MEP *(Mechanical, Electrical and Plumbing)*

Mechanical

As originally designed, the thermal shell of the Keokuk Union Depot is not conducive to energy conservation. Uninsulated masonry walls, single-glazed windows, loose-fitting doors lacking weather-stripping, attics with minimal insulation, uninsulated roofs, and the on-grade construction all add up to considerable heat loss. It will be difficult to heat the building to comfortable occupied temperatures without significant improvements. However, with low, shaded, massive bricks walls, the flywheel effect of summer temperature swings is dampened and the Depot is relatively less difficult to cool. Two intersecting fieldstone and brick-vaulted pipe tunnels provide limited access below the concrete floors to run plumbing and mechanicals **[Fig 74.]**. Abandoned steam mains, condensate returns and domestic-water supply lines remain in the tunnels. Some pipes are covered with asbestos insulation (60% Chrysotile) which must be abated prior to removal of the old piping and masonry repairs to the foundation walls and vaulted ceiling to re-use the tunnels.[57]

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[57] EMlab P&K. Lab Report (ID #1166501). February 4, 2014 (see Appendix D).

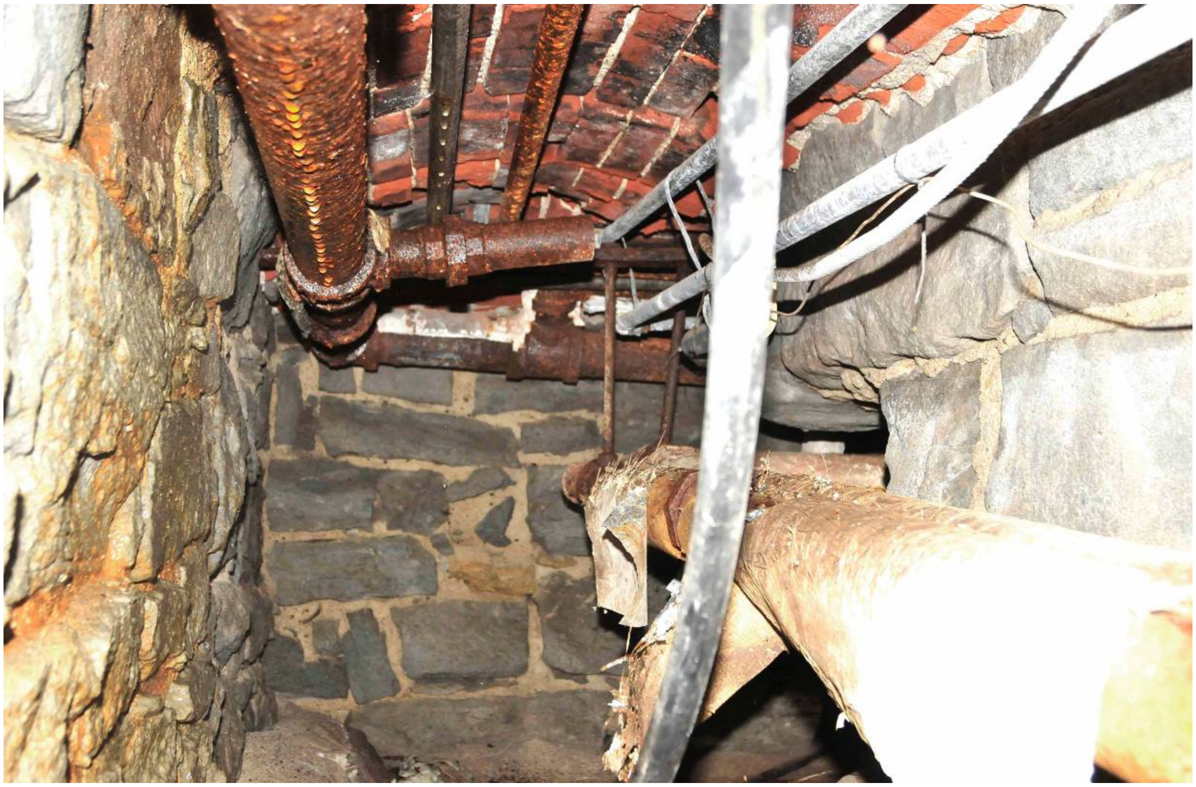
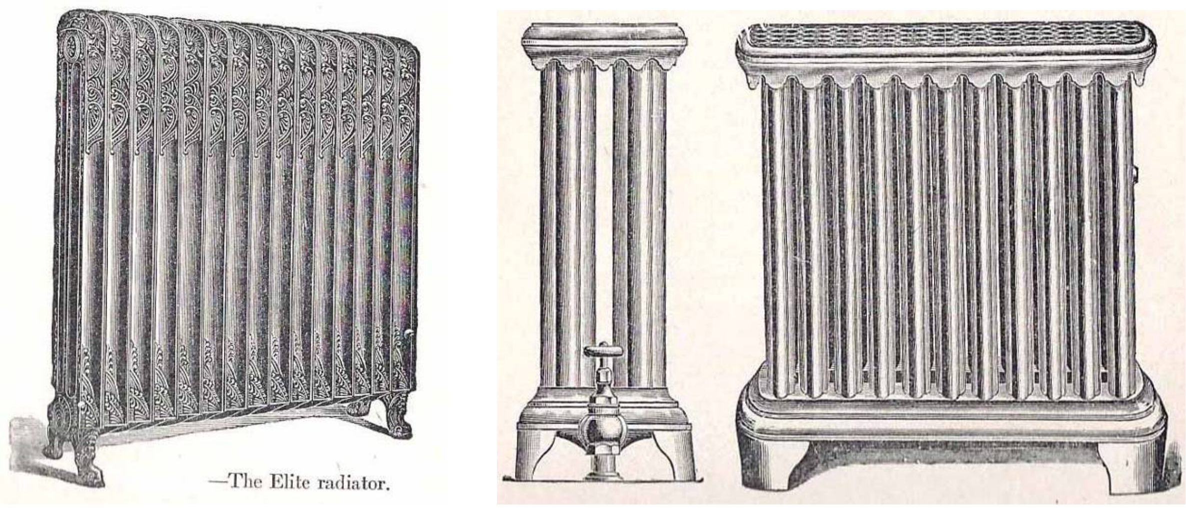


