EE 16: INCREASE LIGHTING EFFICIENCY ON CONSTRUCTION SITES

Summary

Issue:
The standards for temporary lighting on construction sites are outdated, allowing for inefficient fixtures and wasteful practices.

Recommendation:
Update the efficiency standards for lighting on construction sites, provide separate circuits for life-safety lighting and let natural light illuminate foot bridges, temporary walkways and sidewalk sheds.

Proposed Legislation, Rule or Study

Amendments to the New York City Building Code:

1. Amend Section 3302.1 to include the following defined terms:

CONSTRUCTION LIGHTING, GENERAL. Temporary lighting of construction sites that is not construction safety lighting.

CONSTRUCTION LIGHTING, SAFETY. Lighting of foot bridges, temporary walkways, sidewalk sheds, stairwells and other pathways through a construction site for the purposes of illuminating ingress and egress pathways 24 hours a day.

PHOTOCELL SENSOR. A device that detects light and varies the electricity provided to a lamp or ballast according to ambient illumination. All photocell sensors shall fail on, such that if the sensor stops working then lamps will receive electricity by default.

2. Amend Section 3303.2.3 as follows:

3303.2.3 Electrical work. All temporary electrical equipment and wiring shall meet the requirements of the New York City Electrical Code, and shall be maintained in compliance with such requirements. Portions of permanent electrical installations may be used for temporary operations provided the requirements of the New York City Electrical Code are met. Safety construction lighting and general construction lighting shall have a luminous efficacy of 45 lumens per watt or greater. In addition, general construction lighting shall be:

1. Separately circuited from safety construction lighting.
2. Controlled by master switches, which shall also control all non-essential power circuits. The master switches shall be located close to the main access to the construction site and be clearly labeled. The ingress pathway to master switches shall be illuminated by safety construction lighting.
3. Turned off when the construction site is not open.

3. Amend paragraph 2 of Section 3307.2.1 as follows:

All temporary walkways shall be illuminated at all times either by natural or artificial light. The level of illumination shall be the equivalent of that produced by [200 watt, 3400 lumen minimum, standard incandescent lamps] 32 watt 2700 lumen minimum T8 fluorescent lamps enclosed in vandal-proof fixtures and spaced 15 feet (4572 mm) apart and 8 feet (2438 mm) above the floor level. All lamps shall have a luminous efficacy of 45 lumens per watt or greater, be instant-start, and be rated for low temperature use. Artificial lighting units shall be inspected [nightly] daily; and burned out or inoperative units shall be replaced or repaired immediately. Photocell sensors may be used to control artificial lighting according to the amount of natural light available.
4. Amend paragraph 2 of Section 3307.2.2 as follows:

All foot bridges shall be illuminated at all times either by natural or artificial light. The level of illumination shall be the equivalent of that produced by [200 watt, 3400 lumen minimum, standard incandescent lamps] 32 watt 2700 lumen minimum T8 fluorescent lamps enclosed in vandal-proof fixtures and spaced 15 feet (4572 mm) apart and 8 feet (2438 mm) above the floor level. All lamps shall have a luminous efficacy of 45 lumens per watt or greater, be instant-start, and be rated for low temperature use. Artificial lighting units shall be inspected [nightly] daily; and burned out or inoperative units shall be replaced or repaired immediately. Photocell sensors may be used to control artificial lighting according to the amount of natural light available.

5. Amend Subdivision 2 of Section 3307.6.5 as follows:

2. The underside of sidewalk sheds shall be illuminated at all times either by natural or artificial light. The level of illumination shall be the equivalent of that produced by [200 watt, 3400 lumen minimum, standard incandescent lamps] 32 watt 2700 lumen minimum T8 fluorescent lamps enclosed in vandal-proof fixtures and spaced 15 feet (4572 mm) apart and 8 feet (2438 mm) above the floor level. All lighting shall have a luminous efficacy of 45 lumens per watt or greater. Lamps shall be 'instant-start' and rated for low temperature use, Artificial lighting units shall be inspected [nightly] daily; and burned out or inoperative units shall be replaced or repaired immediately. Photocell sensors may be used to control artificial lighting according to the amount of natural light available.

