SAN FRANCISCO
PLANNING
DEPARTMENT

Standards for
Bird-Safe Buildings

SAN FRANCISCO PLANNING DEPARTMENT | ADOPTED JULY 14, 2011

Adopted July 14, 2011

By the San Francisco Planning Commission

SAN FRANCISCO
PLANNING
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Acknowledgements

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San Francisco Planning Commission:
Christina Olague, *President*
Ron Miguel, *Vice President*
Michael J. Antonini
Gwyneth Borden
Kathrin Moore
Hisashi Sugaya
Rodney Fong

San Francisco Planning Department:
John Rahaim, *Director*
Senior Management Team: Alicia John-Baptiste, *Assistant Director;* Scott Sanchez, *Zoning Administrator;* Bill Wycko, *Chief Environmental Review Officer;* Kelley Amdur, *Manager of Neighborhood Planning;* and David Alumbaugh, *Acting Manager of Policy Planning.*

Project Team: AnMarie Rodgers, *Legislative Manager;* Erika Lovejoy, *Project Manager and Senior Environmental Planner;* Sheila Nickolopoulos, *Senior Administrative Analyst;* Craig Nikitas, *Senior Urban Designer;* Joshua Switzky, *Planner* and Gary Chen. *Graphic Design.*

Private Contributors:
Christine Sheppard, PhD, *The American Bird Conservancy, Bird Collisions Campaign*
Noreen Weeden, *Golden Gate Audubon Society, Conservation Project Manager*
Mike Lynes, *Golden Gate Audubon Society, Director of Conservation*
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NYC Audubon Bird-Safe Building Guidelines Credits:
Project Director: Kate Orff, RLA, Columbia University GSAPP ; Authors: Hillary Brown, AIA, Steven Caputo, New Civic Works; Project Staff: E.J. McAdams, Marcia Fowle, Glenn Phillips, Chelsea Dewitt, and Yigal Gelb.

Audubon MN Bird-Safe Building Guidelines Credits:
Project Director: Joanna Eckles, Audubon Minnesota. Contributor: Edward Heinen, Edward Heinen Architectural Consulting.

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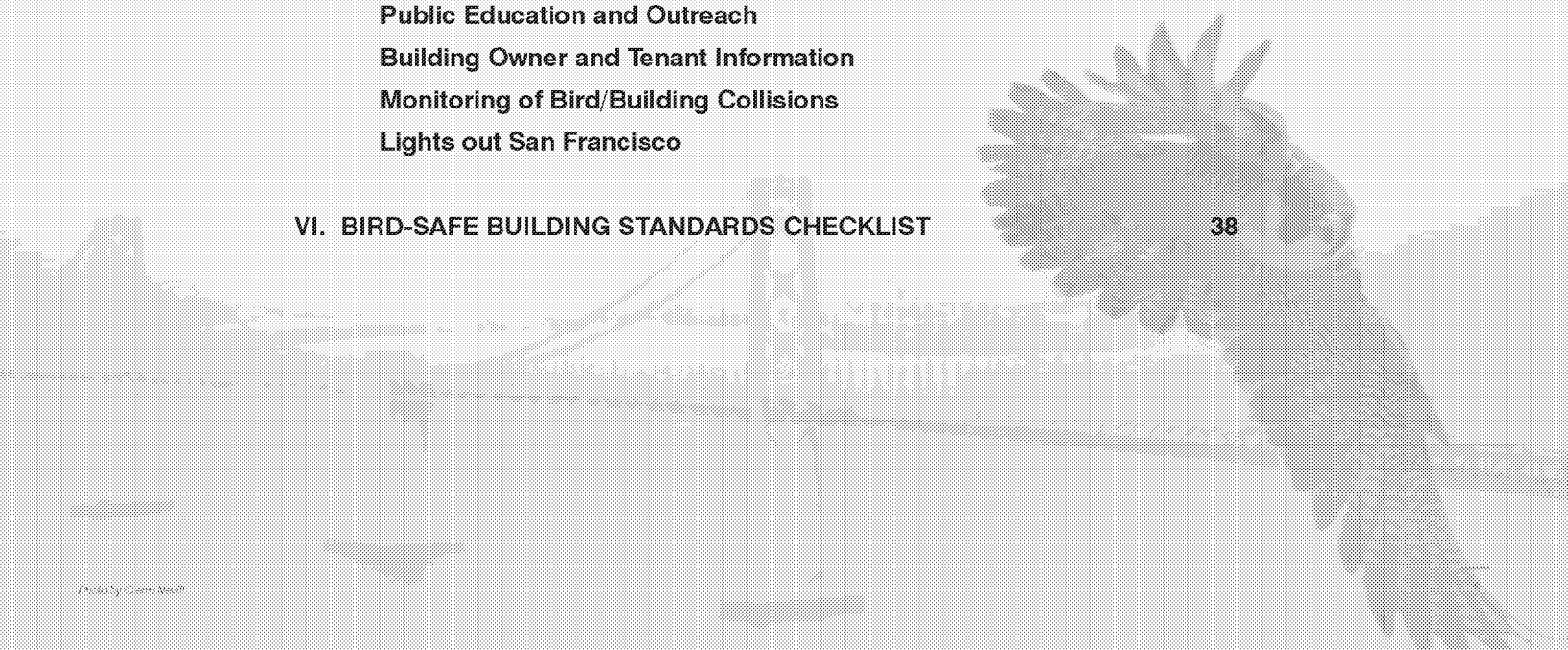
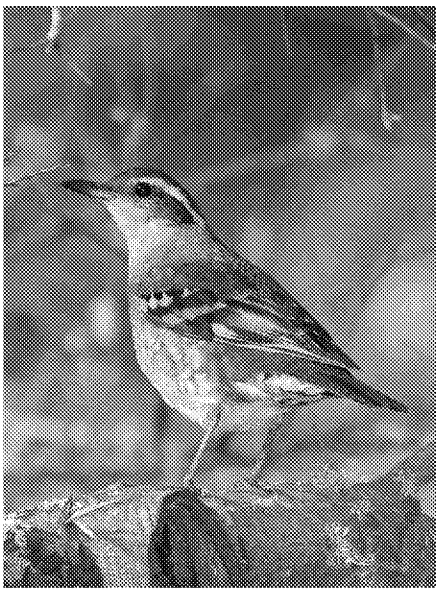


PREFACE: Purpose of the Standards

Photo by Robert Lewis



Varied Thrush

"The wide variety of native birds that thrive in urban areas underscores the importance of these artificial habitats to the survival of many bird populations. Creating greenspace in urban environments, landscaping with native plants in backyards and parks, adopting architecture and lighting systems that reduce collisions, and keeping pets indoors will provide the greatest benefit to breeding birds and migrants seeking safe places to rest and find food during their spectacular journeys."

- 2009 State of The Birds Report by the United States Government US Department of Interior

Pigeons and sparrows are readily visible in San Francisco. These ubiquitous city birds are not shy about sharing our urban spaces. But the casual observer may be shocked to learn that our City's birds are much more diverse. There are about 400 species of birds in San Francisco; remarkably, this is nearly half the species in all North America (*Kay 2009*). For those who look, the shyer species are just around the corner. This is due in part to the diverse habitats of the Bay Area and its position on the coastal migration path, the Pacific Flyway. Some birds are well-adapted to urban life, and they may remain here as year-round "residents." Others are migratory, passing through the City southward in autumn en route to their winter feeding grounds, then returning northward in spring to establish territories in summer breeding grounds.

Photo by Robert Lewis

Anna's Hummingbird

There are special problems posed for birds living in or flying through cities. Over 30 years of research has documented that buildings and windows are the top killer of wild birds in North America (*Banks 1979; Ogden 1996; Hager et al. 2008; Klem 2009; Gelb and Delacretaz 2009*). Structure collision fatalities may account for between 100 million and 1 billion birds killed annually in North America (*United States Fish and Wildlife Service 2002; Klem 2009*). According to the leading expert, Dr. Daniel Klem Jr., this toll strikes indiscriminately culling some of the healthiest of the species. "From a population standpoint, it's a bleeding that doesn't get replaced," he stated, estimating that between one and five percent of the total migratory population die in window crashes annually (*Klem, 2009*). Many of these are endangered or threatened species whose populations are already declining due to habitat loss, toxin loads, and other severe environmental pressures.

Juvenile residents and migrants of all ages — those least familiar with the urban setting — face the greatest risk of injury or death from the hazards of the city environment. Collision hazards include vehicles, bridges, transmission towers, power lines, and turbines, but the majority of avian deaths and injuries occur from impacts with building components such as transparent or reflective glass. Night-time lighting also interferes with avian migrations. Scientists have determined that bird mortality caused by collisions with structures is "biologically significant" for certain species (*Longcore et al. 2005*). In other words, building collisions are a threat of sufficient magnitude to affect the viability of bird populations, leading to local, regional, and national declines. Night-migrating songbirds—already imperiled by habitat loss and other environmental stressors—are at double the risk, threatened both by illuminated buildings when they fly at night and by daytime glass collisions as they seek food and shelter.

While species that are plentiful may not be threatened by structure collisions, many species that are threatened or endangered show up on building collision lists (*Ogden 1996 and references therein*).

Strategies that improve the urban design quality or sustainability of the built environment may help to make a more bird-safe city. For example, San Francisco has a long-standing policy prohibiting installation of mirrored glass, to meet aesthetic goals. This policy also benefits birds, which mistake reflections for real space and don't perceive the glass as a deadly barrier. The launch of the Golden Gate Audubon Society, Pacific Gas and Electric Company, and Department of the Environment's voluntary Lights Out San Francisco program in 2008 links smart energy policy with bird preservation strategies.

Occasionally policy goals may conflict, and we must balance the benefits and costs of one policy against the other. For instance, gains in energy and resource conservation provided by wind generators could also have negative environmental impacts if installations of those wind farms increase mortality among flying animals.

