

# How **Personal Control Lighting** Can **Reduce Eyestrain, Improve Productivity, and Save Energy**

This paper discusses personal control lighting – what it is, and how it can be of benefit to an office worker and to their organization.

## **Q** What is Personal Control Lighting?

**A** Personal control lighting has its roots in task lighting, but unlike some forms of task lighting, the central design focus is on user control.

## **Q** Why is User Control Important?

**A** A large majority of office workers have expressed a desire to have more control over their lighting. Poor office lighting is a serious problem that affects the health, productivity, and creativity of many office workers.<sup>1</sup>

In two studies of user controlled lighting by Cornell University and the Government of Canada National Research Council, significant improvements in employee satisfaction, visual health, and task performance have been found.<sup>2</sup>

Both studies, however, noted that individual controlled lighting needs to be highly usable, in order to realize the most benefits to the user and to the organization.<sup>3</sup>

Not all task lights offer this degree of usability, which is why Kazi Personal Control Lighting was created.

## **Q** What are the Main Benefits of Personal Control Lighting?

**A** Three main benefits – visual health, productivity, and energy savings - are attainable through the use of personal control lighting. Each of these benefits will be discussed separately below.

A fourth benefit, aesthetics, is part of an important new trend in office lighting - lighting quality. Practitioners and users of lighting have recognized that a high quality lighting installation needs to consider not only the visibility of the task, but also the appearance of the space.<sup>4</sup> Personal control lighting is an essential component of any modern, high quality lighting design, and offers one of the simplest ways to improve the aesthetics of an office environment.

## **Q** How Does Personal Control Lighting Improve Visual Health?

**A** Poor office lighting, whether too bright causing harmful glare, or too dark making reading and writing difficult, can lead to eyestrain. In a Steelcase survey, 38% of workers said that the lighting in their workspace was either too bright or too dim, and 80% reported experiencing glare.<sup>5</sup>

According to The Office of Health and Safety, Centers for Disease Control and Prevention, “Vision problems are one of the leading sources of complaints among office workers. Poor office lighting can cause eyestrain and irritation, fatigue, double vision, watering and reddening of the eyes, and a decrease in the power of focus and visual acuity. Headaches as well as neck and back pains may occur as a result of workers straining to see small or detailed items.”<sup>6</sup>

Poor office lighting can also contribute to a very common condition similar to eyestrain, known as Computer Vision Syndrome. The Occupational Safety and Health Administration describes Computer Vision Syndrome as “a repetitive strain disorder that appears to be growing rapidly, with some studies estimating that 90 percent of the 70 million U.S. workers using computers for more than three hours per day experience it in some form.”<sup>7</sup>

It is known that people vary tremendously in their individual preferences and sensitivity to light. Age also plays a significant role in lighting preference. Young people can be very comfortable – indeed prefer - general lighting levels that are darker and less corporate.<sup>8</sup> In fact, the human visual system is often characterized as “young” until about the age of forty. By age sixty, however, the retina receives only about one-third of the light as compared to a twenty-year old.<sup>9</sup> The U.S. Census Bureau predicts that by the year 2010, 26.2% of the population will be age 45 to 60 – an increase of 29.6% or 18.5 million persons over the year 2000.

Personal control lighting has an important role to play in any initiative to improve office worker visual health, and to further reduce the risks caused by improper or inadequate lighting and glare.

In offices where the lighting is perceived to be too bright, or in computer intensive areas that require darker surroundings, personal control lighting makes it possible to reduce general lighting while still providing each worker with glare-free, on-demand lighting that suits their individual preference.

Personal control lighting choices can include under mount lights with single intensity or dimming ballasts, to fully repositionable lights that allow the user to adjust the availability, intensity, and direction of light on a task-by-task basis, throughout the day.

Kazi offers the best selection of personal control lighting on the market. Having personal control of lighting is as important for an office worker’s comfort as having an adjustable chair and an adjustable keyboard.

