

Lakeport Plantation Restoration

Technical Report No. 10

Smokehouse and Mechanicals



The original smokehouse was no longer standing at the time that restoration began on Lakeport Plantation house. It had collapsed sometime during the 1980's and only a pile of bricks remained. There was enough photo documentation, however, to be able to rebuild the smokehouse with historical accuracy. Historic photos showed the original smokehouse to be a large, square, brick building with a board and batten door. Vent holes near the top gave evidence that the building was used as a smokehouse. The hip roof was covered with wooden shingles and a wooden finial could be seen at the peak of the roof. Cornice moldings and frieze board along the eve of the roof matched the trim on Lakeport house.

At the time that plans were being made to rebuild the smokehouse, plans were also being made to construct a concealed mechanical room, located away from the house, in which to place the mechanical equipment for Lakeport Plantation house. The purpose of this was to protect the house and maintain the historic appearance inside the house. Mechanical equipment is noisy and unsightly inside a historic



The original Lakeport smokehouse, seen in the photo at left, fell sometime during the 1980's. When this photo was taken, the west wall had already begun to collapse. This photo was provided by descendants of the Johnson family.

In the photo at right can be seen the original lime plaster walls that were found in Lakeport Plantation house when restoration began. The lime plaster walls on the second floor of the house had never been painted. These walls are in the southeast bedroom on the second floor of the house.



structure. During installation, historic materials are often damaged, removed or destroyed. Operation of the equipment produces a vibration that can weaken the historic structure and moisture produced by the equipment can damage historic building materials. The decision was made to rebuild the smokehouse and place the mechanical equipment inside. The exterior of the smokehouse would be built to replicate the original smokehouse and the interior would serve to hide the mechanical equipment.

Built between 1858 and 1860, the house was in almost original condition when restoration began. Inside, the house still had its original lime plaster walls. Decorative lime plaster cornice moldings and ceiling medallions also remained. The interior doors still held their original rosewood faux finishes and the original marbling could still be found on fireplace mantels. Preserving these historic finishes was very important to the success of the project.

When Lakeport Plantation house was built the tall ceilings and windows, transoms and large porches served well for ventilation. The thirteen fireplaces were the sole source for heat. The only insulation would have been the lime plaster walls. Temperatures inside the house would not have varied greatly from temperatures outside, nor would the relative humidity. This allowed the house to expand and



The photo at left shows the ceiling medallion that was found in the south parlor of Lakeport Plantation house. The ceiling medallion, made of lime plaster, is original to the house.



The door shown in the photo at left opens into the master bedroom on the second floor of Lakeport Plantation house. All of the doors on the second floor still hold their original rosewood faux finish that has never been painted over.

contract with the change of the seasons. As occupancy of the house changed through the years, heating methods changed minimally. During the mid-1900's, gas space heaters were used to heat the main floor of the house. There was no evidence of gas heat being used on the second floor. Ventilation for the house remained the same through the years. Lakeport Plantation house had basically maintained the same environment inside the house from the time that it was first built.

The construction methods used to build Lakeport Plantation house allowed air to continually circulate throughout the house. When restoration is complete, the environment inside the house will change. The house will be tighter and air will not circulate throughout the house as it has in the past. This will affect the humidity inside the house. Humidity can be very damaging to a house. Too little humidity can dry and crack historic finishes. Too much humidity can cause moisture to collect. Moisture can result in rotting wood and peeling paint. The humidity will also affect the stability of the lime plaster walls and decorative moldings.

When planning the mechanical system for Lakeport Plantation house humidity control was considered to be the most important factor in the preservation of the house. When deciding on the type of climate



The photo at right shows the tall windows and doors and large porches that have provided ventilation for Lakeport Plantation house from the time that it was first built.



In the photo at left the floor of the original smokehouse has been exposed by the project archeologists. Excavation showed that the smokehouse floor was built of handmade bricks, many of them half bricks. It is believed that these bricks were left over from the construction of Lakeport house.