Fig 74. South steam tunnel at 90° turn from baggage room to waiting room (February 2014).

A 48’ tall chimney rises from the boiler room that served the original coal-fired boilers. The tall chimney was required to provide the necessary draft for coal combustion (a signature architectural feature to buildings of this era) and should be restored to its original height. There is no coal storage room within the building; coal may have been stored in a small adjacent structure or merely unloaded from a coal-transport rail car. Coal needed for daily use was most likely brought in by a hand cart and stored in the boiler room.

The boiler room has a high vaulted ceiling. This space allows for direct access from the Boiler Room into the attic above the adjacent freight rooms with ample room to run and conceal electrical and mechanicals. The adjacent second floor attic also has ample room to conceal electrical and mechanicals. The waiting room, however, has a cathedral ceiling with minimal clearance between the ceiling and roof. Careful planning is necessary here to conceal electrical and mechanicals in the eaves where necessary. The men’s and women’s washrooms and the ticket office also have ceiling structures that form platforms to hide mechanicals above.

The boilers were removed from the building and most of the radiators were removed from their original locations and stored in the freight rooms and boiler room. Some radiators are still connected to the tunnel piping while others are disconnected or stored. There are three general types of radiators found disconnected in the building: a) ornamental cast iron units from the waiting room that are embossed with decorative relief and were originally “gilded” (probably painted with bronzing powders; b) Reed style wrought-iron radiators from the utilitarian spaces, and; c) plain cast iron radiators that are not original to the Depot **[Figures 75. & 76.]**.



Figs 75. & 76. Ornamental cast iron radiator (left) similar to waiting room radiators and "Reed" wrought-iron radiator (center and right) similar to those found in utilitarian rooms.

Each freight room was heated by a single-pipe steam "Reed" radiator located on the trackside wall. These units were inadequate to sufficiently heat the uninsulated freight rooms and were intended to simply take the chill off and keep perishable goods from freezing in winter. Mismatched cast iron radiators with improvised piping were presumably added to use the freight rooms as machine shops in later years. As a result, numerous styles of odd radiators are found throughout the Depot when there were likely just two styles in the building originally, the cast iron ornamentals in the waiting room and the Reed style radiators in the utilitarian spaces. Most of the freight room radiators are disconnected from the abandoned steam mains today and some remain raised on makeshift blocks. This height adjustment may have been required in subsequent years for the gravity-return system to work properly due to modern replacement boilers.

Restoring the gilded radiators to the waiting room would be a nice historical detail to reintroduce but will reduce the functional floor area for special events. Removal of the terrazzo and tracing the steam risers from the pipe tunnel may verify their original placement but they were almost invariably located under windows. Small units were undoubtedly located in each of the men's and women's washrooms, one in the alcove, perhaps two in the ticket office, and three larger units under the arched windows. It is unknown whether there were any round units in the middle of the room as shown in the Portland Depot **[Fig 57.]** but no evidence of these has been found.

