lighting design lab

group relamping

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News

The largest cost of a lighting system to a commercial user is not initial cost of the fixtures and installation, but energy and maintenance costs. The largest lighting maintenance cost is relamping — changing the burned out light bulbs. It is not the cost of the lamp itself that is expensive (although that does need to be factored), but the labor involved, and the disruption to business. One of the best ways to minimize these costs is to use a practice called "Group Relamping".

In a typical non-group relamping scenario, when a lamp burns out in the workplace, it is replaced individually with a new lamp as soon as possible. This is called *spot relamping* and it proves to be a very inefficient use of maintenance staff (MS) time and hence a waste of money. First, the problem must be identified and communicated to the MS and then there is often a site visit required to assess what is needed. Next a new lamp and proper equipment are acquired (this may require a trip to buy the lamp and rental of a lift). Access to the fixture is gained. This often requires moving workstation equipment out of the way to install a ladder or lift. Once the lamp is changed, the equipment must be put away and the workspace normalized. Hours or days later another lamp burns out somewhere else and the process is repeated. This can take a lot of time, disrupt worker or customer operations, and introduce safety concerns.

With the use of *group relamping* procedures, all of the lamps in an area are installed at once and then at a predetermined interval all of the lamps are replaced, before they start burning out on a regular basis. This allows a trained MS crew to schedule access to an area, bring in all the necessary equipment and supplies, work in an efficient manner (possibly at night, on the weekend or some other scheduled downtime), and then leave that area until the next scheduled group relamping.

Determining the group relamping schedule is based on a number of variables that contribute to what are called Light Loss Factors (LLF). LLFs include lamp life; annual hours of use; and lamp lumen depreciation.

To determine the group relamping interval, find that point when the lamps in an area will start burning out on a regular enough basis to make it cost effective to just replace them all even if they aren't burned out yet. This usually works out to 70% to 80% of rated lamp life (after allowing for burn cycle changes). There will be some lamps that will burn out prior to this time and should be spot relamped as needed.

An expanded version of this article may be found on our website at www.lightingdesignlab.com/articles or on the www.betterbricks.com website.

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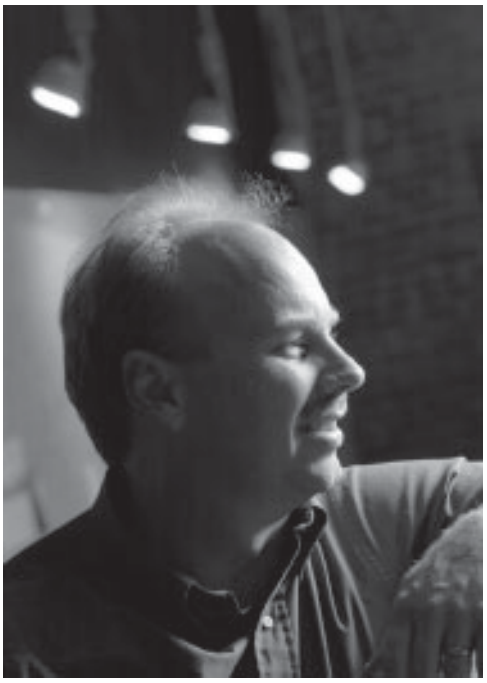
lowbay revisited.



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Back in 1996 I wrote an article that said to stop using metal halide luminaires in warehouse-storage-industrial facilities. Fluorescent is more efficient! Then, I compared Metal Halide and T8 fluorescent and found the Fluorescent used 30% less energy to produce the same light levels in the 20 to 25 foot mounting height range.

Technology has improved in the last 6 years so it is time for an update. Adding to the original study of 400 MH and F96T8/HO I add Pulse Start MH and F54T5/HO. Also, I'm using mean lumens because they are a better representation of the light output of the lamps. Mean lumens are measured when the lamps has burned for 40% of its rated life.

From a mean lumen standpoint, a 4-lamp F96T8/HO/RE70 or 6-lamp F54T5/HO system would produce 20% more lumens using 20% less energy than the 400 MH, 26% more lumens using the same energy as the 320 MH, and 3% more lumens using 10% less energy than the 350 MH. Assuming that the light loss factors were equal for both systems and you used luminaires with comparable efficiencies (I know you can find super efficient HID luminaires, but I can find super efficient Fluorescent luminaires also) the fluorescent system would be the most energy efficient. The 350 Pulse Start Metal Halide would be a good second choice, but skip the 320 Pulse Start and the standard 400 watt Metal Halides.

