Article: Gaseous and particulate filtration for the Pinkney House at the Kern County Museum
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ABSTRACT

The Pinkney House is typical for many of the historic structures at the Kern County Museum. It has problems with particulate and gaseous contamination, and lighting problems. Typical "environmental controls" of heating, cooling, humidification and dehumidification were ruled out, based on the priorities identified for the collection as recommended by the conservator, and the prospects of the high capital and operating costs of treating over thirty such structures at the museum.

Since the environment within the house is not occupied, only viewed by visitors from outside, an innovative approach was used to improve the conservation environment within. First, the building was sealed to prevent entry of particulate and gaseous contaminants. Second, an air filtration system was installed to remove particulate and gaseous contamination from the circulated air, and to introduce a small amount of filtered outside air for pressurization. Third, the display cleaning program was improved to include a vacuum with a high-efficiency particulate filter.

The Pinkney House improvements were developed as a prototype to identify effective solutions for roughly thirty other such structures at the Museum.

The paper presents details of the improvements, with before and after observations for particulate and gaseous contamination. The paper also discusses measures to consider for further work and investigation.

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GASEOUS AND PARTICULATE FILTRATION FOR THE PINKNEY HOUSE
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BACKGROUND

The Kern County Museum is a collection of artifacts and buildings from the Bakersfield area, representing historic activities and structures. The Museum collections are kept in the various buildings, exhibited either in one of the modern buildings, such as the Main Museum Building, or one of the various historic structures.

The Pinkney House is typical of the historic structures, a former residence. The collection is exhibited inside the house and visitors view the collection by way of a glass "view box" which opens onto the kitchen and living room. Museum visitors amy also view the collection through the several windows which afford a view into the kitchen, living room and bedroom.

CONSERVATION ENVIRONMENT PROBLEMS

The consulting conservator, Ms. Mayda Jensen, surveyed the Museum and collections and identified basic priorities for environmental improvements. Humidity extremes, high light levels, high temperatures, particulate and gaseous contamination were cited.

GASEOUS CONTAMINATION. The major acute threat posed to the collection is from the more recent gaseous pollution in the Museum's region, which the conservator has identified as a primary agent in damaging most parts of the collection. The pollution and oil drilling in the San Joaquin Valley in and around Bakersfield has led to high pollution levels, aggravated by the containment of the Valley mountains and frequent thermal inversions.

PARTICULATE CONTAMINATION. A major problem was particulate contamination, primarily due to the dusty areas surrounding the Museum, including the adjacent fairgrounds. The chronic problem of ambient dust presents a lesser real threat the collection's well-being, but considerably diminishes the value of the collection to the viewer.

Cleaning of the collection had previously been done with cloth, feather dusters and portable vacuums. Areas generally needed recleaning in less than 6 months.

HUMIDITY STABILITY AND LEVEL. Due to the high rate of infiltration in the buildings the humidity follows outside conditions. This leads to daily fluctuations and prolonged periods of high humidity when rains occur. Unlike many museums where humidity control is the primary goal, much of the Kern County Museum historic collection has, by definition, already been generally exposed and acclimated to the Kern County ambient environment. The Kern County climate does not present the extremes in humidity found in many other climates, and the lack of low temperature extremes reduces the tendency of extreme drying from heating. There are, however, ambient fluctuations in humidity to which the conservator attributes some of the collection damage.

PROJECT CONSTRAINTS

CAPITAL BUDGET. The Museum has a very limited capital budget, highly dependent on county funding and grants. As such, the cost of major improvements to the many buildings needing attention would likely be prohibitively expensive. Over thirty buildings treated at a cost of roughly $20,000 each for conventional HVAC systems would yield an eventual project cost of over $600,000.

UTILITIES INFRASTRUCTURE. There is very limited utilities infrastructure throughout the Museum grounds, usually limited to 10- or 20-amp/120 volt single-phase electric service. Although available on site, no gas, water or drains are brought to most buildings. To provide such distribution infrastructure might easily double the project capital cost.

