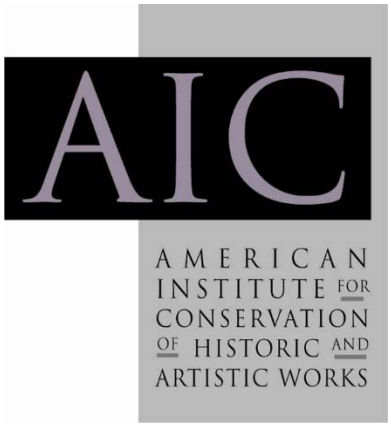

Article: The *Masterworks* exhibition: A case study in climate control and the role of the conservator in an international exhibition
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Shelley Reisman Paine
Objects Conservator

The *Masterworks* Exhibition - A Case Study in Climate Control and the Role of the Conservator in an International Exhibition.

October 13 1990, the Tennessee State Museum in Nashville, Tennessee, opened an exhibit called *Masterworks*, comprised of sixty-one Impressionist and Post-Impressionist paintings from the Bridgestone Museum of Art in Tokyo, Japan. The Bridgestone Museum is a private institution which had made only two previous loans. Nashville was the only venue for this exhibition.

My work on this exhibition began as a consultant retained to solve problems related to the environment should they occur. However, my role in this project changed in some extraordinary ways because problems did occur. Significant changes were made in my role and in my contract. In the process of correcting problems, significant alterations were made in the climate control system. All of these changes were initiated ten days **after** the paintings arrived in Nashville, five days before the exhibit opening.

THE ROLE OF THE CONSERVATOR

Five days before the opening, my initial contract was approved and I began working with Mr. Chiaki Tanaka, the Bridgestone Museum painting conservator and Mr. Tsyuoshi Kaizuka, the assistant curator to solve problems related to the environment. Bridgestone Museum of Art had written into the exhibition contract very specific and narrow acceptable environmental conditions. The Museum was to maintain 70 degrees F and 55% relative humidity within ± 2% over 24 hours.

On my first day of work a leak from the janitors closet above the *Masterworks* gallery caused water to drip next to Matisse's "Odalisque with Raised Arms", and coincidentally the relative humidity in the gallery dropped to 37%. I began work with the building staff to begin to correct these problems. Within five days

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of the opening, a plan to modify the climate control system to sustain 55% relative humidity was initiated. The pipes in the ceiling were mapped and all sources of water cut off. PVC gutters, painted black to blend with the ceiling, were placed under each pipe, drains were sealed, and doors to the janitors closets and adjacent restrooms and drinking fountain were locked and rekeyed. The single key to these new locks was placed in the building managers pocket. The Matisse was then rehung on the wall and the exhibit opened.

At the time of the opening, a week before Mr. Tanaka and Mr. Kaizuka returned to Japan, Mr. Yasuo Kamon, the Director of the Bridgestone Museum of Art requested that I work for the Museum in a position of authority over the collection in the absence of his Museum staff. I was greatly honored by this request but I was already on contract to the Tennessee State Museum. Further, I felt that the best situation would be for me to work jointly for both institutions. Both institutions agreed to this arrangement but neither could find another Museum which had successfully formed this type of contractual relationship.

The question was taken up by the Attorney General of the State of Tennessee who was the contract negotiator for the exhibition. He met our request with some skepticism and asked me if I could work for two masters. I replied that I only worked for the paintings and that if each institution was only concerned with the well being of the paintings then my work could not be compromised. He considered my position and found a precedent in the construction industry. There is a position for a person who represents both the lender and the owner during the construction of a building. This precedent lead to an amendment which identified me as Representative of the Paintings in the contract between the Tennessee State Museum and the Bridgestone Museum of Art. My work was now directed by the paintings using legal instruments agreed to by both Museums.

