

House of Worship: Presents 21st-Century Upgrades to a Mid-20th Century House of Worship

Malden, MA



THE PROJECT

A Synagogue in Malden, Massachusetts wanted to reduce greenhouse gas (GHG) emissions, replace end-of-life equipment, improve comfort and reduce operating cost. Achieve Renewable Energy, LLC., is proud to have met these goals with a Ground Source Heat Pump (GSHP) installation that is worthy of being the 2020 Top Job.

The historic mill building was heated via a fuel oil-fired steam system. HVAC upgrade options were:

It was originally heated via a fuel oil-fired boiler that supplied hydronic air coils in one 40-ton and two-7.5 ton, single-speed air handler units (AHUs). The burner in the boiler was converted from fuel oil to natural gas. A large chiller that provided cold water to the AHUs for air conditioning. The building had two heating and cooling zones.

The house of worship has high occupancy during the weekends, religious holidays or events and low occupancy other times. The HVAC system supplied fresh air via mechanical space wall openings directly

to the outside operating at nearly 100% fresh air. This approach left the building open to the outside. Cold air from the mechanical spaces spread throughout the building via an open stairwell, which resulted in very cold internal temperatures during the heating season.

To support design, Achieve tested Formation Thermal Conductivity and completed a Manual N Heating/Cooling Load Analysis. We used the data to design a customized GSHP system. The GSHP conversion consisted of thirteen variable-speed GSHPs supplying 16 comfort zones.

THE RESULTS

The GSHPs utilize a central vertical-closed loop heat exchanger (VCL) consisting of fifteen 500-foot vertical bores drilled in native Rhyolite. Borings were completed with a 1.25" ID HDPE u-bends and graphite-enhanced grout with a thermal conductivity of 1.2 Btu/hr-ft-°F. The borings were plumbed in parallel in 5 groups to a manifold in the basement. Loop circulation is achieved with a central variable-speed pump system in a primary-secondary configuration with a central hydraulic separator. The ground loop pump adjusts to maintain a set differential temperature over the inlet/outlet to the building loop which matches flow to building demand. The building loop pump adjusts to maintain constant pressure and each GSHP controls its own modulating flow valve which matches flow to GSHP operation. This configuration greatly reduces pumping cost.

Each GSHP is monitored remotely using a WaterFurnace Aurora Web-Link (AWL). The AWLs and programmable temperature controls offer convenience to the Congregation. During the Sabbath and some holidays, the members cannot operate the system controls, telephones or computers. The programmability of the various zones allows temperatures to be pre-set for. Internet-connectivity allows Achieve to make system adjustments remotely without interfacing with members of the Congregation.

Achieve replaced the poorly conceived fresh air system with a ducted fresh air system that is electronically controlled based upon Carbon Dioxide concentrations in the building. With this improvement, the HVAC system provides fresh air consistent with building occupancy. Which reduces HVAC cost.



Antiquated Equipment Before Replacement



Ground Heat Exchanger Installation



Computer Controlled Pumping



Ground Heat Exchanger Drilling



New GSHPs



Precision Flow Control



Building Geothermal Piping

The Director of the Synagogue has received many positive comments regarding comfort. Utility cost has been reduced as have GHG emissions have also been significantly reduced.