Repair and Consolidation of a Large Format Broken Silver Gelatine Print on Melamine Particle Board

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Abstract

This paper presents a collaborative project between a photograph conservator and a furniture and wooden objects conservator to treat large format silver gelatin prints mounted on melamine particle board, which was broken during transportation. The transportation crate for the large and heavy photograph was dropped on its corner, resulting in the corner of the melamine board and photograph breaking into separate pieces. This paper discusses the treatment options considered, preliminary testing, during-treatment choices, materials used, problems encountered and lessons learned.

Introduction

This paper presents a conservation treatment on an artwork composed of two photographs mounted on a secondary support made from two melamine particle boards. The top left corner of the artwork was damaged during transportation when the traveling crate was dropped on its corner, resulting in the breakage of the secondary support and subsequent damage to one of the photographs.

Following this event, the artwork was brought to the lab at Chloé Lucas Conservation for treatment in 2022. To address problems linked to the melamine board secondary support, Anne-Stephanie Étienne, a Furniture and Wooden Objects Conservator, was brought in to work on this project.

This paper will focus on the treatments undertaken on the broken corner and describe the treatment options considered, the preliminary testing to determine materials and methods, as well as during-treatment choices, materials used, problems encountered, and lessons learned.

For legal reasons, only detail pictures of the artwork are included in this paper.

Description of artwork

Materials

The artwork was made in 1981, is part of an edition of ten and measures 1.69 m by 1.94 m. It is composed of two semi-glossy silver gelatin prints on resin-coated paper, containing optical brightening agents. The photographs are adhered overall on two 1.9 cm thick melamine laminated wood particle boards, which are maintained together with a loose tongue and groove joint in the center. Three reinforcing pieces of the same type of board are glued and screwed into the back of the main panels (**Figure 1**). The artwork is framed in a low-profile black aluminum frame, screwed

directly into the secondary support. There is no glazing or spacer between the artwork and the frame on the recto or verso.

Figure 1: Artwork's verso and loose tongue and groove joint (top edge, panel's intersection)

Condition

The artwork shows several physical damages. The main damage is the top left corner breakage and losses to the secondary support and subsequent tearing and losses of the silver gelatin prints on the recto, caused by the dropping of the traveling crate on its corner during handling (**Figure 2**). The corner is entirely detached from the rest of the panel and is only held in place by the frame. The framing system caused most other damages, including a large amount of dust, fingerprints, and soiling on both sides, and numerous abrasions and scratches on the photographs because of the lack of protective glazing or backing. The frame caused cracking of the secondary support where the screws are inserted, as well as losses from the top screws being ripped off the secondary support as the aluminum frame bent on impact.

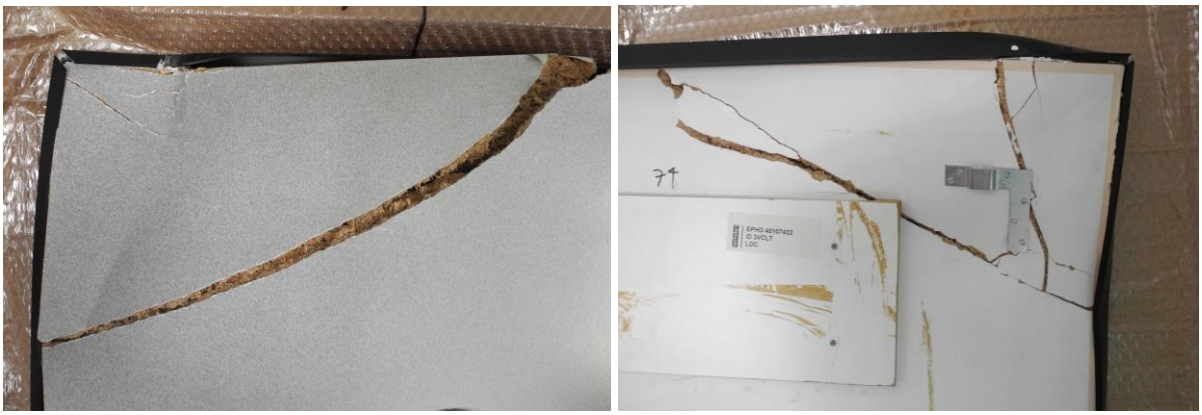


Figure 2: Recto and verso of the broken top left corner before treatment.

