

Back 2 Basics

By Howard McKew, P.E., C.P.E.

Heat Pump System For New College Classrooms Using Integrated Project Delivery

This month's B2B will focus on a new 12-classroom building addition, each room with its own closed loop ground source heat pump (GSHP) unit. The building will have 12 GSHP for classrooms, 2 GSHP for administration, and 2 GSHP for common areas. The units have been standardized at 3-tons cooling, with MERV 11 60% efficiency with no supplemental electric heater. The room sound level will be 30NC and space temperature at 68°F +/- 2°F and 30% rh (heating season) and 74°F +/- 2°F and 60% maximum rh (cooling season). Other areas will have 35NC sound level.

The ground source system consists of two 50-ton closed loop wells piped in parallel with the building's 16 GSHP units using 2-end suction pumps each sized for 100% capacity. The building has general exhaust systems to accommodate the ventilation requirements.

The design engineer is directed to 2015 *ASHRAE Handbook – HVAC Applications*, chapter 7 (Educational Facilities) and chapter 34 (Geothermal Energy) along with chapters 36 through 43 (Building Operation and Management), and chapter 59 (HVAC Security) for design guidelines.

Project delivery method shall be integrated project delivery (IPD) based on 2015 *ASHRAE Handbook – HVAC Applications* chapter 58 (Integrated Building Design). The IPD team shall include the college president, campus operations manager, and a project manager from the school's construction management group. The team should also include the owner representative, who will provide third-party commissioning and air and water balancing. The design team is an engineer-architectural contract with the HVAC consultant engineer (as the team leader), architect, electrical and plumbing consultants, acoustic consultant, environmental/soils consultant, and security sub-consultants. An experienced general contractor and the HVAC, electrical, and plumbing subcontractors make up the rest of the IPD team. The college's O&M department will also participate in the IPD process, beginning at the conceptual phase. The remaining IPD team members will be brought on board at Phase 3, concept development.

For this month's HVAC application, the equipment selections are the 3-ton GSHP units hung above the ceiling in the corridors; locating the equipment outside the occupied space will contribute to the reduction in radiant equipment noise criteria. Each unit shall have metal flexible connectors and duct flexible connectors to avoid unit vibration. Each unit pipe arrangement includes isolation valves, pressure/temperature ports for water balancing and troubleshooting, and strainer with capped blow-off valve. The heat pumps shall be furnished pre-piped with required control valve and pre-wired controls. Remote space thermostats and GSHP-mounted control panels shall have BAC-Net interface functions to the college's campus BAS computer, as well as to the GSHP equipment manufacturer.

The closed loop shall have the wells piped in parallel and then in reverse return with the 16 GSHPs. This GSHP pipe distribution system includes an automatic water makeup control at the air separator upstream of two parallel, lead-lag pumps.

GSHP duct distribution shall include a supply air duct sound

attenuator, insulated and sealed, sheet metal per SMACNA low velocity guidelines. Return air ductwork shall be sealed and the last 10 ft of duct run and the GSHP shall have 1-in duct acoustic lining.

The building design includes a DOAS unit (not part of this test) that provides the minimum required outdoor air ventilation to each classroom and provides ventilation to the administrative and support space GSHPs.

Electrical shall be 480/3/60 electrical power to unit pre-wired automatic controls, pumps, and other HVAC equipment. A factory-installed control logic panel with remote access for troubleshooting, energy management, and response to alarms and safety signal shall be included within the design.

GSHP system shall be furnished and installed with all required temperature and pressure gages, water strainers, flow switches, safety controls and alarms, and shutoff valves, etc. The HVAC subcontractor shall rig units into place and field-install associated GSHP piping outdoors below grade using polyethylene fusion pipe and schedule 40 steel indoors. Pipe and duct insulation shall be per state energy code for the HVAC system. City water make-up shall be by plumbing subcontractor.

The IPD team shall produce Concept Documents and Design Documents (drawings and specifications). The Phase 5 (Construction Preparation), Phase 6 (Construction), Phase 7 (Owner Acceptance), and Phase 8 (Use, Operate, and Maintain) shall follow. The IPD team shall complete a CFD analysis and complete a hydraulic model of the entire GSHP system. The O&M personnel shall review the documents beginning with the concept development phase, and shall observe equipment startup, air and water balancing, and commissioning system demonstration.