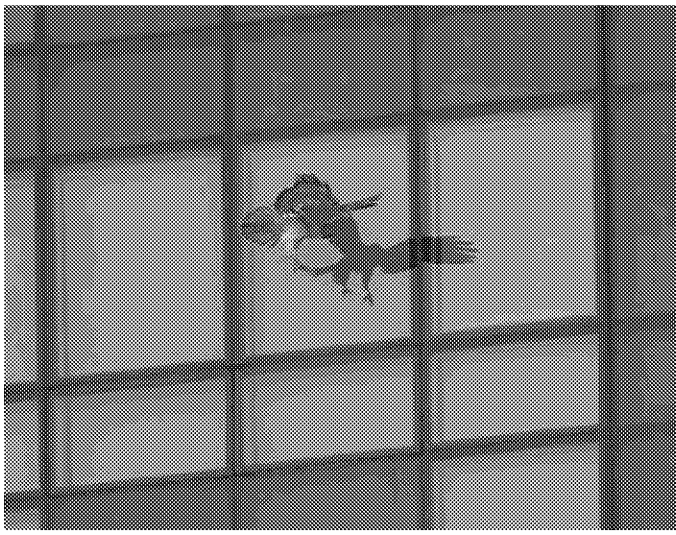


Photo courtesy New York Audubon's "Bird-Safe Buildings"

A Red-Tailed Hawk may see its reflection as a territorial rival to be driven away, resulting in a collision.

WHAT THIS DOCUMENT DOES

Annual kills at high-risk structures are foreseeable and avoidable and merit protection (*Klem, 2009*). This publication serves as the Planning Commission's policy document for Section 139 of the Planning Code, "*Standards for Bird-Safe Buildings*." The controls described within aim to identify high-risk features in an urban setting and regulate these situations to the best of current scientific understanding. In areas where the risks are less well known, the Department does not propose to apply controls but instead recommends project sponsors use the checklist contained in this document as an educational tool to increase their understanding of potential dangers. Qualifications for achieving recognition as a Bird-Safe building are included in the document to acknowledge building owners who voluntarily take measures to help keep birds safe above and beyond the requirements. At this time, the Planning Department also urges local researchers to further explore the issue and for citizens to get involved in local monitoring efforts.

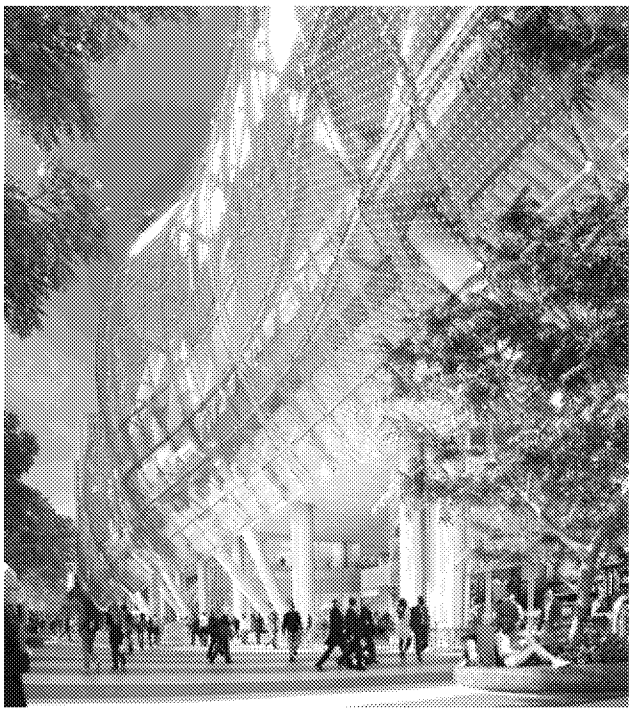
I. The Issue: Birds, Buildings, People and Cities

Changing Nature of North America and Building Design

The consequences of our population growth are well-known: sprawling development across the country compounds habitat loss and disrupts vital ecological functions. The rate of sprawl in the United States almost quadrupled between 1954 and 2000. An area of undeveloped land about the size of Connecticut is converted to urbanized landscapes annually in the United States (*U.S. Department of Agriculture 1997*). This loss of habitat exerts great pressures on our wildlife.

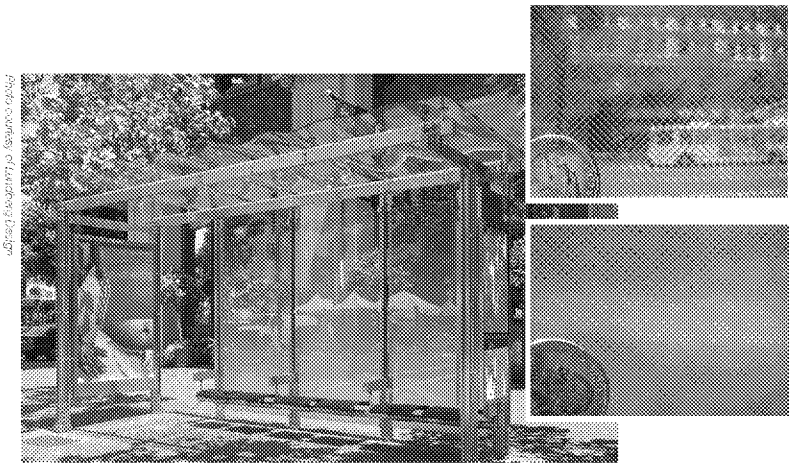
Less well-known to the general public are the effects of our specific development forms on wildlife. Buildings and birds have coexisted since people first sought shelter. Early blocky buildings posed little threat to birds as the building elements were quite visibly solid. The advent of mass produced sheet glass in 1902 greatly increased the potential for transparency. The innovation of steel frame buildings with glass curtain walls resulted in transparent high-rise buildings.

After the Second World War, these steel and glass buildings were widely used and became the iconic 20th Century American building. Today, planners and urban dwellers increasingly demand building transparency to achieve street activation and pedestrian interest. As glass surface area increases so do the number of bird collisions. After World War II birdwatchers began documenting major bird-building, single-event collisions that resulted in the deaths of hundreds of birds. The first recorded event occurred on September 10, 1948 when more than 200 birds of 30 species were killed upon collision with the Empire State Building (*McAdams 2003*). Similar events have occurred every decade with notable events killing 10,000 to 50,000 birds at a strike (*Bower 2000*). In 2011, the New York Times reported, that "After 5,000 red-winged blackbirds fell from the sky in Arkansas on New Year's Eve, many Americans awakened to a reality that had not necessarily been on their radar: many birds die as a result of collisions with buildings" (*Kaufman 2011*). These single-event strikes are often tied to inclement weather, night migration, and brightly lit structures.



ABOVE: The proposed new Transbay Terminal presents a transparent façade with enticing vegetation visible both inside the building and on the roof. The façade is currently planned to include fritted glass.

ABOVE: Many historic buildings such as the old Transbay Terminal present a solid appearance.



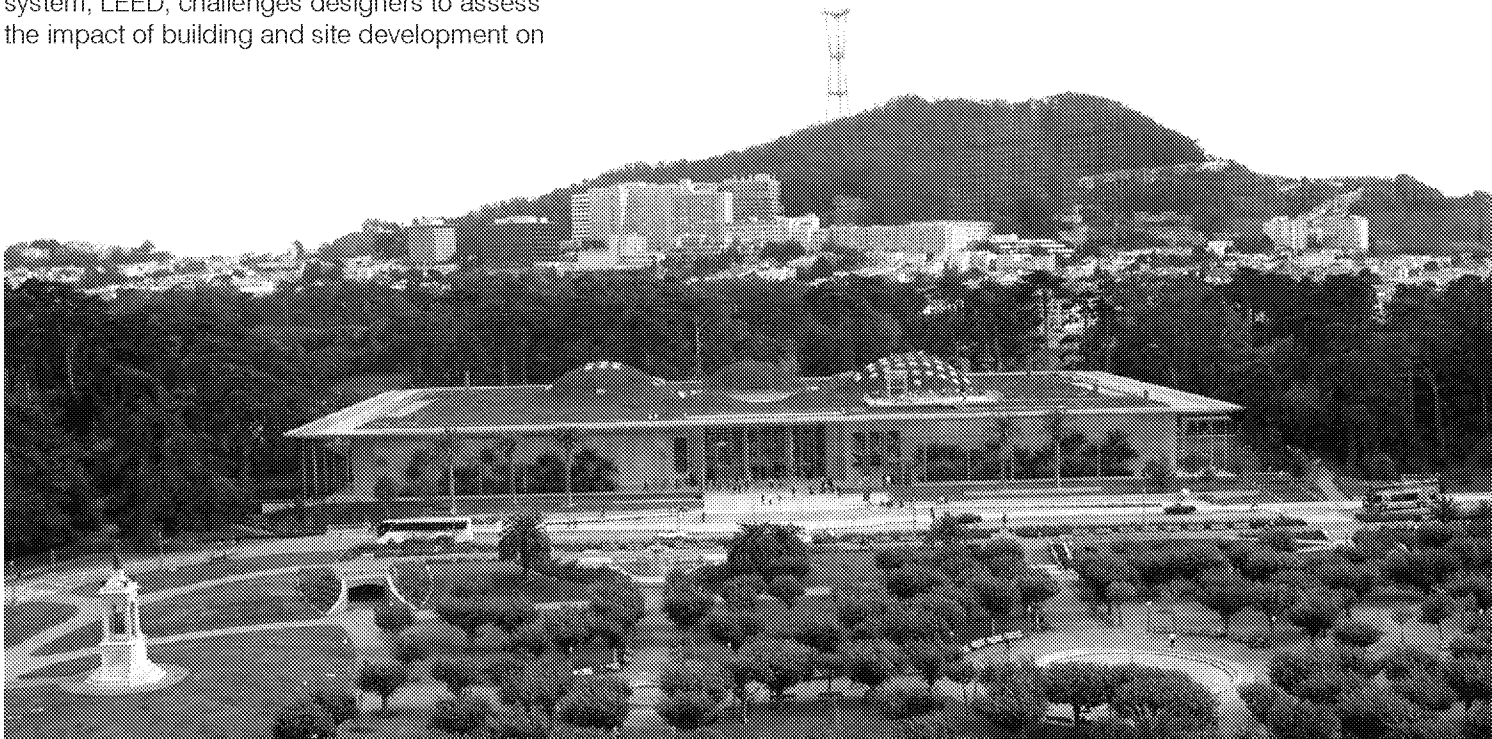
ABOVE: The City's new bus shelters designed by Lundberg Design use a subtle frit pattern to indicate the barrier. This design, called "SF Fog," is effective in alerting both people and birds to the glass. INSETS show how the frit pattern is more dense at the bottom and dissipates like the City's fog at the top.

