

NEW YORK CITY AUDUBON

BIRD-SAFE BUILDING GUIDELINES

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Injured Golden Crowned Kinglet at base of building, Great Neck, NY

Introduction

Gleaming by day and glittering at night, glazed buildings that make up modern city skylines and suburban settings present serious hazards for birds. Bird populations, already in decline from loss of habitat, are seriously threatened by the relatively recent incursion of man-made structures into avian air space. In the United States, an estimated 100 million to one billion birds perish each year from encounters with buildings.[1]

Bird injury or death is largely attributable to two factors: birds, it would appear, are unable to detect and avoid glass, either during the daytime or night. Moreover, buildings' artificial night lighting confounds night-migrating species. Today, preventative actions mindful of these hazards are emerging in building practice. With bird-safe measures at hand, we can avoid the adverse consequences that until recently seemed inevitable though unintended.

The Bird-Safe Building Guidelines (Guidelines) examine the apparent causes of bird mortality in the built environment; convey the ecological, economic, ethical and legal justifications for bird conservation; advocate a series of preventative and rehabilitative strategies, and describe precedents for regulatory initiatives. They strive to stimulate the development of new glazing technologies while creating a market for all bird-safe building systems.

The Guidelines promote measures to protect birdlife in the planning, design, and operation stages of all types of buildings, in all settings. They are intended for use by architects, landscape architects, engineers, glass technicians, environmentalists, building owners and operators, construction industry stakeholders, city planners, civic officials, state and federal agencies, and the general public.

The Guidelines complement and inform today's green building initiatives, especially the widely utilized LEED® (Leadership in Energy and Environmental Design) green building rating system developed by the US Green Building Council.

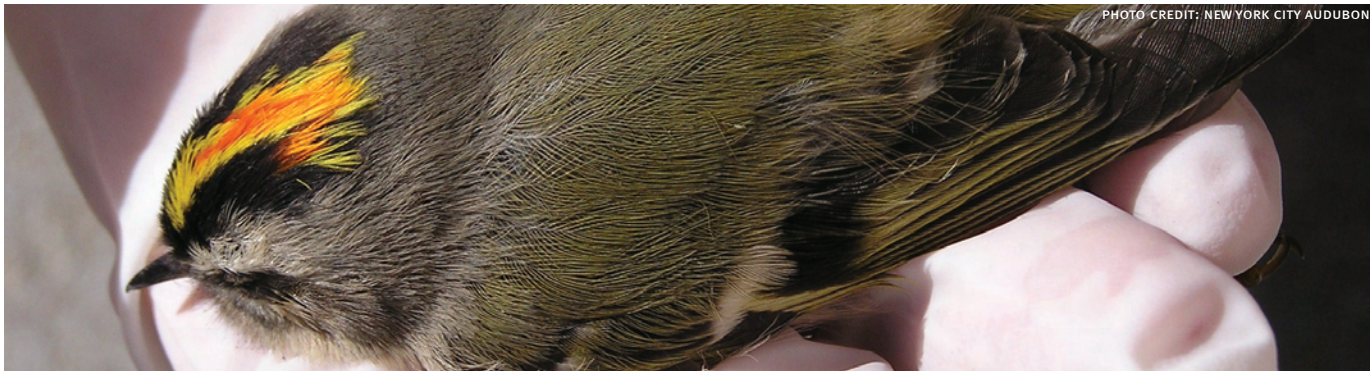


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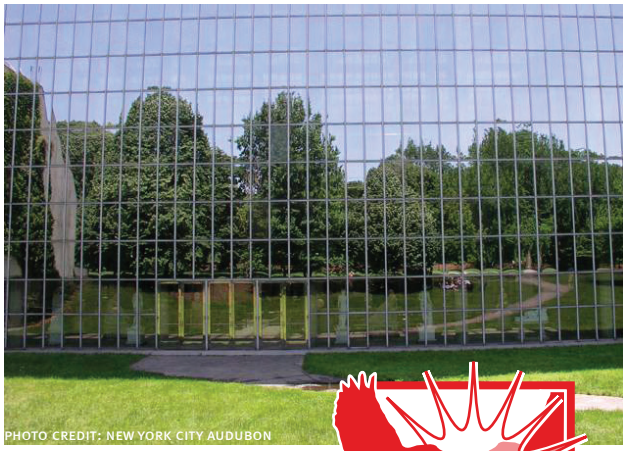
Overview : Causes of Collisions

The magnitude of bird collisions in any one area depends on local and migratory avian populations, densities and species composition; diurnal (daytime) or nocturnal (nighttime) migration characteristics; resting and feeding patterns; habitat preferences; time of year; prevailing winds; and weather conditions. Understanding the conditions that contribute to bird collisions with buildings is the first step towards planning bird-safe environments.

DAYTIME

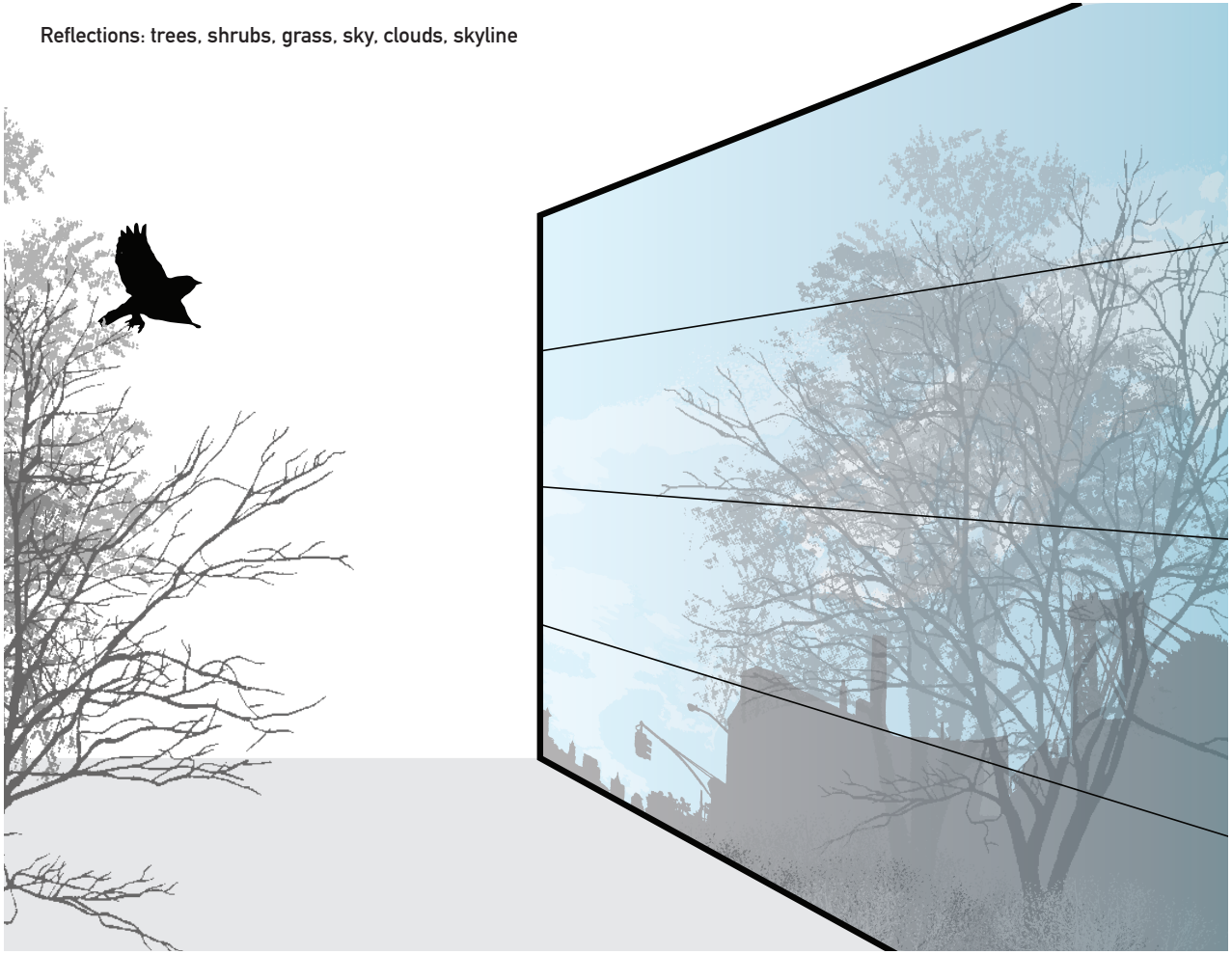
Since birds do not perceive glass as an obstacle to their flight path, collisions and mortality occur at any place where birds and glass coexist.[1] Daytime building collisions occur on windows of all sizes at every building type, from single-story to high rise structures; in all seasons and weather conditions; and in every type of environment, from forested and rural settings to dense urban cores. Glass in buildings is an indiscriminate killer regardless of species, sex, age, size, migration characteristics, or level of adaptation to the built environment.[2] After colliding with a glass surface, the majority of birds either die instantly or shortly thereafter from brain injuries or fall prey to scavengers.[3] Two conditions contribute to birds' inability to see glass:





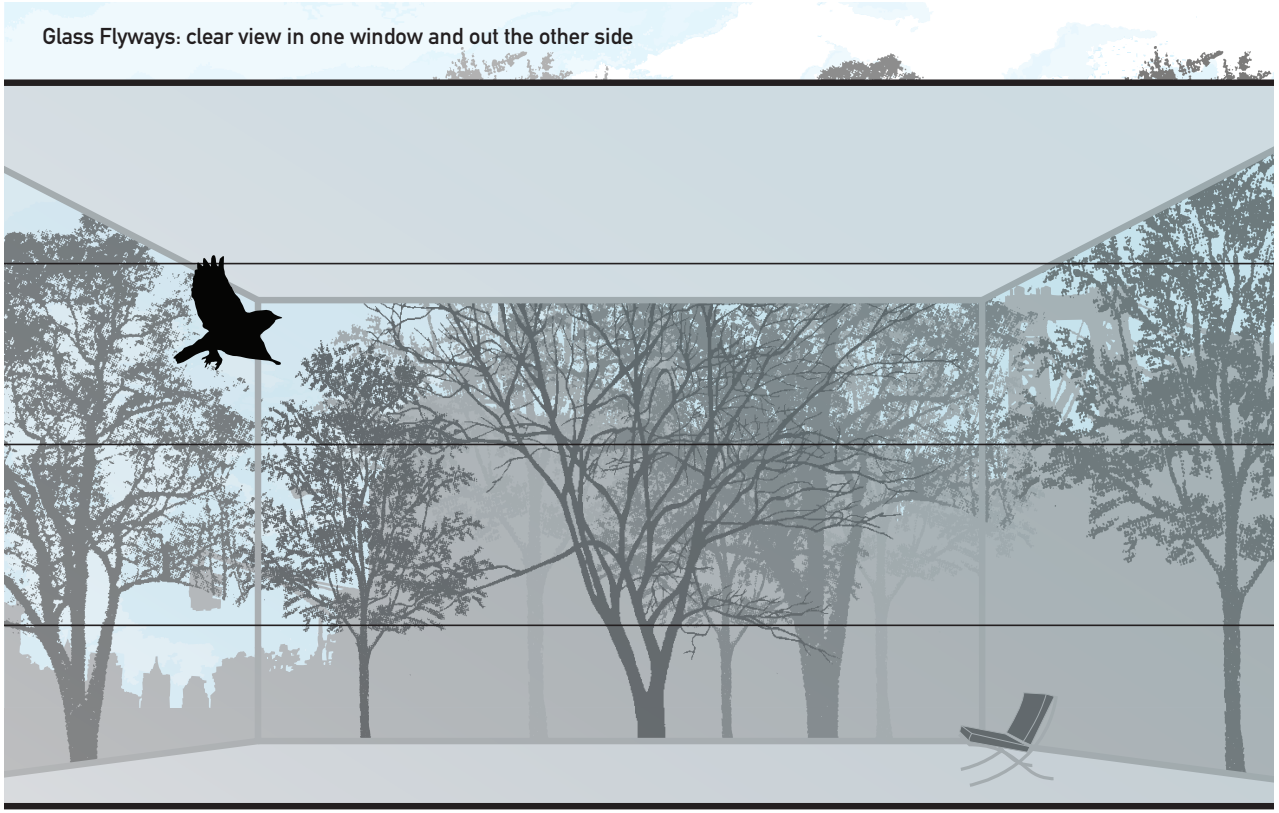
PROBLEM: REFLECTION

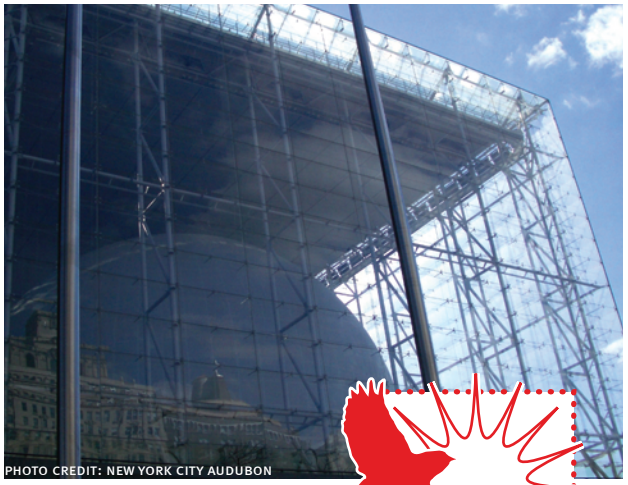
Reflections: trees, shrubs, grass, sky, clouds, skyline



Glass Reflectivity : Mirror Effect

From outside most buildings, glass often appears highly reflective, increasingly so when seen from an oblique angle. Almost every type of architectural glass under the right conditions reflects the sky, clouds, or nearby trees and vegetation, reproducing habitat familiar and attractive to birds.