The lamp life for the two systems is comparable: 18,000 to 20,000 hours for the Fluorescent and 20,000 hours for the Metal Halide. The lighting distribution (softer shadows) will be better with the fluorescent system due to 2 to 3 times the number of luminaires and/or their significantly larger size. The instant-on capabilities of the fluorescent eliminates the need, and cost, of the quartz restrike in the Metal Halide. Daylight control and scheduling scenarios will be cheaper and easier to implement with an instant-on fluorescent light source. Color rendering and color consistency of the fluorescent is significantly better than the Metal Halide.

On the negative side, there will be 4 to 6 times the number of Fluorescent lamps to maintain and possibly 2 to 3 times the number of Fluorescent luminaires to purchase and install. The added cost for installation and maintenance may be offset by the lower cost of the Fluorescent luminaires, lamps, and energy consumption. In unheated spaces the Fluorescent system may have difficulty starting or providing full light output in cold environments (there are 0 degree starting ballasts).

So what is the answer? There are many options, calculations show that the fluorescent system will be more efficient even at 35 foot mounting heights. But you must consider all the variables, number of luminaires, number of lamps, cost of equipment, type and quality of the luminaire, color quality of the light, light distribution, maintenance costs and energy costs.

Lamp	Watts	Mean Lumens	Mean Lumens/W	Lamp Life	Instant Restrike
400 watt MH	460	23,500	51	20,000	NO
350 watt Pulse Start MH	400	27,500	69	20,000	NO
320 watt Pulse Start MH	368	22,500	61	20,000	NO
4-lamp F96T8/HO/RE70*	**370**	28,400	77	18,000	YES
6-lamp F54T5/HO*	**360**	28,440	79	20,000	YES
* 1.0 ballast factor					

common industrial lamps.

F96T12HO
the old 8-foot workhorse, commonly used in the industrial reflector fixtures found everywhere. still available in low-CRI, cool-white versions. 12,000 hours life.

400W Metal Halide
formerly the standard choice for highbay lighting. has a CRI in low 60's, and significant lumen depreciation over life.

F96T8HO
an 8-foot T8 lamp intended to replace the T12HO. obstacles to adoption include lamp life less than the 4-foot T8 and a reputation for breakage.

Pulse Start Metal Halide
design of pulse start shifts the starter to the ballast from the lamp, similar to HPS. although the CRI is the same as standard metal halide, lumen depreciation is improved as is output. also starts reliably at colder temperatures than standard metal halide.

F54T5HO
a nominal 4-foot lamp that produces nearly double the lumens of standard 4-foot lamp. lamp brightness is so great that direct luminaires are not advised, except at the higher mounting heights common to lowbay and highbay lighting.

lamp Watts vs. system Watts
in the chart at the bottom of this page you may note that the lamp Watts are different than the system Watts. generally HID ballasts consume about 15 - 20% of the rated lamp watts. so do not make your payback calculations simply based on the lamp Watts - get the full fixture wattage values to do correct calculations. Note that electronic ballasts operating fluorescent lamps may have system watts equal to or less than lamp watts!

ceramic metal halide.

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Several years ago, Ceramic Metal Halide (CMH) technology was introduced to the lighting industry. Like most new lighting technologies, it has taken some time for these great new lamps to be universally adopted, but today you can find them almost anywhere. CMH lamps were introduced to provide a high quality, energy efficient, alternative to incandescent and halogen light sources.

In order to accomplish this, the lamp technology had to solve many of the problems inherent in older style quartz metal halide lamps such as high lumen depreciation, low color rendition, and poor color consistency. We've all seen projects in which some of the metal halide lamps look white, some blue, some pink, etc.

By contrast, CMH lamps offer high CRI (Color Rendering Index) values in the 80-90 range, color temperatures of 3000K or 4100K, and are guaranteed not to color shift more than +/- 200k over the rated lamp life. They also have improved lumen maintenance characteristics.

