NMl photo

Figure 1. Cape Henry Lighthouse interior at Fort Story, Virginia.

Historic Lighthouse Preservation:

INTERIORS

Historic lighthouse tower interiors are typically simple and utilitarian. Unless used as a residence, most lighthouse towers had little more than a wood, iron, or masonry stairway leading to the lantern and compartments on the ground level for the bulk storage of oil for the light. In lighthouse towers that also served as the keeper's residence, the interiors were typically finished with beadboard paneling or plaster, and trim features were typically those that were popular at the time of lighthouse's construction. In more prominent locations, interior finish detailing may be a little more grandiose, reflecting the skills of the craftsmen who constructed lighthouses. Because they are unique, these interior characteristics are considered character-defining and should be preserved. Regardless of the level of detailing and ornament found in a lighthouse, the building techniques employed were typically unique to lighthouse construction.

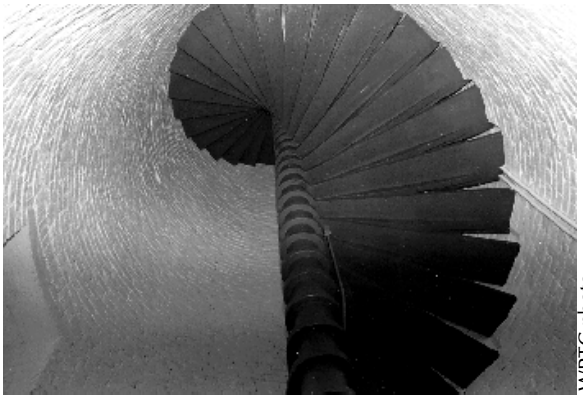

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Figure 2. Utilitarian light tower interior at Cove Point Light Station, Maryland.

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Figure 3. Highly decorated interior of the Cape Henry Light Station (second tower), Fort Story Virginia

Deterioration of Historic Lighthouse Interiors during the Mothballing Period

Damage caused by the ever-present harsh marine environment is readily apparent when discussing the deterioration of exterior lighthouse features. The forces that act on the exterior of the lighthouse may also have a detrimental effect on interior lighthouse features as well. Many factors contribute to this deterioration. During the time a lighthouse is mothballed, the likelihood of such deterioration is increased. If these damaging conditions are not addressed, the lighthouse may deteriorate from the inside out.

Why do historic lighthouse interiors deteriorate?

- **Moisture infiltration:** water entering the lighthouse through holes in the roof, gallery deck(s), lantern glass, exterior sheathing, and gaps around doors or windows.
- **Condensation buildup:** condensation forming within the tower caused by exterior temperatures and ambient humidity. Masonry lighthouses are especially susceptible to this condition.
- **Neglect:** lack of maintenance, i.e., cleaning, painting, or repair of interior features before or during the mothballing period.
- **Inappropriate treatments:** removal of original fabric or the obscuring of historically significant interior elements.

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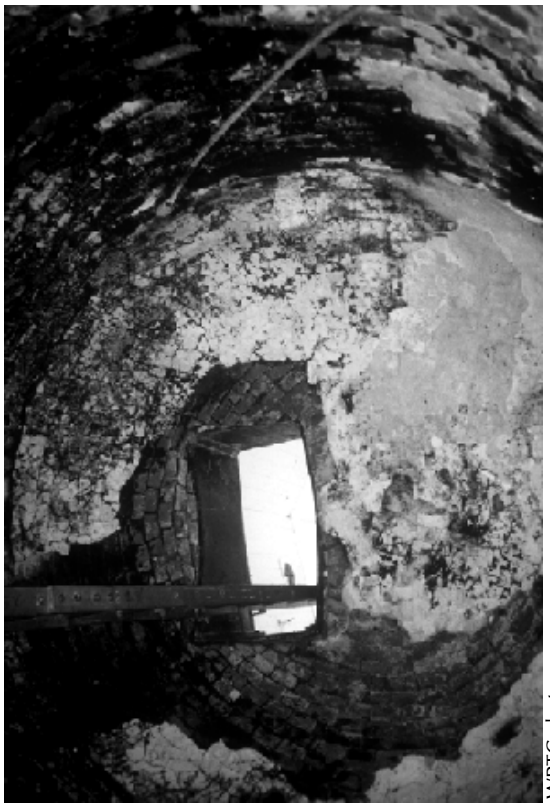

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Figure 4 (left). Extensive interior finish deterioration in a lighthouse that had holes in the roof which were not repaired.

Figure 5 (above). Excessive condensation buildup in this lighthouse caused the interior plaster finish and some mortar joints to fail.

PRESERVATION TREATMENTS: Minimizing Condensation Buildup

The preservation of historic lighthouse interiors is a multistep process. The first step in any lighthouse preservation project is to weatherize the exterior. This step will eliminate the threat of damaging moisture infiltration. The second step is to mitigate any condensation that may build up in the interior of the lighthouse. The third step is to monitor the interior environmental conditions to identify any problems that may arise before they cause more damage. The fourth step is to do no further damage to the interior during equipment installation or removal or during any rehabilitation efforts. This section will focus on minimizing condensation buildup in lighthouse interiors during the mothballing period. (Repair and mothballing treatments to **Masonry**, **Iron**, and **Wood** components can be found in their respective sections elsewhere in this handbook.)

