QUICK REFERENCE GUIDE | MECHANICAL / HVAC SYSTEMS IN PUBLIC BUILDINGS





Left: New six-tier operating panels to control each chilling module and compressors at the National City Christian Church, Washington, DC. Photo by Kevin Cordray.
Center: New heat pump units installed along the Baltimore Avenue alley behind Calvary United Methodist Church, Philadelphia, PA. Photo by Tim Emmett-Rardin.
Right: New air handling unit installed in the kitchen in Calvary United Methodist Church, Philadelphia, PA. Photo by Tim Emmett-Rardin.

MECHANICAL / HVAC SYSTEMS IN PUBLIC BUILDINGS

Early buildings were not designed with mechanical cooling and heating systems. Builders designed buildings for the area's climate, using passive and natural ventilation to capture winter sun, summer winds, and cross breezes to heat, cool, and move fresh air through a building. In addition to natural ventilation, many historic places of worship were built with solid stone walls (often several feet thick) to help maintain a more consistent indoor temperature. The high thermal mass of the stone walls allows heat to be slowly absorbed and released to naturally heat and cool the indoor air.

Early buildings were mostly heated by fireplaces and stoves. The Romans developed an early version of under-floor heating, called hypocaust, by installing underground pipes or channels beneath the floor to circulate hot air. While this was used in some early churches, this system fell into disuse in Western Europe after the decline of the Roman Empire.

The Industrial Revolution provided the technology needed to effectively control the environment in a building for the first time. While fans had been used since the sixteenth century to circulate air, the development of the steam engine allowed fans to be used to circulate air more successfully through buildings. This led to fans being integrated into mechanical systems in the nineteenth century to heat buildings by moving air over steam-heated pipes. Fans were also used to increase ventilation within a building by drawing outside air into a building's basement and forcing hot air out of the top of the building. This was a common practice used in large historic places of worship.

The nineteenth century saw the development of central heating, which helped improve personal comfort. The development of steam energy from coal and the mass production of wrought iron boilers and cast-iron radiators made central heating available for installation in most buildings.

The increased availability of electricity in the twentieth century allowed for the development of new technologies that made mechanical systems more efficient and cost effective. Electricity also allowed for central air conditioning to be installed in buildings. The first use of this technology was in movie theaters and auditoriums in the 1920s. By the middle of the twentieth century, forced-air-systems provided both heating and cooling to all types of buildings. Technological advancements by the end of the twentieth century allowed HVAC (heating, ventilation, and air conditioning) systems to become more efficient and decrease in size with smaller components. These new systems (such as split ductless systems with wall-mounted air handlers, cassette ceiling-mounted diffusers, or high-velocity mini-duct systems) can be especially useful for updating mechanical systems in historic buildings.

HVAC systems are an important part of most modern buildings to ensure that they can continue to function and be occupied. The systems need to work efficiently and meet modern standards for personal comfort. Most mechanical equipment only lasts 15-30 years due to typical wear and tear, or the availability of parts for the system. This means that historic and older mechanical systems will most likely need to be replaced at some point.

There is no single formula that determines the best mechanical system for a building. Each building and its current use needs to be evaluated to make that determination. It is also important to carefully plan the installation of the new mechanical system to ensure that the building's character-defining exterior features, interior spaces, historic materials, finishes, and site features are preserved or impacted as little as possible.

GENERAL RECOMMENDATIONS

All projects funded by the National Fund for Sacred Places must respect the property's historic character and materials, and must adhere to the Secretary of the Interior's Standards for Rehabilitation. Below are general recommendations for updating the HVAC/mechanical systems in historic buildings, but they do not cover all the specific recommendations. Reference the resources in the section below for more detailed recommendations.

- **QUALIFIED PROFESSIONALS:** Work with a design team (architect, mechanical engineer, etc.) and mechanical contractors who have experience working on historic buildings. This is important to consider, because working with a contractor who is not well-versed in working with historic buildings may suggest installing a mechanical system that is not appropriate for the historic building or could damage or obscure important historic features.
- **RETAIN AND PROTECT:** Retain and protect visible features of original or early mechanical systems (such as radiators, vents, fans, and grilles), even if those features are no longer functional.

- **ENERGY EFFICIENT IMPROVEMENTS:** Improve the energy efficiency of the existing building to help reduce the need for a new system. Reference the Quick Reference Guide on Energy Efficiency for more information.
- **REPAIR:** As an option, repair existing mechanical systems by expanding or updating systems through adding components (such as installing new pipes and ducts), adding new compressors or boilers, or rewiring the system.
- **NEW SYSTEM:** When installing a new HVAC/mechanical system, select the correct type and size for the building and use.
- **MINIMIZE IMPACT:** Install a new HVAC/mechanical system in a manner that preserves and minimizes the impact on a historic building's character-defining exterior features, interior spaces, historic materials, finishes, and site features. Install new mechanical equipment, ducts, or piping in existing wall cavities and secondary spaces (such as closets and service areas) to preserve the historic character of the interior spaces.
- **CEILINGS AND SOFFITS:** Ceilings can be lowered, a dropped ceiling can be installed, or soffits can be constructed to conceal mechanical equipment or ductwork in a finished space if it will not result in extensive loss or damage to historic materials, decorative elements, or other features, and will not change the overall character of the space or exterior appearance of the building.
- **EQUIPMENT ON ROOFS:** Mechanical equipment installed on the roof should be done in a way that is as unobtrusive as possible and not visible from the public right-of-way.
- **AIR CONDITIONING COMPRESSORS:** Air conditioning compressors should be installed in a location on a secondary elevation of the historic building so that they are not highly visible.

RESOURCES

The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings | Mechanical Recommendations are found on Pages 125-127

Preservation Brief #24: Heating, Ventilating, and Cooling Historic Buildings: Problems and Recommended Approaches