## **Q** How Does Personal Control Lighting Improve Productivity?

**A** Over the past twenty-five years, lighting levels in modern office buildings have been reduced by approximately 40% to today's average level of 40 foot candles in the workspace.

This illumination level conforms to the recommended practice of The Illuminating Engineering Society of North America for an office worker performing basic computer and paper-based tasks. The procedure for determining how much light is needed takes into account several factors including the type of activity, the legibility and reflectance of the printed material, the person's age, and the need for speed and accuracy.<sup>10</sup> Since many office workers perform a variety of visual tasks, and also perform different tasks from one another, it is unlikely that a single level of lighting will meet the needs of many.

There are also many office and environmental factors that can rob a person of the light needed to work productively. Workstations that are located away from natural light sources may require more lighting. Smaller workstations, high panels, and dark colored panels can also reduce the amount of light reaching the work surface. For example, an increase in panel height from 42" to 66" can reduce the amount of light reaching the desktop by 20%, and a reduction in the size of a workstation from 10'x 10' to 8'x 8' can lower illuminance by 10%.<sup>11</sup>

Even improvements designed to reduce glare, such as the use of parabolic louvers on overhead fixtures, and indirect lighting systems, can create unintended lighting problems at the workstation. Parabolic louvers for example, while directing more light straight downward to reduce glare can create more shadows, especially under overhead bins and shelves. Indirect (upward) lighting also reduces glare but can lower overall illumination to the workstation.

As well, jobs involving more reading and writing, tasks having more detail, late afternoon and evening work, and shared workspaces may require additional lighting.

Studies have shown that, when given control over their lighting, workers will vary their lighting choices according to the tasks they are doing in order to maximize their performance. In one experiment, even after judging their overall lighting as good, participants were able to type 24% faster when provided with an adjustable light. Perhaps most intriguing was the finding that introducing individual lighting control actually reversed the fatigue effect that workers normally experience during the day.<sup>12</sup>

Personal control lighting has an important role to play in any initiative to improve office worker productivity. With personal control lighting, individuals can work faster with fewer errors.

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## **Q Can the Improvements From Visual Health and Productivity be Quantified?**

**A** Common sense tells us that we need to be comfortable in order to be productive over the course of a day. With eyestrain, work is performed less efficiently, more frequent breaks are needed, and absenteeism increases.

The groundbreaking 1989 Cornell University study of a Xerox Corporation office was the first to quantify the amount of productive work time lost due specifically to lighting problems. 25% of the office workforce reported losing over fifteen minutes per day due to eye focusing problems.<sup>13</sup> At sixty hours of lost work time per year, that is the equivalent of 1.5 weeks of annual paid vacation per affected employee.

Given the additional time spent working on computers, and the growing demands of the job in terms of multitasking and hours spent, eyestrain is an even more widespread problem today.

The American Optometric Association in 1997 wrote, "One of the most significant environmental factors affecting computer work is lighting. Surveys indicate that many computer users report problems with general workplace lighting, glare and images reflected on the computer screen."<sup>14</sup> According to the AOA, 61% of computer users in the U.S. are concerned about vision problems resulting from prolonged use of computers.<sup>15</sup> Another independent study in 1999 also listed eyestrain as the #1 workplace hazard.<sup>16</sup>

We have estimated that the loss per year per employee due to eyestrain could average \$2,103.<sup>17</sup> At this rate, a Kazi Personal Control Light could easily pay for itself in well under two months.

## **Q How Does Personal Control Lighting Save Energy?**

**A** The U.S.'s approximately 700,000 commercial office buildings consume more electricity per square foot than any other building type. Lighting, at 44% of the total, is by far the biggest consumer of electricity in a commercial office. About \$5 billion per year is spent lighting commercial office buildings.<sup>18</sup>

With the rising cost and shortages of energy, more attention is being focused on reducing the energy demands from office lighting. One important initiative is the ban on the manufacture and sale of magnetic ballasts in overhead fluorescent lighting fixtures by 2010.<sup>19</sup>

Before the widespread proliferation of personal computers in offices, lighting design typically consisted of rows of brightly lit ceiling fixtures. Strong illumination was necessary in order to read faint carbon copies and penciled ledger sheets. But, within a decade, what was an optimal lighting design quickly became problematic when viewing computer screens.

