Final Technical Report

Project Title: Ohio State 4-H Green Building
Award Number: FG36-06GO86010
Recipient: The Ohio State University Research Foundation
Location: The Ohio State University Main Campus, Columbus, Ohio
Principal Investigator: Dr. Jeff King
Project Director: Bill McCleery
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Executive Summary

A. Project objectives

Ohio 4-H, the youth development component of OSU Extension, housed within the College of Food, Agricultural, and Environmental Sciences, has completed construction of a 4-H Center located on The Ohio State University campus. This facility is approximately 44,820 square feet and will include: meeting and multi-purpose rooms, a classroom with multi-media technology, program support space, and serve as the administrative offices for OSU Extension's state 4-H unit. The facility will be used for various training, conferences, and meetings for youth and adults involved with 4-H and other youth development programming. It will also link research and knowledge of the greater University to the citizens of Ohio.

The 4-H Center is the first "green" building on the OSU campus. As designed and constructed, the Center is geared to meet specifications in the Leadership in Energy and Environmental Design (LEED) rating system, a voluntary national standard for developing high-performance, sustainable buildings that are healthful, environmentally responsible and energy efficient. The 4-H Center will not only focus on research-based youth development programs within the walls of the building, the Center itself will serve as an educational tool for individuals and corporations interested in "green" building philosophy and technology.

B. Project Scope

Geothermal System

The geothermal heating and cooling system is a critical element of this project and a focal point of Department of Energy funding. This particular system is a hybrid geothermal (water source) closed loop heat pump system. Heat is extracted from or rejected to the earth through a vertical geothermal heat exchanger buried under the Center parking lot. Additional heat rejection is accomplished through a closed circuit cooling tower.

The geothermal heat exchanger consists of 72 drilled holes 5 inches in diameter by 280 feet deep. Inserted into each of these holes is a "U" shaped loop pipe which is constructed from two continuous pieces of polyethylene pipe chemically welded to a polyethylene "U". The holes were then back-filled with bentonite grout. All of the vertical piping is connected horizontally or manifolded forming 9 complete closed loop circuits extending into the basement level of the Center. From the basement the manifolded piping connects to a building heat pump water loop which carries a propylene glycol fluid varying in temperature between 90 and 30 degrees F. Heat pumps are located on all levels of the building and each individual pump will extract heat from, or reject heat to, the fluid in the loop. The fluid is a 20% inhibited propylene glycol solution, chosen because it has the lowest environmental impact, should an unforeseen pipe rupture occur in the closed loop piping.

Building space temperature will be controlled through water-source heat pumps located in mechanical rooms on each floor. The required air temperature will be distributed throughout the building via a low pressure duct system. The air is supplied by dedicated air handling equipment that will be packaged heat recovery units made up of supply and exhaust fans, total energy recovery wheel, 30% efficiency filters on the supply and exhaust, heating coil and isolation dampers. A heating coil will be mounted in the unit downstream of the heat wheel and will be connected to a water-to-water heat pump and recover heat or energy from the heat wheel to be used elsewhere in the building. The supply and exhaust fan speed will operate at a minimum speed in the occupied mode. CO2 sensors will establish the need for additional ventilation and the fan speeds will increase as required.

The design conditions by which this system will operate and perform are:

INDOOR TEMPERATURE	OUTDOOR TEMPERATURE
Heating 73 degrees F	0 degrees F
Cooling 76 degrees F dry bulb, 50% relative humidity	92 degrees F dry bulb 73 degrees F wet bulb

The domestic water system will also take advantage of the geothermal system by using water-to-water heat pumps that extract heat from the geothermal loop to provide building domestic hot water.

Structural Steel

As with any structure, a critical component in the 4-H Center is steel. A portion of the funds from the Department of Energy was used to purchase, fabricate and erect steel for building columns and structural beams. Steel is the world's most recycled product. Structural steel produced in US mills using the electric arc furnace (EAF) process contains at least 90% total recycled content. All US structural steel wide flange products are produced by the EAF process. Wide flanges are the main structural component in the 4-H Center.

67 million tons of steel were recycled in the US during 2001, according to the Steel Recycling Institute. Each ton of recycled steel saves 2,500 pounds of iron ore, 1,400 pounds of coal, and 120 pounds of limestone. Recycling steel requires less energy, creates less waste, and releases fewer pollutants than producing the same amount of new steel.

Innovations in steel production have resulted in a 35% decline in steel material costs. The 4-H Center contains 282 tons of structural steel.

Project Goals, Objectives, and Accomplishments

The project was broken into four major tasks or milestones as outlined below.

A. Preparation of Environmental Assessment

A prerequisite to receiving the Department of Energy award was the successful completion of an environmental risk assessment. This was primarily due to the drilling of the 72 holes for the geothermal system. Scientific Applications International Corporation (SAIC) was contracted to do the assessment. On 27 December 2006, notification was received regarding the issuance of the final Environmental Assessment (EA) and a Finding of No Significant Impact (FONSI) in accordance with the National Environmental Policy Act (NEPA) and DOE's NEPA implementation guidelines.

B. Overall Building Construction

This task had to do with the overall construction of the 4-H Center. Construction began 1 September 2006, and was projected to take 14-16 months. As of this writing, work is to be completed on 29 November 2007. With few exceptions, mainly due to extremely cold weather in February, the project has stayed on schedule and on budget.

C. Structural Steel

This task began 22 Dec 2006 after all steel structure designs had been completed and approved and all required recycled steel had been purchased, fabricated, and delivered to the construction site ready for employment.

On 22 December 2006, the basement and ground floor of the tower section were set for structural steel and completed on 26 December. Between 23 January 2007 and 1 February 2007, steel was set and detailed for the multi-purpose section. Beginning 29 January and ending 21 February, steel was set and detailed for the Great Hall section. Steel for the 2nd through 4th floors of the tower section including the high roof was set and detailed beginning 9 February and ending 23 February. And finally, steel for the service section of the building was set and detailed between 6 February and 26 February.

All steel work was completed on 7 March 2007. No problems or variances were encountered.

D. Geothermal System

This task began 1 November 2006 when all supplies and equipment necessary to install the geothermal system were procured and on site ready for employment.

Hole drilling began on 1 November and by 15 November, 11 holes had been successfully drilled and cased. No paleocarst was encountered. Two additional rigs were brought on site to speed up the process. By 30 November, 22 holes had been drilled and cased. By 5 December, 33 holes had been completed. Between 6 December and 31 December, an additional 39 holes were successfully drilled and cased bringing the total to 72 holes, the number required for the system.

The loop system was installed and tested for leaks during the period 1 January and 15 January 2007. No leaks were found. No problems or variances were encountered.