Supporting Information

Issue - Expanded

New York City is filled with construction sites and sidewalk sheds that are illuminated 24/7 with inefficient incandescent light bulbs. Typically, sidewalk shed lights remain on all the time, even when daylight is sufficient. Leaving non-essential lighting on while job sites are closed is wasteful and does not enhance public or worker safety – work on a construction site after 6:00 pm requires a special City permit and thus is not the norm.

These wasteful practices are primarily the result of outdated code provisions. For example, the Building code does not mandate minimum energy efficiency measures for construction lighting and power, as it does for permanent installations. Furthermore, it does not differentiate between lighting requirements for emergency access versus general construction activities.

This proposal would create a minimum efficiency standard for construction lighting and require that non-safety lighting on a construction site be turned off after-hours. The fluorescent lamps specified in this proposal use 65 to 75 percent less energy than incandescent lamps to provide the same amount of light and can last up to 10 times longer.

The proposal would also update outdated illumination standards for temporary walkways, foot bridges, and sidewalk sheds. Among other changes, these updates would allow sidewalk sheds to use photocell sensors to turn off artificial lighting when there is sufficient illumination from daylight.

Implementing this proposal would save energy and money with no impact on safety.

Environmental & Health Benefits

This proposal will save substantial energy, improving air quality and reducing greenhouse gas emissions.

Even if existing lighting standards remain in place, just switching off construction lighting after-hours and using photocell sensors in sidewalk sheds would generate enormous energy savings. Turning off lights 12 hours per day (including weekends) at construction could save 11,680 MWh/year of electricity. Controlling sidewalk shed lighting with photocell sensors could save approximately 7,712 MWh/year of electricity and reduce peak electric demand on weekdays by 1.8 MW.

This proposal was found to have a high, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score 2.

This proposal was found to have no significant health impact.

Cost & Savings

As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.
For some buildings this proposal will result in no increase of capital costs and for others an increase of up to 0.03%. It was thus categorized as incurring no to a low capital cost increment.

Savings to Building Owner:

For a 100,000 SF building with a 10,000 SF floor plate that takes 30 months to construct, turning general construction lighting off after hours would save the building owner approximately $77,000 if the building has incandescent construction lighting and approximately $18,000 if the building uses CFL’s for construction lighting. This assumes that 75% of the construction lighting is general construction lighting and work takes place 12 hours a day, 5 days a week. Reducing lamps’ operation hours also extends their life, thus saving the building owner approximately $4500 of replacement incandescent bulbs (6 fewer bulb changes at $1.67 per bulb) or approximately $4500 of CFL lamps (2 fewer bulb changes at $5 per bulb). These cost savings do not include potential labor savings in avoided bulb replacement.

For Foot Bridges, Temporary Walkways and Sidewalk Sheds, energy savings will range from 9.7 to 11.1 watts per linear foot of sidewalk and maintenance will be reduced by 80% or more because the higher efficacy lamps also have a longer life and require less maintenance. Maintenance savings are particularly significant for these applications, because burned out lamps are costly to replace and threaten public safety.

Savings to NYC:

The direct energy savings for the measures proposed herein would accrue to the owner, but New York’s utility system would also benefit by the corresponding reduction in electricity demand. Switching lights off 12 hours/day during the week and keeping them off throughout the weekend would save 15,000 MWh/year of electricity. This assumes 6 million square feet of building construction illuminated by 100W incandescent bulbs spaced 15’ X 15’ on center. The savings are less, but still significant, if all construction lighting is 23W CFL spaced 15’ X 15’ on center: 2687 MWh/year.

Controlling sidewalk shed lighting with photocells would save 7,712 Mwh/year of electricity and reduce peak electric demand on weekdays by 1.8 Mw. This assumes 80% of NYC’s estimated 25 miles of sidewalk shed have access to daylight and are currently illuminated by 200W incandescent fixtures spaced 15’ on center.

