



Unique daylight system for building illumination

Summary

A unique building project called GreenZone has been constructed in Umeå, Sweden. Containing three buildings, the GreenZone project used the latest technologies combined with an optimal system design to save both energy and lessen the impact on the environment. One of many features of the project was the

installation of an energy efficient daylight system.

This system consists of high two-layer domes, with a prismatic cone made from polycarbonate to reflect sunlight into the buildings. The prismatic cone is translucent which makes it possible to radiant diffuse light even in cloudy weather. Using the system has reduced electricity consumption by 80%.

Highlights

- Electricity consumption reduced by 80% with lower heat radiation
- Excellent luminous flux and light distribution
- Maintenance-free components with long lifetime



The daylight system showing the two-layer domes with the prismatic cone installed on a roof

Aim of the project

The aim of the daylight system project was to demonstrate that it is possible to reduce the negative impact on the environment with current recycling technology without adversely affecting the working environment in a building.

The Principle

The system consists of high two-layer domes with a prismatic cone made of polycarbonate. The cone acts like a mirror reflecting sunlight downwards. The shaft walls leading down into the building through the roof are covered with a highly reflecting film that reflects the sunlight down through the shaft at the end of which is a diffused opalescent light fitting. This spreads the light throughout the room. Figure 1 illustrates the

operating principle. The prismatic cone is translucent, which permits light to enter the building even during cloudy weather.

The daylight system meets the criticisms that are usually directed against similar systems with regard to their efficiency during cloudy weather. The efficiency of sunlight transmission during cloudy weather showed an increase from 175% to 680% when comparing the daylight system to an open window.

The Situation

The construction of the GreenZone project in Umeå in the northern part of Sweden began in midsummer 1999 and was completed by summer 2000. GreenZone is a completely recyclable project. One of the most important

objectives is for the companies involved to learn how to use the experience gained for their future environmental work. In this project non-polluting techniques with long-range view of the economics involved were used.

The total area of the GreenZone construction is 4,700 m² divided over three buildings, a petrol station (685 m²), a restaurant (750 m²) and an auto dealership (3,243 m²).

The companies that took part in this project were Carstedts Bil, Ford Motor Company, Svenska McDonalds and Statoil Detaljist.

A total of twenty-five daylight systems have been installed to date in the three Swedish buildings. The energy consumption in the GreenZone construction was reduced by between 40% and 80% and the total annual savings on illumination were approximately 32,000 kWh.

One benefit of the daylight system is a well-lit working environment with colour-reproduction similar to that in daylight. This is a feature important to many companies.

The Organisation

Three Swedish companies, LDT AB (Lightning Distribution Technology AB), ICOPAL AB and 3M developed the daylight system. ICOPAL AB contributed their experience with roof tightening and daylight copes and 3M developed and manufactured the reflecting film.

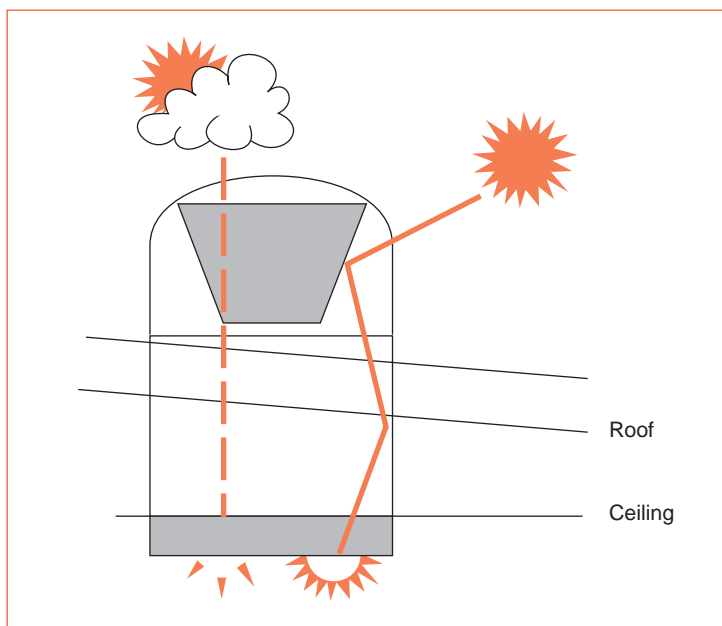


Figure 1: Schematic showing the daylight system cone installed on a building roof (Figure published by permission of Martin Behm, 3M Svenska AB)

Economics

The total cost of investment for the daylight illumination at GreenZone is USD 50,000 (1 USD = 8.80 SEK), from which the buyers received USD 22,500 in support from the Swedish National Energy Administration. While the payback time is long at an estimated 20 years, if one considers natural light as a resource that gives lower absence due to sickness, then the payback time is much shorter.

The system is a so-called passive system i.e. it contains no moving parts which makes the copes almost entirely maintenance-free. The only maintenance required is an

Table 1: Energy savings achieved in the three buildings

Building	Installed power	Consumption	Saving
Petrol station - Store	2.7 kW	23,000 kWh	14,000 kWh
Restaurant - Entrance	1.35 kW	7,800 kWh	5,400 kWh
Auto dealership - Car showroom	3.4 kW	8,600 kWh	5,100 kWh
- Workshop	3.74 kW	9,400 kWh	6,500 kWh
- Motor works	1.0 kW	2,500 kWh	1,800 kWh

annual cleaning that normally forms a part of the building maintenance programme.

The manufacturers of the system have not calculated any specific life cycle cost on the

installation, but the dome, walls and light fittings have a lifetime of 30-40 years, while the cone will be efficient for up to 20 years. This means that the system will need to be updated several times.



Figure 2: Ceiling view of the daylight system showing the opalescent light fittings



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

IEA

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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 11 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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