Conservation treatment

Choice of treatment

Objectives

The two main objectives for the conservation treatment were to stabilize the corner, to prevent further loss of image; and improve the aesthetic appearance of the artwork so that the damage is the least apparent visually by achieving a level repair at the breakage interface.

Treatment options

Several treatment options were considered upon consultation with conservators specializing in objects, contemporary art, furniture and wooden objects. The pros and cons of the three options are summarized in **Table 1**.

Table 1: Pros and cons considered for each treatment option

Treatment options	Pros	Cons
Repair the original corner.	● Conservation of original material.	● Complex to reattach the corner in the same plane as the rest of the panel.
1. Unmount the photograph from the broken corner. 2. Infill the corner loss with conservation material. 3. Remount the photograph.	● Introduction of a stable infilling material.	● Risk of physical damage to the photograph during unmounting. ● Removal of original material ● Complex to reattach the corner in the same plane as the rest of the panel. ● Different aging and reactivity of the infill versus the original melamine board. Potential future problems at the interface.
Complete unmounting of the photographs and remounting on a new secondary support.	● Introduction of a more stable, less heavy and bulky new secondary support.	● Risk of physical damage to the photograph during unmounting. ● Removal of original material. ● Modification of the aesthetic appearance of the artwork. ● Loss of artist’s choice of mounting support.

Upon consultation with the artwork's owner, the option to repair the original corner was selected as it met the treatment goals and preserved the original artist’s intent and choice of mounting material.

Treatment plan

As a result, the treatment plan was as follows:

- Unframe the artwork.
- Clean the recto and verso of the artwork.
- Flatten, consolidate and repair the corner.
- Reattach the corner to the main panel.
- Consolidate the photograph's primary support and image layer.
- Infill image layer, primary and secondary support losses.
- Inpaint image layer losses.

The following section will describe preliminary tests and treatments undertaken on the broken corner (underlined above).

Description of treatments

Flattening the corner

Wood-particle boards are made of wood fragments bonded under pressure. When the board is broken, it is impossible to put the particles back together because they will not fit into the closely-knit arrangement created under pressure. To flatten the broken corner and match the edges of the corner and the panel, it is necessary to remove some wood particles.

The detached corner was first split in two in the core of the panel to access the broken edges from the inside and remove some of the wood particles to enable flattening of the corner. Work was undertaken on a woodworking station, maintaining the corner in the vise or with clamps, either vertically or horizontally to accommodate the bend in the corner. Blotters were placed between the photograph and the clamps to prevent damaging the surface. The corner was cut through the middle of the wood particles with a Japanese plywood saw (**Figure 3**).

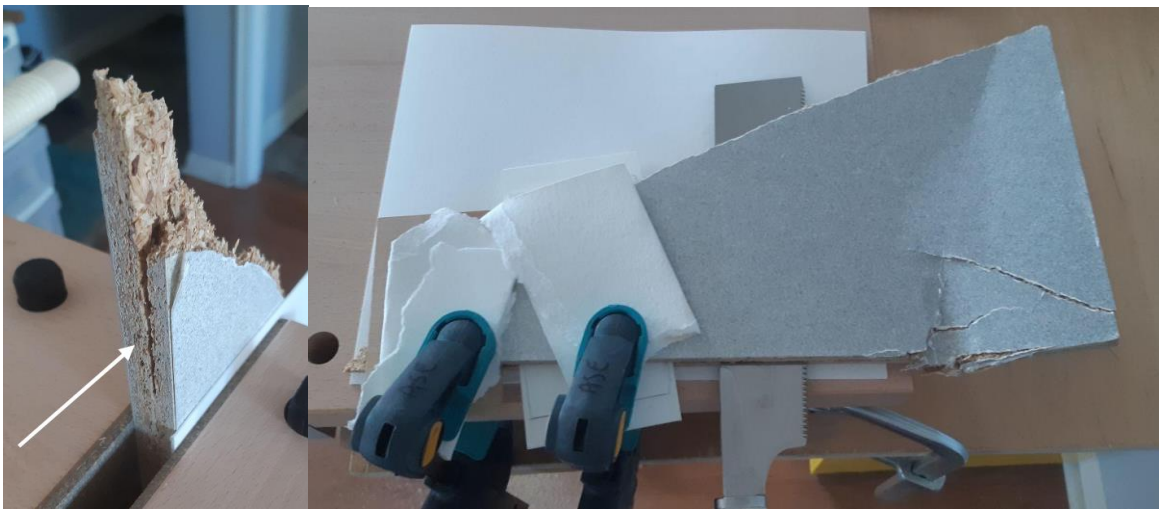


Figure 3: Corner during cutting with a Japanese plywood saw, clamped vertically for the flat area (left) or horizontally when approaching the bent area (right).

