CEILING&WALL | SYSTEMS

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High Light Reflectance Ceilings

Energy savings and environmental benefits of high light reflectance ceilings

Armstrong®

Lighting is the leading source of energy consumption in most buildings. As a result, energy efficient lighting systems are becoming increasingly important in corporate environments, especially as owners must stay within energy budgets dictated by national and local codes. Lighting systems also have an effect on a building's occupants. Systems that provide a softer, more evenlydistributed light can help create an environment of visual comfort in a space, reducing eyestrain and increasing employee effectiveness.

The three most common lighting options are: direct or downlighting, indirect or uplighting, and direct/indirect or a combination of task and ambient lighting.

While each offers advantages and disadvantages, indirect lighting systems are growing in popularity because they overcome many of the shortcomings of direct systems by providing a light source with fewer shadows and less glare.

Indirect lighting has also grown due to lower costs, more compact systems, less obtrusive designs, simplified installation, and broader and deeper product lines.

High Light Reflectance Ceilings

The ceiling is an integral part of an indirect lighting system because it must reflect the light that strikes it back into the space. The ability of a ceiling to reflect light is indicated by its Light Reflectance or LR value. LR values range from 0.00 to 1.00 and denote the percent of light striking the panel that is reflected.

For example, an LR or 0.75 means the panel reflects 75% of the light striking it. Most commonly installed acoustical ceilings have an LR of 0.70 to 0.81. High light reflectance or Hi-LR ceilings have an LR of 0.83 or higher.

In general, increasing the reflectance of a ceiling has a very positive impact on the lighting and energy use of a building, especially when used in conjunction with an indirect lighting system.

Light Reflectance Research

To substantiate the effects of increasing the ceiling reflectance in typical office plans, Brinjac Engineering, a multi-discipline consulting engineering firm based in Harrisburg, PA, conducted two studies, one on work plane illuminance and the other on energy consumption.

In the first study, four room configurations were selected as typical office spaces: a 10' x 10' private office, a 100' x 30' open office, a 60' x 60' open office, and an irregular shaped open office.

Two different light fixtures were used: a direct recessed 2' x 2' parabolic troffer and an indirect pendant. All variables were held constant and only the ceiling reflectance was changed from 75% up to 90%. No daylighting or task lighting was taken into effect.

Work Plane Illuminance

The study results showed that for direct fixtures, work plane illuminance achieved modest increases ranging from 2% to 5% when increasing the ceiling reflectance from 75% to 90%.

FINDING: Compared to a 75% reflective ceiling, the 90% reflective ceiling achieved an average increase of nearly 22% in work plane illuminance with indirect lighting.

This increase in light level means lighting costs can be lowered by using fewer fixtures in the space or by using the same number of fixtures but at lower wattage levels.

Figure 1 demonstrates the difference high light reflectance ceilings can make in workplace illuminance when used with indirect lighting.

The study also showed that compared to 75% reflective ceilings, 90% reflective ceilings enhanced the benefits of indirect lighting by improving lighting uniformity. Poor uniformity leads to visual discomfort.

FIGURE 1: WORK PLANE ILLUMINANCE

Ceiling Reflectance	Work Plane illuminance (footcandles)	Increase in light level
75%	52.0	Reference
78%	54.3	4%
81%	56.6	9%
84%	59.0	13%
87	61.6	18%
90%	63.3	22%

60' x 60' x 10' open office, 12' luminaire spacing

Energy Savings

In the second study, a new lighting design was created to optimize the layout with 90% reflective ceiling tile using the same spaces and indirect light fixtures as the first study.

These results were compared against a layout of 2' x 2' recessed parabolic troffers with standard spacing. The results were then compared against each other to determine the change in energy use that was achieved with the higher value for the ceiling tile.

FINDING: The 90% reflective ceiling allowed spacing between indirect luminaire sections to be increased, thus reducing the total number of luminaires needed to achieve light levels similar to the 75% ceiling.

FINDING: The 90% reflective ceiling and indirect fixtures yielded a 23% lower lighting power density than the 75% reflective ceiling layout and a 21% lower lighting power density than the parabolic troffer layout.

Using the same open office configurations, the effects of the reduced lighting load on the HVAC system were then modeled using two different software programs .