The waiting room is now served by a horizontal high efficiency gas-fired furnace which is installed on the platform above the washrooms and remote condensing unit on the sidewalk outside. Supply grills are located at the edge of the platform to distribute air into the space. The flue and combustion air piping is exhausted through the bluff side hip roof over the alcove bay. The unit is a Carrier (Model 59TP5A120E241122) rated for 120 MBH heating input. The condensing unit is located at grade nearby on the bluffside of the building (Carrier Model 24ABB036A0032010) and is rated for three-tons of cooling capacity (installed in 2012). This system was unable to maintain temperature in the waiting room during the February survey when the outside temperature was near 0°F. The baggage room is currently used as a volunteer workshop where sanding and finishing occurs. It is conditioned with a standard efficiency vertical flow gas-fired furnace rated for 75 MBH input which vents through a window opening. This system is older but adequate for the current use. A window A/C unit provides cooling. The balance of the building is unconditioned.

[*WARNING: Given the wood sanding and finishing that occurs in the former baggage room, the open combustion furnace is not the best choice for heating the space as it presents a nominal, but real, fire hazard for the space and occupants*].

Energy Study & HVAC Load Analysis

An energy study and HVAC load analysis was completed based on the proposed use as a community center to determine the size and type of new HVAC systems. The Depot was first modeled as-built, with the proposed new functions and occupancies to size the systems. The following assumptions were made regarding the building envelope (i.e. "thermal-shell") and occupancies for this analysis:

- *Brick (12") walls (no insulation)*
- *Single-glazed windows (standard glass)*
- *Waiting room to be used for assembly*
- *Baggage room to be used as a kitchen*
- *Remainder of the building to be office/business occupancy*
- *Mechanical ventilation assumed in all areas as required by code*

This is a conservative approach since some areas will be used for storage/utility, but in general there is a low ventilation requirement for this occupancy that allows for flexible design. The existing envelope has very poor thermal performance due to uninsulated roofs, walls, windows and doors. With the proposed occupancy and ventilation included, the existing building requires over 36 tons of cooling and 550,000 Btuh of heating capacity. The load for the building envelope constitutes 80% of the total cooling load and 90% of the total heating load. Due to the high envelope loads, the ventilation load represents a small percentage, even in the waiting room. For a building of this size and occupancy, this is grossly out of proportion to what it will be with even modest envelope improvements. The resulting heating and cooling loads for the as-built Depot are as follows:

- *Waiting room (assembly occupancy)*
    - *19.4-tons Cooling Load*
        - *13.8-tons envelope load*
        - *3.9-tons internal loads (lights & people)*
        - *1.7-tons ventilation (Energy Recovery Ventilator (ERV) assumed)*
    - *276,000 Btuh Heating Load*
        - *257,000 Btuh envelope load*
        - *19,000 Btuh ventilation load (ERV assumed)*
- *Balance of building (office/business occupancy)*
    - *18.1-tons Cooling Load*
        - *13.0-tons envelope load*
        - *3.8-tons internal loads (lights & people)*
        - *1.3-tons ventilation (Energy Recovery Ventilator (ERV) assumed)*
    - *271,000 Btuh Heating Load*
        - *238,000 Btuh envelope load*
        - *34,000 Btuh ventilation load (ERV assumed)*

In order to assess how the Depot performs thermally, the building was also modeled with basic envelope improvements. This reveals the impact on HVAC system size and operating expenses by making reasonable passive envelope changes without changing the historic character of the Depot. These passive measures not only lower energy cost over the long term, they also reduce the initial hard costs for equipment—they normally result in a more comfortable space for occupants as well.

Given the historic integrity of the waiting room, options for energy improvements are limited. Neither the brick walls nor cathedral ceiling can be insulated without destroying their historic character and beauty. New insulation in the narrow roof cavity, or rigid insulation board above the decking could be considered during the new roof project. However, since this space will likely be used intermittently, the thermal improvements to the roof will have a long payback.

