The New York Times Headquarters Case Study

The Success of an Automated-Shading System

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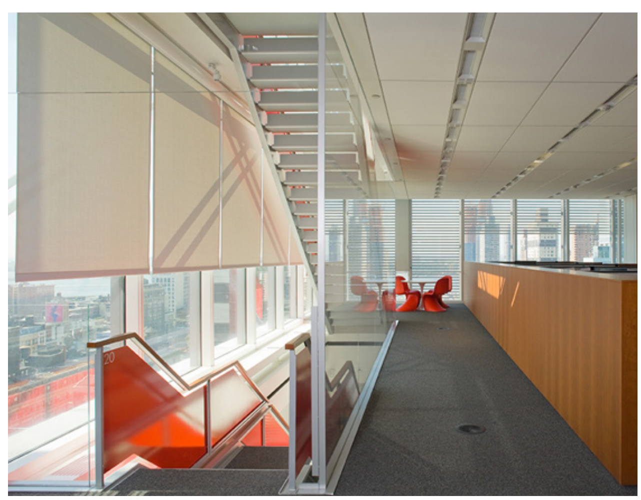
The headquarters of The New York Times occupies floors two to 27 of a 52-story, 800,000-sq.-ft. tower. Most of The Times's space is an open-plan office design, configured to maximize daylighting and views to the outside, and to minimize use of electric lighting. These features are part of the strategy to create a comfortable, productive, and environmentally friendly environment for the staff. The structure is located along Eighth Avenue between West 40th and 41st Streets in New York City, with expansive urban views, including across the Hudson River into New Jersey. The façade is primarily clad in an ultra-clear, low-iron glass, specified by the building's architect, Renzo Piano Building Workshop in association with FXFOWLE. The interior office spaces were designed by Gensler, and the MEP (mechanical, electrical, and plumbing) was engineered by WSP Flack + Kurtz.



The New York Times's management set aggressive goals for the automated-shading and automated-lighting systems. A 4,300-sq.-ft. full-scale mock-up of the south and west corners of the building was constructed in the Queens borough of New York City. The mock-up ensured accurate testing of construction techniques and made it possible to measure, validate, and compare the shading and lighting systems to detailed specifications. With participation by the Lawrence Berkeley National Laboratory and funding from the New York State Energy Research and Development Authority, the two-year mock-up and research project became what *Metropolis* magazine has called: "The most ambitious lighting experiment in American commercial real estate." Through research and testing, the design criteria could be optimized. And once built, the entire building would be continually studied, and obtained results would ensure futher optimization of the systems.

Essentially, The New York Times building is a working definition of evidence-based design, which "is a process for the conscientious, explicit, and judicious use of current best evidence from research and practice in making critical decisions together with an informed client about the design of each individual and unique project," as defined by D. Kirk Hamilton and David H. Watkins, both FAIA, the principals of WHR Architects in Houston.

The automated-shading and lighting designs were planned to meet the needs of all types of workers at The Times, including all of the journalism-, publishing-, and business-related sectors. A key strategy during the planning stage was the touring of the mock-up by a large number of staff from all departments. The employees provided useful feedback to members of the design team on the open-plan office design and toward achieving uniform lighting design, deduction of glare through the building's expansive windows, and energy savings.

A key senior-management objective was to foster high worker productivity without impinging on comfort but rather by maximizing the energy efficiency of all the building's systems. The results of the exhaustive experiment, based on empirical and human factors, led to a publication that contained a tight and rigid set of performance specifications for the automated-shading and lighting systems. (A copy of the specifications can be found at windows.lbl.gov/comm_perf/pdf/NYT_RShades-Spec12-31-04.pdf.)

The parameters of the window-shading system were defined by Eleanor S. Lee, Robert D. Clear, and Luis Fernandes of the Lawrence Berkeley National Laboratory in the "Commissioning and Verification Procedures for the Automated Roller Shade System at The New York Times Headquarters, New York, New York." The document was prepared for Glenn D. Hughes and Larry Dumpert of The New York Times. Within Section 1.2 of the report:

Primary goals of the shade control system are:

1. Maximize natural light.
2. Maximize occupant connectivity with the outdoors (i.e. external views).
3. Intercept sunlight penetration so that direct solar radiation on the occupants is avoided.
4. Maintain a glare-free environment.
5. Provide occupant manual override capability.
6. On any given façade for the shades (as a general rule) to be controlled together, to the same bottom-of-hem height.

(See the Appendix on page 4.)

The automated-shading system of choice was SolarTrac® by MechoSystems. It was installed in The New York Times building in November 2007.