PROBLEM: TRANSPARENCY

Glass Transparency : Fly Through

During daylight hours, birds strike transparent windows as they attempt to access potential perches, potted plants, water sources and other lures inside and beyond the glass. The trick of transparency is exacerbated when windows are installed on opposite sides of a building directly across from one another or at a corner, because birds perceive an unobstructed passageway and fly towards the glass with no awareness of an obstacle.


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PROBLEM: BEACON EFFECT



NIGHTTIME : Beacon Effect

The illumination of buildings at night, and in the early morning and evening, creates conditions that are particularly hazardous to nighttime migrating birds. Typically flying at heights over 500 feet, especially if weather conditions are favorable, nocturnal migrants depend heavily on visual reference to maintain orientation. During inclement weather, these migrants often descend to lower altitudes, possibly in search of clear sky celestial clues or magnetic references and are liable to be attracted to illuminated buildings or other tall structures. Heavy moisture (humidity, fog or mist) in the air greatly increases the illuminated space around buildings, regardless of whether the light is generated by an interior or exterior source. Birds become disoriented and entrapped while circling in the illuminated zone and are likely to succumb to exhaustion, predation, or lethal collision.



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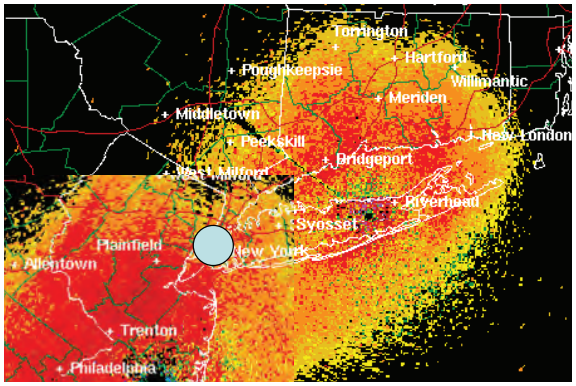
In addition to the adverse impacts on migrating birds, siginificant economic and health incentives exist for curbing the problem of excessive building illumination. Overly lit buildings waste tremendous amounts of electrical energy, increasing greenhouse gas emissions and air pollution levels, and of course, wasting money. Researchers estimate that the United States alone wastes over one billion dollars in electricity costs annually because poorly designed or improperly installed outdoor fixtures allow much of the lighting to go up to the sky. In addition to the threat that this poses to the avian kingdom and other animals, "light pollution" has significant aesthetic and cultural impact as well. Recent studies estimate that over two thirds of the world's population can no longer see the Milky Way, which humans have gazed at with a sense of mystery and imagination for countless millennia. Together the ecological, financial and aesthetic/cultural impacts of excessive building lighting serve as compelling motivation to reduce and refine light usage.

Birds and the Built Environment

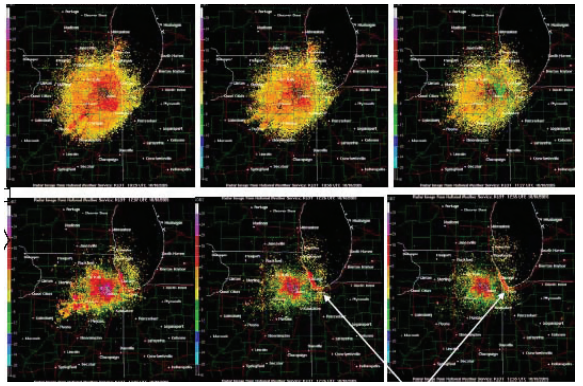
In recent decades, sprawling land-use patterns and intensified urbanization have degraded the quantity and quality of bird habitat throughout the globe. Cities and towns cling to waterfronts and shorelines, and increasingly infringe upon the wetlands and neighboring woodlands that birds depend upon for food and shelter. The loss of habitat forces birds to alight in city parks, streetscape vegetation, waterfront business districts, and other urban green patches. During dawn or dusk, they encounter the nighttime dangers of illuminated structures and the daytime hazards of dense and highly glazed buildings.

The increased use of glass poses a distinct threat to birdlife. From urban high-rises to suburban office parks to single-story structures, large expanses of glass are now routinely used as building enclosure. Energy performance improvements in transparent exterior wall systems have enabled deep daylighting of building interiors, often by means of floor-to-ceiling glass expanses. The aesthetic and functional pursuit of still greater visual transparency (integrating indoors with outdoors) has spurred the production of low-iron glass, eliminating the greenish cast.

The combined effects of these factors have led scientists to determine that bird mortality caused by building collisions is a "biologically significant"[5] issue. In other words, it is a threat of sufficient magnitude to affect the viability of bird populations, leading to local, regional, and national declines. Researchers and volunteers have documented hundreds of thousands of building collision-related bird deaths during migration seasons. Included in this toll are specimens representing over 225 species, a quarter of the species found in the United States. Songbirds—already imperiled by habitat loss and other environmental stressors—are especially vulnerable during migration to nighttime collisions with buildings and daytime glass collisions as they seek food and resting perches among urban buildings.



Time-lapsed radar images reveal the tremendous size and density of the migratory flocks that descend upon North American metropolitan areas during migration seasons frequently spanning hundreds of miles in width.[4]



Time-lapse images of the Chicago region depict a three-hour period, during which a cluster of migrating birds—initially as wide as the state of Illinois—descends upon the southwestern shoreline of Lake Michigan. As seen in the image of at the bottom right, the greatest density of congregating birds—shown in red—corresponds to the City of Chicago's glassy, skyward business district.

Imperatives for Bird Protection: From the Utilitarian to the Ethical

The aesthetic enjoyment and scientific fascination of bird watching is a manifestation of mankind's universal appreciation for its feathered friends. Birds have enthralled and inspired humans throughout history. Birds' vitality, resourcefulness, and grace have led people to adopt them—through metaphor, music and art—as ciphers for a range of social and moral ideals.

In the 1880's, the environmental movement—in particular the bird conservation movement—was launched in reaction to the endangerment of numerous bird species by indiscriminate hunting practices and the plume trade. Audubon societies were founded, the first one in New York State in 1887. In 1918, birds were granted protection with the signing of the Migratory Bird Treat Act. Today this act, signed with Canada, Japan, Mexico, and Russia, "prohibits the take, possession, import, export...of any migratory bird species, their eggs, parts and nests except as authorized under a valid permit..." No other animal species has been the subject of its own protection treaties. And in 1962, Rachel Carson's *Silent Spring* alerted the world to the dangers of pesticides as evidenced by their effect on birdlife. The plight of birds, a sentinel species of overall environmental health, informs stewardship strategies, including those with respect to buildings and infrastructure.

Bird-life is an important asset to the travel and recreational sectors of the economy. According to the United States Fish and Wildlife Service, bird watching is the second fastest growing leisure activity in North America. An estimated 63 million Americans participate in wildlife watching and eco-tourism each year. In the process, they spend close to $30 billion annually, with a major portion related to birds.

Birds perform irreplaceable ecological functions by consuming vast quantities of insects, pollinating plants, distributing seeds, and consuming weed seeds. These processes help to maintain biodiversity worldwide, and they are contributions that have significant economic value. Insect control, for example, reduces damage to many tree species and maintains forest biomass. This in turn ensures the productivity of the timber industry, helps to protect against flooding and water pollution, and preserves the resilience of culturally important landscapes. Birds also help safeguard public health by eliminating many insect vectors of disease, diseases that include West Nile virus, malaria, and dengue fever.

Abstracting from a particular fondness for birds, human beings also seem to display an inherent love for all living things—a deeply resonant, even biologically rooted feeling that scientists call "biophilia." The "biophilia hypothesis" explains why people are sometimes willing to go to such great efforts to protect living things.[6] Society is only beginning to understand the physiological, psychological and spiritual benefits of biophilia. Nevertheless, this phenomenon is compelling general motivation for the sustainability movement, and for promoting bird-safety in particular.



PHOTO CREDIT: NEW YORK CITY AUDUBON



Bird imagery is frequently embedded throughout the built environment, especially in gothic and classical ornamentation, and in freestanding statuary.



PHOTO CREDIT: NATIONAL PARK SERVICE

Bird watching is a popular outdoor pastime.

In New York City, bird watching has become a popular and visible pastime. On almost any day of the year, bird watchers are easy to spot in Central Park and other large urban open spaces. In fact, many bird watchers consider Central Park one of the best bird-watching locations in the United States. One pair of birds that receives constant attention is the red-tailed hawks nesting on a building along Fifth Avenue. A recent effort by tenants to remove their nest fueled citywide protests demanding its replacement. Nearly every major newspaper carried the story as front-page news. The male hawk affected by the tenants' actions is known as "Pale Male" for his distinct white breast feathers. Since the removal and restoration of his nest, Pale Male has become an icon to New York City nature lovers. He is the subject of several books and a website of documentary photography that is updated daily. [7]

Birds and Building Green

The emergence of a recent generation of sustainable or 'high performance' buildings suggests that a transformation is underway in the real estate and construction industry. Advancements in building science, materials and technology, and the emerging emphasis on integration of complex systems in design have produced buildings that display unprecedented levels of environmental responsibility and functionality. The green building movement has enabled vast improvements in energy and resource efficiency, indoor environmental quality, and human comfort and health, all while maintaining an emphasis on the economic bottom line.

Advocating bird-safety in buildings is integral to the green building movement. In many regards, the strategies for reducing bird-collisions complement other sustainable site and building objectives. Common concerns include light pollution avoidance, reduced disturbance to site and natural systems, and lowered energy use. Realistically, however, there may be trade-offs or compromises. For example, expansive glazing used to augment views, daylight, natural ventilation, and, in some cases, save energy by capturing solar gain may lead to increased bird kills. Current energy saving low-emissivity glass, or glazing with low solar heat gain coefficients often contribute to increased reflectivity. Encouraging visual access to a building's surrounding landscape —while it may function to connect people with nature— can also lead to the disorientation of birds. Ill-sited native or naturalized vegetation may create magnets for birds, luring them into harm's way. The desire to bring nature and natural processes into buildings needs to be balanced with knowledge of potential liabilities. Unless carefully considered, greening efforts may actually contribute to the loss of the very creatures people seek to protect.


THERE IS NOTHING IN WHICH THE BIRDS DIFFER MORE FROM MAN THAN THE WAY IN WHICH THEY CAN BUILD AND YET LEAVE A LANDSCAPE AS IT WAS BEFORE.
- Robert Lynd. *The Blue Lion and Other Essays*

Conditions Affecting Bird Collisions

For both new and existing buildings, undertaking bird-safe best practices requires an assessment of a range of macro and micro conditions. These include evaluation of the region and the site; bird demographic chronology and habitat use; building height; glass coverage and glazing characteristics; and building operational criteria for exterior and interior illumination.