The remaining attics over the freight rooms and second floor are very accessible with deep joist bays for R-36 or more blown/bat insulation. The exposed brick walls in the remaining first floor utilitarian spaces can be partially insulated or completely insulated as desired by furring out the walls. Since many areas are covered with multiple coats of lead paint, this approach will save considerable money in terms of both up front costs and energy costs. Interior storm windows would help reduce heat loss without compromising the architecture—ideally glazed with laminated glass to reduce sound transmission from the rail yard into the building. Since the window load for heating and cooling represents a high percentage of the total building load, wooden storm windows should be produced for any rooms to be heated for occupancy in the building. Finally, the doors have wide gaps and were not designed to stop drafts. New weather stripping on the jambs, astragals at double-doors, sweeps on the bottom of the doors, thresholds, and garage door seals on the rolling barn doors will substantially reduce heat loss and cold air drafts during the heating season (see **Windows and Doors**). The following new building envelope assumptions were made in consideration of the recommended energy measures above (with the same proposed usage):

- *Brick (12") walls – no insulation in the waiting room*
- *Brick (12") walls – R-19 insulation from interior furred out walls in the balance of the building*
- *Single-pane windows – standard glass, with new wooden storm windows in heated spaces*
- *Improved infiltration control through weather stripping and sealants, door sweeps*
- *Polyisocyanurate roof insulation (2") atop waiting room roof (applied during re-roofing)*
- *Code compliant roof insulation (R-38) applied in the balance of the building with open attics*
- *Waiting room to be used for assembly*
- *Remainder of the building to have an office/business occupancy*
- *Mechanical ventilation assumed in all occupied areas as required by code*

Here too, this is a conservative assumption since some areas will be likely be used for storage and utility, but in general there is a low ventilation requirement for this occupancy which allows for flexible design. These energy improvements yield a very good thermal performance especially in comparison to the as-built Depot. With the proposed occupancy and ventilation included, the improved building reduces the cooling load to 22-tons (40% less) and the heating capacity to 290,000 Btuh (48% less). The load for the improved building envelope drops to 65% of the total cooling load and 75% of the total heating load for the Depot; much better than the as-built structure. Based on the above, the resulting heating and cooling loads are as follows:

- *Waiting room (assembly occupancy)*
  - *11.6-tons Cooling Load*
    - *6.0-tons envelope load*
    - *3.9-tons internal loads (lights & people)*
    - *1.7-tons ventilation (Energy Recovery Ventilator (ERV) assumed)*
  - *140,000 Btuh Heating Load*
    - *121,000 Btuh envelope load*
    - *19,000 Btuh ventilation load (ERV assumed)*

- *Balance of building (office/business occupancy)*
  - *10.6-tons Cooling Load*
    - *6.0-tons envelope load*
    - *3.9-tons internal loads (lights & people)*
    - *1.7-tons ventilation (Energy Recovery Ventilator (ERV) assumed)*
  - *147,000 Btuh Heating Load*
    - *99,000 Btuh envelope load*
    - *34,000 Btuh ventilation load (ERV assumed)*
    - *14,000 Btuh Other load*

Proposed HVAC Improvements and Zoning

In order to further evaluate how these two envelope conditions perform, two different HVAC system approaches were modeled: a) a standard conventional gas-fired forced-air system that has a relatively low installation cost but higher operating costs, and; b) a more expensive but highly efficient geothermal system that has higher installation costs but lower operating costs, lower maintenance costs, and greater comfort. A radiant system is proposed for the waiting room in both approaches.

In both systems, one aspect that is universal is a desire for improved HVAC zoning, especially since the various portions of the Depot will continue to be intermittently used and do not need to be heated or cooled to occupied temperatures all the time. Zoning always improves the temperature control in a building and often, but not always, reduces the operating costs by reducing the capacity of the operating systems. Each system can be further zoned with additional controls if sub-zoning is desired. The Keokuk Depot splits into just four logical zones: Zone 1 (waiting room); Zone 2 (baggage room); Zone 3 (second floor); and Zone 4) (freight/mail/conductor’s equipment rooms).

Given the intermittent use of the Depot, the HVAC system should be designed for steep temperature setbacks when the building is unoccupied (45° in winter to prevent pipes from freezing; off in summer). It should have the capacity to fully recover from unoccupied space temperatures for events within a few hours. The setback temperature control is easily accommodated with programmable thermostats. These same thermostats should be capable of occupied/unoccupied scheduling as well so that outside air system components can be shut off when the building is not actively in use to save the operational cost of conditioning fresh air. An added benefit of this type of control is that when the building goes into occupied mode, a warm-up/cool-down function can be enabled that extends the disablement of the outside air systems and diverts more system capacity into rapidly recovering the building to occupied/comfortable temperatures. Additionally, since a high percentage of the building load is due to occupants, lights, and other internal loads, this system capacity is also there to assist in the transition from unoccupied mode into occupied mode.

