RESULT 336

CADDET energy efficiency IEA OECD

AIVC 12,395

World's largest solar wall at Canadair facility

Summary

Developed by Conserval Engineering of Toronto, Canada, the Solarwall™ is a solar system for heating ventilation air for buildings. The Solarwall looks like conventional metal cladding, but performs like a solar panel.

Matrix Energy Inc. of Montreal, in partnership with Conserval, installed the Solarwall system at Bombardier's Canadair facility in Montreal, Québec. The installation paid for itself in energy savings in just 1.7 years, and allowed the company to stop using fossil fuels, with their associated emissions. The Solarwall provided a comfortable indoor working environment for the occupants of this busy aircraft sub-assembly manufacturing facility.

Highlights

- **High-efficiency solar collection and improved air quality**
- **Low cost and simple installation on new or old buildings**
- **Doubles the R-value of the wall to R-50**
- **Short payback period compared to conventional systems**
- **Reduced environmental impact**

Solarwall installed at Canadair.

Aim of the Project

The Canadair facility is a key Bombardier facility for machining, parts fabrication, glueing, riveting, painting and cleaning of aircraft parts. Many of these operations produce noxious fumes. Plentiful fresh air is needed to dilute these fumes, but the original ventilation system did not provide the desired level of air quality. Bombardier faced two challenges: improving the quality of the facility's indoor air, and recladding the facility's exterior siding, which had deteriorated beyond serviceability.

Conventional practice would have seen the two problems tackled separately: gas-fired rooftop make-up air units would have been installed to provide increased ventilation air and the siding would simply have been replaced. This would have required a considerable capital expenditure, not to mention the annual fuel and maintenance costs of the heaters. Solar wall technology was chosen as an efficient and cost-effective method to provide both ventilation air heating and building wall cladding.

The Principle

The Solarwall combines cost reduction with the latest in solar energy technology. The Solarwall, or "perforated-plate absorber", resembles a rigid permeable membrane. It is covered with a matrix of millions of holes, about 1 mm in diameter, which allow outside air to travel through its surface. Mounted on the south-facing exterior of the building, 30 cm away from the main structure, it creates a cavity for air flow. Ventilation fans create negative pressure to draw air through the holes. Air passes through and up the back of the membrane, absorbing the solar-generated heat stored in it. The warmed air rises up through the cavity to be collected in a roof-level canopy/plenum and ducted to the nearest fan.

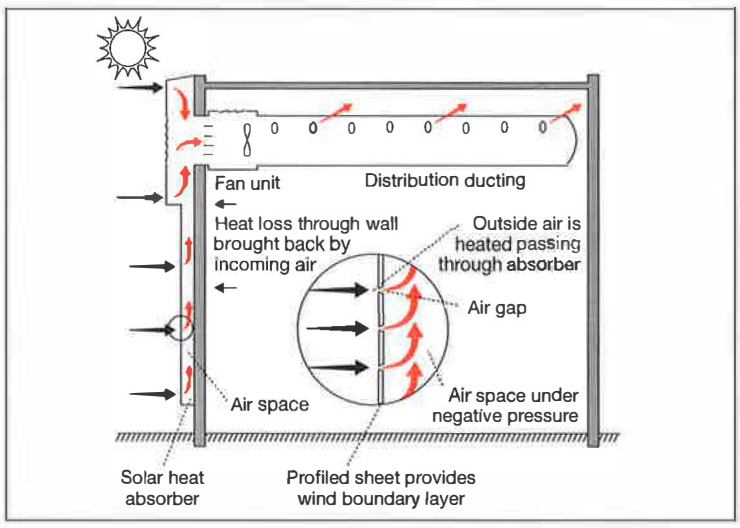
Inside the building, the fan system is coupled to perforated ducts that direct the make-up air to those areas of the building that require ventilation. Two types of Solarwall systems, a stand-alone type and a preheat type, are used at the Canadair facility. The preheat type is connected directly to a gas-fired, make-up air heating unit which provides additional heat as required to maintain the delivery temperature setting. For the stand-alone system, a set of dampers control the mixture of fresh, solar-heated outside air with recirculated plant air in order to control delivery temperature. Additional heat is provided by existing plant unit heaters as required. Figure 1 illustrates the principle of the solar wall operation.

The Solarwall has a number of advantages in addition to the solar energy contribution. The wall heat loss is recaptured, at least doubling the R-value of the wall to R-50. In addition, the ceiling and exhaust air temperatures are reduced. Finally, the particulate levels in air drawn into the building are diminished, reducing filter maintenance where filters are used, or simply providing partial air filtration otherwise.