As humidity levels increase in a lighthouse, the plaster, wood, iron components, and masonry are affected. Increased moisture content in the porous materials—wood, plaster, and mortar joints—causes significant damage. Increased moisture level in the wood makes way for the growth of fungi and attracts wood-eating insects such as termites. Increased moisture levels in plaster will cause mildew which holds more moisture in the plaster and in time will cause the plaster to delaminate and break away from the lath substrate. Increased moisture content in the mortar joints will cause the leaching of the lime from the mortar, which results in the failure of the joint. Increased moisture will cause any exposed iron to corrode or rust. These conditions are easily avoided if the lighthouse is adequately ventilated.

Once the exterior has been made weathertight, adequate air exchange is essential throughout the lighthouse. The needs of each historic lighthouse must be individually evaluated because there are so many variables that affect the performance of each interior space once the lighthouse has been made weathertight. A mechanical engineer or a specialist in interior climates should be consulted, particularly for lighthouses with significant interiors.

When looking at the type and amount of interior ventilation needed for a closed-up lighthouse, there are four critical climate zones: cold and damp (Pacific northwest and northeastern states); temperate and humid (mid-Atlantic states, coastal areas); hot and humid (southern states), and the extremely cold (freezing) and seasonably damp (Great Lakes). Each climate zone has special ventilation considerations.

The absolute minimum air exchange for most mothballed lighthouses consists of one to four air exchanges every hour; one or two air exchanges per hour in winter and often twice that amount in summer. Even this minimal exchange may permit mold and mildew in damp climates. Monitoring the lighthouse for approximately six months during the initial ventilation period will provide useful information on the effectiveness of the ventilation solution.

There is no exact science for how much ventilation should be provided for each lighthouse. There are, however, some general rules of thumb:

- During months of high humidity, it is important to keep the air within the tower moving at all times.
- The most difficult lighthouses to adequately ventilate without resorting to extensive

louvering and/or mechanical exhaust fan systems are masonry lighthouses in humid climates. For this lighthouse type nearly every window will need to be fitted with a louver that occupies at least 50 percent of the window opening.

- Take advantage of prevailing winds during the installation of louvers. This will provide the maximum amount of natural passive (non-mechanical) ventilation.
- The natural chimney effect in most lighthouses is best utilized by installation of vents at the top and bottom of the lighthouse only. Consider vandalism when locating the lower vent.
- Be sure the built-in lantern vents are open and screened. This will also capitalize on the chimney effect that will naturally draw the air up and out of the lighthouse as the hot air in the tower rises.
- In lighthouses with AC power, fans controlled by thermostats and timers provide effective ventilation that can be tuned to operate in reaction to day-to-day climatic change. One fan in a small- to medium-sized lighthouse can reduce the amount of louvering substantially.
- If electric fans are used, study the environmental conditions of the lighthouse to determine whether the fans should be controlled by thermostats or automatic timers. Humidistats, designed for enclosed climate-control systems, generally are difficult to adapt for open mothballing conditions. How the system will draw in or exhaust air is also important. It may be best to bring dry air in from the lantern or upper levels and force it out through lower tower windows. Additionally, less humid dry air is preferred to damper night air; this can be controlled with a timer switch mounted to the fan.
- Small preformed louvers set into a plywood, polycarbonate, or lexan panel generally cannot provide enough ventilation in most moist climates to offset condensation, but this approach is certainly better than no louvers at all. Louvers should be located to give cross ventilation; interior doors should be fixed ajar at least 4 inches (10 cm) to allow air to circulate; and hatches between floors should be left open.
- The type of ventilation should not undermine the security of the lighthouse. The most secure installations use custom-made vents and heavy millwork louvers set into existing window openings. This louver type is also effective in preventing rain from being blown into the lighthouse during storm conditions.

  In some extreme circumstances, heat will be needed during the winter, even at a minimal 45° Fahrenheit (7° Celsius), and using forced-fan ventilation in summer and will require retaining electrical service. For masonry lighthouses the interior temperature should be kept above the spring dew point to avoid damaging condensation. In most lighthouses the need for summer ventilation outweighs the winter requirements.
- Lighthouses using prime power (fuel-powered generator) with hot-air exhaust (not combustion emissions) into the lighthouse interior may not require a vent near the base. The rising heat will cause a natural upward draft to occur. To take advantage of this natural draft, vents should be located near the top and bottom of the tower. The vents near the bottom will allow fresh ambient temperature air into the tower. Vents located near the top of the tower will allow the hot air to escape. This configuration will help keep the interior of the tower dry and minimize the heat buildup that could damage interior finishes.

(For more information on window louver types and installation techniques refer to the **Windows** section.)

Use the gentlest means possible; all treatments should be reversible. Preserving the lighthouse interiors during the mothballing period will minimized the cost of repairs over the life of the lighthouse.