Also exposed were the original smokehouse footer and part of the smokehouse wall. As seen in the photo at right, the smokehouse footer was built in a corbelled design, similar to the footer built to support Lakeport Plantation house.



control system to be used, it is important to consider the building itself as well as its use. Modern climate control systems are often over-designed for historic buildings. In a historic structure, the lowest level of intervention needed is desirable. A state of the art mechanical system was designed for Lakeport Plantation house by Landmark Facilities Group, an engineering firm based in Norwalk, Connecticut. LFG specializes in custom climate control design for museums, libraries, and historic structures. LFG designed a climate control system, as well as a geothermal heat pump system and a dry-pipe fire suppression system for Lakeport Plantation house. The geothermal heat pump system will work with the climate control system to regulate the humidity and temperature to maintain a stable environment inside the house.



Many of the mechanical components were installed prior to pouring the concrete slab for the smokehouse. In the northwest corner of the smokehouse is the piping to the geothermal field. The fire pump sets at the southwest corner. In the southeast corner are the supply and return air ducts and in the northeast corner is the electrical supply for all of the mechanicals.

The photo at right shows concrete masonry blocks being laid as the construction of the new smokehouse begins.



The climate control system is a computerized system designed to monitor the temperature and humidity inside the house. The humidity may be too high in one room while in another room it may be too low. As the system monitors the temperature and humidity in each room, adjustments are made accordingly. This system will also allow for adjustments to be made manually if necessary.

Before construction began on the new smokehouse, project archeologists excavated the original smokehouse site. During excavation, archeologists uncovered the original smokehouse floor, as well as part of the footer and foundation wall. The smokehouse floor was built of bricks, many of which were half-bricks. It is believed that these bricks may have been waste from construction of the house and other outbuildings. The footer of the smokehouse was exposed by removing a section of the brick flooring. The footer and foundation wall were both built of brick. The brick footer was built of four layers, or courses, of brick with the first two layers corbelled. Three brick courses of the foundation wall remained above the footer. The foundation wall was two bricks wide. The bricks were low fired, and hand-made, the same as the bricks that were used for construction of the Lakeport chimneys and dairy. The original brick foundation was removed and salvaged for re-use before construction of the new smokehouse began.



In the photo at left brick masons are laying reproduction "handmade" bricks over the concrete masonry blocks. Reproduction bricks were found to match the bricks from the original smokehouse.



The photo at left shows the construction of the mezzanine floor in the new smokehouse. The mezzanine floor was necessary to be able to house all of the mechanical equipment in the smokehouse.

The new smokehouse was built to appear as a reproduction of the original smokehouse on the exterior and to accommodate the mechanical equipment for the house on the interior. The new smokehouse was built on the footprint of the original smokehouse. A cement floor was chosen to hold the heavy equipment. Many of the mechanical components will enter and exit the smokehouse from below ground. These components were set into place before the concrete floor was poured.

The smokehouse is approximately twenty foot square. It is constructed of concrete masonry blocks. On the exterior, the concrete blocks are covered with reproduction “handmade” bricks found to match the original bricks. Vent holes were left in the bricks near the top, as seen in historic photos of the smokehouse. The hip roof was covered with western red cedar shingles. A rooftop finial was reproduced to match the original. The finial is the decorative end of the king post that extends vertically through the attic space of the smokehouse and gives support to the rafters. The finial protrudes through the peak of the roof to provide rooftop ornamentation. Copper material was used to cover the wood finial and flashing. Copper material does not rust and will last for decades. Although exposed copper does not require painting, the flashing and finial were painted white for historical accuracy. The cornice moldings and frieze boards for the smokehouse



In the photo at right preparations are being made to begin digging the wells for the geothermal field for Lakeport Plantation house. A test loop had previously been dug and it was determined that, to maximize the thermal quality of the ground, each well would need to be three hundred and sixty feet deep with a distance of twenty-five feet between all wells.



The photo at left shows an aerial view of the geothermal field as it is being dug for Lakeport Plantation house. The geothermal field consists of five rows of loops with five vertical loops, or wells, in each row.

were reproduced to match the trim on Lakeport Plantation house and painted white. A board and batten door was built to match the original door with a metal door installed behind the wooden door for security purposes. Wooden louvers were built into the east and west walls of the smokehouse. The louver on the east wall was designed to pull the outside air into the smokehouse for ventilation. An electric heater was placed inside the smokehouse to prevent water from freezing during extremely cold temperatures.