Precedents

The strongest precedent for replacing current code language that specifies illumination in terms of incandescent bulb wattage is the national energy bill George Bush signed into law in 2007. The bill banned manufacturing of 100 watt incandescent bulbs in 2012 and incandescent 40 watt bulbs in 2014.

OSHA’s Standards for the Construction Industry (located under Subpart D, Occupational Health and Environmental Controls) are as follows: 3 foot-candles for “general construction areas, concrete placement, excavation and waste areas, access ways, active storage areas, loading platforms, refueling and field maintenance areas” and 5 foot-candles for other “general construction areas.”

LEED

While this proposal is consistent with the goals of LEED to reduce energy waste and reduce light pollution, LEED does not have any prerequisites or credits dealing with energy use during construction or temporary lighting.

Implementation & Market Availability

The technology and equipment promoted by this proposal are readily available: CFLs fit existing fixtures commonly used in construction lighting and fluorescent lamps specifically designed for rough duty are available. Photocell sensors are widely used for other applications.

Unless the industry begins making left handed screw compact fluorescent lamps, electrical contractors will need to replace the lamp sockets on their temporary light stringers to accept conventional right-handed screw lamps. Conventional sockets are readily available.

Notes

Safety of Photocells:

The committee discussed whether there are any safety concerns with using photocell sensors in sidewalk sheds or other applications.

The issues with doing so are the same as for occupancy sensors, which have been used for years around the country in egress paths. The NFPA 101 2006 Life Safety Code, for example, permits the use of lighting controls (specifically motion sensors) to turn off lights during occupancy.
sensors). NFPA addresses safety concerns by requiring occupancy sensors in egress paths to “fail on,” meaning that if the occupancy sensor is no longer working, the lights will come on as the default position.

The principles for photocell sensors are similar. Photocell sensors will only shut lights off if the sensor detects the level of ambient light programmed by the installer. For example, an installer can set a photocell sensor to keep light on until 60 footcandles are detected, even if an area is only required to have 30 footcandles of illumination. This ensures the electric lights controlled by the photocell can be turned off without dropping the illumination level below the design level and that the area is never darker than intended. Many photocell sensors are already designed to “fail on” so that if a photocell stops working for some reason, lights will come on and stay on until the photocell is repaired or replaced.

Requiring Photocell Sensors for Sidewalk Sheds:

The Committee discussed whether to recommend mandating their use in sidewalk sheds. Since sidewalk sheds are located throughout the city, there may be substantial energy savings from requiring this practice.

In particular, the Committee considered including the following language in Subdivision 2 of Section 3307.6.5:

Any lamp located within 15 feet of an open edge of a sidewalk shed shall be controlled by a photocell sensor that shall turn off the lamp when daylight provides a minimum illumination level of 20 foot-candles measured at the ground at the middle of the sidewalk shed.

However, the Committee was unable to identify any locations in NYC that had used photocells in this manner. For these reasons, the Committee opted to leave photocells as an option in this section and will encourage owners and contractors to pilot this sensor application.

Mercury in Fluorescent Lamps:

Unlike incandescent lamps, fluorescent lamps contain mercury, which can be released if the lamps are broken in uncontrolled circumstances. However, the quantity of mercury released poses relatively little risk to an adult. In the event of a breakage, fluorescent lamps should be cleaned up with a HEPA vacuum or damp cloth to contain the mercury. Further, the primary source of mercury emissions in the U.S. is from electricity generation so using fluorescent lamps instead of incandescent will reduce overall mercury exposure levels. At the end of their useful life, fluorescent lamps should be recycled to recapture the mercury.

ENDNOTES:

1 Assumes 6 million square feet of building construction is illuminated by 100W incandescent bulbs spaced 15' X 15' on center.

2 Assumes that 80% of New York City’s estimated 25 miles of sidewalk shed have access to daylight and are currently illuminated by 200W incandescent fixtures spaced 15' on center.