While single-event collisions are dramatic, the bulk of bird deaths result from the cumulative effects of a lone, confused bird mistaking glass for a safe flight path. The lone bird strike occurs over and over with conservative estimates calculating that each building kills 10 birds per year on average in the United States (*Klem 1990*). Poorly designed buildings kill hundreds per year (*Hager et al. 2008*). Current research finds that earlier estimates of up to 1 billion bird deaths per year due to building collisions were conservative (*Klem et al. 2009 and references therein*).

New trends in green architecture can either increase or decrease the risk for birds. Green design that facilitates bird safety includes: the avoidance of light pollution, reduced disturbance to natural landscapes and biological systems, and lowered energy use. Green design can also be hard on birds. Green buildings surrounded by lush landscaping may attract more birds. Window reflections of adjacent greenery lure birds to false trees. Green atria inside buildings too may call birds to an inaccessible haven only to have their journey harshly interrupted mid-flight. In 2011, the Chicago Tribune reported that birds were crashing into the FBI's Chicago office, a Platinum LEED Building, at a clip of 10 birds a day during migration (*DeVore 2011*).

Green building design can go hand-in-hand with bird-safe design. The Green Building Council rating system, LEED, challenges designers to assess the impact of building and site development on wildlife, and incorporate measures to reduce threats. Buildings may be certified as silver, gold, or platinum according to the number of credits achieved. A LEED a bird-friendly pilot may be developed as early as summer 2011, for testing and eventual inclusion into the main LEED structure. There is still room for improvement. In the future, green design should thoroughly consider the impact of design on wild flora and fauna.

BELOW: The California Academy of Sciences showcases many green design features including a green roof set within a lush, green landscape that is a natural respite for birds migrating through the city. Because its use of glass could also pose a collision risk, researchers at the Academy are studying the effects of the building on birds and testing various methods of improving bird safety, including the use of external screens, as shown on page 29.



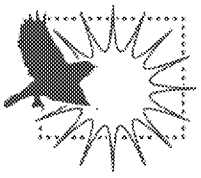
BIRDS AND GLASS

Glass is everywhere and is one of the least recognized, but most serious, threats to birds; one that is increasing as humans continue to build within bird habitats across the planet. Clear glass is invisible to birds and to humans, but both can learn to recognize and avoid it. Unfortunately, most birds' first encounter with glass is fatal. They collide at full speed when they try to fly to sky, plants, or other objects seen through glass or reflected on its surface. Death is frequently not instantaneous, and may occur as a result of internal hemorrhage days after impact, far away from the original collision site, making monitoring the problem even more difficult. The two primary hazards of glass for birds are reflectivity and transparency.

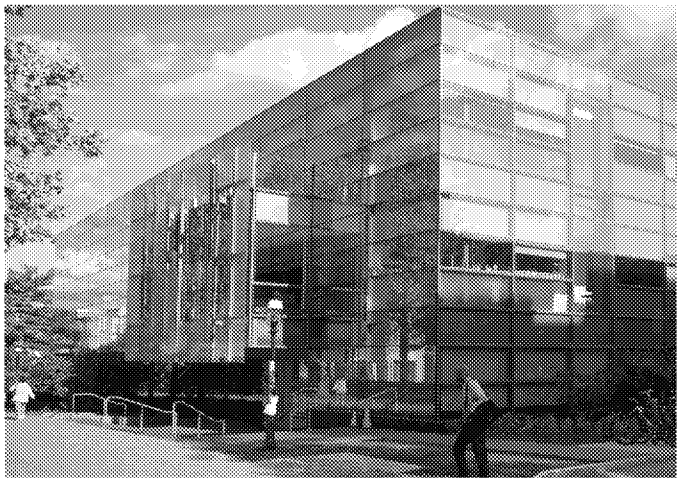
REFLECTIVITY

Viewed from outside buildings, transparent glass often appears highly reflective. Almost every type of architectural glass under the right conditions reflects the sky, clouds, or nearby trees and vegetation. Glass which reflects the environment presents birds with the appearance of safe routes, shelter, and possibly food ahead. When birds try to fly to the reflected habitat, they hit the glass. Reflected vegetation is the most dangerous, but birds may also attempt to fly past reflected buildings or through reflected passageways.

TRANSPARENCY



During daylight hours, birds strike transparent windows as they attempt to access potential perches, plants, food or water sources and other lures seen through the glass. "Design traps" such as glass "skywalks" joining buildings, glass walls around planted atria and windows installed perpendicularly on building corners are dangerous because birds perceive an unobstructed route to the other side.



TOP: Clouds and neighboring trees reflect in the glass curtain wall of Sherrerd Hall on the Princeton campus making it difficult for birds to distinguish real from reflection.

BOTTOM: A Market Street building with a transparent corner may lead birds to think the tree is reachable by flying through the glass.

GLAZING CHARACTERISTICS

Reflective and transparent glass each present hazards to birds (*Gelb and Delacretaz 2009*).

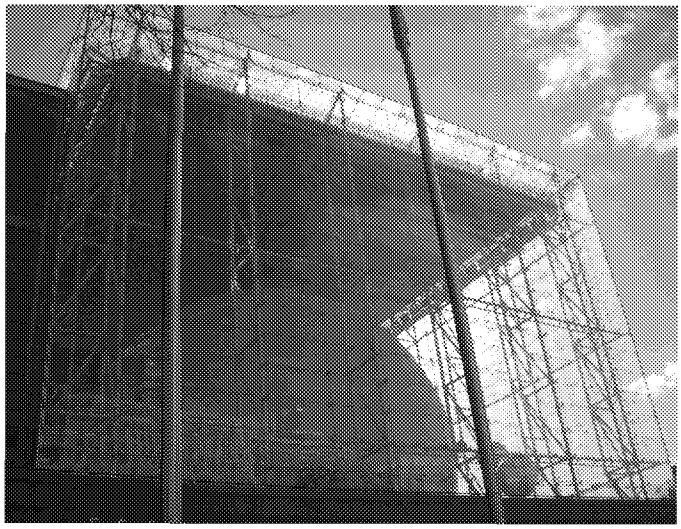
REFLECTIVITY

Image courtesy of Lightsoutindy.org

Photo: Courtesy NY Audubon

TRANSPARENCY

Image courtesy of Lightsoutindy.org



TOP: Reflections: A bird looking for a perch may mistake the reflected tree for an actual tree.

BOTTOM: Transparent glass can be mistaken for a clear flight path.

GLASS RELATIVE TO BUILDING HEIGHT AND MASSING

Typically, as building size increases, so does the amount of glass, making larger buildings more of a threat. Lower stories of buildings are the most dangerous because windows here are at or below canopy height and are more likely to reflect trees and other landscape features that attract birds. This makes a long, low building more of a hazard than a tall one of equal interior square-footage. However, as monitoring programs access setbacks and roofs of tall buildings, they are finding that birds also collide with buildings at the higher floors. This is an area where more information is needed.

AMOUNT OF GLASS

Glass causes virtually all bird collisions with buildings. It's logical that as the amount of glazing increases on a building the threat also increases. A study in New York (*Klem et al, 2009*) found a 10% increase in the area of reflective and transparent glass on a building façade correlated with a 19-32% increase in the number of fatal collisions, in spring and fall, when visiting migrants are present.

TOP: SoMa's Foundry Square presents a full façade of highly reflective glass. While all glass can be reflective, glass manufacturers label glass with standards "reflectivity" ratings.

REDUCING KNOWN BIRD TRAPS

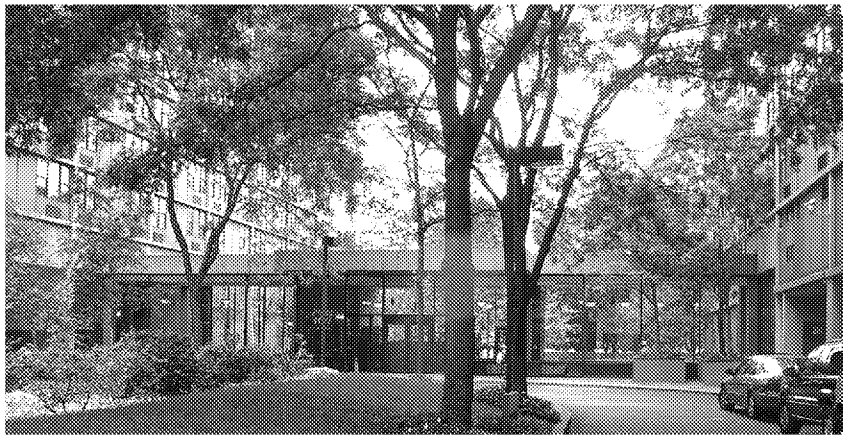


Photo Courtesy NY Audubon

Windowed courtyards and open-topped atria can be hazardous, especially if they are heavily planted. Birds fly down into such places, and then try to leave by flying directly towards reflections on the walls. Glass skywalks, handrails and building corners where glass walls or windows are perpendicular are dangerous because birds can see through them to sky or habitat on the other side.

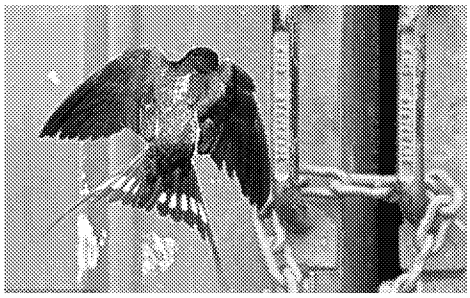
ABOVE LEFT: This café on Market Street uses a glass wind barrier lined with attractive flowers that may entice birds.

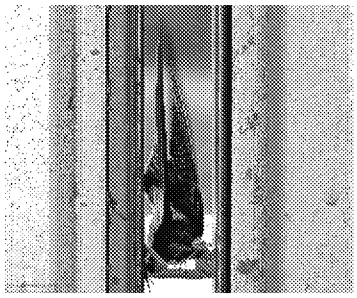
ABOVE RIGHT: This glass walkway allows for a clear sightline though the passage. Without treatment to the glazing, this can create a hazards for birds.

