CADDET energy efficiency
IEA
OECD

CA 90.002/3C.F03

Energy efficient office building

Computer controlled HVAC in the Ottawa Courthouse

Summary

The new Ottawa Courthouse was built using commercial and institutional energy efficient technologies, demonstrating that energy consumption can be minimised by mixing insulation, heat recycling, electronic control of heating, cooling and lighting.

Highlights

- **34% energy savings**
- **Annual electricity consumption 133.5 kWh/m^2**

Natural interior lighting made possible by the atrium helps minimise energy use.

Aim of the Project

The main objective was to create an efficient and comfortable work space, reducing energy consumption to a minimum by using computer-controlled HVAC.

The Principle

The "hidden hand" behind the Courthouse heating and cooling economy is an MCC Powers (currently Landis & Gyr Powers) System 600 which communicates with 3,000 points (including monitoring and control devices) via 62 intelligent stand-alone control units throughout the building.

The System 600 temperature and humidity control system, which opens and closes all valves electronically, was selected over conventional pneumatic operated controllers and actuators (powered by compressed air). The system, supervised by a trained Powers control room operator during building hours, controls temperature differentials, allowing for:

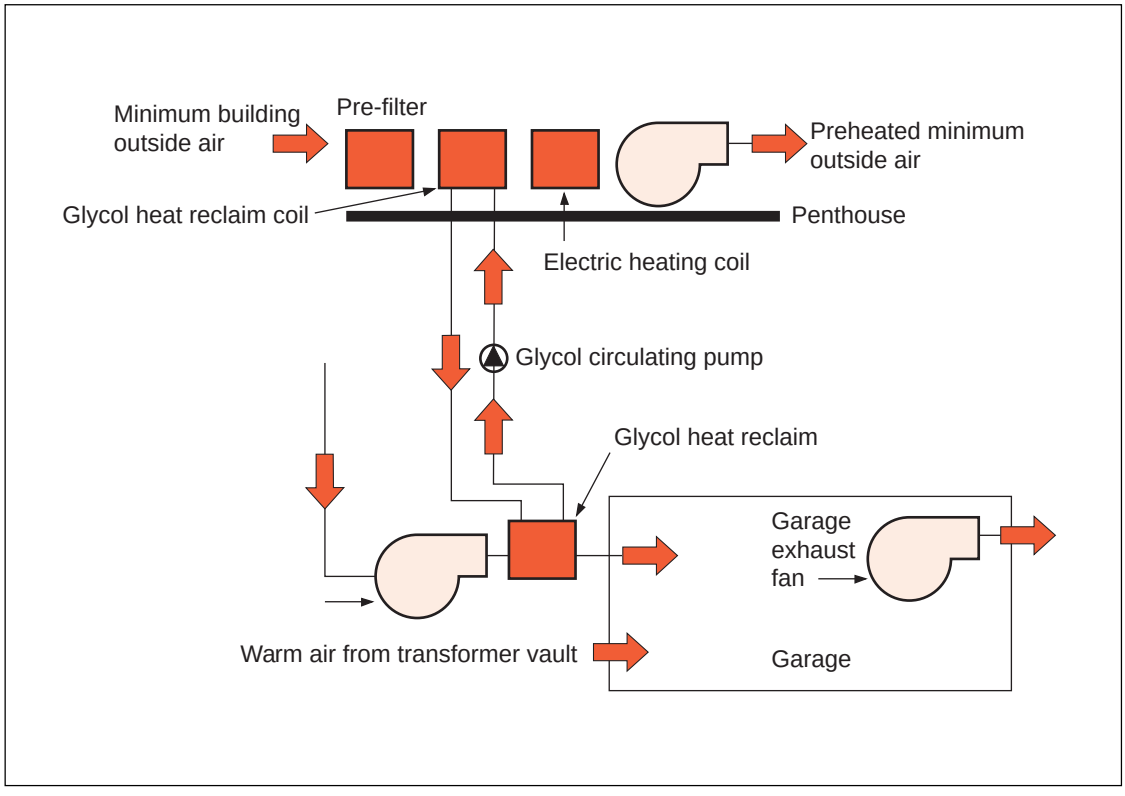
- optimum start up during summer and winter;
- scheduled operating times for all equipment;
- setback temperatures during unoccupied periods;
- operation of heating and chilling equipment at minimum energy levels;
- coordinated control of the HVAC and lighting systems;
- regular monitoring of space conditions and energy consumption.

The system 600 was installed in a well insulated, airtight building, including many building energy efficiency techniques.