OPERATING BUDGET. Even if the Museum could afford the cost of the conventional HVAC equipment, it would be hard pressed to come up with the annual operating costs which might amount to a six-figure recurring annual cost.

TREATMENTS IDENTIFIED AND IMPLEMENTED

Typical "environmental controls" of heating, cooling, humidification and dehumidification were ruled out, based on the priorities identified for the collection as recommended by the conservator, and the prospects of the high capital and operating costs of treating over thirty such structures at the museum.

SEALING OF THE BUILDING. The building was sealed with caulk and repainted. Operable doors were gasketed and inoperable doors and windows were sealed.

IMPROVED VACUUM CLEANING OF THE COLLECTION. A new type of vacuum was used, equipped with a higher-efficiency "toner" bag to trap smaller particulates.

PARTICULATE FILTRATION AND GASEOUS CONTAMINATION CONTROL. A recirculating air-handing system was installed with high-efficiency particulate and gaseous filtration. A small amount of outside air was introduced at the inlet side of the system for slight pressurization of the building, hoping to encourage exfiltration rather than infiltration through any remaining cracks in the building.

TREATMENTS ASSESSMENT

PARTICULATE CONTROL. The Museum noted a dramatic improvement in particulate contamination. Rather than being badly in need of cleaning in less than 6 months, the building needs very little cleaning almost a year after installation of the system. The Museum noted that the particulate filter needed changing about one month after the unit was in operation, but that after that the filter seems to be providing a longer life, indicating that the primary filter loading was from initial original dust which has now been removed with very little dust entering to take its place.

The new vacuum cleaner also seems to be doing a better job of removing the particulates, trapping the smaller particles rather than blowing them through the bag and back into the collection space.

GASEOUS CONTROL. Methods measuring of gaseous contamination levels were only very crude tarnish observations on silver and did not include any laboratory-grade pollution tests or testing of individual collection objects damaged by gaseous pollutants. Nonetheless, silver test objects in the Pinkney House showed improved tarnish protection when compared to similar test objects in the similar but unsealed and unfiltered Dressmaker building.

HUMIDITY EXCURSION REDUCTION. The extremes of humidity often experienced in the past have not been evident in the renovated Pinkney House. However, the House undergoes regular daily fluctuations in humidity coincident with the diurnal temperature fluctuations typical of an unheated/uncooled building.

CONCLUSIONS

The Pinkney House experience leads to the following conclusions.

1. PARTICULATE CONTROL. The use of central high-efficiency particulate filtration, combined with higher-efficiency cleaning vacuums, can lead to a dramatic reduction of particulate contamination, and an associated major reduction in collection cleaning efforts.

   Filtration treatment of each room in a small building is evidently not necessary so long as the central system move a sufficient volume of air (over 1 cfm per square foot).

   Use of an expensive HEPA vacuum ($700-$1,000) is evidently not necessary. A small "toner" vacuum ($150) is evidently effective.

2. GASEOUS CONTAMINATION CONTROL. The use of central gaseous filtration with potassium permanganate pellets is evidently effective in reducing the rate of tarnish on silver objects and may indicate a reduction in long-term damage to other objects damaged by gaseous contaminants.

3. METHOD OF GASEOUS CONTAMINATION MEASUREMENT. A more precise but economical method of measuring gaseous contamination levels in the field would be desirable. Faced with the tarnish-on-silver technique, differences are better seen on flat sliver objects, such as butter knives, rather than complex objects, such as spoons and forks.

4. SEALED BUILDINGS AND TEMPERATURE/HUMIDITY SWINGS. A sealed building can be expected to exhibit diurnal humidity swings psychrometrically

reciprocal to diurnal temperature variations. The diurnal temperature swings of a similar unheated/uncooled building can be expected to be about 4 to 6 degF warmer than for an unsealed building.

