

Three dimensional documentation and surface erosion of andesitic building stones in Yokosuka Arsenal Dry Dock No.1, Japan

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There are 6 dry docks in Yokosuka Naval Base, Japan. Three of them are made with building stones. The first one, which was called as “Yokosuka Arsenal Dry Dock No. 1” had been constructed about 150 years ago. Mount Hakusen, which was composed of Pleistocene mud sediments, was excavated during the construction of the dock. The building stones are mainly andesite from the quarry in Manazuru Peninsula, far southwestern corner of Kanagawa Prefecture. The stone is called as “Shin-Komatus-Ishi”. Shin means new and ishi is stone. The dock was suffered from 1923 Great Kanto earthquake, however there was no serious damage in the dock. The dock is still in use today. However the surfaces of building stones have been eroded by weathering. And some of them show honeycomb structure.

For the purpose of future preservation, three-dimensional mapping of the dry dock No. 1 was carried out by means of close-range digital photogrammetry. About 100 photographs had been taken as photo-sequence for the total area of the dock. And these multiple 2-D images had been installed into a computer and analyzed by a commercial photogrammetric software. After the photogrammetric manual analysis, the software can match the same position on multiple 2-D images and generate 3-D points in the computer. Finally, three dimensional surface model could be generated.

In addition to three dimensional documentation of the total site of the dock, photogrammetric measurement could be applied to the surface erosion of andesitic building stones in the dock. Generally, surface erosion had been measured by scale, and only the depth of erosion could be clarified. Application of photogrammetry makes it possible to measure the volume of erosion on the surface of building stones. Thirteen building stones have been selected for measurement. Those stone show various depth erosion on the surface. As the results of mean erosion depth calculated from erosion volume and surface area of the building stones, erosion process by weathering is clarified by comparison of erosion rates and erosion structures.

The quarry site of the building stone “Shin-Komatus-Ishi” had been closed many years ago. At present, we can observe the old quarry site in the coast line of Manazuru Peninsula. There are many plug-and-feather holes and traces of the pickaxe in the quarry site. And some small honeycomb structures can be recognized on the rock surface of the site. However the depth of erosion is not so much compared to the building stones of the dry dock from the view point of weathering structure. In the case of the dry dock, sea water had been carried in and out every time the ship had been repaired. Therefore, it is considered that surface erosion had been advanced inside the dock with seawater fill and dry.

Keywords: photogrammetry, honeycomb structure, seawater, quarry site