Mechanical Installations and Locations

Waiting Room: Lacking a basement or attic above, this room presents limited options for locating new mechanical equipment without creating an aesthetic or noise/sound issue. Additionally, the high ceilings, exposed uninsulated walls, lighting load, and proposed assembly occupancy of this space pose challenging circumstances for an effective HVAC solution. A radiant floor heating system is the best approach to assist with the base heating load in the waiting room. Radiant systems heat the surfaces that have direct line of sight with the floor instead of heating the air volume, which includes the ceiling and uninsulated walls, thus creating a more comfortable space for people. Radiant floor systems, while slow to respond to building load changes, are extremely efficient in delivering heat to the space. In the case of the waiting room, all air systems could be shut off when the building is unoccupied and the radiant system holding temperature to the lowest safe temperature (typically 45°F) to prevent pipes from freezing. The major caveats here are twofold: whether the existing terrazzo can be effectively removed without ruining the marble floor underneath; and whether the marble floor remains salvageable otherwise. If the original floor cannot be practically saved, a new radiant system becomes more viable and appealing.

However, any radiant floor system will be inadequate to provide the full heating requirement for the space and it would not provide the outside ventilation for the assembly use required by code. A supplemental system(s) will also be required to meet these needs. Since hot water would be provided to the space for the radiant flooring system, some of the supplemental heat could be provided by the re-introduction of decorative cast iron radiators per the original design. If the radiant floor is installed, the original locations and sizes of the radiators may be determined during deconstruction of the floor. Reinstalling active ornamental radiators would take up floor area, but would add to the historic ambiance of the room, especially if “gilded.”

A supplemental forced air heating and cooling system, located either above the ticket office or alcove/restroom ceiling (as currently found) would resolve the balance of the required heating load, provide the bulk of the cooling load, and provide reasonable air distribution. The air devices located around the perimeter of the alcove/restroom ceiling should be better concealed. A lower profile air device that is integrated into a new fascia setback from the crown molding with ornamental iron grills would resolve this aesthetic issue and help conceal the equipment. Since there is no simple way to introduce outside air into this unit, and given the large outside air requirement for the assembly use, a dedicated outside air system (DOAS) should be installed to provide pre-conditioned ventilation air to the space.

This will provide multiple benefits to the overall system configuration: 1) It will keep the forced air system size smaller above the alcove/washroom and/or ticket office ceilings thus making it easier to keep them concealed; 2) the space-cooling load will be reduced by this equipment in addition to providing the ventilation load (which also reduces the size of the equipment located in the waiting room); 3) an Energy Recovery Ventilator (ERV) can be included as part of the DOAS which will save significant operating expense; and 4) it provides for a multi-tiered approach to the system operation (a) radiant floor and cast iron radiator base load (heating only), (b) forced air (heating and cooling), and (c) dedicated ventilation (heating and cooling) that will use only enough system capacity to meet the needs of the waiting room at any given time.

The DOAS and ERV equipment can be located in the attic above the second floor. The conditioned outside air can be introduced through an ornamental grill opening located near the peak of the downriver wall. Relief air from this space could be returned to the ERV through a new opening created for the new common corridor between the baggage room and proposed accessible washrooms downriver. Energy from the interior air would be exchanged with the incoming unconditioned outside air saving significant energy (up to 75%) of the cost to condition the outside air. Outside and exhaust air intake and relief openings must be accommodated from this attic space (possibly in the new upper hip dormers or backside of the proposed corner hip turrets to be restored in Phase I).

As an additional control and energy saving feature, Demand Control Ventilation (DCV) should be included for the waiting room which allows for the continuous measurement of carbon dioxide (CO). The function of outside air ventilation is ostensibly to dilute the CO in a space. Instead of the standard proscriptive method of assuming a maximum occupancy of people that could be in the space and delivering the code required volume of outside air whenever the space is occupied, an objective measurement of CO can be used instead to deliver just enough outside air to provide for proper dilution. This is particularly effective in large volume spaces and where air infiltration or frequent opening of exterior doors provides for the natural ventilation and dilution of this CO .

Baggage Room: The baggage room does not have an attic or basement. A second floor space occupies the full footprint of the baggage room, so it does not have any associated roof load. A catering kitchen is currently planned for this space. In order to maintain the maximum floor space in this room for the proposed new functions, a forced-air system (heating and cooling) should be installed in the attic above the second floor and chased through the second floor rooms to the ceiling of the baggage room. A new dropped ceiling would completely conceal the ducts in the new kitchen. Ventilation air for this room would be provided from the same DOAS and ERV system that serves the waiting room. Instead of dumping this air directly into the baggage room, the air would be directed into the return of the air handling unit up in the attic, thus eliminating the need for an additional duct chase.