FURTHER WORK

Although important conclusions can be reached from the Pinkney House renovation project, it also highlights other issues deserving further attention.

1. DEGREE OF CONTINUOUS GASEOUS TREATMENT REQUIRED. Although effective, it is not clear that the $2,000 installation at the Pinkney House is either too little or too much treatment. More or different gaseous media might prove more effective. On the other hand, long-term protection might be adequately provided with smaller $600 or less filtration systems with less media.

   This could be easily determined by testing the gaseous contamination levels in two buildings treated with each type of system.

   METHOD OF GASEOUS CONTAMINATION MEASUREMENT. A reliable, accurate method of measuring gaseous contaminant levels in the field is needed to help determine the adequacy of the gaseous treatment.

   This might be achieved using one of the new continuous corrosion indicators now available commercially for less than $10,000, or with one of the low-cost passive testing devices just now becoming available.

2. DEGREE OF CONTINUOUS PARTICULATE FILTRATION REQUIRED. Since the primary loading of the fine particulate filter was in the initial weeks of operation, the amount of continuous particulate filtration required may be less than that required initially. Long-term protection might be adequately provided with smaller $600 or less filtration systems.

   This could be easily determined by testing the particulate contamination levels in two buildings treated with each type of system.

   METHOD OF PARTICULATE CONTAMINATION MEASUREMENT. This might be achieved using one of the portable laboratory-grade particulate samplers available commercially for less than $2,000.

3. TREATMENT OF HUMIDITY SWINGS. The diurnal humidity swings of a sealed building may present a long-term problem to the collection, although no evidence has been presented that they are any worse than the humidity extremes of a leaky building. If identified as problematic, treatment of the swings may be possible.

   BUFFERING MATERIALS. The current humidity swings are not entirely psychrometrically reciprocal to the temperature swings - they are less than would be indicated by a pure temperature-driven change. This indicates that there may be a buffering effect in the building, possibly the wood structure itself, reducing the humidity swings. This effect might be enhanced by the introduction of more stabilized humidity buffering materials, such as silica gel.

HUMIDIFICATION. Although dehumidification might be problematic in capital and operating costs, modest humidification might be considered to increase humidity during the low part of the swings. Since the humidity is relatively low (35% RH rather than 50% RH), a wetted media device, such as wetted rotating copper screens, might be added to the system for humidification. The humidifier could be controlled by a low-level humidistat, turning the device on only when humidity falls below the peak or average humidity in the typical daily swings.

However, humidification should be carefully tested. Unlike a buffering material, it will lead to a net increase in humidity, which might end up increasing the average humidity without reducing the peaks.

COOLING. The primary cause of the humidity swings is the change in space temperature. As was planned in the event of over-heating, the building might be cooled with one or two indirect evaporative cooling cells, controlled by space temperature. While this would require a greater capital cost for the cells and cooler scavenger air fans, it would be less than half the cost of a conventional vapor-compression cooling system and less than one-tenth its operating cost.

DETAILS ON TREATMENT EQUIPMENT USED

TONER-RATED VACUUM CLEANER: Metro "Data-Vac II" with optional toner bag installed.

PARTICULATE/GASEOUS FILTRATION SYSTEM: Thurmond "IAQ" filtration system.
- Air Flow: approximately 2,000 cubic-feet-per-minute (CFM).
- Gaseous media: 1 cubic foot of alumina pellets with 4% potassium permanganate loaded into "V" cells.
- Particulate media: 2" Farr 30/30 30% Efficient Prefilter (or equivalent), 12" Farr Riga-Flow 200 90-95% Efficient Final Filter (or equivalent).

The scope of this paper was limited to particulate and gaseous filtration issues for the AIC Meeting at the request of the Objects Group Chair. Once new windows are installed in the Pinkney House the paper is intended to be expanded to include the lighting treatments and submitted to the AIC Journal.