



Windows, Glazings, Facades, Daylighting Resource Guide

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Lawrence Berkeley National Laboratory

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The following resources provide access to LBNL commercial façade/daylighting project results:

High Performance Façade Solutions for Low Energy and Zero Energy Buildings-

<http://lowenergyfacades.lbl.gov/>

Solutions that actively recognize and optimize the synergistic impacts of facades on lighting and HVAC energy use will lower energy use and demand and deliver increased comfort and amenity. Field data and software tools are being developed under this multiyear project to enable A/Es to understand and quantify the potential benefits of such solutions, thus accelerating adoption of leading-edge commercial facade technologies that can help us reach zero energy building goals.

Daylighting The New York Times Headquarters

http://windows.lbl.gov/comm_perf/newyorktimes.htm

This site documents the work we did to assess and quantify the benefits of dimmable lighting and automated shading in a full-scale mockup, develop procurement specifications, then follow-through to the occupancy phase to commission these systems for a Class A building. The underlying approach and technologies are widely useful throughout the sector. The procurement specifications, commissioning package and other support tools developed for the owner to help "guarantee" success are all downloadable from this site.

Switchable Electrochromic Windows

http://windows.lbl.gov/comm_perf/electrochromic

All you wanted to know about switchable electrochromic (EC) windows and more. Includes design guide to understand how EC windows work and what benefits they can provide in commercial buildings.

Double Envelope and All Glass Facades

<http://gaia.lbl.gov/hpbf>

The well-publicized use of all glass, double envelope facades in EU led to significant interest in the US market. What are the benefits and risks of this design approach? This site provides insights into the motivation behind use of these systems, the challenges of using them, and includes interviews with owners and specifiers on applicability to the US market.



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Commercial Windows Website

<http://www.commercialwindows.org>

We've developed, in collaboration with the University of Minnesota, the beginnings of an on-line tool for A/E's or owners to optimize designs and estimate savings quickly from glazing, shading and daylighting strategies. The goal here is to have a well developed site for each city that will use local utility rates, incentive programs. A companion extensive site for Residential Windows is at <http://www.efficientwindows.org> in collaboration with University of Minnesota and Alliance to Save Energy.

Commercial Windows Book: Window Systems for High Performance Buildings

<http://www.wwnorton.com/npb/nparch/carmody731219.html>

Takes you to the WW Norton Books web site for an overview of this 400-page book; much of the information is available on the Commercial Windows web site.

COMFEN: Calculates commercial window/ facade energy, comfort with EnergyPlus

Download software to create and assess energy performance of a wide range of façade systems; varying glazing, framing, shading systems, daylighting, etc. for a range of US cities; reports annual and monthly heating/cooling and lighting, daylighting, comfort, carbon impacts etc. Uses the EnergyPlus calculation engine. Version 4 released August 1, 2011

<http://windows.lbl.gov/software/comfen/3/>

Quick Guide for Daylighting: "Tips for Daylighting"

<http://windows.lbl.gov/pub/designguide/default.html>

In the daylighting area we have a nice downloadable reference, *Tips for Daylighting*. This has been reprinted thousands of times by utility programs etc and is a good, quick checklist-type, "how-to-do-it" reference. This is being updated for republication later in 2011

Advanced Daylighting Concepts: A Source Book on Daylighting Systems and Components:

<http://gaia.lbl.gov/iea21/>

Field data and how-it-works information on a number of innovative daylight-redirecting, solar control, and light diffusing systems catalogued by the IEA Task 21 International Daylighting project. We have several remaining hard copies of this document in addition to the download.



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Note: These are publicly-accessible resource materials developed by LBNL (ver. 6, 6/1/09).

General Websites

LBNL Windows & Daylighting Group

<http://windows.lbl.gov/>

Search and Access 250+ pubs; references and downloads:

<http://btech.lbl.gov/publications.html>

Efficient Windows Collaborative (residential windows):