THE CONTRACT

According to the amendment to the contract, my authority was defined in a protocol of emergencies. The protocol was a separate document agreed upon by me, the State of Tennessee, the Tennessee State Museum and the Bridgestone Museum of Art. The protocol outlined procedures for all forms of potential emergencies and my authority in each situation. The emergency situations included vandalism, fire and flood, earthquake, security and significant shifts

in the gallery environment. An evacuation plan was included as well as a list of who was called during emergencies and in what order. Everyone on the list, including me had a beeper for 24 hour access.

The gallery environment was a critical component of the original contract between the two museums. The guidelines for the climate were re-stated in the protocol for emergencies. The Tennessee State Museum was to sustain a climate of 55% relative humidity and 72 degrees F. with ± 2.5% relative humidity within any given day and ±5% over a month. If the 55% could not be sustained, the relative humidity could be lowered with the permission of the Bridgestone Museum of Art to 50% within the same ranges. If the relative humidity fell below 40% for more 24 hours, then those objects designated "A", extremely delicate paintings which were often unvarnished and unlined would be placed in pre-made Royco envelopes. If a fall in relative humidity was rapid and without reason, then all paintings would be placed in envelopes at 40% relative humidity. At 35% relative humidity all paintings would be placed in envelopes regardless of other circumstances. In the event of an evacuation or an emergency we prepared a "crash cart" with all our necessary supplies. The cart stayed in the gallery in a corner work area within the perimeter security. Provisions were made by the building manager for emergency back up power and chilled water for the HVAC system.

The protocol also clearly stated that ....

"the conservator has the right to recommend to the Bridgestone Museum of Art and the Tennessee State Museum to remove paintings at any time until emergency conditions have been properly remedied. Any dispute regarding the removal or reinstallation of the paintings will be handled directly between the directors of Tennessee State Museum and the Bridgestone Museum of Art."

Knowledge that the paintings could require removal from the walls provided an impetus for all concerned to correct and maintain the proper climate.

The protocol was first adopted in draft form before Mr. Tanaka and Mr. Kaizuka returned to Japan on October 31, and was later modified on December 23. The exhibition was closed on January 20.

As defined in the protocol, my job was to advocate for the collection's safety and security and to work to stabilize the climate. To do this, I went to the Museum every day to survey the environment and care of the collection. Once a week I held a meeting with building, state and museum representatives to sustain progress in stabilizing the gallery climate. At the end of each day I sent a daily report to Japan by facsimile. These reports were helpful in maintaining our work and insuring the accountability of all concerned. Once a week I added copies of each chart from the recording hygrothermographs and a condition report by painting conservators Cynthia Stow or Dee Minault. Over the four month course of the exhibition I averaged two hours of work a day.

THE CLIMATE

In Tokyo, the Bridgestone Museum of Art has a relative humidity between 55-60%. In preparation for the trip to Nashville the collection was acclimatized to 55%. The Museum was very clear in its desire to have the paintings in a constant relative humidity of 55% $\pm$ 2.5% over 24 hours. To monitor the climatic conditions during transit and exhibition, Mr. Tanaka installed data collectors on the back of Picasso's "Saltimbanque Seated", and Monet's "Water Lillies" while they were inside the crates. To monitor the conditions in the gallery I installed three recording hygrothermographs calibrated with a Bendix psychron. The Bendix psychron was identified as the best calibration tool because it consistently matched Mr. Tanaka's Isuzu computerized monitoring equipment.

The climate in Nashville from October to January is variable. We anticipated gradually lowering temperatures, highly fluctuating relative humidities, weeks of rain and a few arctic blasts.

The Tennessee State Museum in located in the lower levels of the James K. Polk State office Building and Cultural Arts Complex. As illustrated in Figure 1., the building has an office tower which rises above three performance theaters and other facilities. The Museum is located in portions of the two lower levels.

The Museum HVAC system is a variable air volume system which uses chilled water and steam. Steam is also used for humidification. The system was designed to use 14% make up air from the outside

provided through dampers into the system. There was general agreement that climatic alterations must be accomplished through the ducts rather than taking localized measures with portable equipment. This was done to avoid isolated micro-climates around the paintings and to accommodate the dynamics of the air flow into the building and the the 25 foot ceiling heights of each gallery.