Since half of all office buildings today were built before 1972, these over-lit offices still exist. In addition to the harmful glare on computer screens, older lighting design can be highly energy inefficient. In fact,

## A Continued

single-source overhead lighting is the least energy efficient way of delivering light to a workstation.

Personal control lighting has an important role to play in any initiative to reduce energy consumption. Why light an entire room with high wattage overhead fixtures, when a low wattage personal control light can provide on-demand light, when and where it is needed at the desktop.

Modern office lighting design will always combine ambient lighting with task lighting. This combination has the advantages of providing ample glare-free lighting, a pleasing aesthetic appearance (users invariably prefer two-component lighting systems to single-source overhead lighting), and the potential to deliver net energy savings.<sup>20</sup> In its many publications, the Department of Energy recommends task lighting as an energy saving measure.<sup>21</sup>

As mentioned earlier, however, it is essential that the light you choose be designed for superior user control. Kazi offers the best selection of personal control lights available, from the most adjustable personal control light on the market (the Kazi Kinetic Glide Light), to under mount lights for diffused lighting. They can be used in combination or alone to achieve the desired goal of lighting that is functional, attractive and energy efficient.

### Summary

Poor office lighting can no longer be overlooked. Workers need to exercise personal control over their environment. A Kazi Personal Control Light is as important to a user's comfort and productivity as having an adjustable chair and an adjustable keyboard. Superior user control plus energy savings – that's Kazi.

### Notes

<sup>1</sup> 68% of employees complain about the light in their offices (American Society of Interior Designers), and 79% of VDT users want better lighting (Silicon Valley study). Source: Hedge A., Sims W., Belker F., "A Summary of the Cornell University Study: Lighting the Computerized Office", October, 1989

86% say that making lighting improvements to the workplace would reduce eyestrain and headaches. 75% say they want more control over their lighting. 75% of office workers would perceive improved efficiency/productivity, and 66% would perceive improved creativity as a result of improved lighting. Source: Steelcase Workplace Index Survey, May, 1999, conducted by Bruskin/Goldring Research.

<sup>2</sup> The first study was an in-depth case study of the Norwegian Trade Council in New York, N.Y., conducted by Dr. Alan Hedge of Cornell University. Each employee was given direct switchable control over the lighting in each office space including indirect pendant and wall lighting, and a portable adjustable task light. The results found that all employees liked having control over the lighting in their offices. The majority of employees reported that they no longer suffered from visual health problems at work, and those that still had problems attributed it to increased workload and not the lighting. Source: Hedge A., "Two-Component Lighting Solves Office Glare Problems", Energy & Power Management, July 8, 2000

The second study was conducted in a controlled test environment by the National Research Council of Canada. Participants were exposed to four different lighting designs. Each design had dimming control of ambient lights, and two of four designs included an angle arm task light. The results found that introducing individual lighting control improved participants' ratings of mood and satisfaction, independent of the lighting design. Subjects were also asked to perform typing tasks. With the task light, average typing speeds were found to be 24% faster. Source: Newsham G., Veitch J., Arseneault C., Duval C., "Lighting for VDT Workstations 2: Effect of Control and Lighting Design on Task Performance, and Chosen Photometric Conditions", National Research Council of Canada, Institute for Research in Construction, March 2004

<sup>3</sup> In the Norwegian Trade Council study (see note 2), all employees made daily use of their controllable ambient light, but only 40% made daily use of their portable, adjustable task light. The study concluded that these employees had positioned the task lights incorrectly, negating some of their benefits and making them somewhat awkward to use.

In the National Research Council study (see note 2), researchers noted that those participants who made the biggest changes to their lighting conditions also tended to register the biggest improvements in mood and satisfaction. They concluded that lighting control systems need to be easily accessible, easy to understand, and able to affect substantial changes in conditions.