The Situation

The installation of the Solarwall at the Canadair facility was completed in October 1996. The system covers a total area of 8,826 m^2. It operates 24 hours a day, with approximately half the system operating at a constant airflow

Figure 1: Principle of solar wall operation.



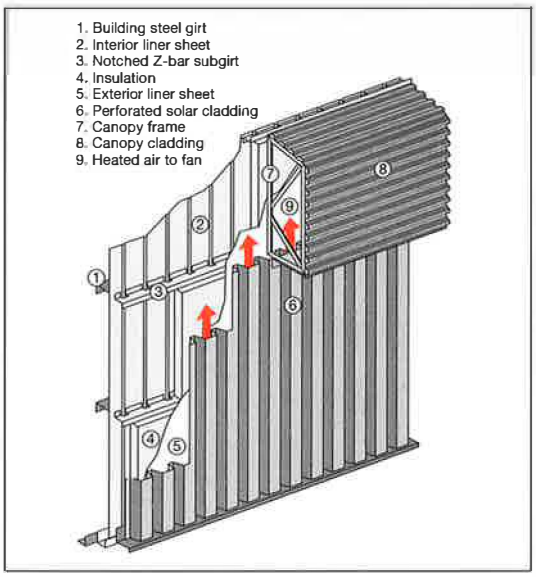
and the remainder at a variable rate. Lightweight precast concrete panels in a complementary colour were installed on the north-facing walls of the facility where the Solarwall would not be effective. Figure 2 shows solar cladding on a metal wall.

All parameters, such as delivered air temperature, temperature for opening the summer bypass damper, temperatures for turning on the exhaust fans and manual control of the system, can be set from the central computer. In addition, the computer contains a program that provides real-time operating characteristics of the system and historic data.

The ventilation air required by the Canadair facility amounts to 1,070,000 m^3/h, which is supplied by a total of 29 fans feeding a ducting network. The actual average airflow during the heating season was measured to be 1,149,280 m^3/h, approaching the design value. An exhaust capacity of 950,000 m^3/h was added to balance the ventilation supply and was installed using 49 roof exhausters that are computer-controlled based on ceiling temperature.

The 1996/97 monitoring results show that the Canadair Solarwall delivers 1.21 GJ/m^2 of solar energy per year, at an average solar collection efficiency of 63%. In addition, the Solarwall system reduces heat transmission through the south-facing building wall, recovers lost heat in the incoming air and destratifies the indoor air. The most recent monitoring results show that these savings amount to 1.42 MJ/m^2 annually.

Figure 2: Solar cladding mounted on a metal wall.



Thus the Canadair Solarwall is contributing an estimated annual total of 2.63 MJ/m^2 of collector area (based on an eight-month heating season).

The Company

Bombardier Inc. is a Québec-based Canadian corporation which is involved in the fields of transportation, motorised consumer products and aerospace. It employs 40,000 people in North America and Europe, including Canada, USA, Austria, Belgium, Finland, France, Germany, and the UK. Bombardier has revenues of CAD 7.1 billion, 85% of which come from markets outside Canada.

Economics

The total installed price of the Solarwall, including labour and all hardware, was CAD 2,575,000. Credit for new siding, insulation and make-up air units which comprised the conventional alternative amounted to CAD 2,290,000. Therefore, the incremental cost of the Solarwall system was CAD 285,000.

The entire system delivers 2.63 $GJ/m^2/yr$, or a total of 23,000 GJ annually. At a fuel cost of CAD 0.25/m^3, the annual fuel savings amount to CAD 153,500. The centrifugal fans use less electricity than a typical make-up air unit. The current fan system runs non-stop all year round (8,760 hours) and has a total energy consumption requirement of 376 kW. Based on an electricity cost of CAD 0.062/kWh, the total cost of the fan operation is CAD 204,400 annually. A conventional system would have a total power requirement of about 400 kW and an annual operating cost of CAD 218,000. Hence annual electricity savings are approximately CAD 13,500. Total annual savings are CAD 167,000, resulting in a simple payback period of 1.7 years.

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* 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 24 IEA Participating Countries to increase energy security through energy conservation, development of alternative energy sources, new energy technology, and research and development (R&D).

This is achieved, in part, through a programme of energy technology and R&D collaboration currently within the framework of 40 Implementing Agreements, containing a total of over 70 separate collaboration 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 12 member countries and the European Commission.

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 ongoing and finalised projects.

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