ASHRAE Chapter Technology Awards

Application Form:

Sarah E. Goode STEM Academy

7651 South Homan Avenue
Chicago, IL 60652

Owner: Public Building Commission of Chicago
Architect: STR Architects / Nia Architects
Engineer of Record: dbHMS

Illinois Chapter, Region VI

CHAPTER/REGIONAL TECHNOLOGY AWARD - SHORT FORM

1. Category (Check one and indicate New or Existing, if applicable)

○ Commercial Buildings	○ New or ○ Existing	
Institutional Buildings:		
◉ Educational Facilities	◉ New or ○ Existing	
○ Other Institutional	○ New or ○ Existing	
○ Health Care Facilities	○ New or ○ Existing	
○ Industrial Facilities or Processes	○ New or ○ Existing	
○ Public Assembly	○ New or ○ Existing	
○ Residential (Single and Multi-Family)		

2. Name of building or project: Sarah E. Goode STEM Academy

City/State: Chicago, Illinois

3. Project Description: 200,000 sq. ft. LEED Platinum high school

Project Study/Design Period: 03/2009 (Begin date (mm/yyyy)) to 12/2012 (End date (mm/yyyy))

Percent Occupancy at time of submission: 100%

4. Entrant (ASHRAE member with significant role in project):

a. Name: Anand (Last) Sachin (First) (Middle)

Membership Number: 5184161

Chapter: Illinois

Region: VI

b. Address (including country): 303 W. Erie St., Suite 510

Chicago (City) Illinois (State) 60654 (Zip) United States (Country)

c. Telephone: (O) (312) 915-0557 d. Email: sanand@dbhms.com

e. Member's Role in Project: Design Engineer

f. Member's Signature: 

5. Engineer of Record: dbHMS

By affixing my signature above, I certify that the information contained in this application is accurate to the best of my knowledge. In addition, I certify that I have discussed this entry with the owner and have received permission from the owner to submit this project to the ASHRAE Technology Awards Competition.

dbHMS
design build engineering

Sarah E. Goode STEM Academy is a 212,000 square-foot facility with a gymnasium, pool, dining room, kitchen, classrooms, library, art rooms, music rooms, and administrative offices. The high school is the first LEED Platinum High School in Illinois and the first Chicago Public High School with a ground source heat pump system. Sustainable features include a green roof, community garden, rain garden and permeable pavers for the parking surface. The project is LEED Platinum certified.

Energy Efficiency

The building is designed to exceed the ASHRAE 90.1-2004 Appendix G Baseline by 40% and achieved 9 points under LEED v2 EA Credit 1. Table 1 provides the predicted energy performance.

Table 1: Summary of Energy Performance				
	Energy Model		Baseline	
Electricity Consumption	1,275,498	kWh	2,198,710	kWh
Gas Consumption	199,000	therms	252,400	therms
Total Consumption	6,342	MMBtu	10,026	MMBtu

The HVAC system consists of distributed, packaged ground-source heat pumps served by a ground heat-exchanger comprised of 170 boreholes at 450 feet deep spaced 20 feet on center. Outside air is ducted directly to the heat pumps from a central, dedicated outside air ground-source heat pump with an integral enthalpy wheel. Custom ground-source heat pumps also serve the gymnasium and pool dehumidifcation. High-efficiency condensing boilers provide back-up heat.

The solar thermal service water heating system consists of 19 roof mounted evacuated tube collector panels and 800 gallons of storage with external plate and frame heat exchangers. The system provides 18% of the pool and domestic water heating energy over the course of a typical year.

Energy efficient lighting is provided with fixture integral daylight dimming controls in the classrooms and select common spaces.

Indoor Air Quality

The system outside air intake exceeds the ASHRAE 62.1-2007 requirements by 30%. The required out-door air intake was calculated via the system Ventilation Rate Procedure for a multi-zone recirculating systems where applicable with system efficiencies ranging from 0.7-0.8. Exhaust requirements were determined per ASHRAE 62.1-2007 and local code.

CO2 sensors monitor CO2 concentrations in densely occupied spaces. Demand control ventilation is provided for units with CO2 monitoring. Airflow monitoring stations are provided for all unit outside air intakes.

Innovation

Sarah E. Goode STEM Academy is the only ground-source heat pump system in the Chicago Public School district.

Each packaged heat pump is provided with a three way condenser valve and a small circulating pump. This allows condenser water control with a single-pass condenser water loop significantly saving on piping cost and pump energy. Designed custom for this project, the condenser water piping arrangement is now offered as a standard accessory by the heat pump manufacturer.

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The heat pumps are located in closets in each classroom. The design team worked carefully with acoustician to achieve the classroom design criteria of 35 dBA (NC-30). Measures to reduce heat pump noise included closet sound insulation, heat pump mounting vibration isolation, dual stage compressors and ECM motors with soft-start programing.

Operation & Maintenance

The heat pumps are floor mounted and easily accessible for filter changes and compressor maintenance. All major equipment excluding the solar collectors is located indoors. The absence of a cooling tower significantly reduces water treatment requirements and eliminates the need for system winterization.

Cost Effectiveness

The building is based on a prototype design with a centralized VAV system, boilers, and water-cooled chiller. Three other schools on Chicago's South side were based on the same prototype and used the prototype system. Sarah E. Goode STEM Academy saved an average of $7 million in installed costs over the three other prototypes due to the packaged ground-source HVAC system. The additional cost of the ground heat-exchanger was significantly off-set by a reduction in the building height due to smaller ductwork and the removal of the mechanical pent-house. The project was actually rejected for a federal grant as it cost less than the conventional system. In addition to the capital cost savings, the ground-source heat pump system reduced the HVAC operating energy by an estimated 20%.

Environmental Impact

Table 2 summarizes the predicted reduction in the building CO_2 emissions relative to the ASHRAE 90.1-2004 Appendix G Baseline:

Table 2: CO2 Reduction from ASHRAE 90.1-2004 Baseline

	Energy Model	Baseline	Reduction
LBs CO2 Emitted*	2,197,038	3,681,246	1,484,209
Estimated Building Energy Intensity (kBtu/sf)	32	51	19

*1.54 lbs CO2/ kWh and 116.97 lbs CO2/MMBtu- EPA 2009

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