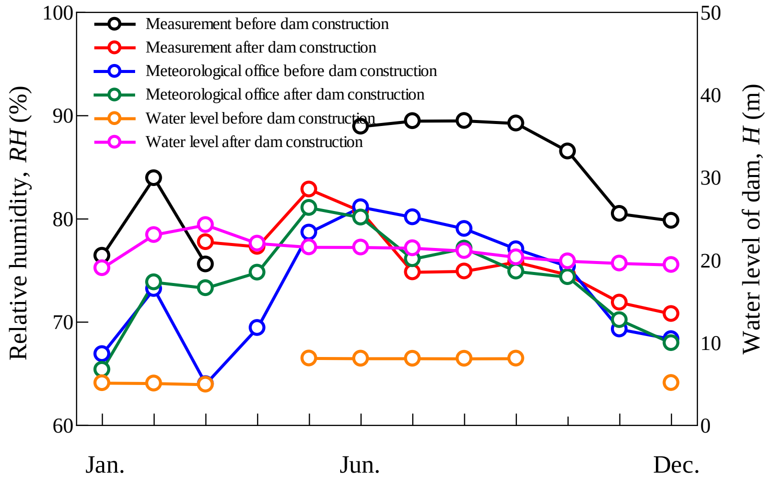


(b) Lower chord members and lateral bracing

Fig. 2 Test sep-up of test specimens and ACM sensors (Jeong 2014)



(a) General area



(b) Vegetation area

Fig. 3 Relative humidity for monthly average before and after dam construction

Their airborne sea salt was analyzed using dry gauze method (JIS Z 2382) for 1 year. The mean corrosion depth on corroded surface was calculated by weight loss after removal of the rust for each corrosion specimen. The corrosion behavior in general area and vegetation area was characterized by the output of the ACM sensors.

3. CORROSIVITY AND CORROSION FACTORS

Distance from lower chord members to the ground was measured about 20m before dam construction, but the distance changed about 10m accordance with rising water level by dam construction. The monthly temperature and relative humidity were similar before and after dam construction, however, the precipitation before dam construction was a little larger than after dam construction.