Controlling the environment in the Museum gallery was a particularly challenging project for several reasons.

1. The Museum was designed to be seen through large openings from one floor level to another in the lobby spaces of the building and theaters. This creates large open pathways for air to come directly from the street into the *Masterworks* gallery;
2. Their was no direct means to monitor the climate in the gallery at the DELTA room, the central computer station for all HVAC equipment;
3. The HVAC equipment did not have adequate humidification capabilities or sensitive control units;
4. The *Masterworks* gallery is located in the corner of a larger HVAC zone. There are two zones on that level, and there are no physical separations between zones.
5. The exhibition proved to be very popular. There were approximately 200 people in a 3,600 sq. foot gallery at any given time over a period of 14 weeks. In the end, 181,000 people saw the exhibition.

Figure 2, shows how outside air enters the gallery. The gallery is two levels below the closest entrance to the building. Air follows the arrows as it enters the lobby and continues to fall down through the "overlooks" (the smallest of which is 31 x 31 feet) down the staircases until it lands in the *Masterworks* gallery.

The week before the exhibition opening a cold front came through Nashville and the relative humidity in the gallery dropped to 37%. This was the first indication that the HVAC system could not sustain the environmental standards of the exhibition which was to last for fourteen more weeks of highly variable weather conditions. To achieve the needed environmental standards for the collection the exhibition area was isolated into a single micro-environment, the perimeter areas were used as buffer zones and all means to prevent infiltration of outside air were employed.

The following steps were taken in this order:

The week before the exhibition –

The outside dampers to the HVAC system were closed to eliminate the use of cold, dry outside make-up air in the HVAC system.

The relative humidity in the building lobby was increased to 55%. This was done to create a buffer envelop around the museum and gallery.

The temperature in the gallery was decreased to 70 degrees F and all the terminals in the ducts were opened to transform the HVAC system from a variable air volume to a constant air volume system. This allowed more air and consequently more moisture to be driven into the gallery to increase the relative humidity.

Three recording hygrothermographs were installed at the front, middle and end of the route through the painting exhibition. The units were installed on the wall at painting level and calibrated for four days until the Isuzu and Bendix psychron's data matched.

A humidifier was relocated into the duct servicing the gallery. This addition brought the number of humidifiers in the ducts to a total of two.

Three humidity transmitters and a temperature transmitter were installed near the recording equipment in the gallery. The data from the three transmitters were averaged in an accumulator. The averaged relative humidity signals and temperature signals were then sent to a new controller. The controller informed the HVAC system of any needed changes in the climate.

A high pressure selector system and sequencing accumulator were installed to allow the gallery humidity controller to override the humidistat in low relative humidity conditions.

Temperature and relative humidity alarms were added to the system. The low setting for relative humidity was 52.5% and the high setting 57%. The low setting for temperature was 70 F and the

high 77F. These settings were consistent with the wishes of the Bridgestone Museum and were also allowed us lead time to solve problems.

During the first week of the exhibition

A second cold front came through Nashville and the relative humidity in the gallery dropped 5% in thirty minutes in the gallery.

A row of bag filters was removed from the HVAC system to increase the air flow by 25%. Increasing the amount of air increased the amount of moisture that entering the gallery.

All outside door closers were adjusted to close as quickly as possible to reduce any infiltration of outside air.

A third humidifier was installed to increase the capability of the system. It was placed in the duct servicing the visitor waiting area outside the exhibit to bolster the perimeter climate area around the exhibition.

The pressure in the building lobby area was reversed. All exhaust fans were shut down in the lobby and adjacent areas thus reversing the air from a negative pressure to a positive pressure at the door. This caused the interior air to go outside causing a substantial reduction of outside air infiltration. This was exciting. No one to our knowledge ever had tried to reverse the pressure in a building one city block square.