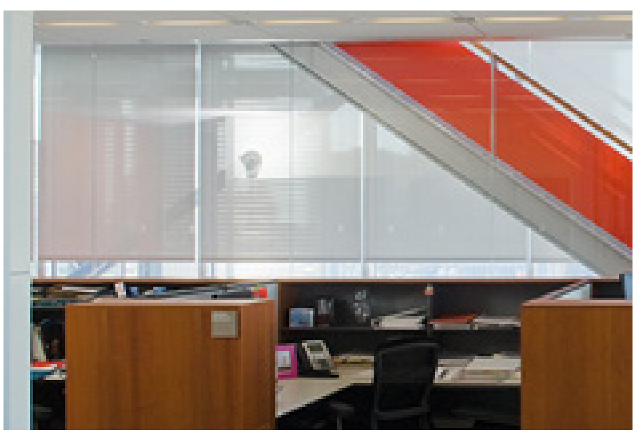
The automated system required the inclusion of predictive and responsive controls and the abilities of solar tracking, brightness override, shadow awareness, allowance for sky-condition inputs, manual overrides, significant data logging, remote access, and reporting capabilities. Sensors (which faced out near the windows) would ensure that stringent glare be controlled by managing the contrast ratio between the window wall and employee work surfaces—achieved through the deployment of shade bands to pre-determined and calculated stopping points (or heights) for each exposure and elevation.

The entire geospatial position of the building was analyzed in relation to the sun angle, building shape, geometry, and proximity of nearby buildings to optimize the shade operation. The overriding goal was for the shade bands to rise as high as possible without compromising glare control or thermal comfort of occupants. The building installation required a robust and sophisticated system to meet The Times's specifications.

Over 500 zones were created, and approximately 1,000 motors were installed so that the calculated shade-band positions would minimize the glare and solar radiation, while allowing the greatest amount of daylight to penetrate the interior. To further satisfy the The Times's directive of ensuring occupant comfort, about 200 touch screens were installed to enable its occupants to override the system, if they were not satisfied with the shade-band positions. The touch screens were placed on walls throughout the open-plan spaces to permit easy adjustment of shade-band positions, to accommodate all the staff's preferences. These manual overrides had to be tracked and trended, with the user selecting a reason for and prior to the override's activation.

SolarTrac, The New York Times building's automated-shading system, was fully functional, commissioned, and optimized before occupants arrived. Five years have passed since the occupancy, and analyses have been ongoing.

In January 2013, the Lawrence Berkeley National Laboratory published the results of its study in "A Post-Occupancy Monitored Evaluation of the Dimmable Lighting, Automated Shading, and Underfloor Air Distribution System in The New York Times Building." It can be called on as a basis for results



correlated to a building's design, and for informing others of its far-reaching successful design. The post-occupancy report clarifies how the specifications were implemented, and provides insight from many perspectives on the effects of natural and artificial light on the interior space.

A significant portion of the energy savings in The Times Headquarters has been realized by the effective automated lighting-control system (by others) that is controlling approximately 18,000 individual luminaires to meet the required lighting levels of departments. Susan Brady Lighting Design (SBLD) developed a lighting plan that incorporates the use of abundant daylight (or natural light) as the preferred light source, and as the basis of the lighting in most areas of the building during daytime hours. The electrical (or artificial) light was designed to supplement the natural light. And the systems were

specified to accomplish this significant design requirement. Therefore, Glenn Hughes, the former facilities director of the building (active at the building's inception and completion) has stated that the intent of the lighting design was to create these lighting-control layers:

1. Daylighting.
2. Occupancy.
3. Target set points (light-level tuning).
4. Manual dimming switches with presets.
5. Time clock.
6. Emergency lights.

The two systems—shades and lighting—operate independently, according to their unique programming instructions. While not connected by direct wires, they are, in effect, integrated by light. The result is that the automated-shading system is the first line of defense, maximizing the amount of light that can be let in, comfortably. The electric-lighting-control system can then react according to the amount of natural light that the shading system allows in.

Efficient use of daylighting has diminished the need for electric lights and, hence, reduces the loading and costs of lighting energy.

The lighting system was designed according to the maximum lighting power density specified by ASHRAE 90.1-2001 code, which allows 1.3W/sq. ft. (or 11.4 kWh/sq. ft., annually). The building was designed to utilize daylighting, occupancy sensors, and dimming controls so that the lighting system would consume less energy. And according to the Lawrence Berkeley National Laboratory study, the building consumed far less at just 3.15 kWh/sq. ft., or 72% less.