Going forward, the piece of the corner with the photograph is called “front corner piece” and the one without the photograph is called “back corner piece” (**Figure 4**).

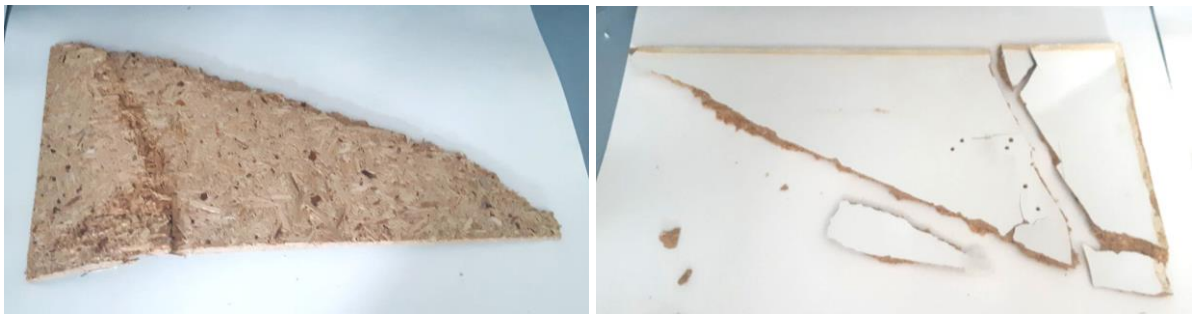
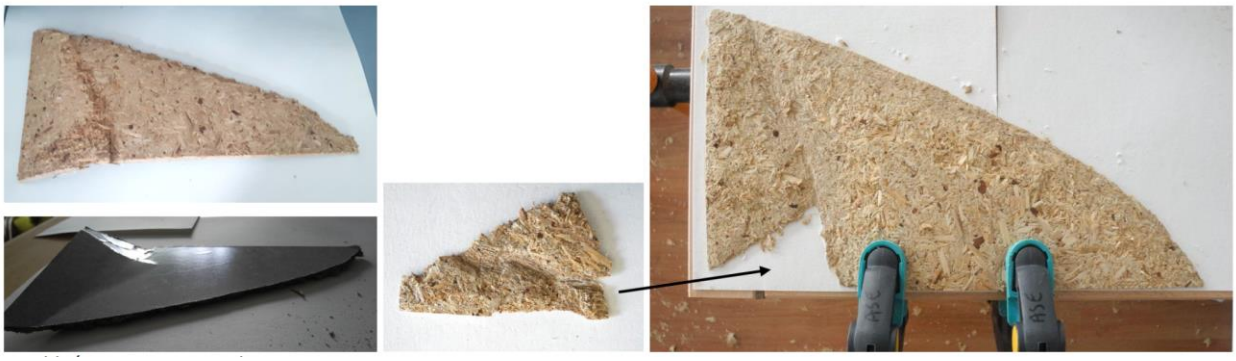


Figure 4: Inside of the front corner piece (left) and outside of the back corner piece (right)

Removal of wood particles around the break was done with various tools depending on the accessibility of the break edge, the tool precision and the varying particle density. Wood scissors were used to remove larger areas of coarser particles in a flat way. A rotary Dremel tool with wood carving bits was used to remove dense wood particles closer to the break because it allowed a more controlled approach, and the tip was easier to insert between the wood particles.

Some of the fragments were only maintained in place by the broken wood particles, which separated from each other as they were cut apart. In some areas, the wood particles had to be pared down to the melamine paper layer to realign the break edges (**Figure 5**).



