Technical Series 01-108

Domestic Cold Water Booster Pump Control Monitoring Pilot Program

INTRODUCTION

To assess whether water booster pump controls result in water and energy savings, Canada Mortgage and Housing Corporation (CMHC) joined with Minto Developments Inc. and the City of Toronto in a pilot project that monitored two different booster pump control technologies:

- Variable Speed Drive (VSD) Motor
  This maintains a set pressure at the top floor (penthouse) of a building by changing the booster pump speed. The test involved an ABB ACS400 series drive on a relatively new motor.
- Variable Pressure Reducing Valve (PRV)
  Building pressure is controlled by a variable PRV which constantly adjusts to maintain a set pressure at the top floor (penthouse) of a building. For the test, Minto installed a new Cla-Val (Model 130-01) PRV with a motorized actuator and integral controller.

Table 1 Buildings, booster pumps and controls

Building	# Suites	# Floors	Booster Pump HP	Control
35 High Park	201	26	30 / 10*	PRV
65 High Park	321	22	25	VSD
95 High Park	218	17	7.5 / 5*	VSD
66 Pacific Ave.	229	16	10	VSD
111 Pacific Ave.	242	17	7.5	VSD
66 Oakmount Ave.	171	12	5	VSD
255 Glenlake Ave.	336	23	15	VSD

* See Methodology for explanation.

The site chosen for the project, Minto's High Park Village in Toronto, is a cluster of seven residential high-rise buildings. The buildings that form High Park Village include 35 High Park, 65 High Park, 95 High Park, 66 Pacific Ave., 111 Pacific Ave., 66 Oakmount Ave. and 255 Glenlake Ave. Table 1 provides details on the size of each building, booster pump power and the control technology used.

In April 1999, Minto had completed a water management program for all seven buildings. This involved replacing all toilets, showerheads and faucet aerators with low-flow water-efficient fixtures. Initial savings were below expectations, and a lengthy investigation revealed that lost water savings were due to creeping of the ballcock assembly used in most of the replacement toilets. After the faulty ballcocks were replaced with new assemblies, water savings in every building increased to 35 to 45 per cent. These savings achieved a simple payback period of less than three years.

Minto was subsequently interested in initiating more advanced water and energy management programs. Following discussions with the City of Toronto and CMHC, Minto undertook to assess domestic cold water booster pump controls.

METHODOLOGY

Building monitoring consisted of recording water flow and pressure at 15 minute intervals for a four-week period prior to installing the control systems, followed by another four-week monitoring period after installation. For all seven buildings, flow was recorded at the main municipal meter and pressure was recorded at the City supply, the booster pump outlet and the top floor of each building. Booster pump consumption was also recorded in each building. In addition to the main flow, an ultrasonic strap-on flowmeter and datalogger was used to monitor the hot water supply at 15 minute intervals in two specific buildings—35 High Park and 95 High Park.

Pre-installation monitoring was completed in March 2000, and post-installation monitoring was completed in April/May 2000, with the exception of two buildings, 35 High Park and 95 High Park.

During pre-installation monitoring, the condition of the primary booster pump at 35 High Park became critical. It not only required constant refilling of the transmission fluid, it was clearly oversized for the building. In addition, the secondary pump was not in operation. It was therefore decided to install a new pump assembly prior to the second phase of monitoring.

Data gathered during the pre-installation monitoring phase at 35 High Park facilitated the design of a properly sized pump assembly. The new pump was downsized from the original 30 HP motor to a 10 HP motor with 100 per cent redundant backup. Post control-installation monitoring was completed in August 2000.

During pre control-installation monitoring, Minto also decided to install a new pump at 95 High Park. The new pump was downsized from 7.5 HP to a 5 HP motor. Post control-installation monitoring was completed in October 2000.

Monitoring was done using the latest technology in monitoring equipment:

- Domestic cold water consumption was monitored using newly installed 5.1 cm (2 in) positive displacement meters with pulse generators. A licensed contractor installed all meters, which were tested to ensure they met American Water Works Association (AWWA) specifications for accuracy.
- Ultrasonic meters used for testing domestic hot water consumption were also tested for accuracy.
- Building water pressures were recorded by high-resolution pressure recorders, which had been recently calibrated to provide a high degree of accuracy.
- Booster pump power consumption was recorded using power monitors installed on each pump. The project monitored actual kilowatt usage, instead of amperage, in order to obtain very accurate data on energy consumption.

Table 2 Pre- and post- installation consumption

Building	Water consumption (unit/day)		Energy consumption (kWh/day)	
	Pre	Post	Pre	Post
35 High Park	444	428	357	108
65 High Park	429	437	239	86
95 High Park	374	445	84	20
66 Pacific Ave	406	443	168	122
111 Pacific Ave	357	359	76	55
66 Oakmount Ave	270	286	47	36
255 Glenlake Ave	330	304	138	118
Averages	**373**	**386**	**1,109**	**545**

RESULTS

Overall, water savings were non-existent but energy savings were very pronounced. Booster pump energy consumption for all seven buildings averaged 1,109 kWh/day prior to installing controls and 545 kWh/day afterwards—a 51 per cent reduction in energy consumption. Table 2 shows the results for each of the buildings.

At a rate of $0.072 per kWh at the time of the project, energy savings equaled $14,882 annually. This gives a simple payback period of 3.4 years, based on installation costs of $5,000 for the pump control system in each of the seven buildings and including pump replacement costs for two of the buildings (total capital investment of $52,000).

CONCLUSIONS

The pilot program demonstrated that water savings are not likely to be achieved through the use of VSD technology on domestic cold water booster pumps in residential high-rise buildings where water use is deemed efficient or where water management programs have been successfully implemented. In fact, the evidence suggests that use of VSD technology in this context should be based solely on energy merits.

Water savings can probably be better achieved through retrofit programs. The results of the booster pump control pilot program suggest retrofitting is a more cost-effective solution for dealing with high water consumption than lowering pressure in leaky buildings.

For proper water efficiency, it was concluded that building owners should:

- monitor water use in their buildings,
- implement cost-effective water conversions,
- continuously track and monitor performance,
- evaluate cost effectiveness of proper pump sizing.

CMHC Project Manager: Cate Soroczan

Consultant: Veritec Consulting Inc.

Housing Research at CMHC

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or contact:

Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, Ontario
K1A 0P7

Phone: 1-800-668-2642
Fax: 1-800-245-9274

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