The Situation

The compact structure has a 40,222 m^2 gross floor area, including 3,600 m^2 of basement and parking space. The design ensures an airtight structure with low heat loss. The exterior walls and roof are insulated to R-20 with an integral galvanized metal vapour barrier and minimal thermal bridging. All windows are triple pane insulated glass in thermally broken aluminium frames. The design allows the concrete building slab to store heat from lights and equipment in the walls and floors. Most of

Figure 1: Heat exchange between exhaust and outside air.



the energy stored in the structure is used either to heat the perimeter areas, or to temper the building's fresh air supply. Building exhaust fans expel air volumes roughly equal to the building's minimum outside air ventilation requirement. In the heating season, a run-around glycol heat reclaim coil transfers the heat from this exhaust air to preheat the minimum fresh air supply to the ventilation system. The exhaust air is used to heat the parking garage and then expelled to the outside. (See Figure1.)

When available, warm exhaust air from the transformer vault also heats the garage. This design configuration has virtually eliminated additional winter heating requirements.

Table 1: Ottawa Courthouse and Registry Offices Billing Summary.

Ottawa Courthouse and Registry Offices Billing Summary		
Month	**Consumption kWh**	**Demand kW**
January	544,800	1,809
February	386,100	1,248
March	499,500	1,038
April	361,200	1,086
May	388,800	1,338
June	428,400	1,310
July	492,600	1,352
August	395,100	1,352
September	365,400	954
October	285,000	1,032
November	405,900	1,284
December	342,300	1,508
Total	4,895,100	1,809 Max. demand
Gross exterior area = 432,960 ft^2 (40,222 m^2) Parking garage = 38,751 ft^2 (3,600 m^2) Energy consumption = 4,895,100 kWh / (432,960 - 38,751) ft^2 = 12.4 kWh/ft^2/year (134 kWh/m^2/year)		

The preheated outdoor air is mixed with building return air and passed through cooling coils before delivery to conditioned spaces by two variable air-volume (VAV) supply air fans located in the mechanical penthouse. The supply air temperature is constantly reset to the optimum level for providing adequate cooling to the warmest zone in the building.

Interior and exterior lighting is controlled by a General Electric computer system with 1,300 sectors. It schedules lighting during occupied hours (7:00 a.m. to 4:30 p.m. weekdays), half lighting during cleaning periods (4:30 to 10:00 p.m. weekdays), and no lights (except for emergency lighting) during unoccupied periods. When a light switch is turned off the direct digital control building automation system knows that the associated space is empty and - when the space condition is satisfied - closes the VAV box.

The natural atrium lighting is supplemented by a unique system of forty 1,000 Watt metal halide lights. They are ceiling mounted and are controlled by photocells to maintain a lighting level of 60 footcandles. They are equipped with solid-state electronic ballast. When outdoor lighting is insufficient to supply 60 footcandles, the ballasts vary the power input thus modulating light output.

The Company

The Courthouse was designed by MCA Architects and Planners, a consortium of three Ottawa architectural firms: Murray and Murray, Griffiths and Rankin; Craig, Kohler, Dickey and Edmundson; and Ala Kantti/Associates. The mechanical and electrical engineers were Ottawa's Clemann, Large, Patterson.

Economics

The total annual cost of energy is CAD 5.80 per square metre. For comparison, annual energy costs at the previous courthouse were CAD 18.00 per square metre. Annual electric power consumption is 133.5 kWh/m^2.

Information Organisation:

Ontario Hydro's Energy management Branch,
Commercial Departement,
Section C26,
700 University Avenue,
Toronto, Ontario M5G-1X6,
Canada.
Tel.: +1-800-387-5493

Please write to the address below if you require more information.

CADDET IEA OECD energy efficiency

Swentiboldstraat 21
6137 AE Sittard
P.O. Box 17, 6130 AA SITTARD
The Netherlands
Telephone: +31-(0)46-4595-224
Telefax: +31-(0)46-4510-389

* IEA: International Energy Agency
OECD: Organisation for Economic Co-operation and Development

IEA
The IEA was established in 1974 within the framework of the OECD to implement an International Energy Programme. A basic aim of the IEA is to foster co-operation among the twenty-one IEA Participating Countries to increase energy security through energy conservation, development of alternative energy sources and energy research development and demonstration (RD&D). This is achieved, in part, through a programme of collaborative RD&D, consisting of forty-two Implementing Agreements, containing a total of over eighty separate energy RD&D projects.

The Scheme
CADDET functions as the IEA Centre for Analysis and Dissemination of Demonstrated Energy Technologies. Currently, the Energy Efficiency programme is active in 15 member countries.

This project can now be repeated in CADDET Energy Efficiency member countries. Parties interested in adopting this process can contact their National Team or CADDET Energy Efficiency.

Demonstrations are a vital link between R&D or pilot studies and the end-use market. Projects are published as a CADDET Energy Efficiency 'Demo' or 'Result' respectively, for on-going and finalised projects.

This brochure is printed on 100% chlorine-free bleached paper *February 1991*