## Notes

<sup>4</sup> Source: Boyce P., Veitch J., Newsham G., Myer M., Hunter C., "Lighting Quality and Office Work: A Field Simulation Study", Lighting Research Center, Rensselaer Polytechnic Institute, Troy, New York and National Research Council of Canada, Institute for Research in Construction, Ottawa, Ontario, September 2003

<sup>5</sup> Source: Steelcase Workplace Index Survey, May 1999, conducted by Bruskin/Goldring Research.

<sup>6</sup> Source: Centers for Disease Control and Prevention  
<http://www.cdc.gov/od/ohs/manual/ofcsfty.htm>

In the Steelcase survey (see note 5), 58% of those surveyed experienced tired eyes, 30% had headaches, 21% had tired eyes, and 56% had watery eyes as a result of the lighting in the workplace.

<sup>7</sup> Source: Herman Miller Inc., "Vision and the Computerized Office", 2004

<sup>8</sup> Source: Donovan-Wright M., "Doing Light Right", Building Operating Management, May 2002

<sup>9</sup> Source: Figueiro M., "Lighting the Way: A Key to Independence", AARP Andrus Foundation and The Lighting Research Center, Rensselaer Polytechnic Institute, Troy, N.Y., 2001

<sup>10</sup> Source: National Lighting Product Information Program, "Lighting Answers – Task Lighting for Offices", Lighting Research Center, Rensselaer Polytechnic Institute, Troy, N.Y., Volume 1, Number 3, April 1994

<sup>11</sup> Source: Newsham G., Veitch J., Reinhart C., Sander D., "Lighting Design for Open-Plan Offices", National Research Council of Canada, Construction Technology Update, No. 62, October 2004

<sup>12</sup> Source: Newsham G., Veitch J., Arseneault C., Duval C., "Lighting for VDT Workstations 2: Effect of Control and Lighting Design on Task Performance, and Chosen Photometric Conditions", National Research Council of Canada, Institute for Research in Construction, March 2004

<sup>13</sup> Source: Hedge A., Sims W., Belker F., "A Summary of the Cornell University Study: Lighting the Computerized Office", October, 1989

<sup>14</sup> Source: "The Effects of Computer Use on Eye Health and Vision", American Optometric Association, April 1997

<sup>15</sup> Source: Herman Miller Inc., "Vision and the Computerized Office", 2004.

<sup>16</sup> Source: Kensington Technology Group survey, 1999

<sup>17</sup> An example of the cost of eyestrain:

Employee annual earnings*	\$53,373
Employee annual benefits*	\$14,040
Total cost to employer	\$67,413
Hours lost per year due to eyestrain	60 hours
Hours employee is available to work per year	1,920 hours
% of time lost to eyestrain	3.12%
Loss per year per employee	\$2,103

\* Department of Labor, Bureau of Labor Statistics, June 2000

<sup>18</sup> Source: Department of Energy [www.eia.doe.gov/emeu/consumptionbriefs/cbecs/pbawebiste/contents.htm](http://www.eia.doe.gov/emeu/consumptionbriefs/cbecs/pbawebiste/contents.htm)

<sup>19</sup> For readers who are interested in this topic, please see the Kazi bulletin "Ban on the Use of Magnetic Ballasts in Commercial Overhead Lighting Fixtures" at [www.ise-ergonomics.com](http://www.ise-ergonomics.com)

<sup>20</sup> For example, Yamakawa et al. [2000] conducted a study of task-ambient lighting use in a mock-up office space. In the study, participants were asked to compensate for lower ambient lighting with task lighting. On average, a 100 lux reduction in overhead lighting was offset by only a 30 lux increase in task lighting. Source: Yamakawa K., Watabe K., Inanuma M., Sakata K., Takeda H., "A study on the practical use of a task and ambient lighting system in an office", Journal of Light & Visual Environment, 24(2), 2000.

<sup>21</sup> Examples include the DOE publication "Energy-Saving Tips for Small Businesses – Hands-on solutions to improve your profits and productivity", and the Federal Energy Management Program "Energy Effective Lighting Checklist