Balance of Occupied Areas: The balance of occupied spaces in the building will have a considerably smaller ventilation requirement than the assembly use in the waiting room. Additionally these spaces have the common feature of attic spaces directly above so that improvements in the envelope through the addition of roof insulation helps to reduce the overall heating and cooling loads. For the second floor rooms, small heating and cooling air handling units can be installed in the attic directly above to serve attic-mounted ductwork and ceiling mounted air devices. This area will probability have a very different operating schedule than the waiting room and outside air for this system should be delivered via a small outside air duct connection directly to the exterior with controls to shut this connection off whenever the space is unoccupied. Alternatively, if desired for increased system efficiency, the outside air could be brought in via a small ERV dedicated for this space. For the freight/mail/equipment rooms that make up the balance of the occupied building, a heating and cooling air handling unit can be mounted in the adjacent boiler room since this room has a direct connection into the attic over these occupied spaces. Air would be distributed through duct-mounted ductwork to ceiling mounted air devices. A dedicated ERV would be installed to serve this air handler.

System Wide Options:

[OPTION A] Conventional HVAC System: The conventional HVAC system would consist of gas-fired equipment to produce the heating effect and air cooled condensing units to produce the cooling effect. In the waiting room, a forced air gas-fired furnace could be maintained at the same location as the existing unit although it will require a second or a single larger unit to provide the additional cooling capacity required. The flue gases and combustion air intake would continue to be routed through the adjacent roof dormer. However, an additional set of pipes may be required depending on the final equipment sizing. This equipment would also include a cooling coil that would be connected to a grade-mounted condensing unit, most likely located on the bluffside of building. Refrigerant piping would be extended between the A/C coils and the condensing units.

A separate boiler will be required to provide the hot water needed for the radiant floor system and cast iron radiators. This boiler can be located in the boiler room and the piping would extend through the existing utility tunnel to the space. The boiler would be a side vent style which would allow for venting through the boiler room wall. Combustion air for the boiler would be provided through modification of an existing window opening. One additional benefit of having a side vent boiler is that there is no need for a chimney. This will allow for the restoration of the chimney to its original height to be completed without concern for a functional flue, reducing costs.

The other spaces in the building can be similarly served by gas-fired furnaces and air conditioning units made up of duct or equipment mounted coils and remote condensing units. The DOAS would function best with a hot water heating coil as the source of supplemental heat, so hot water piping from the boiler should be routed to this unit as well.

The major disadvantage of the conventional system approach is related to the aesthetic impact of grade mounted exterior equipment which must be located, screened and maintained. There is also the noise associated with this equipment—a minor issue for this site.

[OPTION B] Geothermal HVAC System: There are many different types of geothermal systems, although the only one under consideration for this project would be a closed loop ground-coupled system. While the readily accessible river water could conceivably be used in an open loop system, there are inherent issues with these types of systems that add to the on-going maintenance and operating costs making them less attractive then a closed loop system. Heat pumps are widely known as the most energy-efficient method to heat and cool a building, however, there is a cost premium to install the closed loop piping. In a well-designed and properly installed system, this additional cost is often paid back within ten years of operation. Federal, state, local, and utility/industry incentives should be explored to determine funding options to make this system more cost-competitive versus a conventional system.

Within the closed loop category, there are additional choices to make regarding the type. All types use stable deep earth temperatures as an energy exchange medium. A system of pipes is buried in the earth—in a vertical arrangement when there is insufficient land, as with this site. Boreholes are drilled down and the closed loop piping is inserted and grouted in place. These boreholes can be up to 450 feet deep depending on the final design. The boreholes are typically drilled with 20-foot spacing to allow for the ground mass to have sufficient volume to accept the required energy exchange. The closed loops are connected into horizontal piping and brought into the building at a depth not less than five feet below grade so that no part of the system is visible or heard. This is a key advantage of a geothermal system when compared to a system requiring ground or rooftop condensing units. The horizontal piping is gathered into a common header in the steam tunnel or boiler room for the geothermal equipment to produce the heating/cooling for the Depot.

The two types of geothermal equipment recommended for the Depot are water-to-air ground-source heat pump units that directly produce hot/cool air for delivery to the spaces and water-to-water ground-source heat pump units that produce hot/chilled-water for use by other systems to produce the heating/cooling effect. The geothermal loop piping connects each heat pump unit to a small pump that circulates water from the loop through the equipment and back into the loop in order to transfer energy as needed. In heating mode, the heat pump extracts energy from the loop while in cooling mode the heat pump rejects energy to the loop water.

