Scadding Court Community Centre
100 kW Solar Wall Air Heating System

Final Report – January 2012

Technology

Monitoring

Best Practices

SolarCity
Partnership

PROJECT SNAPSHOT

Address:	707 Dundas Street West
Building Type and Use:	Community Centre
Owner:	City of Toronto
Contact:	Joel Arthurs
Phone #:	416-392-5177
Email:	jarthur@toronto.ca
System type:	Solar Air Heating
Collector Manufacturer:	SOLARWALL
System Size (kW):	100
System Size (sq. meters):	165
Installation Date:	November 2006

PERFORMANCE

Estimated Performance:	122,800 ekWh/yr
2007/2008 Actual Performance:	5,109 ekWh/yr

FINANCIAL

Installed Cost (taxes included):	$122,169
External Funding:	$76,334
Annual Savings*:	$4,368
Simple Payback (excluding external funding):	28 years

*Based on estimated performance of 11,914 m^3/yr natural gas reductions at $0.367/$m^3$

MONITORING

Monitoring equipment installed:	Yes
Overview of the monitoring plan:	Invensys VER-PXP-010 air flow stations on building supply air and bypassed air and temperature sensors embedded in air flow stations. Air flow stations and temperature sensors are used to calculate energy recovered from the Solar Wall. The data is stored by the BAS and was designed to be remotely downloaded.
Cost of M&V (% of total project):	Unknown
Who is analyzing the data?	City of Toronto Energy & Waste Management Office
Is there a dedicated staff person responsible for system operation management?	No

Photo by David Nixon

BACKGROUND

The City of Toronto's Scadding Court Community Centre contains a gym, a pool with change rooms, classrooms, café, daycare, and offices. The centre has about 200 daily visitors from Monday to Friday, and slightly more during the weekend.

A whole suite of energy efficiency measures were carried out in 2006. At that time, heating was supplied by forced-draft boilers which supplied heated water to the heating coils in the ventilation system, as well as heating for the pool. Ventilation was provided by three air-handling units; one unit supplied air to the gym, one served the pool and a third one provided general ventilation for the building. There was no building automation system in the building.

As part of the installation of energy efficiency measures in 2006, the City decided to install a solar wall. The solar wall consists of over 165 square meters of solar air heating perforated-plate collectors mounted on the south wall of the Community Centre. Ventilation fans draw in outside air, which then circulates through the collectors and is heated by the metal panels. The warm air passes through ducts to fans and warm, fresh air is distributed throughout the building.

The solar wall would provide better insulation, preheat the incoming air, reduce energy costs, provide adequate ventilation, and improve the building façade.

PERFORMANCE ISSUES

Scadding Court experienced a number of issues that caused the solar wall to significantly underperform, relative to estimated performance.

Estimated system performance was 122,800 ekWh/yr but monitoring from May 2007 to May 2008 by Toronto Hydro Energy Services showed a significantly lower performance at 5,109 ekWh/yr. Toronto Hydro Energy Services hired Conserval Engineering to perform a site visit to determine the cause of underperformance. Their report was completed in October 2008.

During the site visit, it was determined that the solar wall damper was fully closed and the bypass damper fully open, even though the sensor in the solar wall panel was registering 18.9°C and the building was calling for heat.

The solar wall system will deliver solar heated air during the heating season, but only when the solar wall damper is open and the bypass damper closed. The only time that the solar wall damper should be closed and the bypass open is when the building does not require heating and the temperature delivered into the building is higher than the desired temperature delivered from the heating ducts inside the building.

Another issue contributing to underperformance was problems with temperature sensors that are used to control the solar wall system. During the site visit, it was observed on the BAS monitoring screen that the outside air temperature (OAT) sensor, which was assumed to be measuring solar heating gain, registered 9.1°C. This was much higher than the measured air temperature shown on the BAS monitoring screen from two other sensors (5.3°C and 6.4°C) which show the air temperature delivered into the building. Clearly there was a problem with the measurement of outdoor air temperature with three different numbers.

An outdoor air sensor is used to calculate solar energy heat gain. The sensor used to calculate heat gain was either inaccurate or located incorrectly so as to give a false reading. During the site visit, the sensor used to measure outside air temperature could not be located.