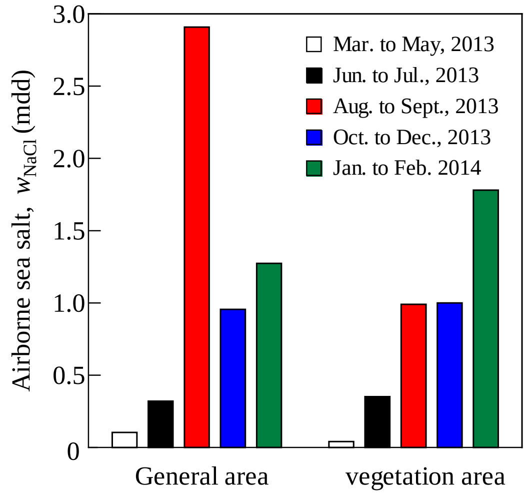


Fig. 4 Airborne sea salt after dam construction

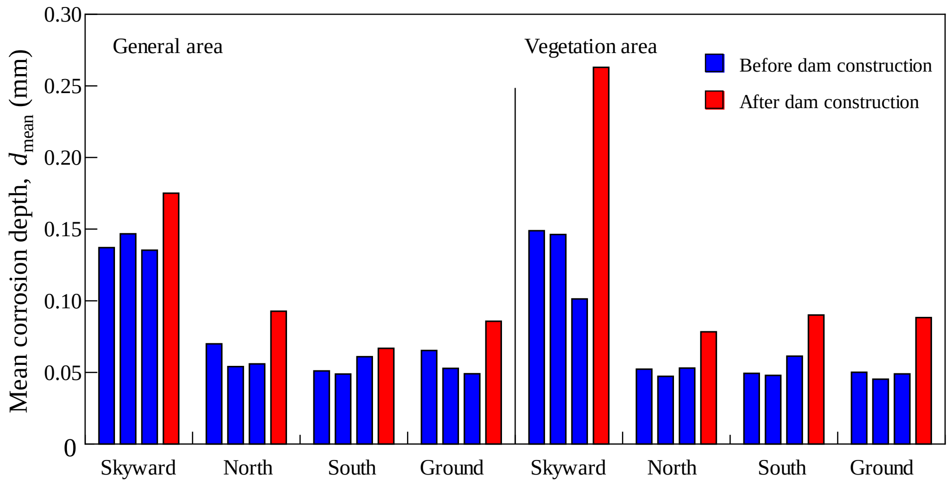
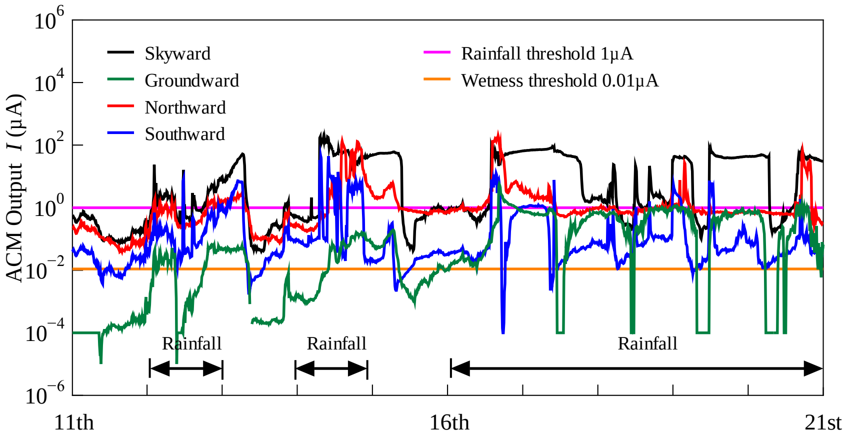
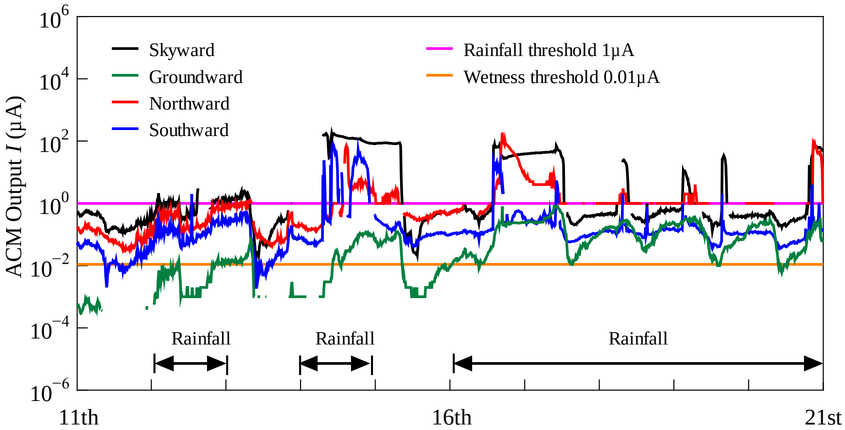


Fig 5. Mean corrosion depth

Fig. 3 shows comparing measured relative humidity for monthly average in lower chord member before and after dam construction. The relative humidity of the lower chord member after dam construction was 5 to 15% smaller than those of before construction. And vibration of relative humidity at vegetation area was larger than general area under lower chord member by before and after dam construction. The airborne sea salt of general and vegetation area was about 0.30mdd and 0.20mdd before dam construction and those of after dam construction shown in Fig 4. The airborne sea salt was increased by dam construction. It can be to increase ventilation depending on felled by dam construction.



(a) General area



(b) Vegetation area

Fig. 6 ACM sensor output in April

Fig. 5 shows that general area and vegetation area were compared with those of mean corrosion depth. From the results, the mean corrosion depth after dam construction was 1.3 to 2.0 times larger than those of before dam construction. It was shown to be similar tendency with airborne sea salt. The general area and vegetation area were compared with those of ACM sensor output for a month shown in Fig. 6. In case of rainfall, ACM sensor output was more than 1μA (rainfall threshold) on the skyward and the northward of lower chord member of general and vegetation area. However, those of the groundward and the southward were less than 1μA.

4. SUMMARY OF FINDINGS

The corrosivity of each structural part in steel structure was examined to quantitatively investigate and identify the micro-corrosion environment of structural member depending on before and after dam construction. The atmospheric exposure tests were carried out for 1 years before and after dam construction, it was examined in effect on the corrosivity with different micro-corrosion environment. Their corrosion depth and their surface figurations of corroded surface were compared depending on dam construction. The mean corrosion depth after dam construction was 1.3 to 2.0 times larger than before dam construction.

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