CMH lamps are available in ranges from 20 watts through 400 watts, and in most standard configurations including ED17, PAR20, PAR30, PAR38, and T6. One of the newest types is designed specifically as a direct lamp retrofit for 400 watt High Pressure Sodium lamps. This retrofit offers far better color quality without requiring the replacement of existing ballasts.

• Accent Lighting

Accent lighting has traditionally been dominated by incandescent and halogen sources due mainly to excellent color quality, source flexibility, and good optical control. Standard Metal Halide and color corrected High Pressure Sodium lamps have been used as energy efficient replacements for some accent lighting applications with mixed success. Problems with color quality and consistency have been limitations of these lamp technologies.

CMH lamps overcome most of the problems of the older style energy efficient lamps while producing crisp light with excellent color rendition and optical control that is almost identical to halogen sources. In fact, many of the available CMH lamp types have been specifically designed to be optically equivalent to the halogen sources they are designed to replace.

• Recessed Downlighting

In high volume spaces, with ceiling heights from 14'-30', lighting has generally been provided by Incandescent or Halogen PAR lamps, or by Metal Halide luminaires equipped with ED17 lamps and 10"-15" reflectors.

Using halogen sources in these retail spaces is inefficient since most of the electricity that is consumed by the lamp is turned directly into heat and not light. This type of application also quickly turns into a maintenance nightmare since an electric lift must be used, or scaffolding installed, to accommodate a 1,000-3,000 hour relamping cycle.

Standard Metal Halide lamps offer a more efficient source of light in these spaces, and will reduce maintenance costs by extending the relamping cycle. Unfortunately, the quality of light is generally inferior. One should also consider the aesthetic appeal of a ceiling surface pocked with very large aperture reflectors that produce as much glare as usable light.

Imagine now that the same space may be efficiently lighted using CMH PAR20, PAR30, or PAR38 lamps recessed into luminaires with small apertures in the 4"-6" range. Using this approach, we produce light of equivalent quality to the Halogen source we seek to replace, extend the relamping cycle by three to four times, and virtually eliminate the glare we would experience from large aperture downlights.

• Retail Lighting

Perhaps the best opportunity for the use of CMH lamps is in retail spaces. Retail lighting generally requires point source accent lighting and high contrast ratios. Most retail lighting in the United States is still delivered by inefficient halogen track heads or recessed accent adjustable luminaires.

We've already seen that CMH lamps may be effectively used in place of halogen sources for accent lighting. 35 watt PAR20 lamps and 70 watt PAR30 lamps are particularly effective at lighting merchandise when used in track heads or other accent luminaires. Many retailers throughout the country are moving to these sources to save electricity and radically reduce maintenance costs.

• Color Critical Applications

While the color rendition of CMH lamps is excellent, spaces like museums or galleries have specific requirements. While the light that is being delivered is perceived as "white," the spectral distribution of the source is not truly continuous like sunlight or halogen light. Some colors may be slightly muted while others are enhanced changing the perception of art.

• Dimming

It is possible to dim metal halide lamps, but the technology remains prohibitively expensive for most applications. If the lighting system needs to be controlled over a wide range of light levels, e.g. note taking downlights in a classroom, stick with Halogen IR PAR lamps or choose dimmable fluorescent sources.

• Benefits

More efficient than halogen
Better color quality than Standard MH
Better lumen maintenance
Better color consistency than Standard MH
Lower operating cost

• Drawbacks

Higher initial cost
Requires a ballast
Not easily dimmable
Requires restrike time

Retailers may realize the greatese energy and maintenance savings by using CMH light sources in their stores.

winter / spring 2003 events.

Registration on Page 6

did you know?

Members of professional design organizations (AIA, NCQLP/LC, ALA, BOC, and others) may be able to receive continuing education credits for attending events offered by the LDL.

To self-certify your credits (sometimes called learning units) make sure you keep the Certificate of Completion that we distribute at each event.

Learning unit credits are almost always issued at a rate equal to the contact hours. So a 2 hour class would be worth 2 credits.

