

Case Study of Transmitted X-ray Imaging for Archeological Objects

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1. Introduction

Radiation has been widely used in various fields such as NDT, medicine, industries, education, and research. In the area of cultural heritages, radiography has been developed from one dimensional to complex three-dimensional images. It is possible to investigate the detailed internal structure that can not be confirmed in one dimension, contributing to the development of cultural property preservation technology. In the academic and research fields, researches on production techniques through age dating, porcelain production area estimation, and principal component analysis are actively under way.

A typical example thereof is X-ray transmission irradiation. The internal shape, corrosion, and cracks of the artifacts which can not be confirmed with the naked eye are confirmed through the radiation device, which is used as basic data for the preservation of cultural properties. The first application of X-rays to cultural properties in Korea was the National Museum of Korea in 1963, the National Museum of Korea and the National Museum of Korea in the early 1980s. We have built professional workforce and equipment. About 5000 cases were surveyed from 1979 to 2008, and they are used for various materials and fields until now. In 2009, X-ray computed tomography (CT), which is capable of tomographic imaging for the first time as a cultural property agency, is in operation. Until now, the Institute for Cultural Properties has been operating a radiation generator (200kVp x 3mA, 150kVp x 3mA, 220kVp x 5mA, 225kVp x 3mA) and Co-60 and Cs-137. In this article, we will examine basic theories and research cases based on the nondestructive transmission survey data at the Cultural Heritage Conservation Science Center.

2. Cultural Heritage Applications

2.1 Eunjejangsikdaedo (Silver-Decorated Big Sword)

Eunjejangsikdaedo was not confirmed by iron rust and soil when it was excavated in Bongdeungri, Gochang in 2009. The shape of silver decoration was confirmed through X-ray transmission and CT, and it was confirmed that the circular decoration of silver ring was covered with corrosive material on the ring head (handle decoration part). It was also confirmed that a phoenix-

like pattern was decorated under the silverware decoration skin.

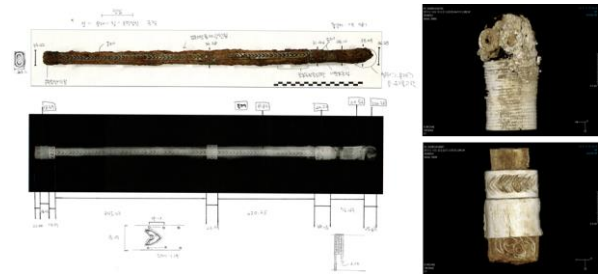


Fig. 1. Eunjejangsikdaedo and its X-ray transmission images.

2.2 Simgoksa bulgam (Buddhist Statues of Simgoksa Pagoda)

Simgoka bulgam is a stone box where a total of 7 Buddhist statues and Bodhisattva statues were placed. It was unearthed in the Seven-story Stone Pagoda of Simgoksa Temple. As a result of the X-ray transmission for the pre-treatment condition, it was confirmed that the structure of the main beam and the left and right bodhisattvas and Hooryeongtong (inner dress artifacts). Inside, Palyeop boju (precious bead with eight leaves) and a round mirror were also identified, and preservation treatments were carefully carried out.



Fig. 2. Simgoksa bulgam. (left: pre-treatment, right : CT image for inner dress artifact)

2.3 Chalgap (Scale armor of Moodeungri)

X-ray transmission is also necessary in the case of the undifferentiated artifact assembly. Arranging individual artifacts within it is impossible. Therefore, artifact assembly is collected together with the soil, and it is necessary to grasp the shape of the artifacts existing in the soil so that the artifacts can be collected and preserved without damage. A representative case is

Chalgap (Scale armor) excavated from the second bulwark of Yeoncheon Mudeungri in 2011 as shown in Figure 3.



Fig. 3. An assembly of Chalgap (scale armor) with soil excavated in Moodeungri, Yeoncheon.

In the preservation treatment process, the X-ray transmission proceeds to grasp the morphology of the artifacts and set the range of removal of soil and foreign matter. In the case of the present invention, it is also possible that X-ray transmission is indispensable since several pie pieces are superimposed on one another, and each hole position is also archaeologically significant.

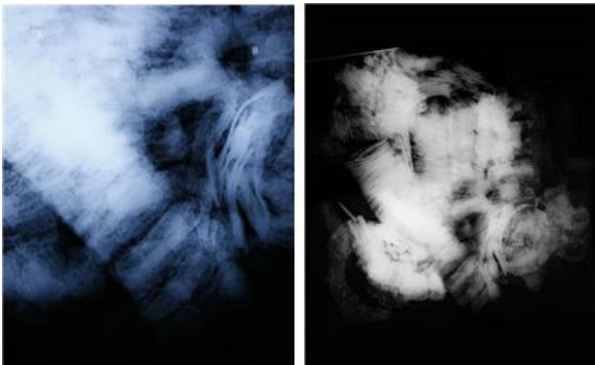


Fig. 4. X-ray transmission image of Chalgap.

2.3 Geumdong sinbal (Gilt Bronze Shoe of Suchonri)

There are cases where the form of the artifacts is substantially lost, and it is practically difficult to conduct the preservation treatment. In such situations, the exhibition may be replaced by X-ray photography. In 2011, gilt bronze shoe, which was taken in Suchonri of Gongju, had almost no metallic part due to severe corrosion and only the shape of the shoe was confirmed in the image by X-ray transmission. It is impossible to arrange the artifact itself separately, and it is fixed together with the soil, and the preservation process is completed. X-ray images are now in the display together with artifacts.

2.4 Togi Yunggimun bal (Elevated Patterned Pottery)

In the case of repairing or restoration of cultural properties, reprocessing may sometimes be carried out due to the aging of the restorative material or changes in form. Excavated from the shell mound of Yeosan-dong of Busan, Togi Yunggimun bal (Elevated Patterned Pottery) is now a treasure belonging to the Museum of Donga University, designated as Treasure No. 597. The preservation treatment was carried out because of the aging. Through the CT survey, the remnants and restorations were identified, and further damage was diagnosed. Based on the surveyed data, we will preserve this artifacts in the near future.

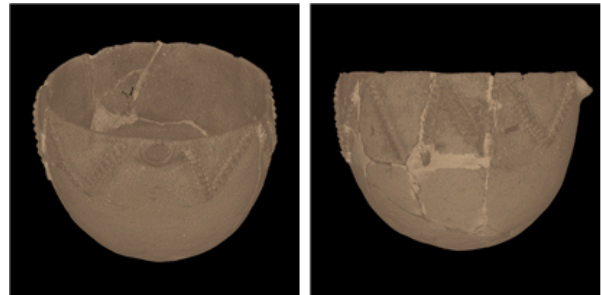


Fig. 5. X-ray transmission image of Togi Yunggimun bal.

3. Conclusions

In this article, we briefly introduced how to use X-ray transmission and tomography in cultural properties. It is not merely checking the structure and form of cultural properties, but also grasping the degree of damage, production techniques, information of inner relics, etc., and is used for conservation, repair and restoration of cultural properties. In addition, it is also being used in the place of replacing the real artifact with X-ray photographs, and will be used for copying cultural objects using 3D printing technology through 3D images shot by CT.