Inside the smokehouse, the main floor will hold the fire pump and ground well for the fire suppression system, the pipes that will connect to the geothermal well field, the cold and hot water expansion tanks, and the supply and return air ductwork and electrical system. The mezzanine floor, constructed to provide additional floor space, will hold the hydronic piping and pumps for the geothermal system, the large air handler and the supply and return air ductwork that connects to the air handler.

The geothermal heat pump system is designed to use ground temperature to provide energy efficient heat and air. Ground temperature five to ten feet below ground remains relatively constant year round at about fifty degrees Fahrenheit. At six feet underground, temperatures range from forty-five to seventy-five degrees Fahrenheit. With the geothermal heat pump system, a series of tubes, called loops or wells, are



The photo at right shows a single row of five wells. What appears to be two pipes running into the ground for each well is actually one pipe that runs into the ground, loops below ground, and then comes up and out of the ground.



The photo at left shows the removal of dirt from beneath the footer of the house to make way for the large cast iron pipes. Once the pipes are run beneath the foundation, they will connect to the sheet metal ductwork that will carry the supply and return air throughout the house.

buried below ground and water circulates through these loops. The water has an anti-corrosive chemical added to prevent the interior of the metal pipes from deteriorating. As the water circulates it is brought near ground temperature. The loops connect to an indoor heat pump and equipment that controls the distribution of the air.

There are two different types of geothermal heat pump systems. The open-loop system uses well water as the heat source and the water is returned to another well or a drainage field. The closed-loop system continually circulates the water through a loop of pipe beneath the ground. Ground loops can be installed vertically or horizontally. Vertical ground loops use less space but are more costly than horizontal ground loops. The Lakeport system is a vertical, closed loop system. Space was a determining factor in selecting the closed loop system for Lakeport Plantation house. The Lakeport geothermal field consists of five rows of loops with five vertical loops, or wells, in each row. Each well is three hundred sixty feet deep. Prior to digging the wells for the geothermal field, a test loop was dug to test how the ground would dissipate heat. This helped to determine how to design the system; how deep the wells should be and how far apart to place each well.

To produce heat, the water circulates through the heat pump system. Because the water is already



In the photo at right a concrete floor has been poured at the bottom of the trench. The concrete floor will support the large cast iron pipes that carry the supply and return air from the mechanicals inside the smokehouse to the inside of Lakeport Plantation house.

The photo at right shows a steel brace being constructed to support the footer while the cast iron pipes are being installed. A steel plate has been placed beneath the footer and L-braces are welded to each side of the plate. The braces will be supported at each end by concrete piers.



The photo at left shows construction of the steel brace from below the house. The large, cast iron pipes will enter Lakeport house beneath the footer of the cook's room. Part of the cook's room flooring has been removed to provide access to the footer from inside the house.



The photo at right shows the bracing completed. The concrete support is poured and ready for the large pipes to be laid. Once the pipes are laid, a cement fill will be used to provide permanent support.

In the photo at right the large cast iron pipes have been run beneath the foundation of the new smokehouse. The pipes that are running upward will connect to the air handler inside the smokehouse.



warmed near to ground temperature by circulating through the ground loops, it will take less energy from the heat pump system to warm the water to the desired temperature. From the heat pump system the water runs through a radiator inside the air handler. A fan inside the air handler blows through the radiator where the air is warmed further. The air is also dehumidified at this point. The warm air is then forced through the large pipes and into the ductwork where it is distributed throughout the house. Cool air is produced in this same manner.

The air that is blown into the house is pulled back through the return air system and reconditioned to go back into the house. At the same time the water circulates through the system and is returned to the ground loop to be reused. Excess hot and cold water that is produced is stored in hot and cold water storage tanks that are housed in the smokehouse. Mixing valves in the plumbing extract the water from the tanks when it is needed.

