Development of Multipurpose Crates for the Transport of Paintings

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Introduction

From the point of view of environmental conservation, the Ishibashi Foundation has taken a long-standing interest in multipurpose, reusable crates for transport (referred to hereafter as multipurpose crates). When Bridgestone Museum of Art (the present Artizon Museum) went into long-term closure following reconstruction of the building in Kyobashi, Tokyo, as one of the new projects to be undertaken while the museum was closed, we decided to work on developing multipurpose crates. In order to do so, in addition to the curatorial section of our museum, we sought the cooperation of YAMATO GLOBAL LOGISTICS JAPAN CO., LTD. and YAMATO PACKING TECHNOLOGY INSTITUTE CO., LTD. (both of which merged into YAMATO TRANSPORT CO., LTD in April 2021). This paper outlines the circumstances of how we came to develop multipurpose crates, a summary of the development, and a survey of the actual use of these crates.

The Ishibashi Foundation inaugurated the Ishibashi Foundation Art Research Center (referred to hereafter as ARC) in Machida, Tokyo in 2015. Consequently, the museum's functions of exhibition and storage were divided. Before the temporary closure of the museum, our collection and reference materials were stored dispersedly in several locations such as the museum in Kyobashi, the museum annex in Azabu-Nagasaka-cho (closed in 2019), Ishibashi Museum of Art (the present Kurume City Art Museum) in Kurume, Fukuoka, and several warehouses we had contracted with in Tokyo. The ARC was established as a new facility where these could be administered in one place. The reason we separated the exhibition and storage functions was a measure to disperse the risks of natural disasters such as the Great Hanshin-Awaji Earthquake of 1995 and the Great East Japan Earthquake of 2011. However, as holding exhibitions of the works in our collection is the linchpin of our activities as a museum, development of multipurpose crates to transfer the works for each occasion was a key issue in order to realize due consideration of the environment and convenience.

The prerequisite for developing multipurpose crates was that they could be utilized for transporting framed paintings from the Ishibashi Foundation collection. Prints and drawings on paper and three-dimensional works such as sculptures and craftworks were excluded from this project as the specifications for such works differ from paintings. In principle, we looked into the specifications for framed paintings transferred by truck between our museum in Kyobashi and the warehouse in Machida. Environmental conditions for transport by airplane and ship differ and require different specifications. Furthermore, cases in which we lend a work from our collection or borrow from another museum were also excluded as they involve coordination with the other party.

Together with YAMATO TRANSPORT CO., LTD., we selected the materials for the inside and outside of the crates and considered the specifications over and over again. Experiments to compare changes in strength, temperature, and humidity with conventional materials were undertaken. We classified the framed paintings to be transported according to the shape and size of their frames and chose works which were not too decorative on the perimeter and those which were glazed. Two types of trial crates were made, one to fit size 6 to 20 canvases, which formed the majority among the works selected, and another to fit larger canvases up to size 40. These crates were tested for transport of paintings within Tokyo, and we reviewed the changes in temperature, humidity, etc. (see p. 76, figs. 1–5)

The project began in 2016, and having exchanged opinions, carried out tests, and put trial crates to actual use, the crates were completed and delivered in October 2019. It was in preparation for Emerging Landscape: The State of Our Collection, the inaugural exhibition commemorating the opening of Artizon Museum in 2020, that we actually began utilizing the new crates. Thereafter, we have been reviewing the specifications once a year, and so far, minor adjustments and improvements have been made three times. In this paper, together with "A Summary of the Development" including test data and analysis, reports on how the crates have been utilized since the opening of the museum and how they have been improved are provided. "A Summary of the Development" was written by YAMATO TRANSPORT CO., LTD. and the "Introduction," "Operational Status (FY2020)," "Issues Requiring Further Consideration and Improvement," and "Conclusion" were written by Artizon Museum.