The IPD team's general contractor shall include the following during the shop drawing submittal phase:

- Equipment submittals - Pump and fan curves - Startup sheet - Troubleshooting sheets -O&M manuals, parts, and lubricants - ATC and energy management submittal including one complete ATC submittal integrating manufacturer's GSHP unit furnished ATC into an integrated overall ATC submittal – Field coordination drawings (piping and sheet metal).

The IPD owner representative shall provide third-party commissioning and TAB services as follows:

- TAB system flow diagram of entire GSHP system with gpm and pump heads indicated at each piece of equipment. TAB flow diagrams shall also be completed for each GSHP unit air distribution cfm, as well as flow diagrams for other air systems (e.g., DOAS system).
- Commissioning functional performance test of HVAC systems (GSHP sequences of operation, GSHP unit/system sequence of operation, and other HVAC systems).

Refer to The Facility Files for additional information pertaining to completing the B2B test.

BASIS OF DESIGN – HEAT PUMP SYSTEM FOR NEW COLLEGE CLASSROOMS USING INTEGRATED PROJECT DELIVERY

The design engineer shall check off the boxes from the list of company's standardized field observation checklists below that he will need to upload on to his tablet computer prior to heading out to the construction site to complete his final HVAC inspection and punchlist. These checklists will be touchscreen type. When the engineer returns to the office or he sends the completed checklists via the internet to the office, the completed checklists shall be automatically downloaded to the company's computer server and placed in the job folder's "Project Closeout" section of the folder. The completed checklists, along with associated digital photographs taken at the time of the field visit, will automatically be electronically sent to the following individuals and departments.

TEAM CORRESPONDENCE DIRECTORY CHECKLIST (check the appropriate boxes)

- Owner College President Owner Representative IPD Lead Engineer
- Construction Manager General Contractor Design-Build Contractor
- Building Manager HVAC Subcontractor ATC Subcontractor
- Electrical Subcontractor Plumbing Subcontractor Acoustic Consultant
- Telecommunication Subcontractor Architect State Energy Department Soils Consultant
- Security Consultant ASHRAE Piping Subcontractor
- Sheet Metal Subcontractor 3rd-Party CxTAB Consultant 3rd-Party TAB Consultant
- Equipment Manufacturers Building Inspector Others: _____

HVAC CONTRACT SPECIFICATION CHECKLISTS (check the appropriate boxes)

- Division 1 Project Closeout Telecommunication Equipment Owner-Furnished Equipment
- Structural Electrical Plumbing Fire Protection HVAC Infection Control ATC
- Temporary Air Cooled Chiller Pumps Chillers Fans Air Handlers Terminal Units
- Piping System Sheet Metal System TAB Commissioning Others (insert list) _____

HVAC CONTRACT DRAWING INSTALLATION CHECKLIST (check the appropriate boxes)

- Telecommunication Equipment Owner-Furnished Equipment Structural Electrical Plumbing
- Fire Protection HVAC Infection Control ATC GSHP Units Pumps
- Chillers Fans Air Handlers Terminal Units Piping System Sheet Metal System
- TAB Commissioning Others (insert list) _____

HVAC STARTUP CHECKLISTS (check the appropriate boxes)

- Telecommunication Equipment Owner-Furnished Equipment Structural Electrical Plumbing
- Fire Protection HVAC Infection Control ATC GSHP Units Pumps
- Chillers Fans Air Handlers Terminal Units Piping System Sheet Metal System
- TAB Commissioning Others (insert list) _____

COMMISSIONING FPT (FUNCTIONAL PERFORMANCE TEST) (check the appropriate boxes)

- Telecommunication Owner-Furnished Equipment Structural Electrical Plumbing
- Fire Protection HVAC Infection Control ATC GSHP Units Pumps Chillers Fans
- Air Handlers Terminal Units Piping System Sheet Metal System TAB Commissioning
- Others (insert lists) _____

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