FINDING: The reduction in lighting power density obtained by the 90% reflective ceiling enabled an average HVAC energy cost savings of up to 9% over the layout with a 75% reflective ceiling and 7% over the troffer layout.

Based on these results, there is a significant impact on the HVAC system by reducing the in-room heat generated by the lighting load through the use of a high light reflectance ceiling. This impact can be positive in the form of energy savings, especially if the building is in cooling year-round, as many buildings are.

Tax Deductions

As a result of their energy-saving potential, Hi-LR ceilings have a significant impact on the Energy Policy Act of 2005 (EPAct 2005), which establishes a tax deduction for expenses incurred for energy-efficient commercial building properties.

Lighting systems are one of the focuses of the act because of their ease and availability of upgrading, and the known achievements in energy efficiency that will be gained. The tax deduction for lighting systems can be as high as 60¢ per square foot.

In the Brinjac study, power densities using high light reflectance ceilings ranged from 0.83 to 0.92 watts per square foot. Even using the worst case of 0.92, this is nearly a 30% decrease compared to the Act's minimum requirement of 1.3 watts per square foot for office space. The associated tax deduction is $0.40 per square foot.

For private buildings, the owner that paid for the installation of the lighting system can claim the deduction. In the case of publicly owned buildings, the person primarily responsible for designing it can claim the deduction.

The deduction currently applies only for property that is put into service between January 1, 2006 and December 31, 2007. However, it is believed the legislation will be extended after its current termination date.

LEED® Credits

In addition to energy savings and tax deductions, high light reflectance ceilings can also contribute to LEED points, especially in the Energy and Atmosphere category under EA Credit 1.0 (Optimize Energy Performance). In the Brinjac study, for example, energy points were achieved by nothing more than increasing the light reflectance.

Based on the spaces used in the study, the reduction in total building energy consumption as defined by LEED NC 2.2 could be as high as 10.6% when optimizing the lighting layout with 90% reflective ceilings. This savings qualifies for 1 point in a new building or 3 points in an existing building.

Hi-LR ceilings are also a factor in the Indoor Environmental Quality category by contributing to EQ Credit 8.1, 8.2 (Daylight and Views). This is because high light reflectance ceilings can "extend" natural daylighting into a space.

And, Hi-LR ceiling systems can contribute in the Materials and Resources category in the following areas: MR Credit 2.1, 2.2 (Construction Waste Management), MR Credit 4.1, 4.2 (Recycled Content), MR Credit 5.1, 5.2 (Local/Regional Materials), and MR Credit 6.0 (Rapidly Renewable Materials).

Seeing the Light

As indicated by the Brinjac study, architects and designers should look at the ceiling system as an integral element of a building's energy reduction strategy. The overall cost impact compared to potential energy savings make high light reflectance ceilings a viable solution for achieving energy reductions without the need for more costly new technology.

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Resources

- TechLine™ at 1-877-ARMSTRONG (1-877-276-7876)
- Brinjac Engineering Research Study, “Energy and Environmental Effects of High Light Reflectance Ceilings in Offices,” 2006 at armstrong.com/performance
- CEU Course: “Energy Savings and Environmental Benefits of High Light Reflectance Ceilings” at armstrong.com/ceu
- Armstrong Web Site: Product Selector Tool at armstrong.com/ceilings
- armstrong.com/ceilings (search keyword: light)

Integrated Ceiling Solution

The ability to provide the benefits of a high light reflectance ceiling along with desired acoustic and aesthetic requirements can easily be accomplished through the use of an integrated ceiling system such as the TechZone™ Ceiling System from Armstrong. TechZone is a high light reflectance ceiling system that organizes all the light fixtures, air diffusers and sprinkler heads in a linear 6-inch-wide technical “zone” to create a clean, uncluttered ceiling visual. The totally integrated ceiling system uses only standard components, while still delivering the desired quantity and quality of light and air into the space. The linear technical “zone” is pre-qualified for fit and finish and visually coordinates with the look of Armstrong Optima® and Ultima® fine-textured ceiling panels. When used with indirect pendant lighting, the combination of TechZone and Hi-LR Optima or Ultima ceiling panels can contribute LEED® points for daylighting and energy consumption. In addition, both panels are recyclable as part of the Armstrong Ceiling Recycling Program.

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