A Summary of the Development

In anticipation of continual transport of paintings between Artizon Museum and ARC, we decided to develop multipurpose crates which could be used over and over again instead of the plywood crates we had been preparing and discarding each time a painting was transported. YAMATO GLOBAL LOGISTICS JAPAN CO., LTD., which has produced numerous boxes for the transport of fine art, and YAMATO PACKING TECHNOLOGY INSTITUTE CO., LTD., an institute within the

YAMATO group undertaking the development and research of packaging materials, (both of which are now YAMATO TRANSPORT CO., LTD. and referred to as YAMATO TRANSPORT CO., LTD. hereafter) cooperated with the development. The crates were manufactured by FUJIKOWA INDUSTRY Co., Ltd., which specializes in the manufacture and sales of aluminum containers and cases. From YAMATO TRANSPORT CO., LTD., Shimamura Junichi, Moriuchi Kasumi, Matoi Michihiro, and Isobe Shigeki, and from FUJIKOWA INDUSTRY Co., Ltd., Nakamura Tetsuya worked on this project. Following are the particulars of the development of multipurpose crates and an overall summary accompanied by data obtained through various tests and photographs of the actual products.

The development began in 2016. Thorough consideration was given to the materials to be newly adopted, and we finally decided upon two kinds. One was aluminum, and the other was a compound of alumite board and corrugated plastic. Safety during transport was surveyed, including comparison with conventional plywood crates.

Being a metal, aluminum does not deteriorate so quickly and can be used for a long time. An aluminum crate is structured with no joints other than the opening, so that infiltration of outside air could be kept to the minimum. Meanwhile, regarding the compound version, corrugated plastic was covered with an alumite board on the top layer. While providing a smart look, the dual structure made it stronger.

As regards how to attach the cushioning material, the conventional method was to absorb any shock with a "plane" fixed around the long side of the rectangle. This was redesigned so that any shock would be absorbed by "points" instead of with a "plane" in the four corners, which would make the crate more shock-resistant.

The aluminum prototype was completed in November 2016, and the prototype made of a compound of alumite board and corrugated plastic was finished the following year in 2017. Tests on whether they were easy to handle, the shock when dropped, and changes in temperature and humidity followed.

As a result, we found out that while the crate made of compound materials was heavier than the aluminum crate, when dropped from a height of 60 cm, the shock to the short side was bigger than the plywood crate and the aluminum crate. (see p. 78, Graph 1)

Drop Test

[Specifications]

Maker: Lansmont Corporation
Type: PDT-56E
Maximum loading weight:
56 kg (with standard drop leaf)
45 kg (with extended drop leaf)
Maximum size of sample:
depth 610 mm (with standard drop leaf)
depth 910 mm (with extended drop leaf)
Dropped from: 280–1830 mm (with standard drop leaf)
400–1830 mm (with extended drop leaf)
[Acceleration (Shock) logger]
Maker: Lansmont Corporation
Type: TP3-USB
Time measured: 1 msec–1000 msec
Trigger level: ±1–100%

Current crate (plywood)

- No changes to the outside and content (frame) were identified.
- Regarding the shock absorption, the higher it was dropped from, the bigger the shock (acceleration), which varied among the different sides.

Aluminum crate

- The shock absorption was much higher compared to the current crate. Data was consistent with little variation.
- Regarding the outside, the spherical metal fixtures on the corners got dented where they touch the ground. However, the amount of deformation was not large enough to be considered a problem.
- No other abnormalities were identified in particular.

Compound-material crate

- Like the aluminum crate, the shock absorption was higher than the current crate. However, side 2 requires further consideration about whether the shock absorption can be raised,
- Regarding the outside, like the aluminum crate, the spherical metal fixtures on the corners got dented where they touch the ground, but this should not be a problem.
- No other abnormalities were identified in particular.