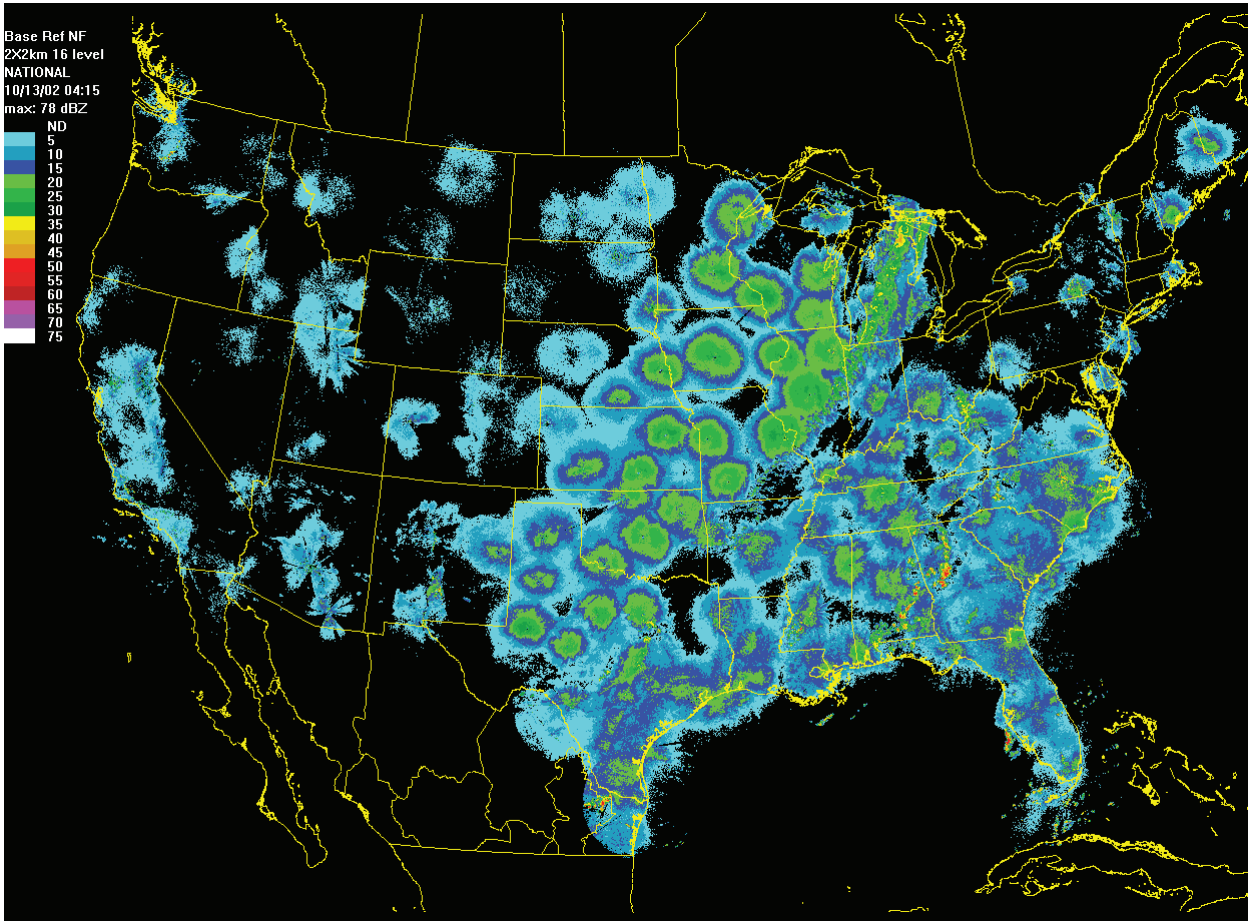
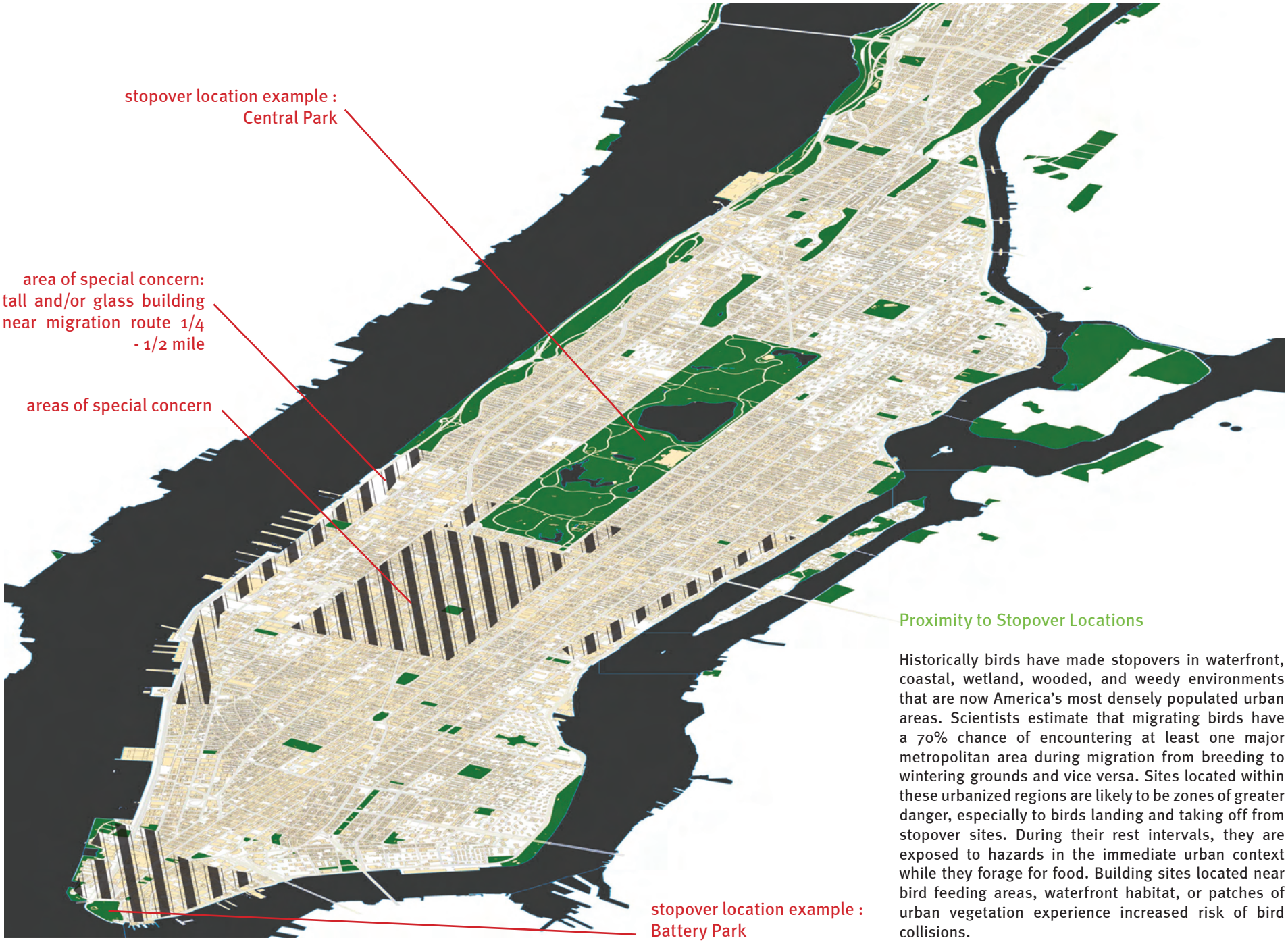


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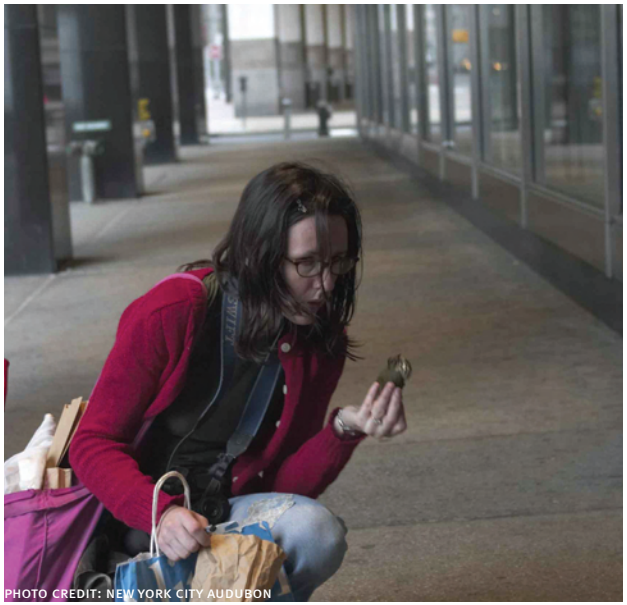
Broad-front Songbird Migrations

Billions of migratory birds travel across North America each spring and fall to seek breeding or wintering grounds in locales that offer abundant food or space for nesting. Songbirds travel primarily at night in what can best be described as “broad-front” migration. These migrations, in which weather plays a significant role, can have seasonal and annual variations in songbird numbers and concentrations and in timing. During fall migration, birds travel from summer breeding grounds in the temperate or arctic northern hemisphere to wintering grounds in the equatorial tropics or temperate zones of the southern hemisphere, making the reverse trip the following spring. These historic routes follow major rivers, coastlines, mountain ranges, and lakes. Along the way densely built urban areas have become migration danger zones.



Proximity to Stopover Locations

Historically birds have made stopovers in waterfront, coastal, wetland, wooded, and weedy environments that are now America's most densely populated urban areas. Scientists estimate that migrating birds have a 70% chance of encountering at least one major metropolitan area during migration from breeding to wintering grounds and vice versa. Sites located within these urbanized regions are likely to be zones of greater danger, especially to birds landing and taking off from stopover sites. During their rest intervals, they are exposed to hazards in the immediate urban context while they forage for food. Building sites located near bird feeding areas, waterfront habitat, or patches of urban vegetation experience increased risk of bird collisions.


PHOTO CREDIT: NEW YORK CITY AUDUBON

Building Orientation and Massing Features

Since migratory routes are broad districts and bird flight patterns vary day to day, one cannot simply address building facades that face an assumed direction of migration. The impacts of all facades, with special emphasis on those adjacent to landscapes or other features attractive to birds, must be considered. Buildings with exterior and/or interior landscaped courtyards create additional hazards, as do glazed areas. As tight enclosures, they can make it very difficult for birds to escape safely.


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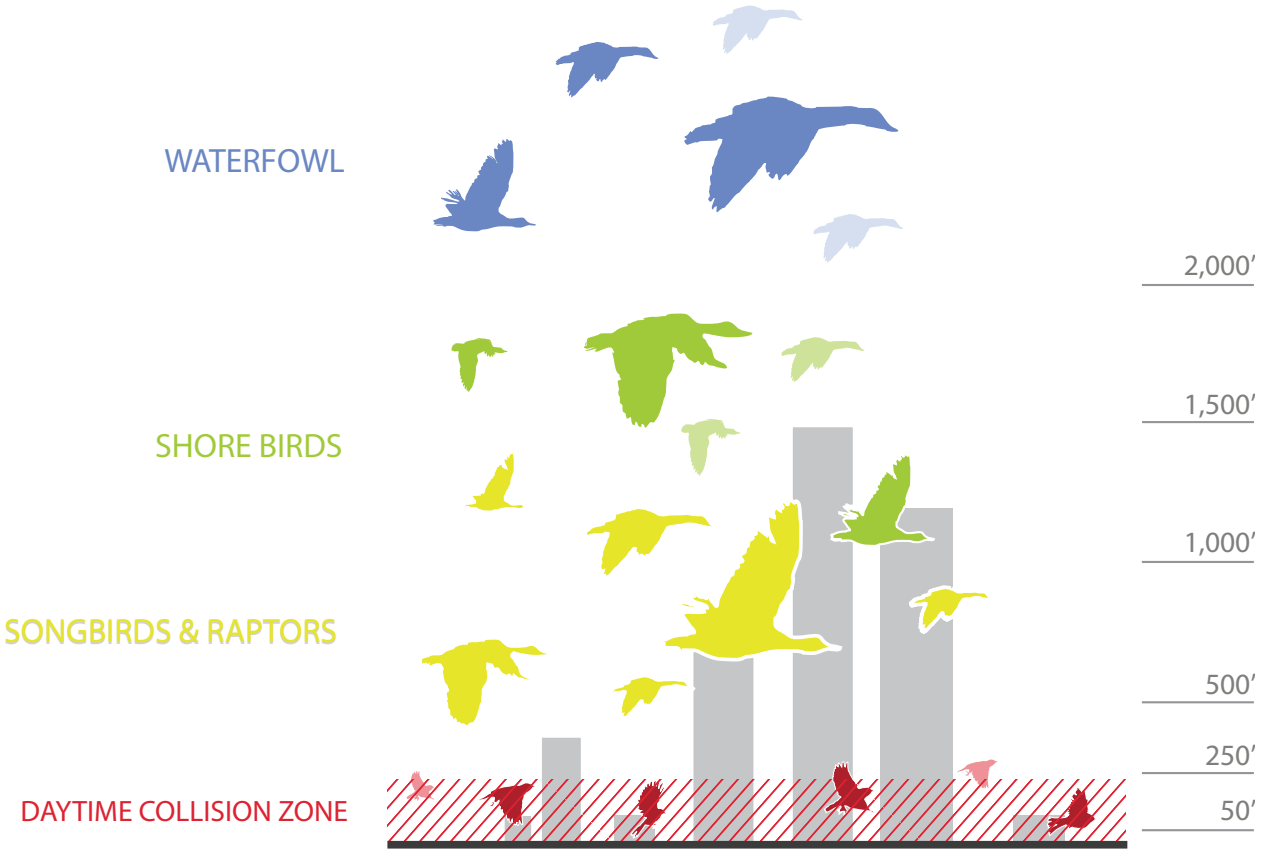
Proximity to Feeding Grounds and Habitat Area

Building sites near water bodies and wetlands—no matter how small—put both resident and migrant species at risk. Sites bordering parkland, pocket parks, habitat patches, green roofs, and street-tree corridors present bird-vulnerable facades, since birds forage these areas for food. Suburban building sites with proximity to natural landscapes also present a range of hazards and can be as dangerous to birds as urban settings.