CLEAR FLIGHT PATHS

Birds have evolved to fly through tree canopies at speed. This ability to navigate tight places is a benefit in most natural settings but may be a liability in the built environment. Early attempts to ward off bird collisions with glass panes included the unsuccessful attempts at placing falcon stickers in the middle of each pane. As the acrobatic bird below demonstrates and as current research has shown, collisions are most effectively reduced when flight paths are eliminated by the breaking of glass swaths to less than either 4" vertically or 2" horizontally (*Sheppard 2010*).

Hand Print Rule: Small birds may try to fly through any spaces that are about the size of a handprint.





Exceptional Acrobats. Some birds such as the barn swallow pictured here can easily fly through spaces that are more narrow. This bird is traveling at 35 mph through a 2-inch seam.

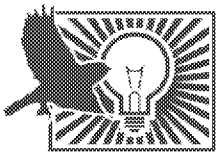
http://auzure.com/2009/07/a-job-for-superswallow/

We don't know exactly what birds see when they look at glass but we do know that the amount of glass in a building is the strongest predictor of how dangerous it is to birds. Other factors can increase or decrease a building's impact, including the density and species composition of local bird populations, the type, location and extent of landscaping and nearby habitat, prevailing wind and weather, and patterns of migration through the area. All must be considered when planning bird-friendly environments. Commercial buildings with large expanses of glass can kill large numbers of birds, estimated at 35 million per year in the US (*Hager et al 2008*). With bird kills estimated at 1-10 per building per year, the large number of buildings multiplies out to a national estimate of as much as a billion birds per year (*Klem et al 2009; Klem 1990, 2009*). As we'll discuss, certain particularly hazardous combinations can result in hundreds of deaths per year for a single building.

Photo by Hendrik Dangan

BOTTOM A fatal bird-strike leaves behind a print of the bird's plumage as evidence of the force of the impact.

BIRDS AND LIGHTING



LIGHT

While recent research suggests that nighttime collisions may be more limited in scope than previously thought (*Gelb and Delacretaz 2009 and references therein*), at night artificial light degrades the quality of migratory corridors and adds new dangers to an already perilous journey. These conditions can be exacerbated by unfavorable weather and San Francisco fog, limiting birds' ability to see navigational markers like the stars and moon. Flood lights on tall buildings or intense uplights emit light fields that entrap birds reluctant to fly from a lit area into a dark one. This type of lighting has resulted in mass mortalities of birds (*Ogden 1996 and references therein*).

Lights disrupt birds' orientation. Birds may cluster around such lights circling upward, increasing the likelihood of collisions with the structure or each other. Importantly, vital energy stores are consumed in nonproductive flight. The combination of fog and light doubly affects birds' navigation and orientation. (*Ogden 2006*)

Besides reducing adverse impacts on migrating birds, there are significant economic and human health incentives for curbing excessive building illumination. In June 2009, the American Medical Association declared light pollution a human health threat and developed a policy in support of control of light pollution.

Overly-lit buildings waste tremendous amounts of electricity, 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 electrical costs annually because poorly designed or improperly installed outdoor fixtures allow much of the light to go up to the sky. "Light pollution" has negative aesthetic and cultural impacts. Recent studies estimate that over two-thirds of the world's population can no longer see the Milky Way, a source of mystery and imagination for star-gazers. Together, the ecological, financial, and aesthetic/cultural impacts of excessive building lighting serve as compelling motivation to reduce and refine light usage (*Scriber 2008*).

Light at night, especially during bad weather, creates conditions that are particularly hazardous to night migrating birds. Typically flying at heights over 500 feet, migrants often descend to lower altitudes during inclement weather, where they may encounter artificial light from buildings. Water vapor in very humid air, fog or mist refracts light, greatly increasing the illuminated area around light sources. Birds circle in the illuminated zone, appearing disoriented and unwilling or unable to leave (*Ogden 2006*). They are likely to succumb to lethal collision or fall to the ground from exhaustion, where they are at risk from predators. While mass mortalities at very tall illuminated structures such as skyscrapers have received the most attention, mortality is also associated with ground level lighting and with inclement weather.

BELOW: Hazards can combine in downtown San Francisco. In this photo beacon lighting, light spillage, and fog mix.

Photo by Michael Rodgers

While we typically think of birds as early risers, during migration season many species will travel at night. White lights, red lights, skyglow, brightly lit buildings and interiors can distort normal flight routes (*Poot et al. 2008*). The risks vary by species. Songbirds, in particular, seem to be guided by light and therefore appear more susceptible to collisions with lit structures. Migrant songbirds have been documented by multiple sources to suffer single night mortalities of hundreds of birds at a single location (*Ogden 1996 and references therein*).

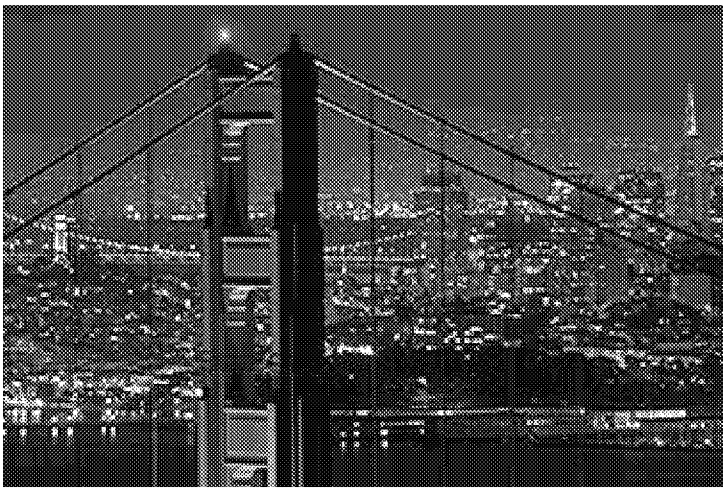


Image courtesy Light Out SF

ABOVE: Lighting and Navigation: Birds migrate by reading light from the moon and stars, as well as by geomagnetic signals radiated from earth. Cumulative light spillage from cities can create a glow that is bright enough to obscure the starlight needed for navigation.

LEFT: Beacon Effect. Individual structures may be lit in a manner that draws birds like a moth to a flame. Beacon structures can draw birds towards land that may offer little shelter or food or towards collisions with glass. Once at the structure, birds may be hesitant to leave the lit area causing them to circle the structure until exhausted. (*Ogden 1996*)

RIGHT: Skyglow can be increased during periods of inclement weather. Current research indicates that red lights in particular may disrupt geomagnetic tracking. Red lights required for airline safety would be permitted (above image). Decorative red lighting, such as on the building below in New York, would be discouraged.

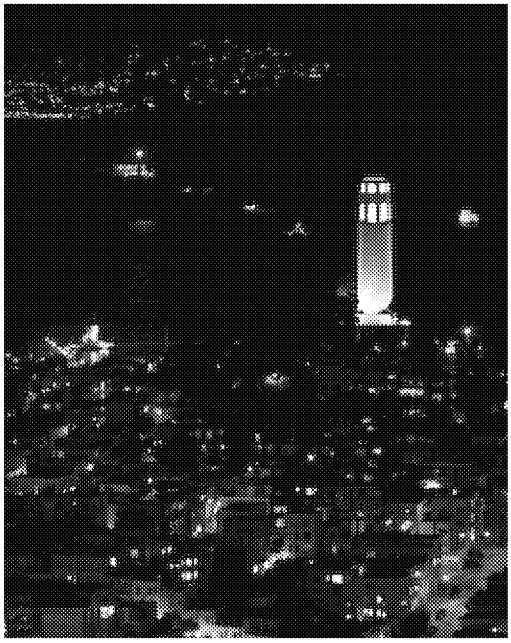


Image courtesy Light Out SF

Image courtesy NY Audubon

Map Courtesy of Point Reyes and Wildlife Department

OTHER CAUSES OF COLLISIONS:

LOCATION: MACRO-SETTING

San Francisco is on the Oceanic Route of the Pacific Flyway. During migration, birds tend to follow rivers and the coastline. In this way migrants funnel southward together in the fall and disperse northward in the spring.

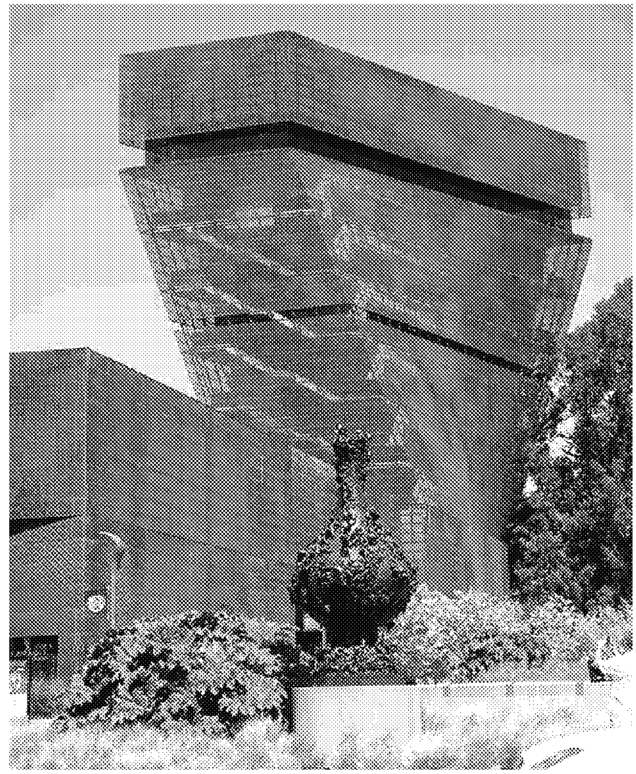
VISITING BIRDS

Migrating birds are unfamiliar with the City and may be exhausted from their flight. Instances of collisions rise during the migratory seasons as birds travel to lower elevations to feed, rest, and use light to recalibrate their navigation. (*Hager et al. 2008*).

LEFT: Millions of birds – more than 350 species – follow the Pacific Flyway. Of the two primary routes, the Oceanic Route passes through the Bay Area. Spring migration occurs between February through May, and fall migration begins in August and lasts through November. During this time, collisions with buildings can increase notably.