In order to address the need for a very quiet air handling system in the waiting room due to the exposed nature of the equipment, a water-to-water heat pump is recommended to create hot/chilled-water for use by a conventional air handling unit. By using a hot/chilled-water air handling unit, there will be no need to create a roof penetration for the gas-fired furnace flue. The hot water produced by the geothermal system could also be used by the radiant floor system and cast iron radiators. The piping for this equipment would be brought to the space via the original steam tunnel and/or below grade if the existing floor is replaced.

In the balance of the zones and for the DOAS unit in the second floor attic space, the most efficient method will be water-to-air heat pumps. These units are self-contained and can be used in lieu of a conventional air handling unit that would otherwise be required. These units will directly create the cooling and heating effect as called for by the system controls. No boiler or any exterior equipment will be required; therefore the chimney will not have to be functional (i.e. “active”).

Life-Cycle Cost Analysis

In addition to the aesthetic and comfort benefits of a geothermal system, they also have lower operating costs. In an effort to establish whether the additional cost of the more efficient geothermal system can be recovered through reduced operating costs, a Life Cycle Cost Analysis (LCCA) was developed. This analysis considered the two proposed systems: conventional versus geothermal and simulates their operation over twenty years. Operational costs assumed included not only gas/electric energy costs but also maintenance costs. A 2% per year escalation has been assumed on energy and maintenance costs to account for annual inflation.

Four payback alternatives are presented in the energy model (APPENDIX D):

- Alternative 1: Conventional system without envelope improvements;
- Alternative 2: Geothermal system without envelope improvements;
- Alternative 3: Conventional system WITH envelope improvements, and;
- Alternative 4: Geothermal system WITH envelope improvements.

The results for this analysis show a clear bias for a geothermal system whether envelope improvements are completed or not. A simple payback of about eight years occurs in either case (this may be longer if the building is used less than anticipated, or shorter if used more). The difference between the two geothermal alternates (2 & 4) is the initial cost of installation. Alternative 2 without envelope improvements will cost almost twice as much as Alternative 4 which includes the envelope improvements. This cost savings in initial equipment costs can then be used to help fund the envelope improvements and provide for a better, more comfortable and energy efficient building.

Given the reduction in overall system capacity due to the envelope improvements and the short payback for the geothermal system when compared to a conventional system, both the building improvements and geothermal system should be completed in the rehabilitation of the Keokuk Union Depot.

ELECTRICAL

The building is served by an overhead, 200-amp, 240-volt, single-phase electric service entering into the baggage room on the bluff side from a pole-mounted transformer. The service then splits into two metered services within the building: two, 200-amp distribution panels served by 100-amp circuit breakers in the main panel, and a third subpanel. The original knob and tube electrical distribution is abandoned with newer surface armored-cable and conduit systems installed in its place. The waiting room may still utilize some of the original cloth wiring concealed behind wainscot. Lighting in the waiting room is provided by up-light spots located above the washrooms and ticket office. Exit signs are temporarily wired with extension cords.

Assuming that building envelope improvements are undertaken to reduce the overall HVAC capacity, a new 400-Amp, 208/120-volt, three-phase, four wire electric service should be installed in the boiler room (regardless of the system selected). A new system of electrical distribution should be provided throughout the building and additional distribution will be required to serve the new mechanical systems. Even if tenant space is created in the building, the usage will likely be a fraction of the power used for the waiting room/kitchen and a single meter should suffice. It will be easier and less expensive to either negotiate the electric cost into any leases or provide sub-meters for any of the small tenant uses.

New and historic reproduction lighting is required throughout the Depot to be energized by the new electric distribution system. This should include the new marquee-style lighting system proposed for the trackside canopy **[Fig 28.]**. Emergency lights and exit signs must be incorporated as well. These are typically package units with self-contained batteries but a remote battery system could be considered for emergency lighting in areas that have historic style light fixtures.

A new fire alarm system should also be provided for the building. This system would ideally include smoke detectors, heat detectors, manual pull stations, audible and visual annunciators and control panels as needed. Since the Depot is often unoccupied for many days on end, the system should be monitored with a phone or radio connection to ADT or similar security communication center to notify the local fire department when an alarm is activated. The Depot will ultimately need new telephone and data services for more extensive use.

The electrical service should be a high priority once the roof project is completed; some work, such as placement of conduit runs in the waiting room eaves and feeds to the future chandelier locations, should be completed while the roof is open to avoid any exposed conduit. This would allow for a more comprehensive lighting, audio/visual and fire alarm system without the need for surface raceways or visible conduit. Temporary removal of wainscot and marble baseboard sections and some channeling of the common brick walls may be required to bury conduit feeds to original wall sconce locations.

