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Development of bridge maintenance system for asset management

Tomohiro Shimizu[1*], Shin Yoshikawa[2], Hideyuki Takinami[3], Tadamasa Nakayama[4]

[1]Graduate School of Eng., OIT, [2]Faculty of Eng., OIT, [3]West Japan Railway Co., [4]JR West Japan Consultants Co.

In Japan, a lot of structures were built in the period of high economic growth. Because these structures have been used for 30 to 50 years since the completion of construction, they are assumed to age quickly in near future. Under the circumstances, appropriate and efficient maintenance is going to be an important theme for the social infrastructure in Japan. Especially in most of railway structures were built earlier than other social infrastructure in Japan. Therefore, there are many old structures that exceeded the service life in the railway structures. Particularly the railway bridge has passed for an average of 60 years after completion, while the road bridge has passed for an average of 30 years. Thus, the maintenance of the railway bridges is the problem which now confronts us. Under such circumstances, this study focuses on the railway bridges.

It is necessary to manage various data in order for maintaining bridge structures appropriately. However, in the drawing that has recorded conditions and repairs on the bridge structures up to now, the following problems exist. The first problem is that the extend elevation in the drawing is only a schematic illustration without dimensions. The second is that the drawing is not shared in both repair and inspection. The third is that the drawing management cannot be performed in chronological order. So, the authors thought that it would be effective to use 3D data excellent in visual representations. In this study, the authors developed 3D models which can make the extend elevation easily and manage the drawing to record the conditions and repairs to maintain bridge structures.

In addition to system development, the authors developed the stereo photo measuring device. They verified the measurement accuracy with an apparatus, and the results are shown that measurement accuracy is secured clearly. This device does not need the measurement from the close distance in on-site work, and the engineers have only to take photos from the distant place to structures in on-site work. Also, the weight of the device is less than 1.5 kg; therefore there are few burdens in the engineer's photo work. Both work efficiency and safety improvement were provided by development of this device.

This system can modify the sizes of 3D model by using detailed dimensions acquired from existing drawings and stereographic photos. As a result, 3D model is created into the more realistic model. It can generate accurate 2D diagrams (extend elevations) based on 3D models, too. In other words, no matter how complicated structures are, this system can output diagrams quickly and exactly. In addition, because the actual size of inspection and repair point is expressed in 3D models, this system can integrate and manage the photos and data (area, length, position, etc.) for inspection and repair.

In maintenance management, it is important to manage the appropriate positions of photos. However, it has become very troublesome work to attach the positional information to photos. In order to solve these problems, this system is created so that positional relationship can be grasped visually. Therefore, even if the photos are taken by different engineers or taken on another day, this system can easily connect the photos with 3D models, that is to say, can manage the photos effectively.

The authors verified the validity of this system by comparing with the conventional method. First, they verified and compared about the number of engineers and working hours. As a result, they found out the reduction of the number of working hours and engineers. Next, they verified the measurement accuracy. They extracted each repair part and calculated the difference of the area by the conventional method and the measuring method of this system. From such results, this system can be applied to maintenance management enough because measurements are reliable.

Keywords: bridge maintenance system, asset management, three-dimensional model, photogrammetry