Photos by Emilie Barker

LEFT: According to the Golden Gate Audubon Society, over 250 species migrate through San Francisco Bay, many of them small songbirds such as warblers, thrushes, tanagers and sparrows that migrate at night and may be more susceptible to collisions with structures when descending for feeding and resting because of unfamiliar territory and confusing signals from the urban environment. Bird photos from left to right are Anna's Hummingbird, Yellow Warbler, and Lazuli Bunting.



LOCATION: MICRO-SETTING

How a building meets adjacent landscape features can be critical in determining the risk to birds. Buildings with large windows located adjacent to extensive vegetation present great hazards. In suburban areas, buildings with these features have been documented to kill 30 birds per year (*Klem 1990; and O'Connell 2001*). This combination may be even more lethal in urban areas. Studies of Manhattan structures with large swaths of glazing adjacent to large open spaces have recorded well over 100 collisions per year (*Gelb and Delacretaz 2009*).

BUILDING FEATURES

Well-articulated buildings orient people as well as birds, directing flow of traffic, creating enticing rest areas and adding aesthetic appeal.

RIGHT: Although located in a park setting, the De Young Museum minimizes hazards due to its low amount of glazing and perforated copper façade.

WEATHER CONDITIONS

Inclement weather can obscure obstacles and exacerbate skyglow conditions (*Ogden 1996 and references therein*).

http://zhumile.com/2009/09/30/beautiful_pictures_of_san_francisco_covered_with_fog_10_pics_1_video.html

Implications for San Francisco

Three decades of researching bird/building collisions has yielded both many answers and posed new questions. The high number of North American bird deaths and the ecological importance of birds demonstrate that the problem exists on a national level, but it is natural to wonder if the dense nature of San Francisco presents the same compelling pressure for a local response. The short answer is yes—San Francisco has both an important population of birds and a potentially injurious built environment for them. As discussed previously, San Francisco is both home to many birds and is on a major migratory pathway. Locally, there are incidents of celebrated birds such, as the Peregrine Falcon, repeatedly losing their young due to collisions with downtown skyscrapers. With only a few studies currently underway in San Francisco and results not yet complete, anecdotally, local birders have monitored several buildings and have noted significant numbers of bird injuries and deaths (*Weeden, 2010*). San Francisco Animal Care and Control staff further reported collecting 938 wild birds over a two year period from May 2008 through June 2010, noting the majority of birds were found during the spring and fall migratory periods. The California Academy of Sciences in Golden Gate Park is spearheading their own research and bird-safe building methods, in a proactive effort to avoid bird fatalities at their facility. In lieu of large-scale local monitoring programs there are a great many studies of dense urban cities that we can further draw upon. These studies demonstrate that birds respond similarly to certain building and environmental features, regardless of geographic location.

SPOTLIGHT ON A LOCAL CELEBRITY

The Peregrine Falcon population suffered a huge blow to their numbers due to the use of pesticides including DDT beginning in the 1950s. In 1970 the California Peregrine Falcon population was reduced to only two known breeding pairs. The Santa Cruz Predatory Bird Research Group (SCPBRG) participated in the reintroduction of the species and has monitored the Peregrine Falcons nesting in San Francisco and other sites.

Natural cliff dwellers, the species adapted to nesting in bridges and downtown high-rises. As the population increased, Peregrine Falcons were reported in the San Francisco financial district and in 1987 a nest box was placed near a commonly used perch on the PG&E Headquarters Building. In 2003, Peregrine Falcons nested in the downtown for the first time and have been a closely watched since. SCPBRG trained citizens to participate in a group called "Fledge Watch" to increase understanding of how young falcons fare in the city. In 2009, 76 people volunteered for 5 hour shifts monitoring the 36-58 day old Peregrines from sunrise to sunset in either San Jose or San Francisco. The public could also view the falcons from the downtown building nest via a webcam.

According to Glenn Stewart of SCPBRG, "while there have been building collision fatalities, the target nest success of Peregrine Falcons in San Francisco was 1.5 per nest and has been exceeded at 1.6 young fledged per nest."

It appears that several weeks after fledging, urban Peregrine Falcons recognize glass as a barrier. In the first few weeks when the young are learning to fly they are most at risk for a collision. In other habitats, falcons face predators like eagles, owls, and when on the ground by bobcats, and coyotes. Like other birds, Peregrine Falcons see in the ultra violet (UV) range.

The architects and designers of the downtown environment did not consider bird building collision as a potential risk. In the future when buildings are being designed and upgraded, the latest information and options should be considered.

- Noreen Weeden, *Golden Gate Audubon Society*

Photo by Glenn Stewart

A native San Franciscan juvenile Peregrine Falcon (deceased offspring of "Dapper Dan" and "Diamond Lil") perched on sill near reflective glass. All three fledged young from that year (2009) died as a result of building collisions. Two more fledglings died from collisions in 2011.

LESSONS FROM MAJOR CITIES

Academic researchers and bird-rescue organizations in Chicago, Toronto, and New York City have documented thousands of structure collisions and come to some interesting conclusions.

Perhaps the most established monitoring program of bird-building collisions in a dense city is NYC Audubon's Project Safe Flight in Manhattan. Project Safe Flight documented over 5,400 collisions between 1997-2008. A recent study (*Gelb, Delacretaz 2009*) analyzed this data to determine the critical contributing factors for the structures with the largest number of bird fatalities.

- The study looked at the 10 most deadly collision sites and found the combination of open space, vegetation, and large windows (greater than 1 meter x 2 meter) to be more predictive of death than building height.
- The frequency of collisions is highest along façades that have lush exterior vegetation and either reflective or transparent windows.
- The majority of the collisions occurred during the daytime and involved migrant species.
- High-rise buildings and night lighting presented less risk than windows adjacent to open spaces one hectare or greater in size.
- The majority of collisions are likely due to high-collision sites that feature glass opposite exterior vegetation.
- Urban mortalities may be higher than previously thought. Non-urban studies estimated that high-collision sites would have about 30 collisions per year. At the Manhattan collision sites examined in this study, well over 100 collisions were recorded per year.

The most dangerous building in this study was not a high-rise, but instead was a 6-story office building adjacent to densely vegetated open space.

Studies in Toronto and other eastern and Great Lakes cities have documented tens of thousands of bird fatalities attributable to building collisions. A 10-year study of bird-building collisions in downtown Toronto found over 21,000 dead and injured birds in the city's downtown core. A 25-year study by researchers from Chicago's Field Museum of Natural History documented a particularly problematic building in Chicago (McCormick Place Convention Center) with over 30,000 dead birds of 141 species. The lights at the McCormick Palace were left on at night until 2000. Anecdotal reports for this building cited an 80% decrease in the number of birds killed, by simply turning out building lights (*Kousky 2004*).

Other researchers have agreed that lights can cause a significant problem, but that turning off lights isn't the only answer *(Shephard, Klem 2011)*. As shown in the Manhattan study of ten buildings, daytime collisions were higher and occurred in areas with vegetation opposite glass. Toronto's approach to tackle this dual issue was to provide mandatory construction standards for daytime, while continuing to increase participation in their Lights Out program at night.

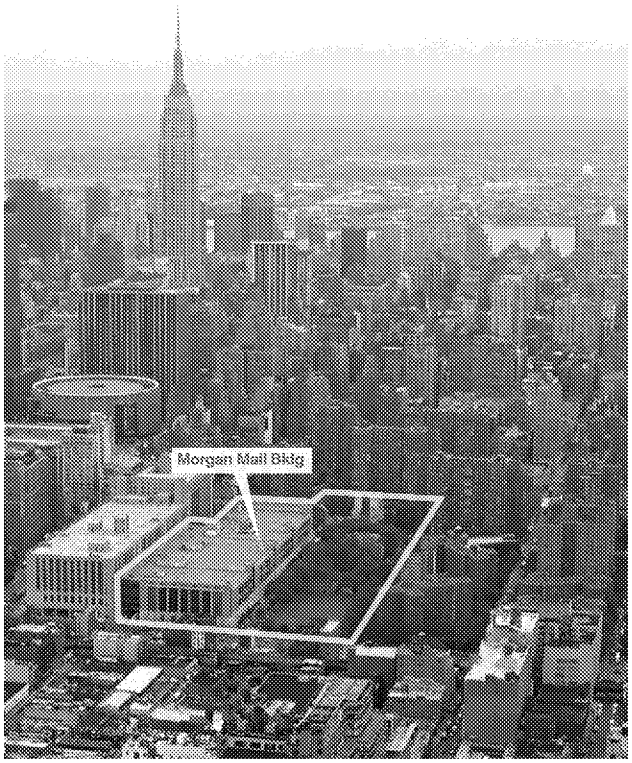


Photo courtesy NY Audubon

ABOVE: The windows of Morgan Mail Building in Manhattan are adjacent to green landscaped open spaces, making it the most dangerous for birds in a recent study.

RIGHT: Morgan Mail Building causality.

Spotlight on San Francisco's Migrant Birds

Bird collisions with buildings occur year-round, but peak during the migration period in spring and especially in fall when millions of birds travel between breeding and wintering grounds. Migration is a complex phenomenon, and different species face different levels of hazards, depending on their migration strategy, immediate weather conditions, availability of food, and anthropogenic obstacles encountered en route.

Photo by Richard Blaylock

Nocturnal migrants: Many songbirds migrate at night, possibly to take advantage of cooler temperatures and less turbulent air, and because they need daylight to hunt insects for food. Generally, these birds migrate individually, not in flocks, flying spread out across most of their range. Migrants depart shortly after sundown. The number of birds in flight peaks before midnight, then drops. Songbirds may fly as many as 200 miles in a night, then stop to rest and feed for one to three days, but these patterns are strongly impacted by weather, especially wind and temperature. Birds may delay departure, waiting for good weather. They generally fly at an altitude of about 2,000 feet, but may descend or curtail flight altogether if they encounter a cold front, rain, or fog. There can be a thousand-fold difference in the number of birds aloft from one night to the next. Concentrations of birds may develop in 'staging areas' where birds prepare to cross large barriers such as the Great Lakes or Gulf of Mexico.