For information about how your organization works with continuing education credits visit their website at:

AIA
aia.org

ALA
americanlightingassoc.com

ASID
asid.org

BOC
neec.net/boc.htm

BOMA
boma.org

IFMA
ifma.org

IIDA
iida.com

NCQLP
ncqlp.org

All Registration **must be in advance**. All fees must be **paid in advance**. No registrations or fees will be accepted at the door. On-line registration is available at ***http://www.lightingdesignlab.com/classes***

1 • retail site visit: pacific place shopping center. $20

Seattle: Wednesday 2/26 • 4:00pm - 6:00pm

Design classes are one great way to learn about lighting. Another is to look at the lighting that we experience everyday and evaluate what we like, or don't like, and why. Join us on a guided tour focusing on the lighting design at Pacific Place, one of Seattle's premiere retail spaces. The discussion will center on aspects of conceptual design in the project and the design realization.

The tour is timed to bridge sunset so that we can review aspects of the lighting design through daylight and evening hours. Guiding the tour will be Lighting Specialist, and project designer, Shaun Patrick Darragh, LC.

2 • retail lighting design workshop. $50

To be truly successful, any architectural conception must include an awareness of the play of light, shadow, and vision. This hands-on interactive workshop will help participants learn to balance conceptual application of light with human vision and task requirements. Integration of the two results in superior projects.

Seattle:	Wednesday 3/5	• 9:00am - 4:00pm
Eugene:	Tuesday 4/8	• 9:00am - 4:00pm
Portland:	Wednesday 4/9	• 9:00am - 4:00pm
Boise:	Wednesday 3/19	• 9:00am - 4:00pm
Bozeman:	Wednesday 3/26	• 9:00am - 4:00pm

Participants in the workshop will learn the process of developing a lighting design by working with a provided retail space. Students will explore the conceptual effect of accent and ambient lighting on the space and occupants. The initial concept will be refined through an interactive process into a working design. Issues of increased sales productivity and system efficiency will also be addressed.

The participant will leave with an understanding of the steps involved in creating a successful retail lighting design. Participants will have an understanding of lighting's role in attracting customers into a retail space, and lighting's importance in evaluating merchandise. They will have an understanding of lighting concepts and strategies applicable to future retail projects. Additional resource information will be available to participants.

Class size is limited to 16

(6 CEU contact hours)

• project design reviews. no cost.

The lighting specialist will be available by appointment on the day following the workshop for schematic design review of proposed lighting strategies on your commercial and industrial lighting projects. Please contact the specialist for your territory to directly set up an appointment in your office.

3 • daylighting measurement and meaning. $50

Seattle: Quarter begins Tuesday 4/1 • 13 weeks • Tues. & Thurs. Afternoons • Time TBA

UW Class — Arch 598. A detailed investigation of Seattle's new Justice Center by NBBJ Architects. The class will measure and understand how the building performs in a range of environmental areas with an emphasis on daylight. Class builds on the experiences and lessons learned from the Vital Signs project. Students will leave with an understanding of how daylighting performance is measured and evaluated. Class meets twice a week for the quarter.

= basic = intermediate = expert

Northwest Energy Efficiency Alliance
www.nwalliance.org

4 • daylighting: lessons learned from 2002. $20 by Joel Loveland

Billings:	Monday 3/24	• 4:30pm - 6:00pm
Bozeman:	Wednesday 3/26	• 4:30pm - 6:00pm
Missoula:	Thursday 3/27	• 4:30pm - 6:00pm
Spokane:	Tuesday 4/8	• 4:30pm - 6:00pm
Seattle:	Wednesday 4/2	• 4:30pm - 6:00pm
Boise:	Thursday 4/10	• 4:30pm - 6:00pm
Portland:	Tuesday 4/22	• 4:30pm - 6:00pm
Eugene:	Thursday 4/24	• 4:30pm - 6:00pm

The BetterBricks Daylighting Lab at the Lighting Design Lab has been able to develop a database of valuable experience in what works in daylighting design in our region. By analyzing real buildings over the past 3 years, we have extensive experience in the performance of real designs in many different locations. Students will leave with an understanding of the impacts of building designs and orientations in real-world applications in our region. (2 hours)

5 • daylighting forum: new windows and glazing technology. $40

Seattle: Wednesday 4/16 • 9:00am - 3:00pm

This day-long Daylighting Forum will integrate presentations about glazing, windows and daylighting design with a manufacturer's product showcase. The Forum will offer presentations on recently developed daylighting guidelines by the Daylighting Lab, new technologies for window and glazing selection from the Northwest Energy Efficiency Alliance's Commercial Windows Initiative design team, and conclude with a presentation of an architectural design team's daylighting design case study. (5 hours)

lunch & learn seminars (no cost):

LDL is now offering lunchtime seminars at the offices of design firms throughout the region. Our lighting specialists are scheduling one week a month in their specific territories. The following are your topic choices. Times may be limited, so contact us early. If you are interested in arranging a seminar at your office, complete information on registration form and you will be contacted by the lighting specialist who serves your area.