Regarding changes in temperature and humidity, there were no changes worthy of special mention in all three cases including the conventional plywood crate. (see p. 79, Graphs 2-a, b)

Temperature and Humidity Tests

[Specifications]

Maker: Espec Corp.
Product: Built-in chamber (thermo-hygrostat chamber)
Type: TBL-2E20A6PK
Temperature control range: −30–80 ºC
Humidity control range: 10–90% (within + 10~80 ºC)
Dimensions of the inside: w. 1970 × d.1970 × h.2100 mm
Opening: w. 1400 × h.1800 mm
Canvas size: F6
Weight: 2.9 kg (total of frame and canvas)
2.9 kg when packed in polyethylene sheet (representative value)

[Format of the inside of the crate]

From the layer closest to the painting outwards
①LD polyethylene sheet: 100 µm thick
②Urethane foam board: 50 mm thick
③WF carboard: 8 mm thick
④Expanded polystyrene: 50 mm thick

Judging from the results indicated in Graphs 1 and 2 (see pp. 78, 79), we decided to adopt the aluminum version for the multipurpose crates.

Regarding the cushioning material inside the crate, by employing the supercritical nitrogen gas foaming method, we newly adopted a material which not only outgases very little formaldehyde, sulfur, and siloxane ammonia but discards little

powder, and is suitable for long-term use. The adhesive used to install the cushioning material is also a non-formaldehyde product very suitable as an adhesive for polyethylene foam and polyurethane foam.

The biggest problem about the conventional crates was that as the plywood was processed according to the size of each painting, the same box could not be used for other works. This was one of the causes for them to end up being disposed of after having been used one time only. Consequently, vertical and horizontal rails were installed in the multipurpose crate, along which fixtures to hold the painting in place were attached. By fastening the fixture in the required position with a bolt, a two-dimensional work within a certain size range could be fit into the multipurpose crate. Moreover, by making it possible to move the fixtures not only backwards and forwards but also up and down, we were to accommodate the thickness of each work and fix it in the best position.

Regarding the size of the multipurpose crates, we made crates capable of storing size 5 to 40 canvases weighing up to 20 kg. Bearing in mind the sizes of the works in the museum collection, this was the standard which we assumed would be used most frequently within the technically feasible range. As handles are attached to the top, bottom, left, and right of the crates, they can be rotated 90 degrees and used for both vertical and horizontal paintings. The finished products were delivered in October 2019 and were put to use officially from the transport of works for the inaugural exhibition which began in January 20212020. Thereafter, taking the results of actual use of these new crates into account, we produced improved versions, which are being used to this day.

Operational Status (FY2020)

1. Removal of the inaugural exhibition *Emerging Landscape: The State of Our Collection*: 27 out of 206 works were transported in multipurpose crates. Approx. 13%
2. Transport of *Selections from the Ishibashi Foundation Collection* (Part 2, 2020): 9 out of 54 works. Approx. 16%
3. Transport of *Rimpa and Impressionism* (2020): 7 works out of 86 works. Approx. 8%

Regarding FY2021, we used multipurpose crates in the same manner for the removal of *STEPS AHEAD* and the transport of *Selections from the Ishibashi Foundation Collection*.

Issues Requiring Further Consideration and Improvement

As the cost is lower compared to producing individual wooden boxes to pack the works for each occasion, on the one hand, in the long run, ecological transport can be realized. On the other hand, as there is not enough space to store the crates at the museum and as the packing requires a certain amount of time, there is room for the handling to be improved in the future.

Conclusion

While it goes without saying that the development of multipurpose crates for transport was inevitable from the point of view of environmental conservation, we need to investigate how we can further reduce their weight and improve the handling. Furthermore, in order to examine whether the crates currently in our possession are being used effectively and how much maintenance is required for each crate, we have assigned identification numbers etc. to the individual crates. We shall continue checking that the frequency of the use of the crates is well-balanced and how often repairs and improvements are required. Regarding these issues, we shall assess further details with due consideration of the exhibition schedule for 2022 onwards and the work efficiency of the shippers who handle the transport and hanging of the exhibition and the curators.

How many crates each can be kept and utilized at the Art Research Center in Machida, where the Ishibashi Foundation Collection is kept, and the Artizon Museum in Kyobashi, to which the paintings are transported, also needs to be considered together with the exhibition schedule.

(Translated by Ogawa Kikuko)