



# DAYLIGHTING *initiative*

Design tools and information from PG&E

Industrial Application

Retail Application

Museum Application

Restaurant Application

School Application

Office Application



National Gallery of Canada

Internal and external shading devices, in south-side lobby and circulation area, moderate direct sunlight without completely eliminating it. This animates the space without causing overheating or visual discomfort.



## PG&E'S DAYLIGHTING INITIATIVE

PG&E's Daylighting Initiative has two goals: to raise awareness of good daylighting practice within the design community and to improve the practice of daylighting design. This case study is one of a dozen case studies undertaken within the initiative. Together, they document a wide range of successful technical solutions demonstrated across a number of different commercial applications.

The Daylighting Initiative includes projects that will make better design tools available to the daylighting design community. The Desktop Radiance project, a collaborative effort of Lawrence Berkeley National Laboratory and PG&E, is bringing the powerful Radiance lighting simulation capabilities into the practical world of architectural CAD software. The Daylighting Initiative also includes a series of workshops and seminars at the Pacific Energy Center in San Francisco. For more information, visit the project's web site at [www.pge.com/pec/daylight](http://www.pge.com/pec/daylight).

### DAYLIGHTING FEATURES THE NATIONAL GALLERY OF CANADA

Located in a prominent position overlooking the city of Ottawa, the National Gallery of Canada is one of Canada's most identifiable buildings. Its Great Hall, a crystalline dome-like structure, is a contemporary interpretation of the Gothic design style prevalent in the neighboring government buildings. Like 19th century museums, the rooms are illuminated with skylights, but this 20th century version has a uniqueness all its own.

Creating daylight in the galleries became a high priority for the design team during the initial design phase. They were able to satisfy this requirement in the galleries by using modeling techniques to design a novel skylight system that brings light to both upper and lower floors.

Opened in 1988, the National Gallery offers an appealing combination of atriums, courtyards, skylit galleries, and a glass-bottomed fountain that acts as a skylight for the space below. It is a fascinating environment for museum attendees.

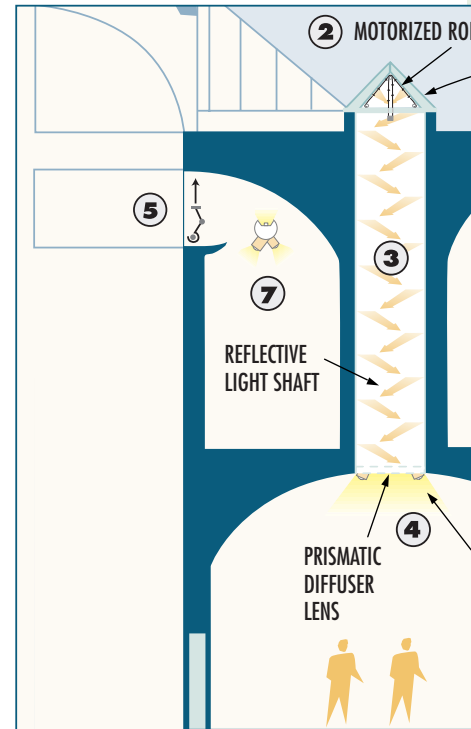
### DAYLIGHTING FEATURES

#### 1 SKYLIGHTS

A desire to use daylight in the galleries of both upper and lower floors produced a unique skylight design. The skylight width is limited to six feet to minimize heat loss. The glazing assembly consists of three components. A translucent inter-layer diffuses incoming sunlight in a clear thermopane assembly with a Low E coating to minimize heat loss during cold winters.