Procedures were written to inform the guards how to monitor the climate. The data from the accumulator was transported to the Delta room for 24 hour surveillance. Guards stationed in the gallery 24 hours a day recorded hourly reading from the recording equipment. If the reading fell outside the permissible limits, the guards were to check the accumulator in the mechanical room and contact the Delta room immediately.

Figure 3 demonstrates how the air infiltration was reduced. The modification are shown here in black.

During the first week of the exhibition:

The openings at the base of the stairwell were closed with plywood sealed in place. This restricted outside air from falling through the openings directly into the gallery level.

The doors to the escalator stairwell were closed, again preventing the easy passage of air.

The freight elevator and loading dock use procedures were changed. The elevator opens both onto the dock and into the Masterworks gallery. The elevator was sealed at the gallery level to prevent the cold, dry air from dropping down from the loading dock into the gallery. Procedures were changed to prevent the dock door from being open when the elevator door was open to prevent outside air infiltration.

During the second week of the exhibition

A plastic wall was installed between the ceiling and the top of the *Masterworks* gallery perimeter exhibit wall to reduce infiltration of outside air.

During the third week

We thought we were out of the woods when the mechanical engineer informed us that the system could not sustain 55% if the outside air dropped below 20 F. This was a potential problem. During December, 1989, low temperatures dropped to ten degrees below zero for several days. This was unusual for Tennessee but we could not ignore the possibility of it happening again. Also, the tall buildings downtown create wind tunnels which increased the wind chill.

During the sixth week

The forecast indicated that the temperature would drop to 10 F. Ten degrees below what the engineer reported the HVAC could handle.

Therefore, when the temperature dropped to 15 degrees F, and the relative humidity in the gallery dropped to 53% over twenty

minutes, plastic was installed in the window openings in the escalator stairwell to the gallery level to prevent air flow. Three days after this wall was installed condensation appeared on the ceiling above the stairwell. The corner of the plastic was peeled back to allow controlled air flow. The condensation disappeared and the humidity level in the gallery stabilized.

No further modifications were made to the the building after this point. However, adjustments to the controller were made to fine tune how the system operated. At no time, during the exhibition, did the environment leave the contractual limits for more than eight hours. The charts from the recording hygrothermographs showed our progress. The chart lines remained largely flat and with the 2% variation we were permitted.

Our results in stabilizing the climate were very satisfying. At no time did the environment ever leave the appropriate range. To achieve the desired results we buffered an outer envelope to the gallery and physically created a micro-environment within the gallery and restricted air infiltration as much as possible. All the equipment and labor costs to modify the building and gallery were under $5,000. The alterations to the climate had a negligible effect on the climate in the other gallery areas. Although the contract amendment was not signed during the exhibition, the protocol for emergencies directed my authority.

I want to thank Governor Ned Ray McWherter for his direct support of the exhibit, Mr. Yasuo Kamon, Director of the Bridgestone Museum of Art and Mrs. Lois Ezzell, Director of The Tennessee State Museum, for asking me to participate in this project. To Chiaki Tanaka, Conservator and Tsuyoshi Kaizuka, Assistant Curator, from the Bridgestone Museum of Art for their support and determination.

I also want to give my special thanks to Hunter Allen, consulting mechanical engineer for Johnson controls, who services the HVAC equipment at the Tennessee State Museum. To Bill Griffith, special representative of the State of Tennessee for the building who approved our expenses on this project and Mr. Ernest Dearmen, building manager who pointed his staff in any direction the project required. To Bob Pennington and Peg Schneider from the Tennessee State Museum who helped in monitoring the gallery. To Barbara Heller and Leon Stodulski at the Detroit Institute of Art for their prompt and thorough analsys of water and paint samples. And to all

of them and to my friend and colleague Steven Weintraub, who shipped our equipment overnight. A special thanks for all their assistance and constant focus of the care of the paintings.