6 • light & architecture.

To be truly successful, any architectural conception must include an awareness of light, shadow and human vision. This hour will be a visual discussion of how light reveals the forms and surfaces of architecture and enables optimum human functionality in the buildings..
(1 CEU contact hour)

7 • using mockups as a lighting design tool.

Whether you are an architect, engineer, designer or contractor, nothing gives you and your clients an evaluation of how a lighting strategy will work than literally walking through the space. This presentation describes the process of creating a full-size mock-up at the Lighting Design lab, and will show examples of previous mock-ups.
(1 CEU contact hour)

8 • what's new in lighting?

This presentation summarizes the most interesting and efficient lamps, ballasts, fixtures, controls and other products of interest for your projects as seen at LightFair International.
(1 CEU contact hour)

9 • daylighting.

The BetterBricks Daylighting Lab offers a set of 3 seminars: Introduction to Daylighting; Schematic Design for Daylighting; and Modeling for Daylighting Design and Analysis. E-mail your request and topic choice to joel@lightingdesignlab.com or call him at the LDL at extension 32.
(1 CEU contact hour)

class locations:

Bozeman: Montana State University
Strand Union Bldg, Room 275
7th & Grant
Bozeman MT

Portland: BetterBricks Daylighting Lab
U. of Oregon Portland Ctr, Rm 102
722 SW 2nd Ave
Portland, OR

Eugene: EWEB Training Center
N. Bldg. Community Rm.
500 E 4th Ave
Eugene, OR

Boise: Idaho Power Headquarters
1221 W Idaho St, 1st Floor
Auditorium East
Boise ID

Seattle: Lighting Design Lab
400 E Pine St
Suite 100
Seattle WA

Seattle: Retail Site Visit
6th & Pine St
Downtown Seattle WA

Spokane: Avista Auditorium
1411 E. Mission St.
Rooms A& B
Spokane WA

Billings: Prudential Floberg Realtors
1550 Poly Drive
Billings MT

Missoula: Univ. of Montana
Continuing Education
32 Campus Drive, Room 205
Missoula MT

registration form.

Winter 2003 Classes

PAYMENT POLICY: **Fees MUST BE PAID IN ADVANCE before attending class.** Purchase Orders, checks, and credit cards are accepted. A credit toward future LDL classes will be issued for unused registration fees.
NO PAYMENT OR REGISTRATION WILL BE ACCEPTED AT THE DOOR.

Secure On-line registration is available at ***http://www.lightingdesignlab.com/classes***

registration fee paid by. (circle one)
credit card • enclosed check • purchase order • credit from previous LDL event •

registration information.

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E-Mail • _____ Fax • _____

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Credit Card Number (**VISA & MasterCard ONLY**) • Please include your CVV Code - last 3 digits of the number on the back of your card near your signature

_____

Expiration Date • _____

please check the circles of the class(es) and event(s) you wish to attend (online registration available).
event locations on page 5.

1 • retail site visit. $20
❍ Seattle: Wed 2/26 • 4:00pm - 6:00pm

2 • retail lighting workshop. $50
❍ Seattle: Wed 3/5 • 9:00am - 4:00pm
❍ Eugene: Tues 4/8 • 9:00am - 4:00pm
❍ Portland: Wed 4/9 • 9:00am - 4:00pm
❍ Boise: Wed 3/19 • 9:00am - 4:00pm
❍ Bozeman: Wed 3/26 • 9:00am - 4:00pm

3 • daylight measurement & meaning. $50
❍ Seattle: Begins 4/1 • Tues & Thurs • Afternoon Sessions • check website for times