Pipes will run below ground from the smokehouse to the main house to carry the supply and return air, plumbing, and electrical. To hide the pipes, a trench was dug from the smokehouse to the back wing of the house and the pipes are buried below ground. The large pipes that carry the supply and return air



The photo at left shows the large cast-iron pipes being run from the smokehouse to Lakeport Plantation house. The large pipes are twenty-four inches in diameter.

The photo at right was taken from inside the cook's room. In this photo the cast iron pipe can be seen as it enters below the footer of the house.



In the photo at left the cast iron elbow has been brought in through the east entrance of the cook's room and is being lowered to beneath the floor. It will connect to the pipe that enters from the exterior.

In the photo at right the elbow has been set in place. Below the house, the cast iron pipes will connect to custom fabricated metal ductwork that will run throughout the house.



The photo at right is an aerial view of the mechanical pipes as they enter Lakeport Plantation house. The smaller cast iron pipe to the left is a dry-line pipe for the fire suppression system. The large cast iron pipes carry the supply and return air. The small pipe on the right carries the electrical conduit for the mechanical system.



from the smokehouse to the main house are two feet in diameter and made of cast iron. Insulation covers the pipes to prevent sweating. A concrete pad was poured at the bottom of the trench to support the heavy pipes. Concrete was also used to anchor the pipes and keep them from moving. The large pipes enter Lakeport Plantation house below the brick footers of the house.

Underneath the house, the cast iron pipes are connected to insulated, rigid metal ductwork. The ductwork runs up through the house and into the attic. Inside the house, the ductwork is hidden in the storage closet on the first floor and the dressing room closet on the second floor. Shelving was removed from both of these closets to make room for the mechanical equipment.

To hide the supply air ducts in the main house, the chimney flues in each room were used. The tops of the chimneys were capped and the flues were opened up in the attic to allow entry for the ductwork. The ductwork used for the flues was made of flexible round metal material. Plaster was removed from the face of each chimney and bricks were carefully extracted in areas to give access to the interior of the flues for easy maneuvering of the ductwork during installation. An insert, called a plenum, and an air diffuser, which is the vent through which the air flows, were installed in the throat of the firebox. Once the



The photo at left shows two sections of the main ductwork that runs beneath the house. The main ductwork connects to the cast iron pipes as they enter the house. The two sections shown in this photo will be joined together.



The photo at left shows one of the chimneys in the attic of Lakeport Plantation house. This chimney has four flues which serve the south parlor and dining room on the main floor and the southeast and southwest bedrooms on the second floor. The bricks have been removed to provide access to each of the four flues in preparation for the ductwork to be installed.

The photo at right shows the flexible, round metal ductwork being run down one of the chimney flues. This particular chimney has only two flues.



In the photo at left the ductwork has been run down the four chimney flues. The custom made collars that lay on the floor are ready to be attached to the chimney face. They will secure the ducts and ready them for attachment to the main supply ducts in the attic.

In the photo at right, bricks are being removed to provide access into the chimney flue. This will allow restoration workers to guide the ductwork down the flue. A special carbide-toothed handsaw is being used to remove the bricks. This type of saw blade will help to reduce damage to the bricks. Plans are to salvage the bricks for reuse.



ductwork was run down the chimney flue, it was connected to the plenum. The fireboxes had been repaired earlier in the restoration. Damaged firebricks were removed and replaced with new bricks to match the original and the fireboxes were repointed. After installation of the ductwork was complete, the chimney flues were closed back up using salvaged bricks and new plaster was applied over the bricks.

The commissary of Lakeport Plantation house did not have a chimney in which to hide the supply air ductwork and the original cast iron cookstove still remains in the kitchen, making the kitchen flue unavailable for use. The ductwork for the kitchen, commissary and cook's room was run into the attic space above these rooms and a diffuser was installed in the ceiling of each of these rooms.

The large return air vent that serves the main house is hidden in a small closet beneath the stairway. The closet was there originally and is used well for this purpose. The return air vents for the commissary,



kitchen and cook's room are in the floor. The vent holes were cut into the wood floor in each room to make these vents less obtrusive.