Figure 1

JAMES K. POLK STATE OFFICE BUILDING AND CULTURAL ARTS COMPLEX

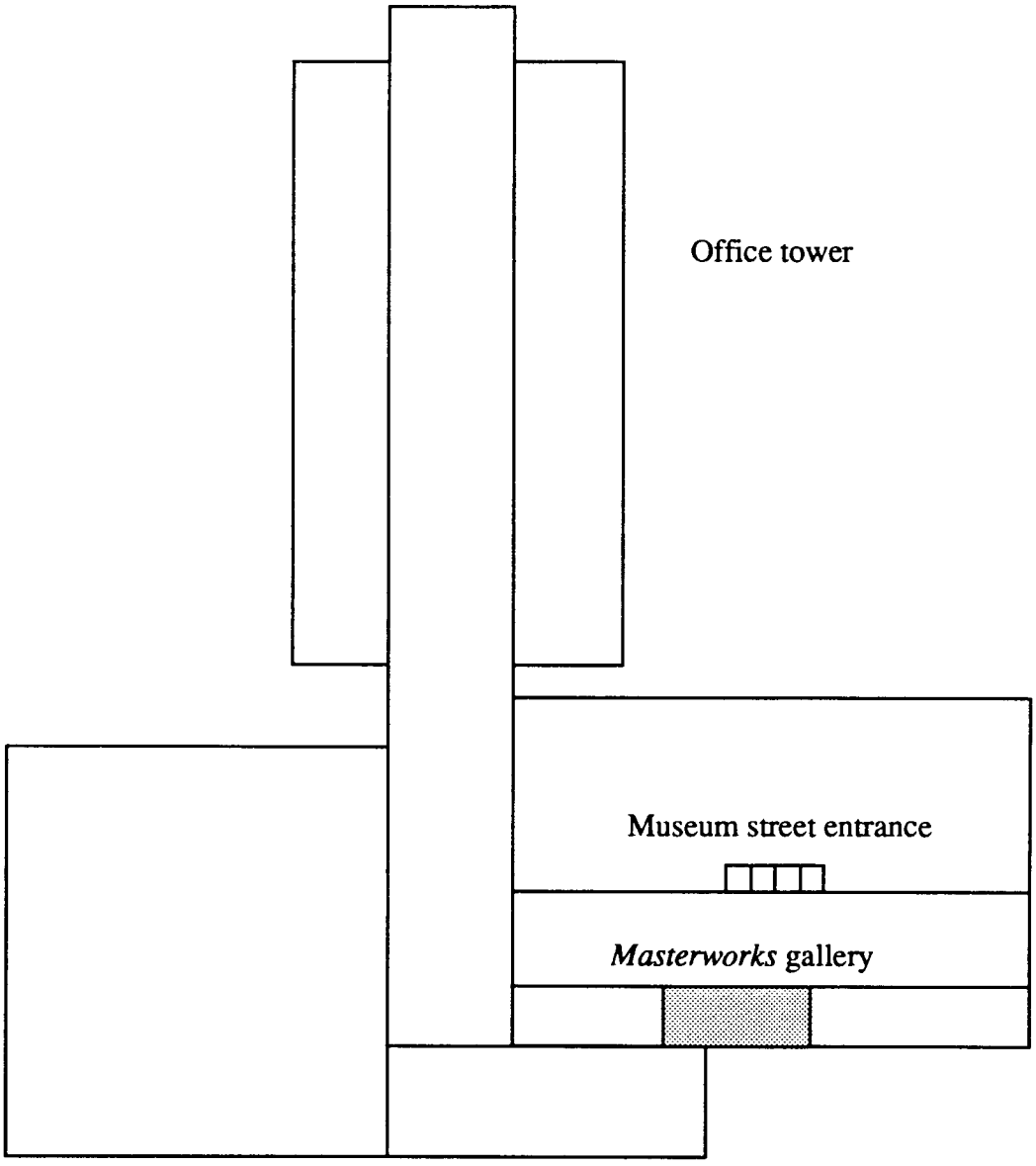

Figure 2

PATTERN OF OUTSIDE AIR FLOW INTO