# Where Art and A

## Physical modeling proved this novel tw



#### 2 MOTORIZED ROLLER BLINDS

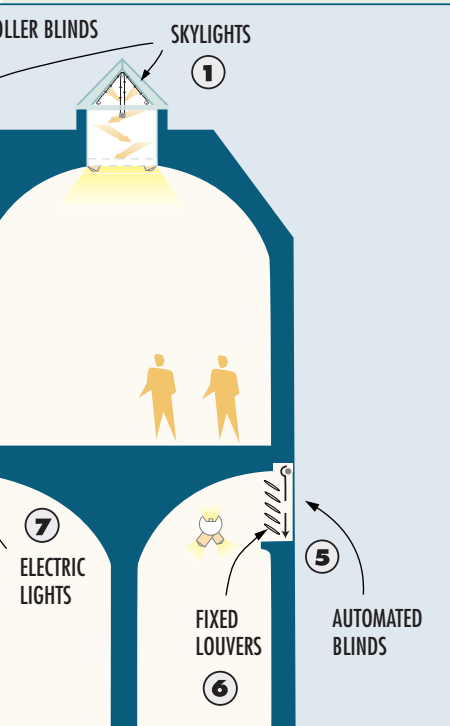
Fabric roller blinds are mounted on the inside of each skylight above the galleries. Their position is controlled automatically. A photosensor, located in the skylight, signals the controller to adjust the position of the roller blinds to maintain the desired light levels in the gallery below. A 15 minute delay is programmed in to moderate the blinds' motion and to allow some daylight variation in the space. When fully closed, the blinds darken the galleries completely.

#### 3 REFLECTIVE LIGHT SHAFT

The six-foot-wide shafts extending 25 feet from the upper floor to the lower, are lined with mirrored acetate, propagating light to

# Architecture Meet

Two-story daylighting design would work.



at the ceiling level helps to diffuse the daylight across the room. This lens is installed only on the lower gallery and not on the upper floor galleries.

## 5 AUTOMATED BLINDS

In the side galleries, daylight is brought in through a vertical clerestory. To control the light levels in this space, automated blinds mounted on the interior of the clerestory are adjusted via a photosensor control to maintain the illuminance levels in the room (see photo). The photosensor is mounted below the windowsill.

## 6 FIXED LOUVERS

Wide aluminum louvers, installed at a fixed pitch to prevent direct sunlight from entering the gallery, are mounted inside the clerestory of the lower side galleries. The automated blinds, described above, are positioned between the louvers and the clerestory to control the quantity of light.

## 7 ELECTRIC LIGHTS

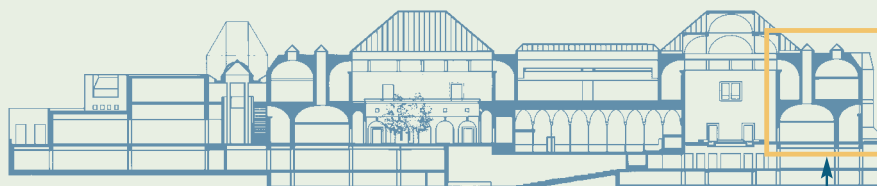
Most of the electric lights in the galleries are spotlights. The electric lights are linked to a building management system where curators can decide when to turn the lights on or off based on scheduling, the season, time of day, and curatorial specifications. Photosensor control is not used in this case.

## 4 PRISMATIC DIFFUSER LENS

Much like the lens common in fluorescent fixtures today, a prismatic acrylic lens

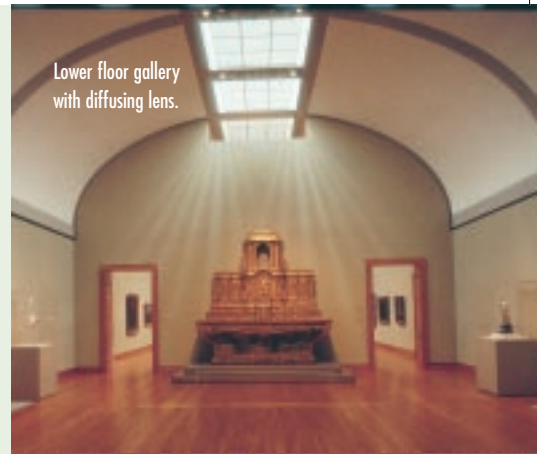
the lower-level rooms. This unusual device needed additional evaluation before curators would commit to the design.