PHOTO CREDIT: NEW YORK CITY AUDUBON

Local Meteorological Conditions

Regions that are prone to haze, fog, mist, and/or low-lying clouds may see more frequent bird-kills, especially if the area contains tall buildings over 500 feet that are highly illuminated. Generally, there are fewer birds aloft during precipitation; however, inclement weather can reduce their navigational awareness forcing them to fly at lower altitudes in search of visual clues. Heavily illuminated buildings in their path can serve as a deadly lure.



Building Height

Lower levels:
The most hazardous areas of all buildings, especially during the day and regardless of overall height, are the ground level and bottom few stories. Here, birds are most likely to fly into glazed facades that reflect surrounding vegetation, sky and other features attractive to birds.

Moderate height:
Buildings between 50 and 500 feet tall pose hazards since migrating birds descend from migration heights in the early morning to rest and forage for food. Migrants also frequently fly short distances at lower elevations in the early morning to correct the path of their migration, making moderate-height buildings a prime target, especially if they have large expanses of reflective or transparent glass, or if they are highly illuminated.

Tallest:
While the exact height of birds' migratory paths varies depending on species, geography, season, time of day/night, and weather conditions, radar tracking has determined that approximately 98% of flying vertebrates (birds and bats) migrate at heights below 500 meters (1640 feet) during the spring, with 75% flying below that level in the fall. Today, many of the tallest buildings in the world reach or come close to the upper limits of bird (and bat) migration.[8] Storms or fog, which cause disorientation, put countless numbers of birds at risk during a single evening. Any building over 500 feet tall then—approximately 40-50 stories—is an obstacle in the path of avian nighttime migration and must be thoughtfully designed and operated to minimize its impact.

Glass Coverage and Glazing Characteristics

A major determinant of potential strikes is the sheer percentage of glass used on the building facade. In general, collisions will occur wherever glass and birds coexist. The ground level and lowest stories are the major collision zones. At these levels large expanses of monolithic glazing should be minimized, glazing reflectivity (especially when adjacent to landscapes) reduced, and situations where glazing promotes the false vision of unobstructed passage limited. One proven technique is to maximize a façade's "visual noise", or the readily visible differentiations of material, texture, color, opacity, or other features that help to fragment glass reflections and reduce overall transparency.[9] "Visual noise" at the scale of the building and at the level of the individual glass unit should be incorporated.



Example of Visual Noise:
metal sunscreen at L'Institut du Monde Arabe
architect: Jean Nouvel



ABOUT 5 MILLION BIRDS PASS THROUGH NEW YORK CITY EACH MIGRATION PERIOD. AND WE WANT TO MAKE SURE THEY ARE WELL CARED FOR WHILE THEY ARE HERE, SO THEY CAN PASS SAFELY ON TO THEIR ULTIMATE DESTINATION.

- E. J. McAdams, New York City Audubon Society

HERE IS THE BOTTOM LINE :
BIRDS JUST DON'T SEE GLASS. THESE ANIMALS ARE NOT ABLE TO RECOGNIZE GLASS AS A BARRIER AND AVOID IT.

- Professor Daniel Klem, *New York Times*, September 24, 2005



Technical Strategies

Bird-Safe Best Practices for Buildings

The following sections address specific recommendations in the planning, design, retrofit, and operation of buildings to minimize bird collisions. Each 'best practice' includes technical strategies; describes potential benefits and limitations; identifies measures that complement the LEED (Leadership in Energy and Environmental Design) Green Building Rating System; and presents case studies.

The LEED green building rating system™ [10] (continuously refined) is the U.S Green Building Council's nationally accepted standard of sustainability for the commercial, residential, and institutional building industries. Credits are awarded in six categories:

1. Sustainable Sites
2. Water Efficiency
3. Energy and Atmosphere
4. Materials and Resources
5. Indoor Environmental Quality
6. Innovation and Design Process



Comprehensive Local Actions for Bird Safety

OBJECTIVE

Identify and document specific sites and districts that are in predictable migratory and resident bird collision areas. Promote bird-friendly policies and activities in those areas. Raise awareness of the bird collision issue.

BENEFITS & LIMITATIONS

+ Educates public on bird-safe practices.

+ Improves bird safety on a district-wide or city-wide scale.

+ Encourages local market forces to facilitate industry change.

+ Complements local green building initiatives.

+ Reduces light pollution and results in energy savings.

– Requires systematic data on bird-collisions and mortality to achieve effectiveness.

– Depends on real estate industry acceptance and initiative.

– May require implementation of effective policy measures (incentives or regulatory) to help overcome general resistance to change, based on perceived cost increases.

LEED INTEGRATION

Sustainable Sites (SS) Credit 5.1:
Site Development: Protect or Restore Habitat

Sustainable Sites (SS) Credit 5.2:
Site Development: Maximize Open Space

TECHNICAL STRATEGIES
Comprehensive Local Actions for Bird Safety

Support voluntary efforts to conduct district-wide, daily surveys that are based on peer-reviewed scientific protocols for injured and dead birds resulting from building collisions:

• Conduct surveys in major business or residential districts near waterfronts, parks and other habitats that are attractive to birds.

• Encourage local conservation groups to compile data on the mortality rate and injury rate of bird collisions.

• Instruct volunteer monitors in methods of temporarily caring for injured birds before transporting them to certified wildlife rehabilitators.

• Donate dead specimens to authorized bird conservation organizations or museums to aid in species identification and to benefit scientific study, as per the Migratory Bird Treaty Act of 1918 (see page 10).

• Produce educational materials on bird-safe practices for public officials, building owners and operators, and the general public.

• Advocate for appropriate, cost-effective building or site changes at bird collision 'hot spots.'

Develop district-wide Lights-Out Programs:

• Encourage building owners and managers to extinguish all unnecessary exterior and interior lights from 11pm to sunrise during the spring migration, from mid-March to early June, and the fall migration, from late August to late October.

• Encourage building operators to use gradual, "staggered switching" to turn on building lights at sunrise rather than instant light-up of the entire building.

• Monitor the effectiveness of lights-out programs. Estimate reductions in district-wide energy usage, light emissions, bird collisions, and bird mortality.

• Publicize results and expand participation.

Develop planning mechanisms to encourage bird-friendly development and building operation:

• Integrate maps of predictable bird-hazard zones (e.g. where migratory and resident bird collisions are prevalent) into the planning process.

• Consider integrating bird-hazard districts into local zoning ordinances.

• Consider zoning or financial incentives to encourage bird-safe building design and operation.

• Promote implementation of bird-safety measures in publicly funded parks, infrastructure and facility capital projects.

• Promote the local use of bird-safe design methods to achieve a LEED Rating System Credit

• Develop funding mechanisms for bird-safe products research and development.

Injured bird under temporary care rescued by volunteer.



Case Study

City of Toronto
Fatal Light Awareness Program (FLAP)

The City of Toronto, with its glassy skyline located on the northern shore of Lake Ontario, is an alluring and potentially harmful stopover destination for migrating birds. Since 1993, a volunteer organization known as the Fatal Light Awareness Program (FLAP) has patrolled the downtown during spring and fall migration seasons to collect birds that were killed or injured by building collisions. The group has collected over 32,000 dead birds, representing 140 different species.[11] Five of the twenty most abundant species recorded by FLAP have experienced significant long-term population declines. Fortunately, over half of the birds FLAP volunteers collect annually survive thanks to their rehabilitation efforts. In 1997, FLAP sponsored the Bird Friendly Building Program, which successfully encouraged sixteen major downtown buildings to extinguish unnecessary interior and exterior lighting after midnight during migration seasons. The program has reduced nighttime light emission and bird mortality throughout the downtown. Eliminating the floodlighting of the CN Tower, for example, virtually eradicated bird mortality at that site. FLAP estimates that the participation of all sixteen buildings in the Bird Friendly Building Program saves $3.2 million in energy costs, an equivalent reduction of 38,400 tons of carbon dioxide emissions. For most participants, this bottom line cost savings is justification alone to reduce or eliminate nighttime lighting.

http://www.flap.org



SOLUTION: LIGHTS OUT



PHOTO CREDIT: MICHAEL MESURE / FLAP

Bird-Safe Site Planning and Landscape Design

OBJECTIVE

Minimize the potential for bird collisions when siting buildings near existing landscape features and when planning new landscapes in close proximity to buildings.

BENEFITS & LIMITATIONS

+ Simple and cost-effective strategy for reducing the attractiveness of glazed buildings to birds.

+ Encourages the placement of habitat attractive to birds away from buildings.

– May conflict with aesthetic desires to reflect the surrounding landscape in building façades or to make the building totally transparent to, or integrated with, significant landscape features.

LEED INTEGRATION

Sustainable Sites (SS) Credit 5.1:
Site Development: Protect or Restore Habitat

Sustainable Sites (SS) Credit 5.2:
Site Development: Maximize Open Space

Sustainable Sites (SS) Credit 7.2:
Heat Island Effect: Roof

Energy and Atmosphere (EA) Credit 1:
Optimize Energy Performance

PETER KERZE



TECHNICAL STRATEGIES
Bird-Safe Planning and Landscape Design

Analyze the site to determine potential attractions for bird populations:

• Consider the proximity of the building to vegetated streetscapes or urban parks.

• Identify mature trees and shrubs, grassy meadows, water features, seed and insect sources, and other natural features, especially those that function as food sources and shelter for migratory and resident bird populations.

• Identify human-made structures or other site features that attract birds, such as sources of water, nesting and perching sites, and shelter from adverse weather conditions.[12]

• Integrate with LEED Credit SS 5.1 - Site Development: Protect or Restore Habitat.

Site building(s) in relation to existing landscape features to reduce conflicts with existing features that may serve as attractive bird habitat:

• Minimize the reflection of existing vegetation on building facades.

• Consider reducing the size of the building footprint to avoid conflicts with existing landscapes. Coordinate with LEED Credit SS 5.2 - Site Development: Maximize Open Space.

• Consider means to isolate existing vegetation that is especially attractive to birds.

• If sited near water features, use soil berms, furniture, landscaping, or architectural features to prevent reflection of water in glazed building facades.

• In places where situating buildings near existing landscapes is desired or unavoidable, utilize architectural strategies to ensure that building glazing and avian habitat can coexist safely. See “Bird-Safe Enhancements to Building Envelope” on page 28.

Create bird-safe landscaping:

• Place new landscapes sufficiently away from glazed building facades so that no reflection occurs.

• Alternatively, if planting of landscapes nearby a glazed building façade is desirable, situate trees and shrubs immediately adjacent to the exterior glass walls, at a distance of less than three feet from the glass.[13] Such close proximity will obscure habitat reflections and will minimize fatal collisions by reducing birds’ flight momentum from the vegetation towards the glass. This planting strategy also provides beneficial summertime shading and reduces cooling loads.

• Minimize the reflection of rooftop landscapes in adjacent building features or surrounding properties. Ensure adequate space for birds to fly safely to and from rooftop vegetation. Coordinate with LEED Credit SS 7.2 - Heat Island Effect: Roof.

• Minimize the exterior visibility of interior landscaping to reduce its attractiveness to birds.

• Utilize fritting, shading devices or other techniques to obscure attractive habitat for bird populations. See “Bird-Safe Enhancements to Building Envelope” on page 28.

Properly locate new water features:

• Take special care to isolate from glazed facades any ponds, stormwater retention basins, wetlands, swales or related infrastructure that offers food and shelter to birds.



STUDIO GANG ARCHITECTS / SCAPE

Case Study

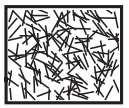
Ford Calumet Environmental Center

City of Chicago Dept of Environment
International Design Competition Winning Entry
Chicago, Illinois
Architects: Studio Gang Architects
Landscape Architecture: Kate Orff SCAPE
w/Site Design Group

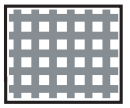
The Ford Calumet Environmental Center is a proposed 4,000-acre open space located on Chicago's south side that was the subject of a recent international design competition. The site incorporates large expanses of marshes, wetlands, and prairies that serve as stopover sites for migratory birds. Concerned that a glass-clad visitor center would kill the species that the public is coming to see, the competition's winners made bird safety a guiding priority in their design proposal. The designers took inspiration from birds' nest construction, envisioning a basket-like woven screen that also incorporated locally discarded industrial steel scrap. Positioning the screen around the glass façade and porch reduces glass collisions while still allowing views of the surrounding environment. In addition to promoting bird safety, the woven screen shades the building, creates an exciting spatial and textural experience for visitors, and functions as a 'blind' on the viewing deck that allows people to get close to the birds without creating a disturbance.

http://www.studiogang.net/studiogang.net/projects/pages/ford.htm

http://www.scapestudio.com/projects



SOLUTION: VISUAL NOISE



SOLUTION: SCREEN / SCRIM / FRITTING

Bird-Safe Enhancements to the Building Envelope

OBJECTIVE

Improve upon conventional building envelope design to prevent bird collisions with glazed surfaces, while maintaining transparency for views, daylighting and passive environmental control.