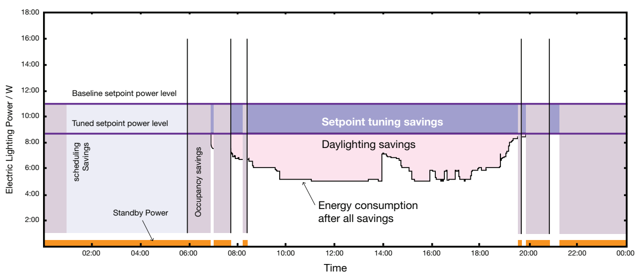
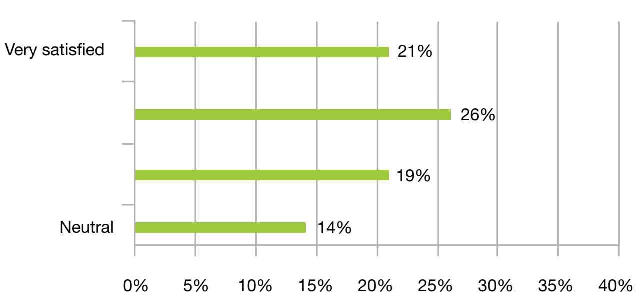


Figure 7. Example of how lighting energy use savings are attributed to each control strategy over a 24 h day. Control strategies include scheduling, occupancy, setpoint tuning, and daylighting. Copyright: LBNL.

According to this recent post-occupancy analysis, 78% of The Times building's occupants are pleased with the overall lighting quality of their workspaces. And 61% of occupants reported that the new building's lighting contributes to—even enhances—their productivity. Occupants also only manually overrode 80% of the automated-shading system's motors 18 times, for a total of 38 hours (or, for 1.5% of the year). This confirms an overall user satisfaction with shade-band positions on windows, allowing The Times's employees to focus on tasks instead of operating shades. The system keeps the shade bands up as often as possible, while meeting the occupants' needs, and satisfying the key requirements of the client's specifications.

How satisfied are you with the visual comfort of the lighting (e.g., glare, reflections, contrast)?



In addition to a low power-consumption factor, less greenhouse gases are produced due to significant energy savings. As the cost of fuel rises, less money is spent on operating expenses. Through reduced energy consumption, the ROI (return on investment) of the cost of the automated shading system is significant, measurable, and justifiable by all calculating methods. In addition, the extensive use of daylight integration has resulted in a productive workforce without compromising on new technological amenities.

The automated-shading and lighting systems were implemented with careful consideration of life-cycle costs and economic payback. Extensive modeling was conducted to verify the payback periods. The return on investment for the entire project including the lighting, automated-shading, and underfloor air-distribution systems, was determined. At a 12% internal rate of return, the overall building's simple payback is eight years. (See Table 1, below.)

ROI based on an assessment of a single floor (20th floor)

Table 1. Summary Statistics

Project	Offices
Climate Zone and Type	ASHRAE Zone 4A, hot and cold and humid
Ownership Type	Owner Occupied
Barriers Addressed	Integrated design practices Dimmable electronic ballasts and daylighting Automated interior shading Underfloor air distribution system
Gross Square Footage of Project	25,784 ft^2 (20th floor); 628,000 ft^2 (The Times Company portion of the building)
Monitored Energy Savings – 20th floor (vs ASHRAE 90.1-2001 baseline)	66,623 kWh/yr. electricity 35,120 kBtu/yr. natural gas
Energy Cost Savings – 20th floor	$ 13,081/yr.
Project Payback	8 years, IRR 12%

Assuming $0.19/kWh and $ 1.20/therm

The installed automated-shading system fulfilled the initial brief by maximizing natural light ingress, providing views to the outside, managing solar penetration, and regulating a glare-free environment while still allowing the building occupants manual control if these desired design criteria are not met.

Appendix: Fulfillment of the parameters of The New York Times Headquarters' automated-shading system as defined by the Lawrence Berkeley National Laboratory.

1. Maximize natural light.

During one solstice-to-solstice period, SolarTrac (the automated-shading system) adjusts the shade bands according to many factors, including the building geometry and façade orientation. Reviewing data for the height movements of all the shade bands and in conjunction with daylight hours, the shade bands were fully raised 72.7% of the time and lowered only 23.2% of the time. (Incidentally, there are almost 15 hours of daylight on the longest day of the year and a little over nine hours of daylight on the shortest day of the year.) About 50% of the total number of days in the New York City area are considered clear, and the remainder are cloudy. Therefore, the automated-shading system succeeded in keeping the shade bands raised as much as possible while meeting specification requirements.