Several small models were built, then larger (1:20) scale models were tested. Finally, a full-size mockup of one gallery was built to verify that such an unorthodox idea would work. It did.

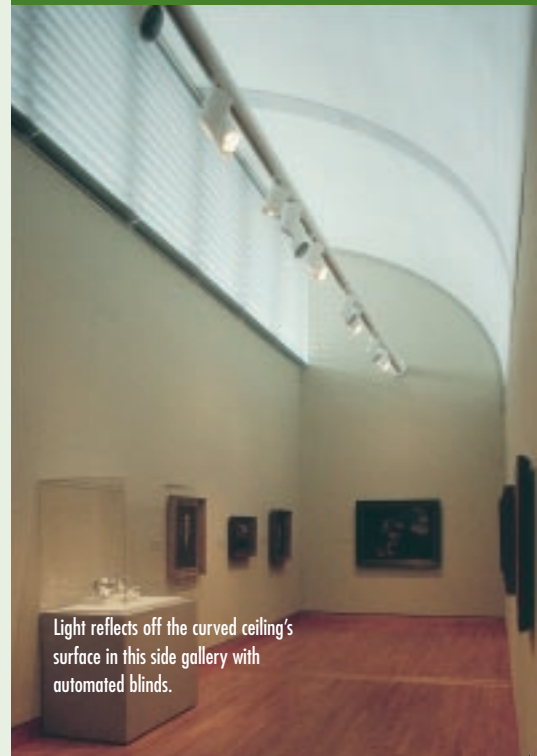


See detail of this area above.

Lower floor gallery with diffusing lens.



Deep light shafts coated with highly reflective mirrored acetate conduct light to lower-level rooms.



Light reflects off the curved ceiling's surface in this side gallery with automated blinds.



The ceiling design varies from one gallery to the next. The shape (curved or sloped) and color are used to give each space a different feel. This gives exhibit designers a wide latitude in designing their presentations.

## RESULTS

Challenged by the demands of providing daylight to a museum, the designers took a chance with an innovative skylight design. Direct sunlight was not to be allowed in the galleries. The resulting design using a 25-foot reflective light shaft to bring daylight to the lower gallery raised some concerns. Physical modeling demonstrated two things: direct sunlight would not penetrate into the galleries; and even in the worst case conditions under cloudy skies, the electric lights were not necessary during daytime hours.

Designed and built from 1983–1988, the designers were successful in demonstrating through physical models the functionality of a unique skylight design prior to being built. After ten years of operation, the automated daylight shading system continues to function as desired, protecting the galleries from direct sunlight while providing natural light in a way that greatly enhances the overall experience of visiting the museum.

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## RESOURCES

PG&E does not endorse particular products or services from any specific manufacturer or service provider. High efficiency products and services similar to those used in this project are available from multiple suppliers. For informational purposes, PG&E notes that the following companies provided equipment or services to the project:

### *Architect:*

Moshe Safdie & Associates, Boston, Massachusetts  
<http://blackader.library.mcgill.ca/cac/safdie> — 617-629-2100

### *Lighting Designers:*

Fisher Marantz Stone, New York, New York  
212-691-3020

### *Automated Blinds:*

Solarfactive, Toronto, Ontario  
Tel: 416-421-3800 — Fax: 416-421-8424

### *Photosensor Controls:*

Technical Blinds, Gloucestershire, UK  
Tel: 01594 832010 — Fax: 01594 836674

*Photos: Courtesy of George Loisos*

## ADDITIONAL CONTACT INFORMATION

Pacific Energy Center, San Francisco, California  
[www.pge.com/pec/daylight](http://www.pge.com/pec/daylight) — 415-973-7206

National Gallery of Canada, Ottawa, Ontario  
<http://national.gallery.ca>