

6.0 Lighting Breadth

The original LA Fitness lighting selection was designed to meet the 2001 edition of ASHRAE Standard 90.1. This standard specifies that for an exercise facility, the overall lighting power density shall not exceed 1.4 W/ft².

The original design provided 53,097 Watts of lighting to the interior spaces. The resulting power density for this configuration is 1.18 W/ft². The Table showing this energy calculation can be found in Appendix F. This design meets the 2001 version of the standard. However, the current version of this standard (ASHRAE Standard 90.1-2004) has been updated to include more stringent lighting power density requirements for most facilities in an attempt to further reduce energy consumption and cooling requirements in buildings. The 2004 version of this standard calls for exercise centers to maintain power densities no greater than 1.0 W/ft².

Building Area Method:

Building Area Type:	Exercise Center
Gross Lighted Floor Area:	45,000 ft ²
Lighting Watts Used in Spaces:	53,097 W
Original Lighting Power Density:	1.18 W/ft ²

Table 6.1 – Original Lighting Power Density Using Building Area Method

There is one type of lamp that is used very frequently throughout the building's original lighting design. The most frequently used product is a 32 W T8 fluorescent lamp that has a mean output of 2850 lumens. The first step in the redesign of this system included an exchange of all of these lamps for more efficient ones with comparable light output. The lamp selected as a replacement for this bulb is a 30 W T8 lamp that is made to fit in the exact same ballast that was initially used. This lamp has a mean output of 2710 lumens. Each lamp's lumen output is rated at the same condition (performance at 25°C).

Designation	Lamp	Nominal Energy (Watts)	Nominal Length (in.)	Mean Lumens (25 C)	2 Lamps in ballast (Watts)
Original Design	FO32835XPECO	32	47.78	2850	65
Redesign	FO30835XPSSECO	30	47.78	2710	61

Table 6.2 - Comparison of Original Design and Redesign Lamp Choices

With this first change in place, there are savings of 4 Watts for every 2 lamps replaced with only a 5% decrease in lumen output in the redesigned spaces.

The racquetball courts were the first areas investigated after the lighting power densities for each space were calculated. These rooms each had 1,920 Watts of lighting being provided to 835 ft² spaces. This results in power densities of 2.3 W/ft² for the courts. These spaces should be kept slightly brighter than other areas because of the nature of the activity in the rooms; however, power densities greater than 1 W/ft² will be more than bright enough for the sport (played in a completely white room with a bright blue ball). The courts were redesigned to have a lighting power density of 1.2 W/ft².

After these two issues were addressed the building complied with the more stringent lighting power density set forth by the 2004 version of the standard. The redesigned lighting power density result is 0.989 W/ft². These calculations can also be found in Appendix F.

The power density in the redesign will lead to reduced annual energy use which correlates to less annual electric cost and a reduction of annual emissions.

Annual Savings Harvested from Lighting Redesign						
	Energy Consumption (kWh)	Annual Lighting Cost	Particulates (lbm)	SOx (lbm)	NOx (lbm)	CO ₂ (lbm)
Original Design	315576	\$25,246	142	1654	959	278338
Redesign	260087	\$20,807	117	1363	791	229397
Reduction	55489	\$4,439	25	291	169	48941

Table 6.3 – Reductions Resulting from Lighting Redesign

Most of the wattage that enters a building for lighting ends up as sensible heat that the building’s mechanical system will have to remove. It is estimated that 99% of the total input wattage will result in heat; therefore, the resulting redesign also reduces the necessary cooling demand by 2.7 tons.

The first cost of the 30 watt lamps is rated at \$4.29/lamp while the first cost of the 32 watt lamps is rated at \$3.79/lamp. The overall first cost of the original lamps is \$1224.17. The first cost of the new lamps for the redesign is \$1312.17. The redesign is easy to justify economically because of the cost of energy saved. The first cost discussed in this section refers only to the first cost of the lamps that have been changed by the redesign. This is to say that the first cost of the entire lighting design has not been calculated for this study.