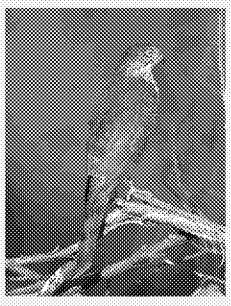


Photo by Eddie Bartley

Diurnal migrants: Daytime migrants include raptors, which take advantage of air currents to reduce the energy needed for flight. Other diurnal migrants, including shorebirds and water-birds, often fly in flocks and their stopover sites are less dispersed because of their dependence on bodies of water. This means that daytime migration routes often follow land forms such as rivers and mountain ranges, and birds tend to be concentrated along these routes or 'flyways'. Not all songbirds migrate at night—species such as robins, larks, kingbirds and others migrate during the day. Birds' daytime flight altitudes are generally lower than their nighttime counterparts.

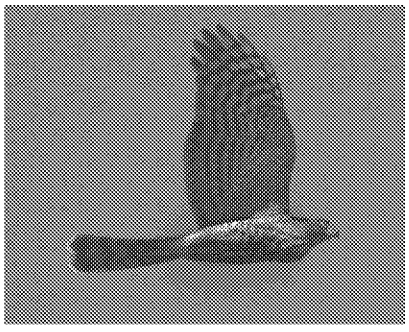
Millions of birds, especially songbirds, are thus at risk, as they ascend and descend, flying through or stopping at or near populated areas. As city buildings grow in height, they become unseen obstacles by night and pose confusing reflections by day. Nocturnal migrants, after landing, make short, low flights near dawn, searching for feeding areas and running a gauntlet of glass in almost every habitat: in cities, suburbs and, increasingly, exurbs. When weather conditions cause night flyers to descend into the range of lighted structures, huge kills can occur around tall buildings. Urban sprawl is creating large areas lit all night that may be causing less obvious, more dispersed bird mortality.

- Christine Sheppard, *American Bird Conservancy*

THE IMPORTANCE OF MACRO-LOCATION (ON MIGRATION PATH) VS. MICRO-LOCATION (WITHIN A PARK-LIKE SETTING) AS A RISK FACTOR

A study of collisions at suburban office parks in Virginia found a large mortality rate for migrant birds even though the office parks were not on a migratory route—suggesting that the combination of mirrored windows and vegetation was more of a collision risk to visiting birds (*O'Connell 2001*). This study also suggests that the location of the building relative to the flyway may be less important than other risk factors such as building design and siting relative to plantings and open space.

Photos by Eddie Bartley



By flying at night, migrants like the Orange-Crowned Warbler (NEAR RIGHT) and Western Tanager (ABOVE LEFT) minimize predation, and avoid overheating that could result from the energy expended to fly such long distances. This also enables them to feed during the day and refuel for the night.

Daytime migrants like this Cooper's Hawk (FAR RIGHT) and the Sharp-shinned Hawk (ABOVE RIGHT) depend on the heating earth for added lift. Riding rising air currents called thermals, these birds take advantage of this lift to rise to the top of one thermal, set their wings in the direction they want to travel and then coast to the next thermal.

Spotlight on Building Height and Bird Migration

Upper Levels:

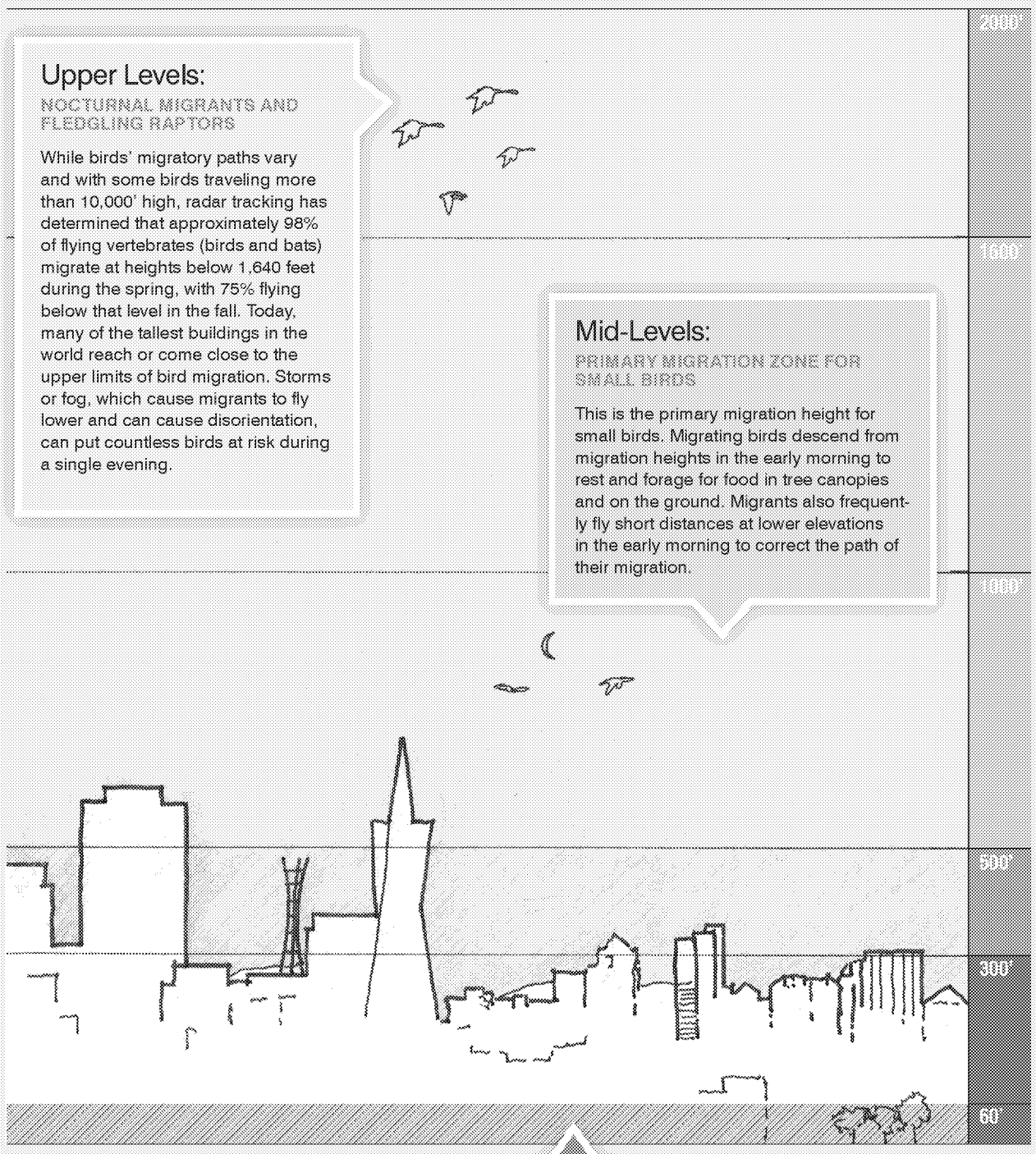
NOCTURNAL MIGRANTS AND FLEDGLING RAPTORS

While birds' migratory paths vary and with some birds traveling more than 10,000' high, radar tracking has determined that approximately 98% of flying vertebrates (birds and bats) migrate at heights below 1,640 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 migration. Storms or fog, which cause migrants to fly lower and can cause disorientation, can put countless birds at risk during a single evening.

Mid-Levels:

PRIMARY MIGRATION ZONE FOR SMALL BIRDS

This is the primary migration height for small birds. Migrating birds descend from migration heights in the early morning to rest and forage for food in tree canopies and on the ground. Migrants also frequently fly short distances at lower elevations in the early morning to correct the path of their migration.



Bird Building Collision Zone:

INCREASED COLLISIONS FOR LOCAL BIRDS AND MIGRANTS SEARCHING FOR FOOD AND SHELTER

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 attractive features.

II. Bird-Safe Treatments

A Survey of Treatments from Easy to Innovative

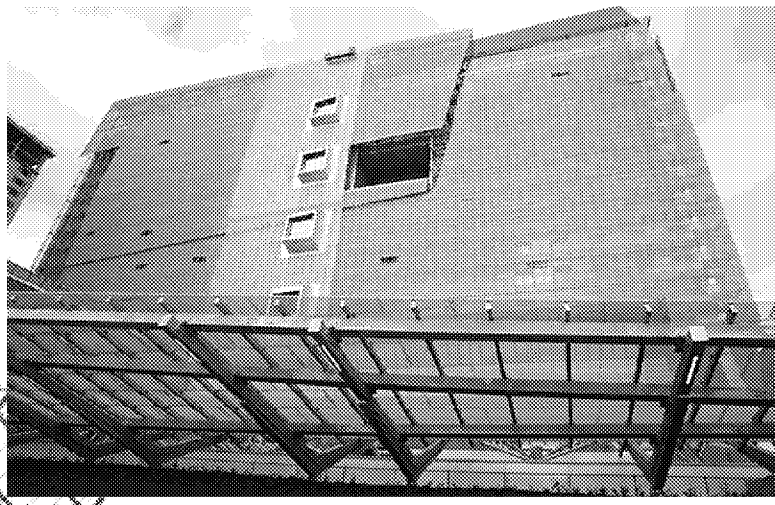
Effective bird-safe building treatments exist and have been employed on buildings of significant architectural stature. San Francisco has a local example of such treatments that has been recognized nationally. The new Federal Building is cited as an example of bird-safe building design in United States Representative Mike Quigley's (D-IL) pending bill,"Federal Bird-Safe Buildings Act of 2011" (*House Bill No. 1643*). This bill, if adopted, would require federal buildings to incorporate bird-safe design principals.