BENEFITS & LIMITATIONS

+ Complements efforts to control interior building climate passively and to create variable climate zones depending on programmatic uses.

+ Encourages innovative aesthetic approaches to façade treatment in addition to increased bird safety.

– Potentially increases construction costs.

– May compromise daylighting and view objectives.

– Potentially conflicts with desired aesthetic of maximal transparency.

– Untested strategies may not achieve desired outcome.

LEED INTEGRATION

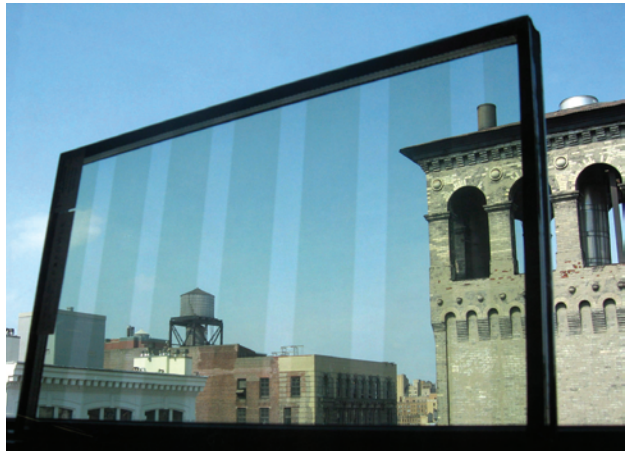
Sustainable Sites (SS) Credit 8:
Light Pollution Reduction

Energy and Atmosphere (EA) Credit 1:
Optimize Energy Performance

Indoor Environmental Quality (EQ) Credit 6.1:
Controllability of Systems: Lighting

Indoor Environmental Quality (EQ) Credit 8.1:
Daylight & Views

Bird-Legible Pattern: Ornilux Glass



TECHNICAL STRATEGIES
for Bird-Safe Enhancements to the Building Envelope

Plan building layout to minimize the likelihood of bird collisions:

• Integrate site and landscape features to minimize those hazards that bring birds close to buildings such as vegetation, water and other features attractive to birds. See "Bird-Safe Site Planning and Landscape Design" on page 25.

• Where practicable, limit the overall amount of glazing in areas that are in predictable migratory and resident bird collision areas.

Design ground level stories, which are the most hazardous areas of all buildings, to minimize bird collisions:

• Wherever possible, limit the amount of glazing used on ground level stories, particularly in areas that are adjacent to landscapes.

• In glassy areas, seek to maximize "visual noise", or readily visible differentiations of material, texture, color, opacity, or other features that help to fragment glass reflections and reduce overall transparency.[14] Incorporate "visual noise" at the scale of the building and at the level of the individual glass unit.

• Utilize etching, fritting, and opaque patterned glass to reduce transparency.

• Utilize low-reflectivity glazing.

• Utilize low-e patterning in glass.

• Utilize shading devices, screens, and other physical barriers to reduce birds' access to glass.

• Consider the use of angled glass, between 20 and 40 degrees from vertical, to reflect the ground instead of adjacent habitat or sky.[15]

• Minimize bird habitat near ground level stories.

At the whole building scale, develop strategies to make glazing more apparent to birds:

• Avoid monolithic, undistinguished expanses of glazing.

• Create building elevations that simulate large scale 'visual noise'.

Utilize bird-legible patterns on individual glass units to make glass more apparent while maintaining its visual acceptability:

• Employ patterns in sizes that, according to experiments, discourage birds from attempting through-passage: a maximum space measuring two inches tall by four inches wide, or the equivalent size of a human handprint oriented horizontally.[16]

• Consider creative glass patterns that accomplish objectives for shading, views, and bird-safety. Integrate glass patterning with the overall building design.

• In locations where bird collisions are predictable, seek uniform covering of glass with bird-safe patterning.[17]

• Consider applying acid-etched or sandblasted patterns to glass on the outside surface to "read" in both transparent and reflective conditions.

• Use applied ceramic fritting in dot matrix patterns and grids to make glass visible to birds, while achieving solar shading. (Note: Although fritting is useful for creating visual noise, it is less effective at reducing reflectance since it is generally applied on the interior face of the glass.)

• Use real or applied divided lights to break up large window expanses into smaller subdivisions.

• Pay particular attention to treating the ground level stories—which is where most bird collisions occur—as well as any areas that are adjacent to landscapes and other bird habitat.

Develop strategies to minimize the reflection of surrounding habitat or sky in glass facades:

• Wherever possible, specify reduced- or low-reflectivity glass (0 to 10% reflectivity).

• In utilizing spectrally selective glass, seek to balance good thermal control and daylight transmittance with reduced or muted reflectivity (less than 10%), or provide exterior devices to reduce reflection.

• Consider the use of angled glass, between 20 and 40 degrees from vertical, to reflect the ground instead of adjacent habitat or sky.[18]

• Pay particular attention to treating the ground level stories—which are where most bird collisions occur—as well as any areas that are adjacent to landscapes and other bird habitat.

Employ exterior shading or other architectural devices on glazed façades to enhance bird safety:

• Incorporate louvers, awnings, sunshades, light shelves or other exterior shading/shielding devices to reduce reflection and give birds visual indication of a barrier.

• Consider other highly patterned shading/shielding devices that will encourage bird safety. Integrate these features with the building's overall design. (See examples for details.)[19]

• Where appropriate, use plastic or metal screens over windows to reduce reflectivity and decrease the damage caused to birds colliding with the glass.

• Pay particular attention to treating the ground level stories—which are where most bird collisions occur—as well as any areas that are adjacent to landscapes and other bird habitat.

• Coordinate bird-safety efforts with daylighting and passive cooling efforts. See LEED Credit EQ 8.1 Daylight & Views, and LEED Credit EA.1 Optimize Energy Performance for more details.

Design and operate interior window treatments to improve bird safety:

• Use light-colored solar reflective blinds or curtains to reduce glass transparency and add visual noise.

• Close curtains and blinds if evening illumination is utilized.

• Consider photo-sensors, timers, or other automatic controls to regulate shading devices.

Design to eliminate nighttime light trespass from the building's interior:

• Integrate automatic lighting controls to extinguish lights in the evening by 11:00pm.

• Create smaller zones in lighting layouts to discourage wholesale area illumination.

• Incorporate and encourage the use of localized task lighting.

• Install light dimmers in lobbies, atria and perimeter corridors for nighttime use.

• Install motion detectors to turn off lights in the evening when no occupants are present.[20]

Design exterior lighting to minimize light trespass at night:

• Minimize amount and visual impact of perimeter lighting and façade up-lighting.

• Specify full-cutoff exterior fixtures to reduce light trespass.

• Utilize motion-detection as lighting controls wherever possible.

• Utilize minimum wattage fixtures to achieve appropriate lighting levels.

• Avoid use of floodlighting.

• On skyscrapers or other tall structures that must comply with federal aviation or marine safety regulations, install minimum intensity white strobe lighting with a three second flash interval instead of continuous flood lighting, rotating lights, or red lighting.[21]

• Ensure that all exterior light fixtures are properly installed to prevent unintended light trespass.[22]

Minimize rooftop obstacles to bird's flight:

• Minimize the amount of exterior antennas and other tall structures, including cell phone, television and other media equipment. Collocate all necessary antennas and tall equipment, and locate them to minimize conflicts with birds.

• Utilize self-supporting lattice or monopole towers that do not require the use of guy wire supports.

• Avoid up-lighting rooftop antennas and tall equipment, as well as decorative architectural spires.

PHOTO CREDIT: RENZO PIANO BUILDING WORKSHOP AND FXFOWLE ARCHITECTS



PHOTO CREDIT: RENZO PIANO BUILDING WORKSHOP AND FXFOWLE ARCHITECTS



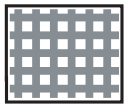
Case Study

New York Times Headquarters

New York, NY
Architects: Renzo Piano Building Workshop
and FXFOWLE Architects

The 52-story headquarters for the New York Times is a new landmark for both sustainability and sensitivity to birdlife. From the outset, the architectural firms of Renzo Piano Building Workshop and FXFOWLE Architects collaborated with experts to formulate a comprehensive daylighting strategy that reduces lighting energy use, minimizes cooling loads and controls glare. The fully glazed curtain wall is shaded by an exterior framework, placed one and a half feet from the glass and is comprised of a series of thin horizontal ceramic tubing placed on 4 1/2" centers that corresponds to the vertical spacing of a bird-safe pattern. The only place where horizontal tubes do not occur is at eye level on each floor, allowing for an unobstructed view through the glass. In addition to shading significant portions of the glass, reducing solar heat gain by 30%, and allowing deep penetration of daylight, the shading device may minimize avian mortality by blocking birds from the glass surface.

http://www.lbl.gov/Science-Articles/Archive/sb-EETD-NYT-building.html



SOLUTION: SCREEN / SCRIM / FRITTING

Case Study

Swarthmore College
Unified Science Center

Swarthmore, PA
Architects: Helfand Architecture and Einhorn Yaffee Prescott
Landscape design: Gladnick Wright Salameda; ML Baird & Co.

This renovation and 75,000 square foot addition to an existing science facility was planned to create a series of outdoor courtyards that took advantage of the site's beneficial topography and mature trees. Sensitive to the liabilities of extensive glazing placed near attractive landscapes, the College and its architect Margaret Helfand consulted ornithologist and noted building-related bird mortality expert Daniel Klem. (See footnote# 1) Klem proposed patterning portions of the glass at potential collision 'hot spots.' After testing several configurations, the designers decided to use a glass with a ceramic frit matrix at locations deemed susceptible to bird collision. (The initial tests prior to installation had shown significant reduction in bird strikes, according to objective experimental evidence.) Swarthmore engineering professor Carr Everbach, a member of the College's green-design committee, designed a "thump sensor" webcam for installation next to windows to detect bird collisions. According to Klem, collisions have been reduced significantly to a mere one or two a year, giving Swarthmore confidence to extend the treatment to other campus buildings.[23]

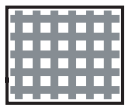
http://www.archnewsnow.com/features/Feature171.htm