<http://www.efficientwindows.org>

LBNL Lighting Systems Research Group: Controls and Communications

<http://lighting.lbl.gov/controls.html>

High Performance Commercial Buildings R&D

<http://buildings.lbl.gov/>

<http://energybenchmarking.lbl.gov>

Energy efficient buildings activities at LBNL

<http://eetd.lbl.gov/>

Lawrence Berkeley National Laboratory (LBNL) main site

<http://www.lbl.gov/>

Fenestration and Daylighting Design, Decision-Support Resources and Guides

Commercial Windows Book: *Window Systems for High Performance Buildings*

<http://www.wwnorton.com/npb/nparch/carmody731219.html>

Commercial Windows Website

<http://www.commercialwindows.org>

Tips for Daylighting

<http://windows.lbl.gov/pub/designguide/designguide.html>

Daylight in Buildings: A Source Book on Daylighting Systems and Components:

<http://gaia.lbl.gov/iea21/>

Spectrally Selective Glazings: Federal Technology Alert

http://www1.eere.energy.gov/femp/pdfs/FTA_Glazings.pdf

Virtual Lighting Simulator: Explores impact of window design on daylighting

<http://gaia.lbl.gov/vls/>

Double-Envelope and Other Advanced Façade Systems

High Performance Commercial Building Facades: (website and report)

Overview piece on all types of advanced façade systems but focuses on highly-glazed buildings that are prevalent today.

<http://gaia.lbl.gov/hpbf/>

Report (pdf) can be downloaded at <http://gaia.lbl.gov/hpbf/content.htm>

San Francisco Federal Building – Naturally Ventilated with Automated Windows

http://www.energy.ca.gov/reports/2003-11-20_500-03-097F-A10.PDF



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“Daylighting with Integrated Window and Lighting Systems” project

General Overview of an older project examining façade integration issues
Progressive Architecture Award 1999 – Winning submittal

http://windows.lbl.gov/comm_perf/daylight/default.html

Research Papers

<http://gaia.lbl.gov/btech/pubs/pubs.php?code=Integrated%20Systems>

<http://btech.lbl.gov/papers/40967.pdf>

Basic Principles: Optimizing Daylight versus Solar Heat Gains

See LBNL-32931 at <http://gundog.lbl.gov/reports.html>

Software

LBNL Buildings Software Site

<http://eetd.lbl.gov/eetd-software.html>

DOE Building Energy Software Tools Directory

http://www.eere.energy.gov/buildings/tools_directory/

Radiance: day/lighting design and rendering

<http://radsite.lbl.gov/radiance/HOME.html>

DELIGHT: simulation engine for daylight and electric lighting system analysis in buildings.

<http://gundog.lbl.gov/dhomepage.html#delit>

BDA: Building Design Advisor: Suite of Tools for Schematic Design (no longer supported)

<http://gaia.lbl.gov/BDA/> (no longer supported)

EnergyPlus, DOE-2, SPARK, GenOpt: Hourly Building Energy Simulation programs

<http://gundog.lbl.gov/>

OPTICS: Analyzes optical properties of glazing systems

<http://windows.lbl.gov/materials/optics5/default.htm>

THERM: Analyzes 2-dimensional heat transfer through building products.

<http://windows.lbl.gov/software/therm/therm.html>

WINDOW: Analyzes window, thermal and optical performance.

<http://windows.lbl.gov/software/window/window.html>

RESFEN: Calculates residential window, heating and cooling energy use.

<http://windows.lbl.gov/software/resfen/resfen.html>

COMFEN: Calculates commercial window/facade, heating and cooling energy use.

<http://windows.lbl.gov/software/comfen/>

Facilities

Test Facility For Low-Energy Integrated Building Systems (under development)

<http://utbf.lbl.gov>

Window Systems and Façade Test Lab: Thermal and daylighting analysis of windows

<http://www.lbl.gov/Publications/Currents/Archive/Sep-19-2003.html#story4>

Glazing Optics Lab: Film and glazing characterization.



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http://windowoptics.lbl.gov/facilities/OpticsLab_detail.pdf?attredirects=0&d=1

Electrochromic Coatings Lab: Coating development.

<http://windows.lbl.gov/materials/chromogenics/hydrides.htm>

Coating Process Lab: Plasma Assisted Deposition.

<http://windows.lbl.gov/Materials/deposition/default.htm>

Infrared Thermography Lab: Thermal analysis of windows.

<http://windows.lbl.gov/facilities/irlab/default.htm>

MOWITT Facility: Window side-by-side thermal testing.