To rectify the performance issues, the following recommendations were made.

1. Modify the operating schedule to ensure that the entire outdoor airflow is pulled though the Solar Wall panels during the heating season. The Solar Wall damper should be 100% open and the bypass 100% closed, or modulated as necessary to maintain air at a minimum of 15°C or 18.5°C. Unless the supplied temperature rises above the desired delivered air temperature there is no reason to open the bypass damper. This recommendation was carried out in 2008.

2. Check the OAT sensors to ensure that they are providing an accurate reading of outdoor air temperature. Two sensors are required to measure the Solar Wall energy savings. One sensor measures outdoor air temperature and the other measures solar heated air entering the ventilation system. These sensors must be calibrated and be accurate within 0.1 C of each other if the temperature readings are to provide meaningful results. Unknown if this recommendation was carried out.

3. The mindset around maintaining as a low temperature as possible in the building to save energy during the heating system must be re-evaluated when free solar heat is available. The building automation system could be easily programmed to deliver higher temperature air when solar heat is the heat source. This first stage of solar heating could have a set point one or two degrees higher than the gas heat. This recommendation was carried out.

When the solar wall was initially installed through the Civic Centre Retrofit program in 2006, the three heating units for the gym, general, and pool areas were located in the sub-basement. These were integrated with the solar wall. But when a new roof-top heating unit was installed for the gymnasium portion of the building in 2007, it was not integrated with the Solar Wall (the contractor did not know that there was a solar heating system at the facility). As such, the solar wall does not provide any heating to the gymnasium and is now over-sized for the heating load.

Another factor contributing to low performance is a large deciduous tree approximately 5 metres directly south of the system which shades much of the system during the summer and most likely a significant portion during the winter.

Hampering performance analysis is the fact that the BAS stores instantaneous data for 24 hours and daily data for 5 days. It is difficult to troubleshoot performance issues with only energy totals. With such low storage capacity, staff time required to download the data would be significant. It is recommended that a device with larger storage capacity be connected to the BAS.

In early 2009, the IP address used to communicate with the BAS system was switched to be used for the main Scadding Court website. This disabled the ability to remotely download date. No data since early 2009 was available for this report.

FINANCIAL

The solar wall was installed in November 2006 for $122,169, tax included. Natural Resources Canada contributed $63,550 and the Toronto Atmospheric Fund provided $12,784 for monitoring and reporting purposes. The remainder was financed through the City's Civic Centres Energy Efficiency Retrofit Project.

Based on the estimated offset of 11,914 cubic metres of natural gas use at $0.367/ cubic metres, the project would save approximately $4,368 per year and provide a simple payback, before grants, of 28 years.

However, 2007/2008 data indicated that the system was significantly underperforming. During that period, the system produced 5,109 ekWh, which was about 4% of initial performance estimates. The financial case should be re-evaluated once the causes of the underperformance have been rectified.

About the SolarCity Partnership

The SolarCity Partnership is a joint initiative of the Toronto Atmospheric Fund, Toronto and Region Conservation Authority and the City of Toronto designed to promote best practices and careful monitoring of large solar installations. SolarCity Partnership is an information-sharing hub for both public and private organizations involved in deploying solar power. Our **SolarCityPartnership.ca** website provides case studies, research, and solar weather data to help with the effective use of zero emissions energy from the sun.

Toronto Atmospheric Fund

Toronto and Region Conservation for The Living City

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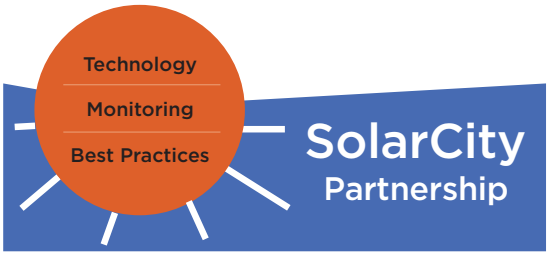
We want to hear from you!

If you have further best practices recommendations, insights into system design, deployment or maintenance or a project to profile, please get involved with the SolarCity Partnership! Contact us at:



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