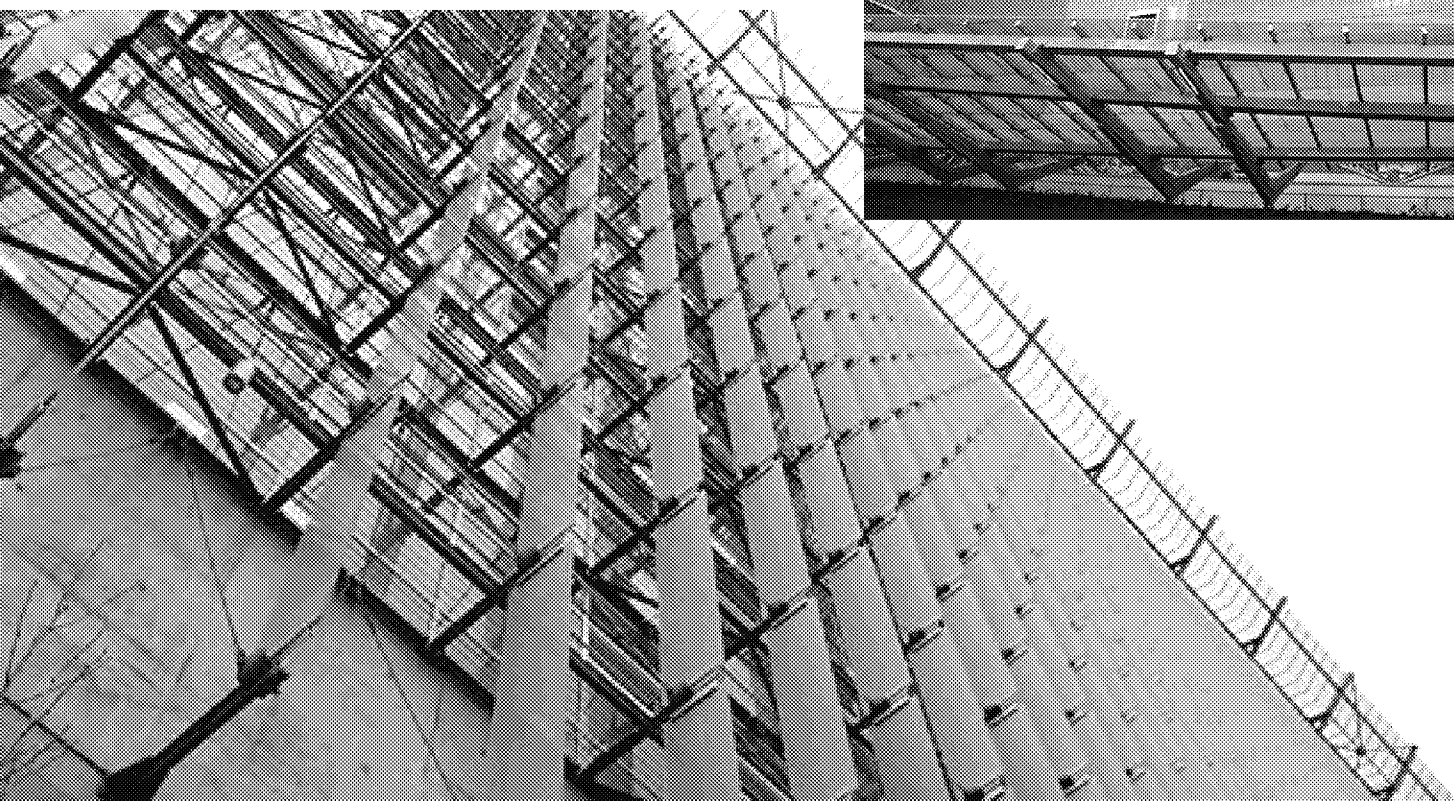
Bird-safe design options are limited only by the imagination. Safe buildings may have large expanses of glass but use screens, latticework, grilles and other devices, both functional and decorative, outside the glass or integrated into the glass. There are treatments for existing glass that will reduce mortality to zero. These treatments do provide a view from inside, though often presenting a level of opacity from the outside, a factor that can deter application of these solutions. Glass treatments that can eliminate or greatly reduce bird mortality, while only minimally obscuring the glass itself, are therefore highly desirable and encourage more 'bird-friendly' design.

RIGHT: The south façade sports perforated steel panels that filter sunlight and serve as thermal buffers but also may convince birds that the structure is solid.

BOTTOM: San Francisco's Federal Building's north façade boasts floor-to-ceiling glass buffered behind a grid of metal catwalks and opaque glass fins.

Photos by Kurt Rodgers, SF Chronicle
http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2007/02/25/MNG2DOATON1.DTL





GLASS AND FAÇADE TREATMENTS

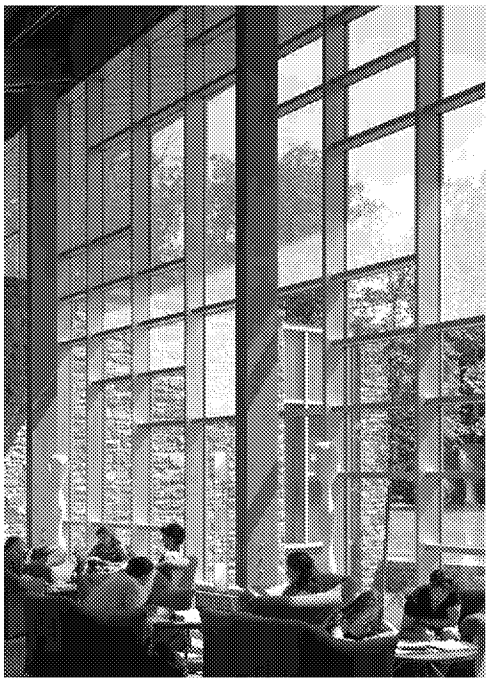
Reduction of bird strikes with new buildings can be achieved with simple and cost-effective means. Creating a visual signal, or "visual noise barrier," that alerts the birds to the presence of glass objects can be achieved with relatively little additional cost. Fritting, the placement of ceramic lines or dots on glass, is one method of creating a visual noise barrier. People inside the building see through the pattern, which has little effect on the human-perceived transparency of the window. Fritting can also reduce air conditioning loads by lowering heat gain, while still allowing enough light transmission for day-lighting interior spaces. There is now a commercially available insulated glass with ultra-violet patterns that are designed to deter birds while largely being imperceptible to humans.

FRITTED AND FROSTED GLASS

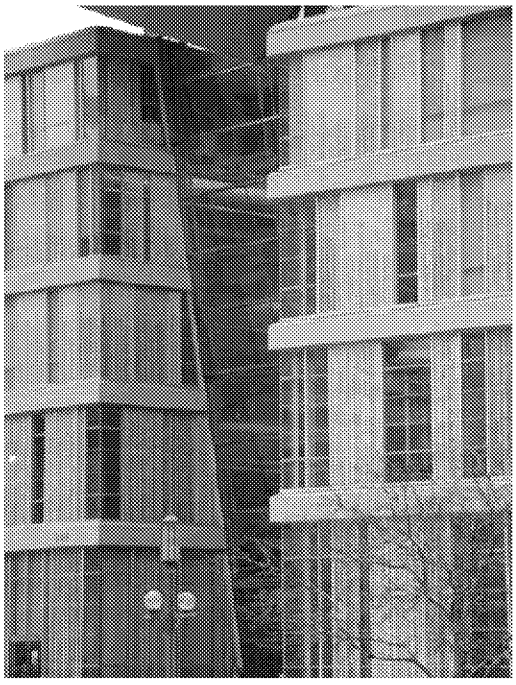
Ceramic dots, or frits, are applied between layers of insulated glass to reduce transmission of light. These can be applied in different colors and patterns and can commonly be seen on commercial buildings. At Swarthmore College, external, densely fritted glass was incorporated into the design of the Unified Science Center. Virtually no strikes have been reported at either site. Fritting is a commonly-used and inexpensive solution that is most successful when the frits are applied on the outside surface.

ANGLED GLASS

While angled glass may be a useful strategy for smaller panes, it is generally not effective for large buildings. Birds approach glass from many angles, and can see glass from many perspectives. Generally, the desired angle for effective treatment is 20-40 degrees. These angles are difficult to maintain for large buildings, however, this strategy may work in low-scaled buildings with a limited amount of glass (*Ogden 1996 and references therein; and Klem et al. 2004*).



Minnesota Bird-Safe Building Guidelines



Minnesota Bird-Safe Building Guidelines

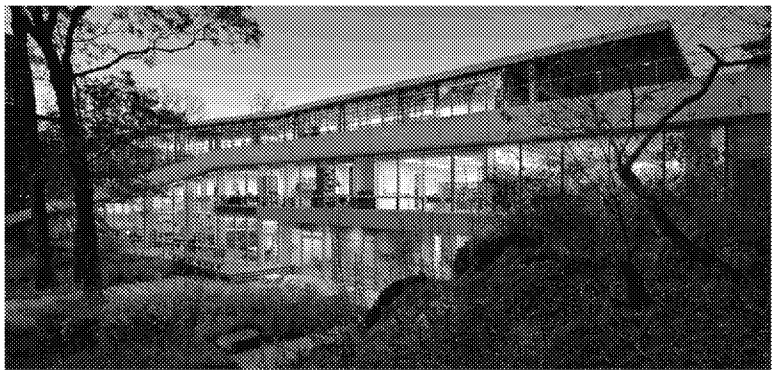
LEFT: Swarthmore College uses fritting on a large expanse of glass facing an open space.

RIGHT: The Minnesota Central Library's atrium features angled glass, a dramatic architectural feature that reduces reflections of habitat and sky from most angles. The likelihood of fatal collisions at this angle is lessened.

ULTRA-VIOLET GLASS

The Bronx Zoo uses glass that reflects UV light—primarily visible to birds, but not to people (*Klem 2009*). This glass may be about 50% more expensive than typical glass but is comparable to energy-efficient glass (*Eisenberg 2010*).

TOP RIGHT: The Bronx Zoo from the NYTimes.

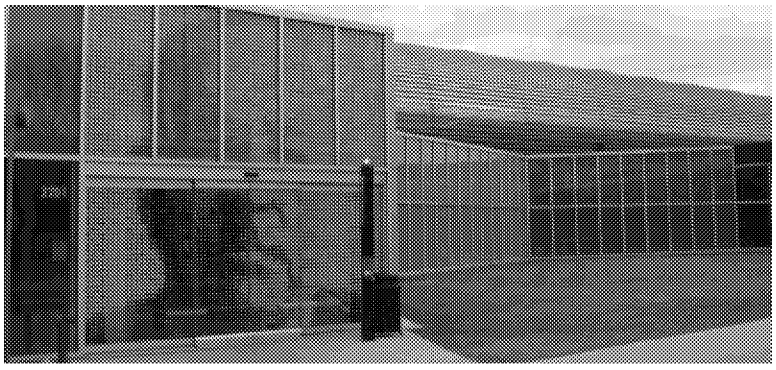


http://www.nytimes.com/2010/06/20/business/20novel.html?ref=anne_gf_eisenberg

FILM AND ART TREATMENT OF GLASS

Windows may be used as canvases to express building use through film and art. In certain instances, windows made bird-safe through an application of art may receive funding through San Francisco's One Percent for Public Art Program.