THE *MASTERWORKS* GALLERY

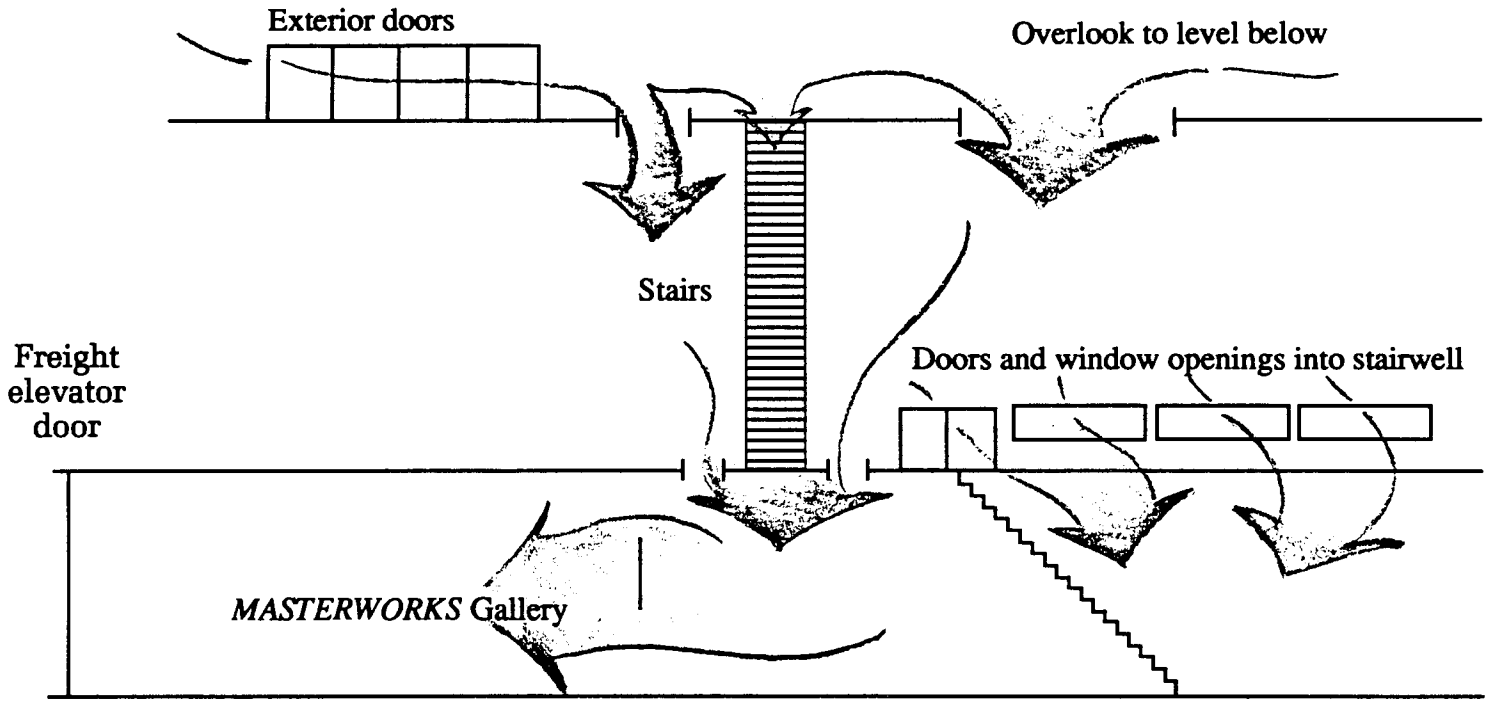

Figure 3

MODIFICATION TO REDUCE INVASION OF OUTSIDE AIR INTO THE *MASTWERWORKS* GALLERY