BEFORE AFTER

Figure 5: Front corner piece before and after flattening

Choice of adhesive

To decide which adhesive to use to repair and consolidate the corner, a list of required specifications was made, including:

- Compatibility with constituent materials.
- Gap-filling properties with added fillers, to fill the areas where wood particles were removed during flattening.
- Compatibility with preselected consolidation and reinforcement materials, to strengthen the core of the corner.
- Resistance to mechanical stress for secure handling of the artwork, relative to the panels’ size and resulting panel movement during handling.

- High viscosity, to limit the risk of the adhesive seeping toward the photographs.
- Long setting time to allow for positioning of the different fragments and clamping.
- Capacity to be screwed in, if required to secure the framing system to the artwork or potentially adding a reinforcing mounting structure.
- Low health and safety risk, as the conservation lab was not equipped with a solvent extraction system.
- Availability in-store.

The characteristics of several adhesives, used in furniture and wooden object conservation, in relation to our specifications are summarized in **Table 2**.

Table 2: Furniture and wooden object conservation adhesive characteristics in relation to set requirements

Criteria*	**PVA**	**Animal glue**	**Polyurethane**	**Epoxy**	**Cyano-acrylate**	**Elastomer**
Compatibility with constituent materials	Yes	Yes	Yes	Yes	Yes	Yes
Gap-filling properties with added fillers	Limited	Yes	Limited	Yes	No	No
Compatibility with preselected reinforcement materials (plywood)	Yes	Yes	Yes	Yes	Yes	Yes
Resistance to mechanical stress**	Good	Insuficient	Good	Good	Insuficient	Insuficient
Viscosity	Low to medium	Low to medium	Low to high	Low to high	Low to medium	Low to high
Setting time	Short to Medium	Short to medium	Short to medium	Short to long	Very short	Medium
Health and safety risk	None	None	Vapours	Avoid skin contact	Adheres to skin & irritates eyes	Flammable & toxic vapors

*Resorcinol and Urea-formaldehyde are not included in this table as they are not easily available in-store.
**Estimation made by the authors based on available data and the artwork's characteristics.

We decided to work with West System epoxy resins because they met most of our criteria.

Choice of consolidation material

To stabilize and consolidate the melamine fracture from inside the corner, three backing materials were tested in six different combinations with epoxy resin.

1. Japanese paper, 25 g/m^2 - 3 layers
2. Non-woven polyester, 32 g/m^2 - 3 layers
3. Fiberglass, 34 g/m^2 - 1 layer
4. Fiberglass, 34 g/m^2 - 3 layers
5. Fiberglass, 78 g/m^2 - 1 layer
6. Fiberglass, 78 g/m^2 - 3 layers

The tested backing materials were adhered to melamine panel samples (0.4 cm thick) with clear epoxy applied by dabbing with a brush. Once cured, the samples were broken to observe how the consolidation system was behaving (**Table 3**).

Table 3: Consolidation materials applied on melamine board samples with clear epoxy, before and after breaking.

	#1 Japanese paper	**#2** Non-woven polyester	**#3** 1 layer 34 g/m^2 fiberglass	**#4** 3 layers 34 g/m^2 fiberglass	**#5** 1 layer 78 g/m^2 fiberglass	**#6** 3 layers 78 g/m^2 fiberglass
Before						
After						

Combinations 1 and 3 were eliminated as they broke upon impact. Combination 2 was eliminated because it was not porous enough and was not letting the epoxy pass through to bond with the wood fibers, creating well-defined layers of epoxy and polyester.

Combinations 4 to 6 were kept as an option for treatment, with a preference for combinations 5 and 6 because they were easier to apply.

Repair of the corner

Repair took place on a glass plate covered with silicone-release-coated polyester film to prevent the epoxy resin from adhering to the glass. The glass plate allowed for continued visibility of both sides of the corner to realign the fragments and check the outside of the corner during gluing.

The back corner piece was repaired first. The fragments were realigned on the glass plate and clamped in place (**Figure 6**). The epoxy and a strip of 78g/m^2 fiberglass were applied with a brush along the break.

Figure 6: Outside and inside view of the back corner piece clamped on a glass plate for consolidation.

The first gluing showed that the fiberglass was not easy to apply to the artwork, which can be explained by the fact that the surface was irregular, unlike the flat surface of the samples. As a result, we decided to provide consolidation with another material (see Reinforcement material section below).