PHOTO CREDIT: BIRDSANDBUILDING.ORG



PHOTO CREDIT: BIRDSANDBUILDING.ORG



SOLUTION: SCREEN / SCRIM / FRITTING

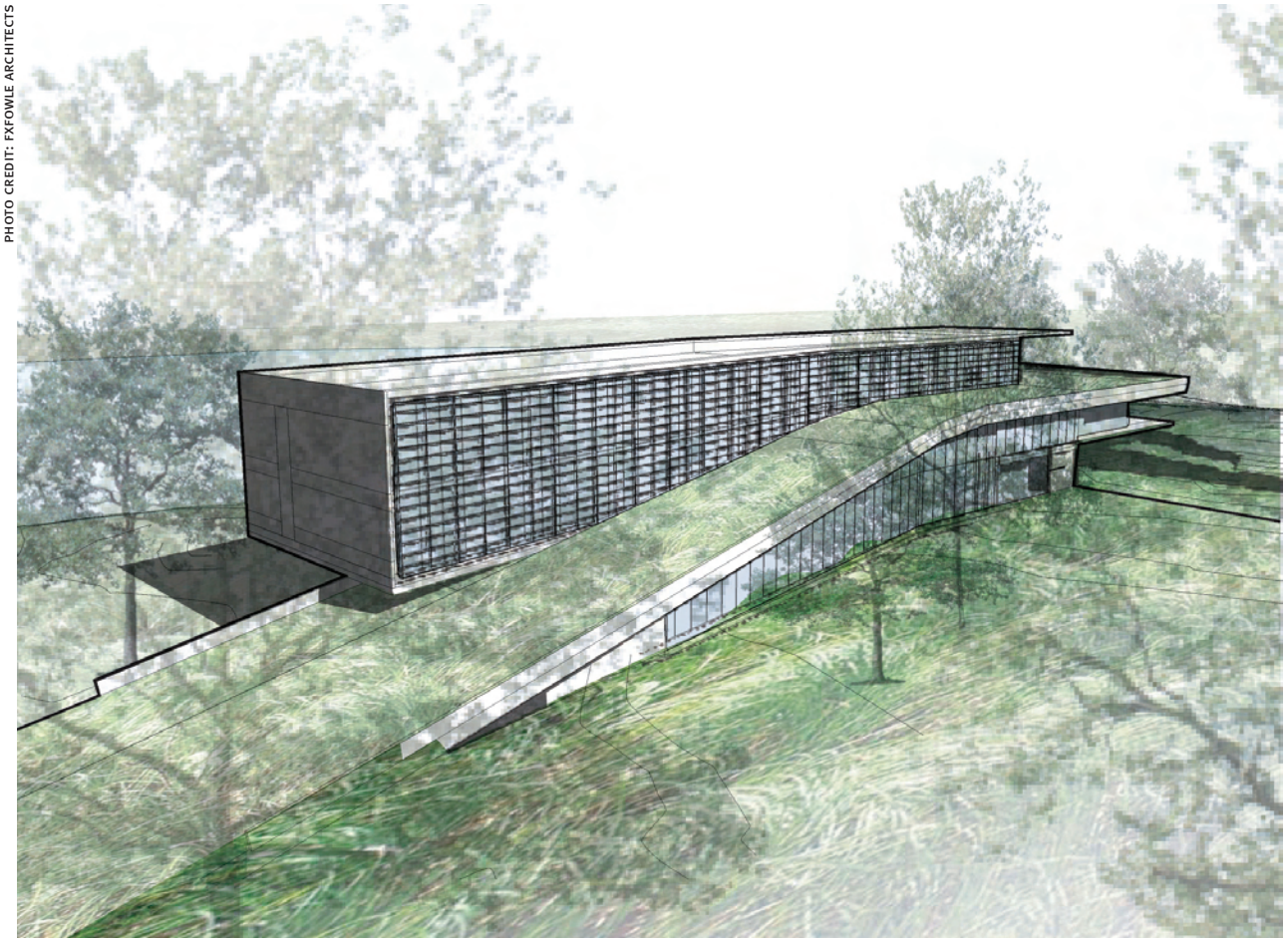


PHOTO CREDIT: FXFOWLE ARCHITECTS

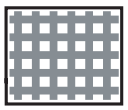
Case Study

Wildlife Conservation Society's Center for Global Conservation

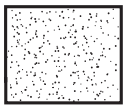
Bronx, NY

Architects: FXFOWLE Architects

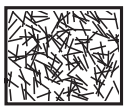
For their new 40,000-square-foot Center for Global Conservation, the Wildlife Conservation Society/Bronx Zoo sought a building design that would embody their mission to preserve wildlife and habitat. Aiming for a LEED gold rating, the Wildlife Conservation Society and FXFOWLE team integrated a host of sustainable features into the design, including a green roof that is connected directly to the landscape. Sited between the Bronx Zoo's Aviary exhibition and a body of water, bird safety was a priority consideration. Four bird-safe strategies were developed: 1) A wooden screen doubles as a solar shading device and bird deterrent. 2) Exterior acid-etched glass patterned to minimize interference with human views reduces transparency and reflections of sky and habitat. 3) Glass with interior ceramic frit patterns adds aesthetic weight to a stone-clad base while creating visual noise. 4) Non-reflective exterior glass is employed in the glazed conference room and entry areas. Additional bird safety measures include minimizing night lighting and utilizing full cut-off luminaries, both of which reduce energy consumption and light pollution.



SOLUTION: SCREEN / SCRIM / FRITTING



SOLUTION: NON-REFLECTIVE MATERIAL



SOLUTION: VISUAL NOISE



SOLUTION: LIGHTS OUT

Modifications to Existing Buildings to Reduce Bird Collisions

OBJECTIVE

Undertake alterations or retrofits to buildings with high incidence of bird collisions.

BENEFITS & LIMITATIONS

+ Retrofits can target specific problem areas and do not require comprehensive building intervention.

+ Many techniques are cost-effective and require little or no construction work.

+ Some retrofits are easily integrated with regular building maintenance.

+ The aesthetic impacts of most retrofit solutions are minimal.

– Some retrofit choices are expensive.

– Retrofits may be difficult to achieve or impractical for large towers.

LEED INTEGRATION

Sustainable Sites (SS) Credit 5.1:
Site Development: Protect or Restore Habitat

Energy and Atmosphere (EA) Credit 5.2:
Site Development: Maximize Open Space

Indoor Environmental Quality (EQ) Credit 8.1:
Daylight & Views

TECHNICAL STRATEGIES

Modifications to Existing Building to Reduce Bird Collisions

Retrofit problematic windows and glass facades to reduce bird collisions:

• Consider installing transparent or perforated patterned, non-reflective window films that make glass visible to birds (examples include Scotchprint, or CollideEscape).

• Consider painting, etching, or temporarily coating collision-prone windows to make them visible to birds.

• Install louvers, awnings, sunshades, light shelves or other shading/shielding devices at large expanses of glass to reduce reflection and to signal the existence of a barrier.

• Install and operate reflective blinds, shades or curtains to reduce glazing reflectivity and indicate the presence of a barrier to flight. Close curtains or blinds during the evenings if the interior is illuminated.

• Consider re-glazing existing windows that experience high rates of bird collisions with low- reflectivity, etched, frosted, or fritted glass. Also, consider replacing large existing windows with multiple smaller units, divided lights or opaque sections.

Undertake strategies to create a physical barrier to the glass:

• Install exterior coverings, nettings, insect screens, latticework, artwork, shading or shielding devices at notably hazardous windows to deter birds or otherwise reduce the momentum of their impact.

• Consider planting trees and shrubs close to the building within a maximum of three feet from a problematic façade or curtain wall. This planting strategy will block access to habitat reflections and birds alighting in these trees will not have the distance to build momentum if they move towards the glass. This planting strategy also provides beneficial summertime shading and reduces cooling loads. See “Bird- Safe Site Planning and Landscape Design” on page 25.

Remove or relocate features attractive to bird populations to reduce the frequency of collisions:

• Relocate interior plantings, water sources or other features that are causing birds to crash into glass windows.

• Consider relocating or altering landscapes to minimize reflection in glass facades. See “Bird-Safe Site Planning and Landscape Design” on page 25.



Case Study

Cusano Environmental Education Center

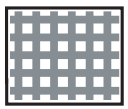
Philadelphia, PA
John Heinz National Wildlife Refuge

This green building demonstration project, completed in 2001, was built adjacent to a wetland. Its glazed elevations, while affording intimate views of the natural surrounding, caused bird fatalities. The problem was successfully remedied through a partial retrofit with fine netting.





PHOTO CREDIT: BILL BUCHANAN / JOHN HEINZ NATIONAL WILDLIFE



SOLUTION: SCREEN / SCRIM / FRITTING

PHOTO CREDIT: BIRDSANDBUILDINGS.ORG



PHOTO CREDIT: BIRDSANDBUILDINGS.ORG

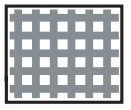


Case Study

Adler Planetarium

Chicago, Illinois
Retrofit to lakeside glass pavilion
Museum Management

This glass pavilion positioned directly adjacent to Lake Michigan encloses the Adler Planetarium's exit stair. Noting it was causing bird death and injury, the Museum maintenance staff sought to address the problem first through the application of traditional bird decals. When that solution proved ineffective, they subsequently upgraded to this striping system for the glass fronting the lake, which has largely addressed the problem.



SOLUTION: SCREEN / SCRIM / FRITTING

Case Study

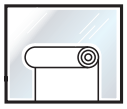
Patuxent Research Refuge Visitors Center

Laurel, Maryland
Retrofit to facility
Senior Research Staff

Dedicated to wildlife research, this U.S. Fish and Wildlife Service national wildlife refuge had experienced a high incidence of bird strikes at this glassy visitors center since its opening in 1994. To eliminate this problem while studying the efficacy of such a retrofit, exterior films were applied to major portions of the windows. Bird strikes and mortalities were monitored on these partially filmed windows for two migration cycles. It was determined that un-filmed panels still experienced bird strikes and a few bird mortalities whereas adjacent filmed window panels experienced very few strikes and no mortalities. These films, which reduce glass reflectivity, offer other performance characteristics such as UV reduction and solar heat gain reduction.



PHOTO CREDIT: HOLLIDAY H. OBRECHT III (SENIOR REFUGE BIOLOGIST) / U.S. FISH AND WILDLIFE SERVICE



SOLUTION: USE OF PLASTIC FILMS, DIACHROIC COATINGS AND TINTS ON FACADE



PHOTO CREDIT: BIRDSANDBUILDINGS.ORG

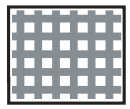
Case Study

Levy Senior Center

Evanston, Illinois

Retrofit to courtyard

This facility has as a major feature, an interior courtyard, which was well landscaped to attract birds. Reflections of the sky and vegetation were causing bird strikes. This retrofit consisted of light-colored blinds and shades, producing sufficient reflectivity reduction to reduce the problem.



SOLUTION: SCREEN / SCRIM / FRITTING

Bird-Safe Building Operations

OBJECTIVE

Undertake strategies to reduce light trespass from buildings, particularly during migration seasons. Undertake monitoring programs to evaluate success.

BENEFITS & LIMITATIONS

+ Highly effective at reducing nighttime migratory bird collisions and mortality.

+ Saves money by reducing energy costs.

+ Decreases air pollution and light pollution.

– Requires the commitment and participation of both building owners and users.

– Less effective without public awareness about the problem of bird collisions with all types of buildings.

– Conflicts with aesthetic preconceptions that buildings should be brightly lit at night, particularly in urban skylines.

LEED INTEGRATION

Sustainable Sites (SS) Credit 8:
Light Pollution Reduction

Energy and Atmosphere (EA) Credit 1:
Optimize Energy Performance

Indoor Environmental Quality (EQ) Credit 6.1:
Controllability of Systems: Lighting



TECHNICAL STRATEGIES
Bird-Safe Building Operations

Develop Lights-Out programs during peak migration periods:

• Encourage building owners and managers to extinguish all unnecessary exterior and interior lights from 11pm to sunrise during the spring migration, from mid-March to early June, and the fall migration, from late August to late October.

• Utilize gradual, "staggered switching" to turn on building lights at sunrise rather than instant light-up of the entire building.

• Dim lights in lobbies, perimeter circulation areas, and atria.

• Monitor the effectiveness of lights-out programs by tracking bird collisions and mortality rates. Determine light emission reductions and cost savings. Publicize positive outcomes.

• Contact local bird conservation organizations for support and to share the results of the Lights-Out program.

Reduce light trespass from interior sources:

• Turn off unnecessary interior lighting by 11 pm until sunrise, especially during fall and spring migration seasons.
• Utilize automatic controls, including photo-sensors, infrared and motion detectors, to shut off lights automatically in the evening when no occupants are present.
• Encourage the use of localized task lighting to reduce the need for extensive overhead lighting.
• Schedule nightly maintenance activities to conclude before 11:00pm.
• Educate building users about the dangers of light trespass for birds.
• Encourage voluntary light-closing in the evenings.[24]

Reduce light trespass from exterior sources:

• Reduce perimeter lighting wherever possible.

• Attach cutoff shields to streetlights and external lights to prevent unnecessary upward lighting.

• Install motion-sensor lighting wherever possible.

• Utilize minimum wattage fixtures to achieve required lighting levels.

• To comply with federal aviation and marine safety regulations in large buildings, install minimum intensity white strobe lighting with a three second flash interval instead of continuous flood lighting, rotating lights, or red lighting.[25]

• Ensure that all exterior light fixtures are properly installed to prevent unintended light trespass.[26]

Implement daily bird-collision monitoring:

• Encourage building management or maintenance crews to conduct a daily sweep of the building perimeter, setbacks, and roof to inspect for injured or dead bird species.

• Encourage volunteer participation in bird-collision monitoring.

• Instruct workers and volunteers in methods of temporarily caring for injured birds before transporting them to certified wildlife rehabilitators.

• Document all bird deaths. Donate specimens to authorized local bird conservation organization or museum to aid in species identification and for use in scientific studies, as per the Migratory Bird Treaty Act of 1918 (see page 10).

• Partner with other buildings in the area as well as local bird conservation groups to develop a district-wide monitoring program and corresponding Lights-Out strategies.

• Undertake retrofits and other strategies to reduce bird collisions. See "Modifications to Existing Buildings to Reduce Bird Collisions" on page 34.

Case Study

City of Chicago
Lights-Out Program

Chicago, IL

Twice annually, approximately five million birds—representing 250 species—fly through Chicago in migration. From 1978 to 2003 a group of researchers from Chicago's Field Museum of Natural History studied the rate of bird collisions at one particularly problematic building on the waterfront, the McCormick Place exhibition hall. During that period, researchers collected 30,990 dead birds of 141 different species outside the exhibition hall.[27] As a result of this endeavor, Chicago Mayor Richard M. Daley decreed a lights-out program in the fall of 2000 to reduce exterior lighting from tall towers during peak migration periods. When lights were extinguished at the McCormick Place exhibition hall, researchers found that the number of birds killed in collisions declined by 83%. Today, nearly all tall buildings in downtown Chicago participate in the Lights-Out program. In November 2006, Mayor Daley announced the release of Chicago's 18-Point Bird Agenda that include decreasing bird collisions with buildings, creating bird habitat, and increasing public awareness of bird populations.

http://www.lightsout.audubon.org/
http://www.cityofchicago.org/Environment/BirdMigration/sub/lights_out_chicago.html



SOLUTION: LIGHTS OUT

PHOTO CREDIT: ERIC FOGLEMAN / WWW.LIGHTSOUT.AUDUBON.ORG





Lights-Out Chicago
Two photos of the Chicago skyline taken before and after 11 pm on the same fall night in 2003.