Before restoration began, Lakeport Plantation house was tested for the presence of hazardous materials. Due to the age of the house, many of the paint finishes inside the house were found to be lead-based. Lead-based paint can be harmful when ingested. When work began inside

In the photo at left, the southwest bedroom fireplace has been opened up to allow access to the ductwork that has been run down the flues from the attic. The ductwork seen in the center of the chimney will serve this bedroom while the ductwork on the right in the photo continues on to the dining room fireplace below.

In the photo at right, more bricks have been removed to prepare for installation of the plenum and air diffuser.



In the photo at left, the plenum and air diffuser have been installed. The air diffuser, placed at the bottom of the plenum, dispenses air into the room.



In the photo at right, the mechanicals have been installed and the brick mason is replacing the bricks.



The photo at left shows the small closet beneath the stairway that was used to hide the return air vent for the main area of the house. The door will remain open at all times. The interior of the closet door, as can be seen in this photo, was used to demonstrate the application of the original rosewood faux finish.

the house, it was recommended that the hazardous paint be removed from the house for the safety of the workers. This recommendation was extremely controversial as many of the paint finishes were original to the house and it was important that they be preserved. At one point it seemed possible that all of the historic paint finishes were to be removed. Measures were taken to protect the restoration crew by covering the interior of the house with

plastic sheeting while they were working inside. Vent holes were made in the plastic to allow the walls to breathe and prevent sweating. When work that involved the disturbance of the lead-based paint was complete, the plastic was removed.

For fire protection, a dry line fire suppression system was used. The purpose of this type of system is to prevent the possibility of water leakage which would cause damage to the house. With a dry line fire suppression system the pipes are filled with pressurized air rather than water. The pressurized air keeps a remote valve closed so that water does not enter the pipes until the system becomes activated. Each sprinkler head houses a sensory bulb that, when exposed to high temperature, allows the sprinkler head to open, allowing the air to escape. The water then enters the pipes, flowing through the sprinkler heads and onto the fire. Each sprinkler head operates individually. The only sprinkler that will function is the



The photo at right shows a return air vent being cut into the kitchen floor. This method was designed and used, rather than cutting a large opening in the floor to fit a metal vent, because it is less destructive to the historic fabric of the house.

In the photo at right the interior of Lakeport Plantation house has been covered with plastic. This was done for the restoration workers as a protective measure against the lead based paint found inside Lakeport Plantation house before restoration began.



one that senses the rise in temperature.

Water for the fire suppression system is provided by a well that is located below the concrete floor of the smokehouse. Because of this, the well had to be dug before construction of the smokehouse began. The well head and mechanicals for operation of the fire suppression system are housed inside the smokehouse. The pipes for the system run below ground from the smokehouse to Lakeport Plantation house.

Inside the house, sprinkler heads were installed in each room. Walls were trenched, removing plaster and lath, to give access inside the walls for installation of the water pipes. Sprinkler heads were also installed on the porches and in the attic. For additional fire protection in the attic, partition walls were built to isolate areas of the attic for fire containment purposes. The walls were framed using metal studs and walled with



The photo at right shows two of the trenches that were cut in the walls of Lakeport house to run the pipes for the fire suppression and electrical systems. The photo above shows one of the fire sprinkler heads that will be left exposed inside the house.

The photo at right shows metal stud framed partition walls, with fire retardant gypsum board, being built in the attic of Lakeport Plantation house. The purpose of the walls is to isolate areas of the attic to help contain a fire if one should one break out. The photo below shows a close-up of one of the fire sprinklers that were placed in the attic.



a fire retardant gypsum board.

Electrical service was needed for operation of the mechanical equipment inside the smokehouse. It was also needed for the security system and emergency lighting inside Lakeport house. Utility lines were buried underground and the transformer was hidden behind a latticework fence so as not to interfere with the historic appearance of the house. An electrical service panel was installed inside the smokehouse. A small pipe carries the electrical wires underground to the main house. Inside the house, electrical service panels are hidden in the utility closets on the first and second floors.

In the event that a power outage should occur, a generator was installed to operate the fire suppression system. The generator was hidden from sight behind the latticework fence along with the transformer. A transfer switch inside the smokehouse will transfer the mechanical equipment from utility power to



In the photo at right the transformer and generator are hidden behind the latticework fence. The purpose of the transformer is to reduce high voltage electricity down to a safe level for domestic use. The generator is used as a backup for the fire suppression system should there be an electrical outage.