Additionally, we observed that some epoxy seeped to the outside of the back corner piece due to the small surface losses along the fracture and to the viscosity of the epoxy which was identified as too low. This resulted in a thin layer of epoxy along the break edge (**Figure 7**). This layer was removed mechanically with a scalpel without damaging the melamine surface.

Figure 7: Overflow of epoxy on the outside of the back corner piece after the first gluing.

In order to thicken the epoxy and prevent it from seeping through the cracks, wood powder filler was added until a thicker but still malleable consistency was reached (5:1:1 resin / hardener / filler). The addition of the filler succeeded in preventing the epoxy from seeping through, and the remainder of the back corner piece was repaired with this adhesive mix (**Figure 8**).

Figure 8: Back corner piece inside and outside after repair.

The same adhesive mix and application technique was used to repair the first break on the front piece of the corner, however, due to the fact that along this break, the wood particles had been pared down to the melamined white paper layer to optimize the adjustment of the fracture line, the epoxy soaked through the melamine and stained the photograph (**Figure 9**). Additionally, the brown colour of the epoxy with wood powder filler was slightly visible through the melamined paper layer. The stain was inpainted to be less visible.

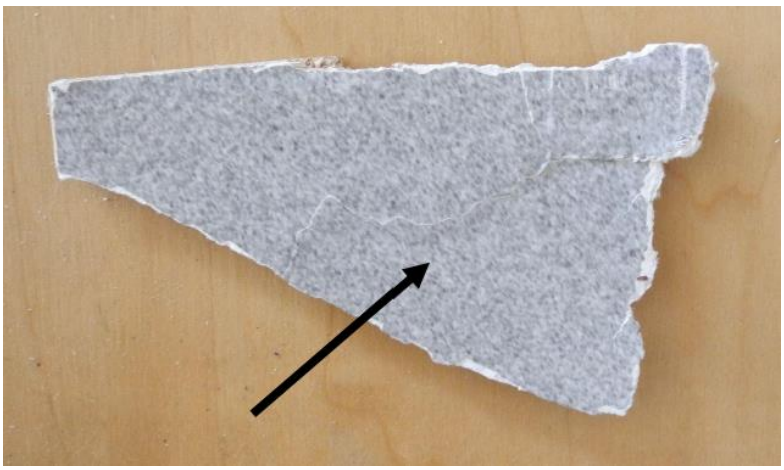


Figure 9: Epoxy resin stain on the photograph (outside of front corner piece)

<u>Alternative adhesive combination and application method</u>

To avoid further staining of the photograph, additional testing was conducted to adapt the adhesive combination and application method.

West System epoxy offers several different types of fillers. Small samples of the epoxy adhesive with different fillers were created to determine the most appropriate one for our situation (**Table 4**).

Table 4: Characteristics of the different epoxy resin / filler combinations

	Filler quantity (for 12 g of clear epoxy)	Texture	Colour	Epoxy resin is soaking through the paper
Wood powder	5 g	Coarse	Brown	++++
Microfibers	2.5 g	Coarse	White	++
Colloidal silica	1 g	Smooth	White	+++
Microlight	1.6 g	Very smooth	Beige	+++
Microfibers + Colloidal silica	0.5 g each	Smooth	White	++
Microfibers + Microlight	0.8 g each	Smooth	Beige	++

The microfibers and colloidal silica fillers, separately and as a mixture, are the most satisfying in terms of colour. The microfibers, on their own and mixed with colloidal silica and microlight, soak through the paper the least.

We decided to do more tests with isolation layers to prevent the epoxy resin / filler combination from further staining the photographs. For this second batch of tests, we selected the microfibers and microfibers / colloidal silica combinations, because they were the whitest and soaked the least through paper. We also selected the wood powder filler as a control as it was the combination of epoxy resin / filler soaking through the paper the most.

Japanese paper (25 g/m^2) pasted with Lascaux 498 HV was tested as an isolation layer, used in one, two, or three layers. 3 g of each epoxy resin mix was applied to the isolation layer. Once cured, the verso of the isolation layer was examined for any visual signs of the epoxy soaking through (**Figure 10**).