CHICAGO TRIBUNE SECTION 1

Thursday, May 9, 2002

CHICAGO

Dimming lights saves birds, study says

A two-year study at McCormick Place offers new evidence that turning off the lights in tall buildings could save the lives of thousands of migratory birds, officials announced Wednesday.

Field Museum scientists collected birds killed after striking the windows and found that turning off the interior lights or pulling drapes reduced deaths by 83 percent, said museum ornithologist Mary Hennen.

In 2000 and 2001, Hennen and several colleagues tallied the number of dead birds found around the building during the spring and fall migration periods—from late March to the end of May and from mid-August to Thanksgiving. They found 1,297 birds died after striking lighted windows, while only 192 died in crashes into unlit windows.

Chicago sits in the path of the Mississippi Flyway, a major migratory route. Many of the birds passing through Chicago fly at night and rely on the stars or the moon for navigation. Building lights disorient them, causing them to fly into windows, Hennen said.

PHOTO CREDIT: NEW YORK CITY AUDUBON



PHOTO CREDIT: NEW YORK CITY AUDUBON



Case Study

New York City Audubon's Project Safe Flight

New York, NY

Spring and fall, hundreds of thousands of birds fly in broad-front migration over the northeastern United States. They stop over in New York City's Central Park, Jamaica Bay, and other green areas—even very small ones—to rest and refuel. But, as in Toronto and Chicago, NYC's urban landscape poses serious threats to migrating birds as well as resident birds.

In 1997, NYC Audubon's Project Safe Flight was founded by Rebekah Creshkoff to monitor bird collisions with NYC buildings during migratory periods. To date, over 5,000 dead and injured birds representing more than 100 species, mostly migrating songbirds, have been recorded. Casualties have resulted from both nighttime light-entrapment and daytime collisions with transparent and reflective glass.

In 2000, Project Safe Flight encouraged the Port Authority of NY and NJ to install fine-mesh garden netting over ground floor windows at the World Trade Center that were causing especially high rates of bird collisions.[28] The mesh functioned like a trampoline, preventing birds from hitting the glass, and reduced mortality 65% as compared to the previous spring's record.[29]

Project Safe Flight volunteers identified another NYC high-collision site, six-story Morgan Mail Processing Facility located in upper Chelsea not far from the Hudson River. The site comprises an especially lethal combination of conditions—a highly reflective, mirrored curtain wall that is located opposite a park and a set of street trees. In the fall of 2006, 338 bird collisions were recorded along the building's 250-yard-long non-transparent glazed exterior. Experts believe that birds feeding in the adjacent habitat fly towards the vision of "alternative" feeding grounds reflected in Morgan Mail's façade. Alerted to the mortality findings by NYC Audubon, postal officials have agreed to modify the façade with etched patterns or other applications. Project Safe Flight volunteers will continue to monitor the site to determine the effectiveness of this renovation.

http://www.nycaudubon.org

Emerging Technologies

LEED INTEGRATION

Indoor Environmental Quality (EQ) Credit 8.1: Daylight & Views

Innovation & Design Process (ID) Credit 1 to 1.4: Innovation in Design

OBJECTIVE

Encourage glass manufacturers to advance the search and development of innovative technologies that make glass visible to birds without visually impairing glass for humans. Such bird-safe glass may involve novel uses of known manufacturing processes, new/unexplored technologies or even the use of polycarbonates.

BENEFITS & LIMITATIONS

+ The development of an integral glass technology would greatly reduce the problem of building-related bird mortality without imposing major aesthetic modifications to contemporary building designs.

+ Encouraging a technological solution would stimulate research and development in the glass industry, and encourage wide-ranging innovative product development with beneficial economic consequences.

+ An innovative technological solution would be widely accepted in the design and construction industry, with beneficial economic consequences, particularly if it minimized aesthetic impacts and was cost-competitive.

+ Significant development would serve as a model for other potential “bio-mimetic” technological solutions to design problems.

– Developing effective technologies may require large investments and may prove challenging in the short term.

– Ineffective without the support and leadership of glass and construction industry officials.

TECHNICAL STRATEGIES
Emerging Technologies

Refine methods of obscuring transparency of glass:

• Continue research on pattern recognition of both humans and birds to identify patterns that inhibit bird 'fly-throughs' while minimally obstructing human views.

• Encourage manufacturers to offer "bird-safe" patterns as stock products in a variety of finishes for design flexibility (i.e. ceramic frit, acid etching, laminated LEDs, electrochromic coatings etc.).

Encourage the development of glass that eliminates reflections. The exterior surface of glass is of primary concern, however all surfaces of glass reflect habitat to some extent:

• Lower reflectivity of existing "non-reflective" glass.

• Develop plastic films, diachronic coatings, and tints for exterior use.

• Experiment with particles that can be cast integrally into glass during the production process.

• Enhance existing patterning materials such as ceramic frits and acid etching for exterior use.

• Encourage the development of other forms of non-reflective tinted or spectrally selective glass.

Develop new technology:

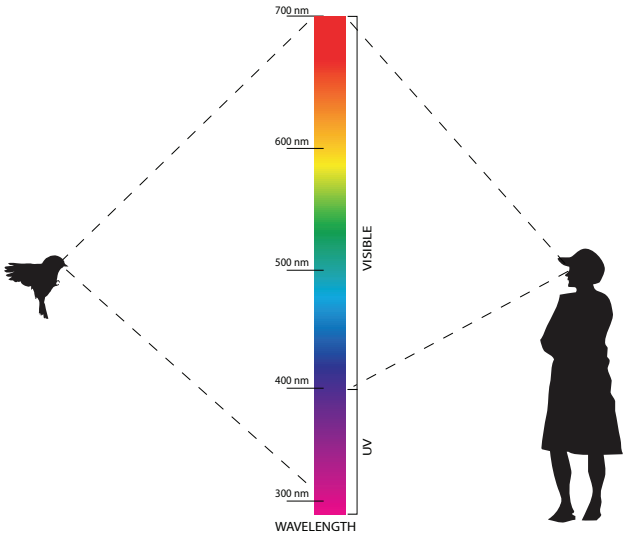
• Develop glass with integral patterns in the ultra-violet range that will be visible to birds and not humans.[30]

• Improve polycarbonates as an alternate to glass and explore its bird-safe potential.

• Encourage research into experimental technologies such as nanotechnology, meta-materials, and other unforeseen solutions.

A "Bio-mimetic" Solution on the Horizon

Scientists have concluded that birds perceive UV daylight as a separate, enhanced color. In fact, most birds have UV-colored plumage that is invisible to humans but important to birds in distinguishing among bird species and sexes. UV vision is also important for bird's orientation during migration and it facilitates feeding practices. Given bird's receptivity to UV light, it is possible to develop a "bio-mimetic" solution for bird-safe glass.[30]



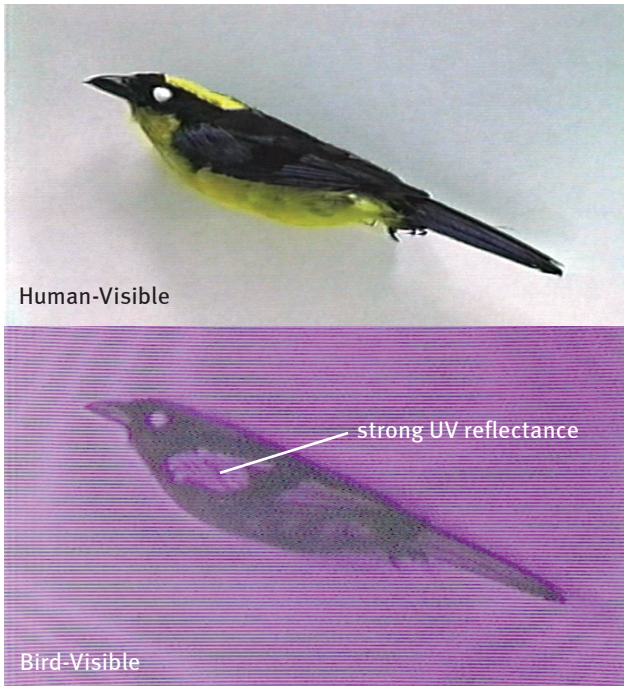


IMAGE CREDIT: ROBERT BLEIWEISS/PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

Example: Emerging Technology

UV Reflective Coatings: Glaswerke Arnold's Ornilux Glass

"According to Christian Irmscher, Director of Applied Technologies at Glaswerke Arnold, Ornilux glass uses a unique UV reflective coating that allows birds to easily identify glass surfaces and therefore avoid collisions with them. 'Our new application is based on the anti-bird-strike patent and basic research conducted by Dr. Alfred Meyerhuber which examined the use of glass coatings and the UV vision of birds.'"
(For more information, see source: http://www.glaswerke-arnold.de)



Case Study

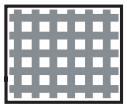
IIT Student Center

Chicago, IL

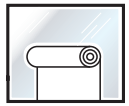
Architects: OMA/Rem Koolhaas

This building incorporates faceted glass, Panelite panels, and a dot matrix pattern (pictured here) in its facade. These elements create visual noise which is perceptable to birds, preventing the fly-through effect and the mirror effect.





SOLUTION: SCREEN / SCRIM / FRITTING



SOLUTION: USE OF PLASTIC FILMS, DIACHROIC COATINGS AND TINTS ON FACADE



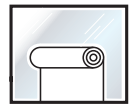
La Defense Offices, 2004, UNStudio © Christian Richters

Case Study

La Defense Offices

Almere, Netherlands
Architects: UN Studio

This building incorporates faceted glass, Panelite panels, and a dot matrix pattern (pictured here) in its facade. These elements create visual noise which is perceptable to birds, preventing the fly-through effect and the mirror effect.



SOLUTION: USE OF PLASTIC FILMS, DIACHROIC COATINGS AND TINTS ON FACADE

Case Study

Tower Woermann

Madrid, Spain

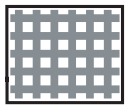
Architects: Abalos & Herreros

This building beautifully incorporates a screening element which is bird-visible and provides sun shading. The facade is also striated with horizontal elements that cast shadows on the glass, rendering it bird-visible.





Tower Woermann, abalos herreros, ©Paolo Rosselli



SOLUTION: SCREEN / SCRIM / FRITTING

PHOTO CREDIT: CHELSEA DEWITT





Case Study

IAC Offices

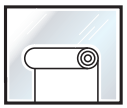
New York, NY

Architects: Frank O. Gehry and Partners

This building has a sculpted glass facade that is etched or fritted with white pattern. It is anticipated that this building will be bird-safe due to the faceting of the glass and the patterned facade.



SOLUTION: NON-REFLECTIVE GLASS



SOLUTION: USE OF PLASTIC FILMS, DIACHROIC COATINGS AND TINTS ON FACADE

Case Study

Minneapolis Central Library

Minneapolis, MN
Architects: Pelli Clarke Pelli Architects
Landscape design : Cohen + Partners

The Minneapolis Central Library incorporates bird-safe design techniques in several ways. Its variegated and curtained facade presents an identifiable pattern to birds, while an indigenous shale and birch garden at the building's north perimeter filters views to and from the main level reading rooms. This technique of planting very close to a building facade, in addition to providing shade, prevents incidents of fatal bird strike. Birds can perceive patterns and shadows of the foliage cast on the glass, which identify it as a barrier. At the same time, birds are less likely to develop fatally high speed collision rates due to the close proximity of planting to glass.