The photo at left shows the large air handler being maneuvered through the smokehouse door. Once inside, the air handler will be raised to the mezzanine floor where it will be installed.

The large air handler can be seen in the photo at right setting on the mezzanine floor of the smokehouse. The supply and return air ductwork comes from the floor below to tie into the air handler.



The photo at left shows the hydronic piping and pumps which direct the feed from the geothermal field to the mechanicals inside the smokehouse.



In this photo, the ground well and motor that will pump the water for the fire suppression system are to the left. To the right, the pipes that are coming through the concrete slab are joined to the ground loops as they enter the smokehouse from the outside. On the inside they will join the hydronic piping for the system.

emergency generator power during a power outage.

A mechanical system that is well maintained is very important to the preservation of the house. Maintenance staff should be trained to operate, monitor and maintain the mechanical equipment. Routine maintenance schedules should be developed for changing and cleaning filters and vents. This will help to ensure peak performance and longevity of the equipment. The climate control system in a historic building requires constant monitoring and should be inspected regularly to assure that it is performing as needed. Areas that are vulnerable to moisture damage should be inspected frequently.

Maintenance staff should be trained on how to react in case of an emergency. Warning devices should be used to alert staff of equipment failure and backup systems are needed when the main system is not working. Only knowledgeable, well-trained staff should be responsible for operation of the mechanical system. The best intentions, such as adjusting comfort levels or saving energy, can often be destructive to a historic structure.



The two large tanks seen in this photo are the hot and cold water storage for the geothermal heat pump system. To the far right of the photo can be seen the supply and return air ducts. These ducts are connected to the large cast iron pipes that run underground to Lakeport Plantation house. Inside the smokehouse they go up and over to connect to the air handler.

Resources:

California Energy Commission: Consumer Energy Center. Geothermal or Ground Source Heat Pumps. Dec. 16, 2009. <http://www.consumerenergycenter.org/home/heating_cooling/geothermal.html>.

Guendling, Randall L. Archeological Investigations at Lakeport Plantation, Summary Report. Arkansas Archeological Survey, 2003.

Historic Structures Report for the Lycurgus Johnson House at Lakeport Plantation ca. 1858-61, Vol. 1. WER Architects/Planners, 2003.

Lakeport Plantation Museum, Interview with Ernest Conrad. Feb. 25, 2003.

Landmark Facilities Group, Inc. Dec. 14, 2009. <<http://lfginc.com/>>.

Technical Preservation Services: National Park Service, U. S. Department of the Interior, 1996. Park, Sharon C., AIA. Preservation Brief 39: Holding the Line, Controlling Unwanted Moisture in Historic Buildings. Jan. 20, 2010. <<http://www.nps.gov/history/hps/tps/briefs/brief39.htm>>.

Technical Preservation Services: National Park Service, U. S. Department of the Interior, 1991. Park, Sharon C., AIA. Preservation Brief 24: Heating, Ventilating, and Cooling Historic Buildings, Problems and Recommended Approaches. Jan. 20, 2010. <<http://www.nps.gov/history/hps/tps/briefs/brief24.htm>>.

Toolbase Services. Geothermal Heat Pumps. Dec. 14, 2009. <<http://www.toolbase.org/Building-Systems/HVAC/geothermal-heat-pumps>>.

Union of Concerned Scientists: Citizens and Scientists for Environmental Solutions. How Geothermal Energy Works. Dec. 16, 2009. <http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-geothermal-energy-works.html>.

Historic Preservation Websites:

National Park Service, U. S. Department of the Interior. Technical Preservation Services. <http://www.cr.nps.gov/hps/tps/>.

The Secretary of the interior's Standards for the Treatment of Historic Buildings with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings. <http://www.cr.nps.gov/hps/tps/standguide/index.htm>.

Reference Books:

Lakeport Plantation is an Arkansas State University Heritage Site located in Chicot County, Arkansas. The *Lakeport Plantation Restoration Technical Reports* were compiled by Ronnie and Sonya Walker to document the restoration of Lakeport Plantation.