4 • daylighting lessons learned 2002. $20
❍ Billings: Mon 3/24 • 4:30pm - 6:00pm
❍ Bozeman: Wed 3/26 • 4:30pm - 6:00pm
❍ Missoula: Thurs 3/27 • 4:30pm - 6:00pm
❍ Spokane: Tues 4/8 • 4:30pm - 6:00pm
❍ Seattle: Wed 4/2 • 4:30pm - 6:00pm
❍ Boise: Thurs 4/10 • 4:30pm - 6:00pm
❍ Portland: Tues 4/22 • 4:30pm - 6:00pm
❍ Eugene: Thurs 4/24 • 4:30pm - 6:00pm

5 • daylighting forum: new windows. $40
❍ Seattle: Wed 4/16 • 9:00am - 3:00pm

lunch & learns. no cost.

6 • light & architecture.
❍ Please contact me at the address above

7 • using mockups as a design tool.
❍ Please contact me at the address above

8 • what's new in lighting?.
❍ Please contact me at the address above

9 • daylighting.
❍ Please contact me at the address above

You can register instantly and securely online. Payment is accepted by credit card, check and purchase order.
www.lightingdesignlab.com/classes

daylighting lessons 2002.

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The Lighting Design Lab's Betterbricks Daylighting Lab has had a fantastic run of luck over the last 3 years. We have had the opportunity to watch and work with some of the most innovative architects in the Pacific Northwest. They have brought great daylighting work into the Lab, and we've had the opportunity to work with them to test and fine-tune their ideas. Winter 2003 marks the first time when, after 3 years we have a significant number of buildings that have been completed that illustrate the good work of these design teams.

It's on this basis that we are setting out to document this work and publish a series of articles entitled, Daylighting Lessons Learned. We have sketched a preview of several of these architectural ideas. I will offer a class this winter in your region on Lessons Learned 2003. An expanded article is available on our website.

• You don't need to trade LESS - building area for BETTER - performance.

A well daylight illuminated building can be built for the capital budget allocations, typical of common construction, and these buildings can save 40-60% on their overall electric lighting operations costs with daylighting controls. A typical daylight illuminated (high performance) office, classroom, or gymnasium in this context will be saving 60-80% of lighting operations expenses.

• Don't over glaze for daylighting.

The typical window to wall area in most commercial buildings is commonly limited to 25-30% of the wall area through the value engineering process. The daylighting work being completed this last autumn indicates that the window area doesn't need to exceed this range, or 10-20% of floor area. The most critical caveat to those rules-of-thumb is to be concerned about the orientation of the window to the path of the sun.

• Let the building and its windows tell the story of the daylight/sunlight.

South-facing windows, within 15° of due South, are often best because the sun moves on a daily basis more horizontally, and therefore can be more easily protected from glare and overheating by an exterior overhang.

West-facing windows, can provide excellent daylighting when shaded as we would recommend you shade a south window. This is particularly true in K-12 schools that are occupied more in the morning than the afternoon.

North-facing windows, can be a great daylight asset in Cascadia, but when further East, the climate is colder and most probably clearer. Here North windows mean greatly increased heat loss, but conversely, an exceptionally dark North clear-sky, requiring greater amounts of glazing.

East-facing windows, generally East windows are not of great daylighting value in most commercial or institutional buildings because of glare, and are difficulty to control overheating from the sun, . (for a more, see *"Loveland - Common Myths of Daylighting Design"* @Betterbricks.com)

• Refine the Window's design.

The window MUST be shaded with fixed architectural elements, whether they are exterior overhangs, interior lightshelves, vegetation etc. The period for this shading must be carefully timed to balance sun time and position with clock time and the space's hours of use.

• Match the daylight where people need it most AND where they spend the most time.

Daylight the most critical visual task areas such as offices, classrooms, or gyms. NOT directly into the circulation spaces. A well daylight illuminated office or school concentrates well balanced and controlled daylight from the North and South.

Left: Back to the Future 1952, Wilson School, first daylights the classrooms and secondly borrows the light to illuminate the corridors. A good daylighting design matches the daylight to the students' critical learning environments.

lighting design lab

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The Northwest Energy Efficiency Alliance is a nonprofit group of electric utilities, state governments, public interest groups, and industry representatives committed to bringing affordable, energy-efficient products to the marketplace.

NORTHWEST ENERGY EFFICIENCY ALLIANCE
www.nwalliance.org