2. Foster occupant connectivity with the outdoors.

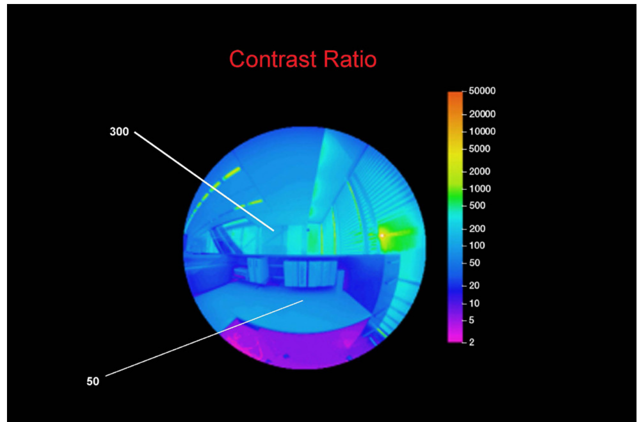
During one solstice-to-solstice period, the shade bands of SolarTrac (the automated-shading system) were raised, to any height, 95.8% of the time. This condition was based solely on the actions of the automated-shading system, on its configuration, and on the continual computerized analyses of current sky conditions in relation to the predetermined parameters for the building's geospatial orientation. The specifications for connectivity to the outdoors were fully met.

3. Intercept sunlight penetration so that direct solar radiation on the occupants is avoided.

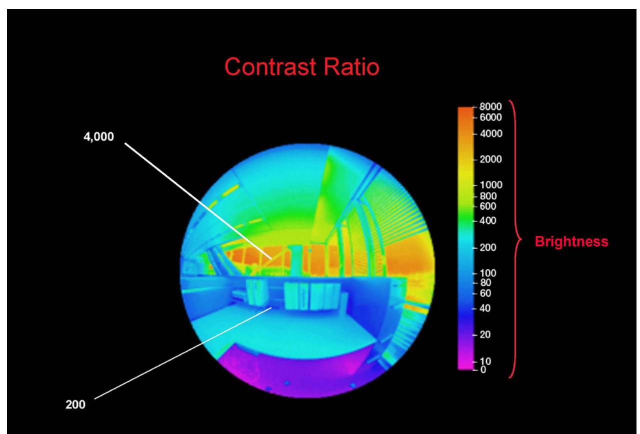
During one solstice-to-solstice period, SolarTrac (the automated-shading system) adjusted the shade bands according to many factors, including the façade's geographical orientation. For instance, on the north façade, the shades were fully raised 88.4% and lowered 10.5% of the time. On the west façade (facing the Hudson River and late-afternoon sunlight), the shade bands were fully raised 76.1% and lowered 22.5% of the time—for various reasons determined by the automated-shading system, and in compliance with the client's specifications.

4. Maintain a glare-free environment.

In the mock-up phase photographs, there are shade bands in one image and none in the other.



Shades are down, no problem with brightness. Lowering the contrast ratio to keep it at 1:10 or less.



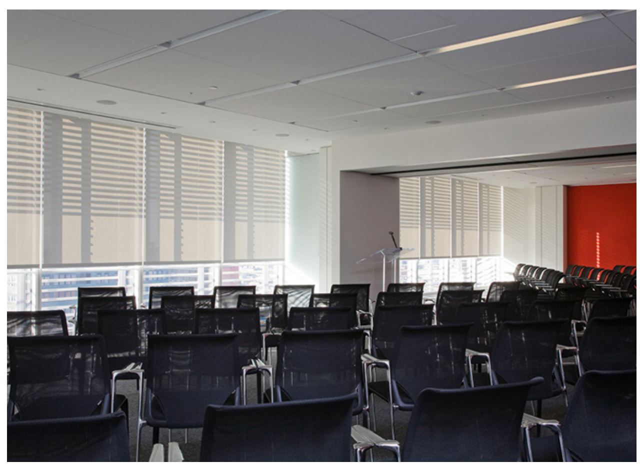
Luminance maps from The New York Times Mockup: Shades are up

5. Provide occupant manual override capability.

Building occupants were provided with access to a touchscreen user interface to manually override the automated-shading system. They were asked to specify a reason for their chosen shade-position override in order to activate the override. Of the six reasons to choose from, the most commonly chosen was to reduce sunlight, and the least chosen was to adjust brightness (42% and 2% of all overrides, respectively).

6. On any given façade for the shades (as a general rule) to be controlled together, to the same bottom-of-hem height.

The system is designed to operate motors based on floors, zones, and groups. All motors have been carefully calibrated and adjusted to meet the shade-band heights that were analyzed for the maximum-allowable solar penetration into a given space. During installation and the start-up phases, these criteria were measured and verified. Due to the special nature of the motors used with SolarTrac (the automated-shading system), the specifications were achieved.



MechoSystems
Design with light.®

MechoSystems
Corporate Headquarters
42-03 35th Street
Long Island City, NY 11101
T: +1 (718) 729-2020
F: +1 (718) 729-2941
E: marketing@mechosystems.com
W: mechosystems.com