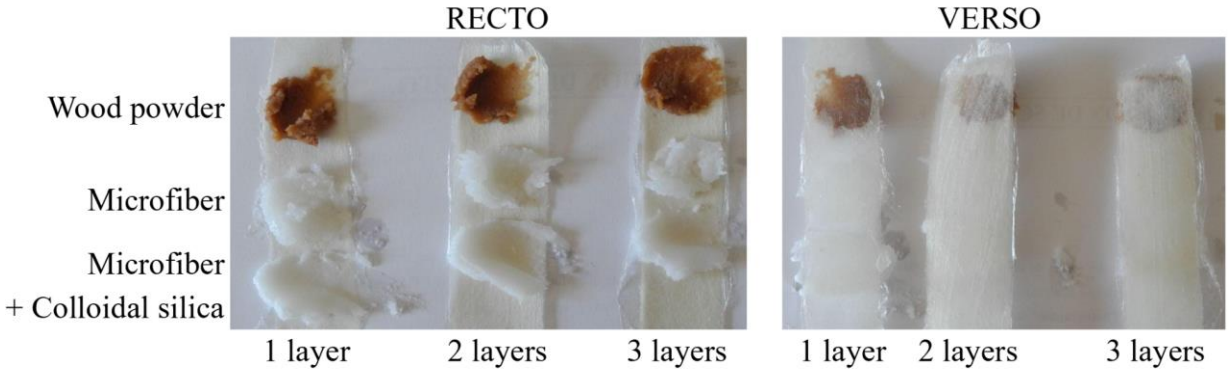


Figure 10: Isolation layer samples

The single layer option of Japanese paper / Lascaux 498 HV was eliminated because, in the case of the wood powder filler, the epoxy resin had soaked through the paper and stained the underlying paper. The double and triple layers of Japanese paper / Lascaux 498 HV were kept as a treatment option as the epoxy resin did not soak through them.

The remainder of the front corner piece consolidations were completed using three layers of Japanese paper / Lascaux 498 HV and the epoxy resin with the microfiber / colloidal silica combination because it was the whitest and required the least amount of filler to reach the desired consistency (**Figure 11**).

Figure 11: Front corner piece inside and outside after repair.

The front piece of the corner was then reattached to the main panel with the same method and material (**Figure 12**). Once the front piece was reattached to the main panel, an alternative to the fiberglass consolidant was implemented.

Figure 12: Front corner piece after reattachment to the main panel.

Reinforcement material

The objective of the inner reinforcement was to add a material to bridge over the break line to add structural strength. We decided to use two layers of 3 mm plywood as a consolidant.

The front and back pieces of the corner were levelled down to 0.5 cm with an oscillating power tool. The same tool was used to create a groove at the joint between the corner and the main panel, where one layer of plywood could be inserted (**Figure 13**). It was decided not to insert both plywood layers in order to avoid making the area with a wider groove more fragile than the rest of the panel.

Figure 13: Front corner piece levelling and creation of a groove to insert the plywood consolidation piece.

To adhere the first layer of plywood, we used the microfiber / colloidal silica-filled epoxy applied as a 0.5 cm layer on the whole inner surface of the front corner piece. The first plywood piece was then inserted inside the groove and clamped in place to cure. Clamping pressure was increased progressively, and the epoxy overflow was removed from the edges to prevent it from potentially going on to the recto of the artwork. The second layer of plywood was adhered to the first with a thin layer of clear epoxy (**Figure 14**).