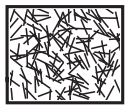




PHOTO CREDIT: ERIC FOGLEMAN / WWW.LIGHTSOUT.AUDUBON.ORG



SOLUTION: VEGETATION NEAR BUILDING



SOLUTION: VISUAL NOISE



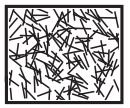
Case Study

Jupille: Project for Living

Angers, France

Landscape design : Duncan Lewis

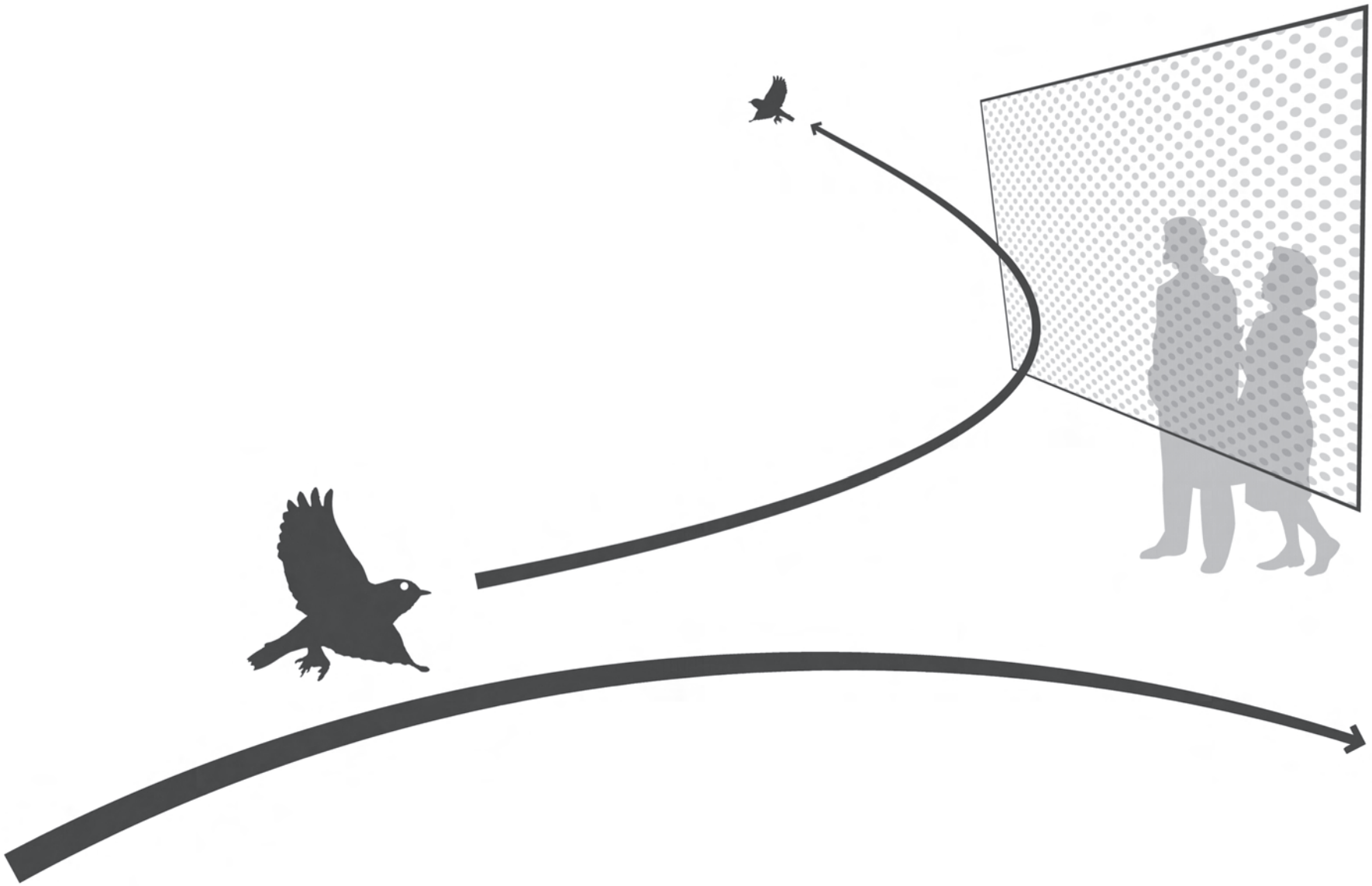
This green screen offers shading while providing a bird-visible layer between sky and glass.



SOLUTION: VISUAL NOISE



SOLUTION: VEGETATION NEAR BUILDING



Appendix :
Checklist of Bird Collision Liabilities

This checklist summarizes conditions that contribute to bird injury and mortality. It may be used to evaluate existing or new buildings for potential problems.

Region
- ☐ Within of migratory route
- ☐ Proximate to migratory stopover destination

Locale
- ☐ Proximate to attractive habitat areas
- ☐ Dense urban context (reduced sky visibility)
- ☐ Fog-prone area

Site
- ☐ Nearby trees and shrubs
- ☐ Adjacent to grassy meadows
- ☐ Water features/wetlands

Façade Glass Coverage (overall percentage*)
- ☐ < 20%
- ☐ > 20, < 35 %
- ☐ > 35, < 50%
- ☐ > 50%

Special features
- ☐ Unbroken glass expanses at lower levels (atrium wall, lobby wall)
- ☐ Courtyard(s)
- ☐ Transparent corners
- ☐ Glazed passageways

Glazing characteristics
- ☐ Tinted
- ☐ Reflective
- ☐ Mirror/Specular

Dusk and Night-time Illumination
- ☐ External facade up-lighting
- ☐ Non-cut-off exterior lighting
- ☐ Spill of interior lighting

Other building elements
- ☐ Antenae
- ☐ Spires
- ☐ Guy-wires

* Percentages here assume many areas of surface are already opaque: areas for penthouse, mechanical space, service areas. Lower ranges reflect punched openings or partial curtain wall; higher ranges are full curtain wall.

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2. The exception seems to be pigeons, starlings and sparrows that do not collide with buildings in significant numbers due to their high level of adaptation to urban environments.

3. Daniel Klem, Jr. "Bird Injuries, Cause of Death, and Recuperation from Collisions with Windows." *Journal of Field Ornithology*, 61(1), 1990, pp.115-119.

4. Sidney A. Gauthreaux, Jr. and Carroll G. Belser. Radar Ornithology and Biological Conservation. The Auk 120(2):266-277. 2003.

5. Travis Longcore, Ph.D. (Land Protection Partners) et all. *Scientific Basis to Establish Policy Regulating Communications Towers to Protect Migratory Birds*. Published by the American Bird Conservancy, Defenders of Wildlife, and partners. Available at: http://www.defenders.org/wildlife/birds/fcc.pdf.

6. Edward O. Wilson. *Biophilia*. Cambridge: Harvard University Press, 1984. Edward O. Wilson and Stephen R. Kellert. *The Biophilia Hypothesis*. Washington, D.C.: Island Press, 1993.

7. See the following books: Marie Winn's, *Red-Tails in Love: a Wildlife Drama in Central Park*. New York: Vintage Books, 1999. Cal Vornberger, *Birds of Central Park*. With foreword by Marie Winn. New York: Harry N. Abrams, Inc, See also online: www.palemale.com, and www.birdsofcentralpark.com.

8. Note that the Empire State Building is 1454 feet from the ground to the tip of its lightning rod.

9. For more information on creating visual noise in building facades and glazing, see Randi Doeker, *Bird and Buildings: Creating a Safer Environment*. Birds & Buildings Forum. http://www.birdsandbuildings.org/docs/birdsafedesign.pdf

10. Buildings may achieve a certified, silver, gold or platinum rating according to the number of credits achieved.

11. For current statistics, see FLAPs website: http://www.flap.org/. For background, see Lesley J. Evans

Ogden, *Collision Course: the Hazards of Lighted Structures and Windows to Migrating Birds*. Published by World Wildlife Fund Canada and the Fatal Light Awareness Program. 1996. Available at: http://www.flap.org/new/ccourse.pdf.

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13. Daniel Klem, Jr. "Collisions Between Birds and Windows: Mortality and Prevention." *Journal of Field Ornithology*, 61(l), 1990, pp. 120-128. Available at: http://elibrary.unm.edu/sora/JFO/v061n01/p0120-p0128.pdf.

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15. Daniel Klem, Jr., et all. "Effects of Window Angling, Feeder Placement, and Scavengers on Avian Mortality at Plate Glass." *Wilson Bulletin*, 116(1), 2004, pp. 69–73. Available at: http://www.birdscreen.com/Klem_WB_WindowAngling2004.pdf

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18. Klem, et all. "Effects of Window Angling." See Footnote 17.

19. See also: Randi Doeker, *Bird and Buildings: Creating a Safer Environment*. Birds & Buildings Forum. http://www.birdsandbuildings.org/docs/birdsafedesign.pdf.

20. For more information on interior light-reduction initiatives, see Lesley J. Evans Ogden, *Effect of Light Reduction on Collision of Migratory Birds*. Published by the Fatal Light Awareness Program, 2002. Available at: www.flap.org/new/Effect%20of%20Light%20Reduction%20on%20Collision%20of%20Migratory%20Birds.pdf.

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22. For more information on exterior light-reduction initiatives, see Lesley J. Evans Ogden, *Collision Course: The Hazards of Lighted Structures and Windows to Migrating Birds*. Published by the World Wildlife Fund Canada and the Fatal Light Awareness Program. 1996. Available at: http://www.flap.org/new/ccourse.pdf.

23. For background, see: Grasso-Knight, Guido & Waddington, Michael. *Spring 2000 Report on Bird Collisions with Windows at Swarthmore College*. 2000. http://www.swarthmore.edu/es/birdcollisions.html. For building description, see also: Stephens, Suzanne. "Swarthmore College Unified Science Center." *Architectural Record*. December, 2004.

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BROWN CREEPER SEP.21, 2006
BROWN CREEPER SEP.22, 2006
RED-EYED VIREO SURVIVOR
MAGNOLIA WARBLER SEP.22, 2006
NASHVILLE WARBLER SEP.22, 2006
RED-EYED VIREO SEP.22, 2006
RED-EYED VIREO SEP.22, 2006
RED-EYED VIREO SEP.22, 2006
SWAINSON'S THRUSH SEP.22, 2006
RED-EYED VIREO SEP.22, 2006
RED-EYED VIREO SEP.22, 2006
GOLDEN-CROWNED KINGLET OCT.02, 2006
GOLDEN-CROWNED KINGLET OCT.02, 2006
GOLDEN-CROWNED KINGLET OCT.02, 2006
GOLDEN-CROWNED KINGLET OCT.02, 2006
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OCT.03, 2006
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RUBY-CROWNED KINGLET OCT.03, 2006
WHITE-THROATED SPARROW OCT.03, 2006
NASHVILLE WARBLER OCT.10, 2006
RUBY-CROWNED KINGLET OCT.10, 2006
RUBY-CROWNED KINGLET OCT.10, 2006
YELLOW-BELLIED SAPSUCKER OCT.10, 2006
GOLDEN-CROWNED KINGLET SURVIVOR OCT.10, 2006
BROWN CREEPER OCT.19, 2006
HERMIT THRUSH OCT.19, 2006
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HERMIT THRUSH OCT.24, 2006
GOLDEN-CROWNED KINGLET SURVIVOR OCT.24, 2006
RUBY-CROWNED KINGLET OCT.24, 2006

IT IS ESTIMATED THAT **100 MILLION BIRDS** ARE KILLED EVERY YEAR IN THE UNITED STATES ALONE THROUGH **COLLISIONS WITH BUILDINGS**. SECOND ONLY TO HABITAT LOSS AS A CAUSE OF DECLINING POPULATIONS, SOME EXPERTS BELIEVE THE NUMBER IS EVEN HIGHER, PERHAPS AS MANY AS **ONE BILLION** KILLED ANNUALLY. - New York City Audubon

SEPTEMBER 22, 2006 - **2** BROWN CREEPERS + **5** RED-EYED VIREOS + **2** SWAINSON'S THRUSHES + **1** MAGNOLIA WARBLER + **1** NASHVILLE WARBLER

OCTOBER 02, 2006 - **4** GOLDEN-CROWNED KINGLETS + **5** NORTHERN PARULAS + **1** MAGNOLIA WARBLER

OCTOBER 03, 2006 - **3** GOLDEN-CROWNED KINGLETS + **1** RED-EYED VIREO + **1** RUBY-CROWNED KINGLET + **1** WHITE-THROATED SPARROW

OCTOBER 10, 2006 - **2** RUBY-CROWNED KINGLETS + **1** GOLDEN-CROWNED KINGLET + **1** NASHVILLE WARBLER + **1** YELLOW-BELLIED SAPSUCKER

OCTOBER 19, 2006 - **2** RUBY-CROWNED KINGLETS + **1** BROWN CREEPER + **1** HERMIT THRUSH

OCTOBER 23, 2006 - **8** RUBY-CROWNED KINGLETS + **1** GOLDEN-CROWNED KINGLET

OCTOBER 24, 2006 - **8** RUBY-CROWNED KINGLETS + **5** GOLDEN-CROWNED KINGLETS + **2** HERMIT THRUSHES + **1** DARK-EYED JUNCO

OCTOBER 26, 2006 - **6** GOLDEN-CROWNED KINGLETS + **4** RUBY-CROWNED KINGLETS + **1** DARK-EYED JUNCO

IN **8** DAYS, **72** BIRDS WERE **FOUND DEAD** AROUND THE OFFICE BUILDING (PICTURED HERE) IN **GREAT NECK, LONG ISLAND, NY**