<http://windows.lbl.gov/facilities/Mowitt/>

New York Times Daylighting Mockup facility (Queens, N.Y.)

http://www.metropolismag.com/html/content_0504/nyt/index.html

Strategic Viewpoints on Daylighting

The Elusive Challenge of Daylighted Buildings 25 Years Later

<http://btech.lbl.gov/papers/41414.pdf>

Advanced Fenestration Systems for Improved Daylight Performance

<http://btech.lbl.gov/papers/41461.pdf>

Smart Daylighting Systems

Automated Roller Shades

The New York Times Building: Designing for Energy Efficiency Through Daylighting Research

http://windows.lbl.gov/comm_perf/newyorktimes.htm

Smart Window Shades for Punched Window Applications

<http://windows.lbl.gov/projects/dynamicshades/>

Switchable Electrochromic Windows

Three-year field study sponsored by DOE-CEC to advance EC windows into the marketplace: systems engineering, performance impacts in buildings, and information resources:

http://windows.lbl.gov/comm_perf/Electrochromic/

Switchable Window Coatings

About Switchable Window Coatings on Glass

http://windows.lbl.gov/doeseci/how_they_work.htm

<http://windows.lbl.gov/materials/chromogenics/default.htm>

<http://btech.lbl.gov/papers/37766.pdf>

Switchable Reflective Hydrides

<http://windows.lbl.gov/materials/chromogenics/hydrides.htm>

Automated Venetian Blinds

General Overview

<http://btech.lbl.gov/papers/41443.pdf>

Full-Scale Field Test: Energy and Control System Performance

<http://btech.lbl.gov/papers/40509.pdf>

<http://btech.lbl.gov/papers/38130.pdf>

Pilot Study on Occupant Satisfaction with Automated Blinds

<http://btech.lbl.gov/papers/40134.pdf>



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Demand-Responsive Window and Lighting Control Systems
Demand-Response with Window Systems: Research and Industry Perspectives
<http://btech.lbl.gov/papers/50855.pdf>

Daylighting Systems

Related Activities

<http://www.lbl.gov/Science-Articles/Archive/EETD-demand-response.html>

Internet-Based Control Systems for Building Energy-Efficiency

Overview

<http://www.lbl.gov/Science-Articles/Archive/sb-EETD-internet-controls.html>

<http://btech.lbl.gov/papers/46009.pdf>

<http://btech.lbl.gov/papers/49975.pdf>

Low-Cost Networking for Automated Window and Lighting Systems

http://buildings.lbl.gov/hpcbs/Element_3/02_E3_P2_2_3.html

Daylight-Redirecting Window Systems

IEA Task 21 Daylighting in Buildings

IEA Website

<http://www.iea-shc.org/task21/>

Resource Book

<http://gaia.lbl.gov/iea21/>

IEA Task 31 Daylighting Buildings in the 21st Century

<http://www.iea-shc.org/task31/>

Determining Daylight Properties of Optically-Complex Window Systems

http://gaia.lbl.gov/hpbf/perfor_a.htm

Simulating complex window systems using BSDF data

<http://gaia.lbl.gov/btech/papers/4414.pdf>

<http://gaia.lbl.gov/btech/papers/4416.pdf>

Visual comfort analysis using high resolution luminance imaging:

<http://gaia.lbl.gov/btech/papers/4417.pdf>

Optically Complex Light Pipes and Light Shelves

Design and Performance

<http://btech.lbl.gov/papers/38133.pdf>

<http://btech.lbl.gov/papers/34458.pdf>

Palm Springs Chamber of Commerce Demonstration

<http://btech.lbl.gov/papers/38131.pdf>

Angular Selective Glazings

<http://btech.lbl.gov/papers/41694.pdf>

Diffraction Holographic Glazings

<http://btech.lbl.gov/papers/44167.pdf>

See LBNL-35382 Rev at <http://btech.lbl.gov/papers/35382.pdf>



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How Windows Affect Photoelectric Controls

How Venetian Blinds Impact the Reliability of Daylighting Control Systems

<http://btech.lbl.gov/papers/40867.pdf>

Simulating Photosensor Controls with Radiance

<http://btech.lbl.gov/papers/47544.pdf>

Daylighting Control Systems

Field Study at the San Francis Philip Burton Federal Building

<http://btech.lbl.gov/papers/41633.pdf>

<http://btech.lbl.gov/papers/43096.pdf>

Commissioning Daylighting Controls

<http://btech.lbl.gov/papers/41010.pdf>