Finally, whether the original marble-and-quarry-tile floor is restored once the terrazzo is removed—or completely removed and reproduced for new radiant floor heating—consideration should be made for several brass-covered floor outlets in the center of the room and ticket office floors to accommodate power needs in the middle of these rooms for special events without running extensions across the floor.

PLUMBING

The main water service is fed through the tunnel from the northeast and enters the building on the trackside of the baggage room. The only functioning plumbing in the building today consists of men's and women's washrooms in the waiting room. Hot water for these rooms is provided by a small electric six-gallon, two-kW, point-of-use tank heater (Rheem Model 81VP6S) located above the washrooms. A second electric tank water heater is located below the stairs to the second level. The piping is generally exposed within the washrooms. Sanitary waste is connected to a below grade sanitary sewer while vent piping is extended surface mounted up through the roof. During the MEP survey in February, 2014, a small leak in the cold water distribution piping was located near the trapdoor access to the pipe tunnel in the baggage room. The bathroom on the second floor consists of a toilet, sink and shower; since this bathroom is unheated, these fixtures are all out of service. Similarly a kitchenette sink located in the bunkroom on the second floor has been removed from service.

Storm drainage from roof drains is located around the building. Drains are extended to grade along Water Street but are directed below grade on the trackside of the building.

The plumbing in the building is antiquated, defunct or replaced with surface mounted piping. In order to utilize the Depot as a public venue for special events, additional fixtures are required including handicapped stalls. Depending on the final occupancy rating for the waiting room along with the potential tenant spaces in the building, the plumbing fixture count is grossly inadequate. Additionally, given the nature of the installed surface mounted piping in the restrooms located in the waiting room, these systems should be replaced as part of larger improvements to the Depot. If the existing washrooms are to remain in service, the sanitary sewer should be replaced with modern materials whenever the proposed floor replacement would occur. Similarly, the domestic water piping serving these washrooms should be replaced with modern piping whenever access to the below grade piping becomes available.

The best way to avoid all of the remedial work on the plumbing piping systems serving the waiting room is to abandon and remove these washrooms from their current location and relocate their function in the freight rooms. This would allow for better use of the waiting room and would allow for consolidation of the needed plumbing fixtures at a new location that could also serve the rooms downriver which will need access to toilet facilities to be code compliant. This new location could then allow for a shared fixture count as required to meet the occupancy requirements.

Given the likely increase in total fixture count for the building, a new larger water service will be required. This should be verified and only undertaken if warranted due to poor condition of the service piping or inadequate capacity. The galvanized piping in the tunnel will continue to have performance and maintenance issues until it is replaced. Domestic water piping to all new or existing fixtures should be replaced with modern materials. Since the second floor bathroom is disconnected and no longer in use, this piping would need to be replaced also during any reconstitution of this bathroom. Plumbing vents that are not of modern materials should be replaced since perforation of this piping is common in old systems.

New plumbing will also be required for the new HVAC systems. This will include floor and/or hub drains and make-up water connections.

CONCLUSION

The Keokuk Union Depot Foundation has made significant progress in preparing a capital campaign to raise the necessary funds to restore the building. This includes very recent and encouraging news from the Jeffris Foundation that the Depot Foundation will be invited to apply for a substantial matching grant for the Phase II project to restore the original roofline, chimney, clay tile roofing, eaves and soffits. While it will take time to raise the matching funds, the roof and chimney restoration is an outstanding, prominent, visual showpiece to rally the local community and inspire other individuals and organizations to contribute to eventual restoration of the entire Depot, a highly architecturally significant building to the Midwest and beyond. This HSR is intended to help fuel the momentum to undertake the roof restoration and leverage funding for that monumental project planned for 2016, the 125th anniversary of the grand opening. The care for authenticity and attention to details will result in the eventual award-winning restoration of the Depot. Such efforts will earn the praise of architectural and railroad buffs, win mention on websites, encourage tourism—and leverage contributions from others.

Every effort should be made to engage and utilize local labor, materials and equipment when available and feasible, including the Keokuk Union Depot volunteers (who have already donated thousands of hours toward cleaning up, repairing and preserving the Depot since 2011). The success of the Keokuk Union Depot restoration will require unwavering support from the City for Keokuk and the entire community alike.

This HSR is intended to guide the restoration of the Depot, drawing on the ongoing advice and oversight from the State Historical Society of Iowa, Jeffris Family Foundation, Midwest Office of the National Trust, and other preservation and restoration professionals for advice and oversight and following the Secretary of Interior’s Standards for Rehabilitation.

END