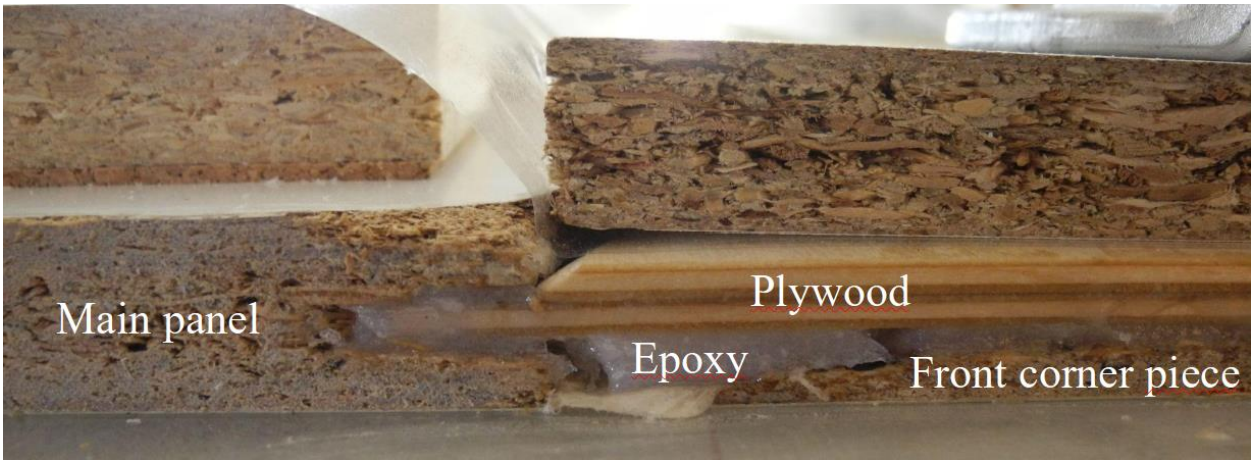


Figure 14: Cross-section view of the front corner piece and two plywood reinforcement pieces during curing.

The back corner piece was then adhered to the second layer of plywood with the same method described above for the front corner piece and first plywood layer adhesion (**Figure 15**).

Figure 15: Recto and verso of corner after consolidation and repair

Conclusion

After treatment, the corner breakage is still visible in raking light, and under close examination, because of the differential gloss between the semi-glossy photographs and the matte losses; however, when the artwork is viewed from the front as a whole, the corner damage blends in (**Figure 16**).

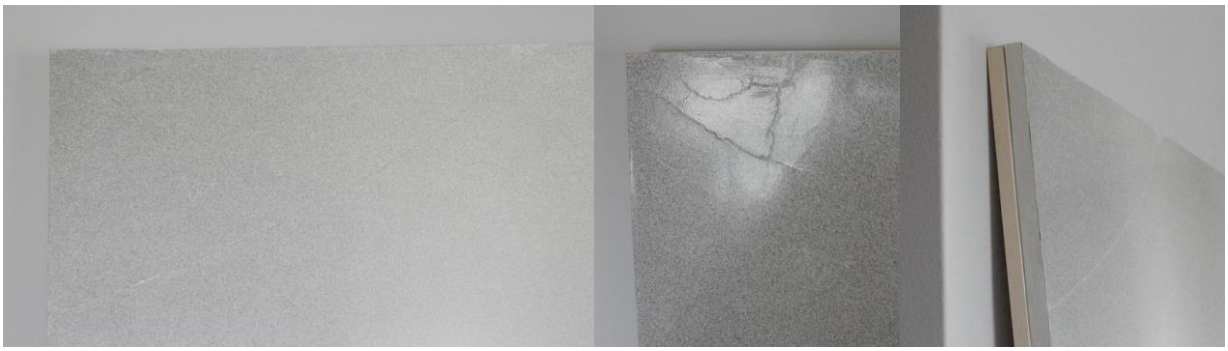


Figure 16: Recto of the corner after treatment.

The successful completion of this treatment was based on the collaboration between two conservators with different specialities, knowledge, and skill sets. It emphasizes the importance of re-assessing plans, chosen materials and methods as the treatment progresses, as well as the value of empirical preliminary testing.

Acknowledgements

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Materials

Consolidation and reinforcement materials:

- Baltic birch plywood, KJP Hardwood, 3 mm
- Japanese paper, Sekushi Mare (kozo), The Japanese Paper Place, 25g/m^2
- Fiberglass, Deluxe Materials, 34g/m^2 and 78g/m^2
- Non-woven polyester, Hollytex #3257, 32g/m^2

Isolation layers:

- Acrylic adhesive, Lascaux 498 HV
- Japanese paper, Sekushi Mare (kozo), The Japanese Paper Place, 25g/m^2

West System epoxy resins:
www.westsystem.com

- 105 Epoxy resin, https://www.westsystem.com/products/105-system/
- 206 Slow hardener, https://www.westsystem.com/products/206-slow-hardener/
- Fillers:
    - 403 Microfibers, https://www.westsystem.com/products/403-microfibers/
    - 406 Colloidal silica, https://www.westsystem.com/products/406-colloidal-silica/
    - 410 Microlight, https://www.westsystem.com/products/410-microlight/
    - Systemthree Wood flour, https://www.systemthree.com/collections/woodworking/products/wood-flour

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