

Degradation factors of a metal spraying system for steel bridges

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ABSTRACT:

A metal spraying system applied to steel surface at room temperature had been developed about thirty years ago, and the system would not raise the steel substratum surface temperature. The system has been applied to approximately three thousand real steel structures construction in Japan.

The sprayed zinc-aluminum pseudo alloy in the system has superior corrosion prevention effect for a long-term based on sacrificial anodic protection and atmospheric isolation.

The outline, characteristics, steel corrosion prevention mechanism of the spraying system and the actual condition survey results of structures applied the system more than 10 years ago have been introduced in past IABMAS 2004, 2006, 2008 and 2010 proceedings. Furthermore, in 2012 proceedings the reference service life and a life cycle cost estimation of the spraying system had been discussed based on only limited data from three actual steel bridges applied the system.

In this paper, the actual condition survey results for 39 steel bridges applied the metal spraying system about 5 to 20 years ago in Japan (from Hokkaido to Okinawa) have been reported to discuss in more detail durability of the sprayed zinc-aluminum pseudo alloy onto steel bridges.

The surveyed bridges are in coastal zone, urban district and rural area. Classification estimation standard for degradation of the sprayed metal and coating on them has been established and deterioration degree has been quantitatively calculated. Deterioration phenomena for the evaluation includes coating blistering, cracking, peeling and substratum steel rust. After that, on-site visual observation of the bridge appearance has been carried out.

The overall evaluation is judged as falling into one of the four levels, A (Urgent repair), B (Quick repair as possible), C (Local repair) and D (Continue to monitor).

In addition, the surveyed subjects are classified using 4 elements (Vertical section, Horizontal element, Splice and Others) and is quantitatively calculated.

In order to estimate factors affecting the steel bridges deterioration, multiple regression analysis in a) and b) is used.

- a) Multiple regression analysis for all surveyed steel bridges, where the objective variable is the average of the total scores and the explanatory variable is the elapsed years and the distance from the coastline.
- b) Multiple regression analysis for bridges having visible deterioration, where the objective variable is the average of the total scores and the explanatory variable is the evaluation score of each element (vertical section, horizontal element, splice and others).

The results of surveys on the actual condition of steel bridges where a zinc-aluminum pseudo alloy metal spraying system was used at room temperature are as follows.

- 1) As an overall evaluation, out of the 39 cases, 35 cases fell into category D “(Continue to monitor)” and four cases fell into category C “(Local repair is required)”. All surveyed bridges, including bridges where the spraying was applied 20 years ago in coastal zone, have not reached a state requiring urgent repair (A). Therefore, it is judged that the metal spraying system at room temperature maintains excellent durability even in harsh environments such coastal zone.
- 2) As a result of the multiple regression analysis, the value $|t|$ is higher for distance from the coastline than for elapsed years, and the value $|t|$ is high in the order of horizontal elements, splice, others and vertical section.
It is found that the factors that have a major effect on the degradation of the sprayed metal film are not only the elapsed years since the spraying was applied but also the environment (distance from the coastline) where the bridge is located and the elements that compose the bridge.
- 3) Where the design and construction adopted the metal spraying system as the corrosion prevention specification for the bridge, this is shown to be effective in improving durability considering the above factors identified in this report that promote degradation.