SECOND RIGHT: IIT Student Center, Chicago.

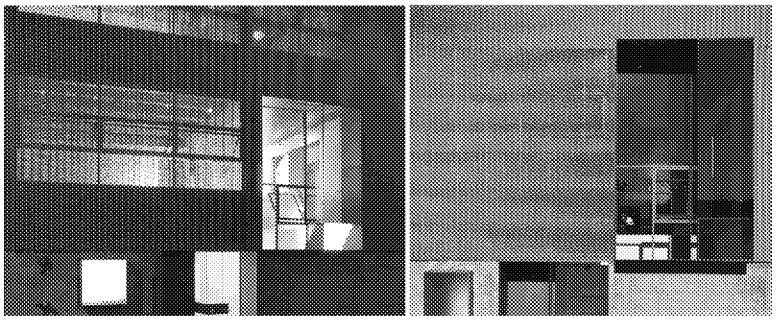


NY Bird Safe Design Guidelines

EXTERNAL SCREENS

External screens are both inexpensive and effective. Screens can be added to individual windows for small-scale projects or can become a façade element of larger developments. This time-tested approach precludes collisions without completely obscuring vision. Before non-operable windows, screens were more prevalent. At the other end of the spectrum are solutions that wrap entire structures with lightweight netting or screens. To be effective, the netting must be several inches in front of the window, so birds don't hit the glass after hitting the net.

THIRD RIGHT: The Matarozzi/Pelsinger Building in San Francisco is a LEED Gold building designed by Aidlin-Darling. It has screens over the majority of its façade that protect birds from impact and allow views out for users of the building (left nighttime/right daytime)

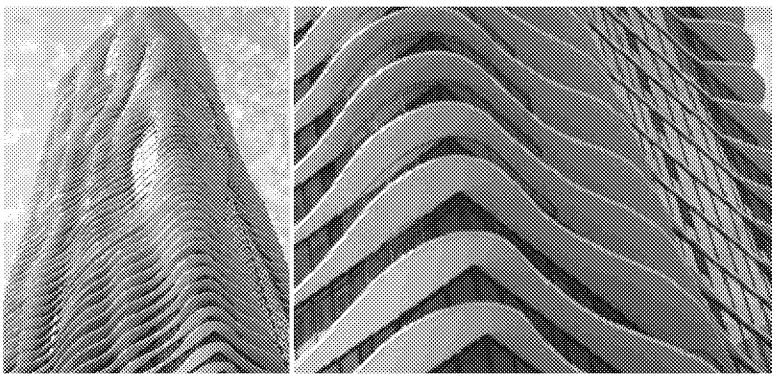


Minnesota Bird-Safe Building Guidelines

ARCHITECTURAL FEATURES

Overhangs, louvers, and awnings can block the view of the glass from birds located above the feature but do not eliminate reflections. This approach should be combined with window treatments to achieve results.

BOTTOM RIGHT: The award winning Aqua Tower, Chicago, uses overhangs and other features that provide bird-safe design as well as energy efficiency.



Steve Hall/Chicago Curbed

NETTING

Netting has proven to be a versatile and effective option for bird-safe window treatment. Netting is stretched several inches over windows or entry ways to prevent birds from hitting the glass. Specifically designed netting is almost completely invisible and does not require invasive installation techniques. It can be used for new buildings, retrofits to existing buildings, replacement glass façades, and for preserving original features of historic buildings.

During the spring and fall migrations, agency staff at the FBI building in Chicago discovered at least 10 birds a day crashing into windows outside of their first floor, plant filled indoor atrium. Seasonal netting was installed and bird collision monitors noted a substantial reduction in bird strikes, without compromising the look of the building or the ability to see into or out of the lobby (*DeVore 2011*).

Netting has also been used successfully to treat historic buildings, where it's critical to maintain the original character of the building. Prestigious historic preservation awards have been earned for netting work on famous buildings such as the American Museum of Natural History and the US Department of Justice. Other historically significant structures with netting include New York Metropolitan Opera, Independence Hall, and even Alcatraz Prison.

Heather Charles, Chicago Tribune

Photo Courtesy of Birdmasters, Inc.

Photo Courtesy of Birdmasters, Inc.

TOP RIGHT: Special agent Julia Meredith discovered so many dead and injured birds on the ground outside the Chicago offices of the FBI that she lobbied to have special bird-friendly netting installed on the building's first floor windows. She estimates that the nets have reduced the number of birds crashing into the windows by 90 percent.

CENTER RIGHT: A close-up view of the New York Public Library barely shows the marble toned and clear netting over the building.

BOTTOM RIGHT: The netting placed over the windows at the New York Public Library is virtually invisible and helps prevent both bird strikes and building deterioration from pest species.

WIND GENERATORS

San Francisco has a policy to encourage the installation of on-site, renewable energy systems, such as small wind generators. Currently, there are two general types of wind generators available. One uses scoops or blades to spin on a vertical axis, shown at far left below. It is probable that birds would perceive this type as a solid barrier even when it's rotating.

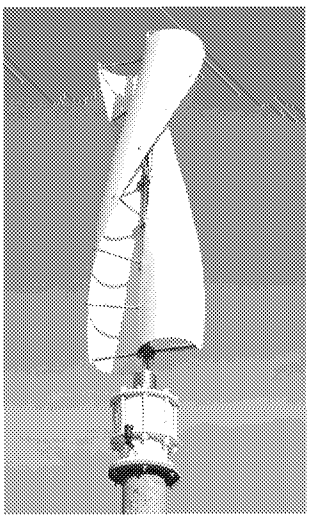
The second design uses a propeller-like rotor to spin on a horizontal axis. This is a small-scale version of the most common generator used on large-scale wind farms throughout the world.

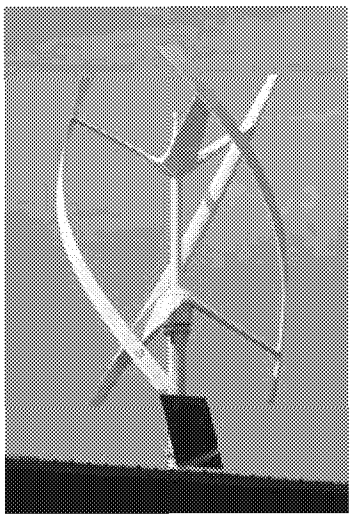
While it is unreasonable to believe that these small urban systems would cause the annihilation of birds such as the well-known disaster at Altamont, California (see discussion on adjacent page) a certain amount of caution is prudent in the absence of established scientific research. The Planning Department has exercised that caution by allowing a more widespread installation of vertical axis machines, and limiting locations of horizontal axis, open-bladed generators to areas that would seem to be less densely populated by birds, especially migrants and juveniles.

The only clear way at present to learn whether small urban wind generators will harm birds is to allow the installation of a few, and to monitor the interactions with animals, if any. For this reason, all approvals for wind generators have conditions that require monitoring and reporting of bird and bat strikes. These reporting protocols are in accord with recommendations made by the Mayor's Task Force on Urban Wind.

As of June 2011, none of the approved windmills have submitted monitoring information to the Planning Department.

LEFT: Horizontal axis and vertical access wind generators that do not present a solid appearance are discouraged, especially adjacent to water or open space larger than 2 acres.





ABOVE: Vertical axis wind generators may vary in appearance. Blades that present a solid appearance (such as the left image) are encouraged.

Golden Eagle photo by Eddie Bailey

Spotlight on the Altamont Windmills

Golden Eagles, named for the golden feathering at the nape of their necks, are majestic raptors that can be found throughout most of California and much of the northern hemisphere. California protects these magnificent raptors as both a species of special concern and a fully protected species, making it illegal to harm or kill them. Golden Eagles are protected under the Bald and Golden Eagle Protection Act. Golden Eagle are also protected under the Federal Migratory Bird Treaty Act, which forbids the killing (even unintentional killing) of any migratory bird.

Golden Eagles typically prefer open terrain, such as the rolling hills of eastern Alameda County. The open grasslands, scattered oaks, and bountiful prey make this area ideal habitat for Golden Eagles. Today, it supports the highest-known density of Golden Eagle nesting territories in the world.

Conservation Issues

Every year, an estimated 75 to 110 Golden Eagles are killed by the wind turbines in the Altamont Pass Wind Resource Area (APWRA). Some lose their wings, others are decapitated, and still others are cut in half. The lethal turbines have been reduced from 6,000 to less than 5,000 which are still arrayed across 50,000 acres of rolling hills in northeastern Alameda and southeastern Contra Costa counties. The APWRA, built in the 1980s, was one of the first wind energy sites in the U.S. At the time, no one knew how deadly the turbines could be for birds. Few would now deny, however, that Altamont Pass is probably the worst site ever chosen for a wind energy project. According to a 2004 California Energy Commission (CEC) report, as many as 380 Burrowing Owls (also a state-designated species of special concern), 300 Red-tailed Hawks, and 333 American Kestrels are killed every year. The most recent study by Dr. Shawn Smallwood, a member of the Altamont Scientific Review Committee estimates that approximately 7,600-9,300 birds are killed here each year. (*Smallwood 2010*)

In 2004, Golden Gate Audubon joined four other Bay Area Audubon chapters (Marin Audubon, Santa Clara Valley Audubon, Mt. Diablo Audubon, and Ohlone Audubon) and Center for Biological Diversity and Californians for Renewable Energy (CARE) in challenging the renewal permits for this facility. The Audubon/CARE CEQA lawsuit settled, with terms requiring the wind companies to reduce avian mortality by 50% within three years and to complete a comprehensive conservation plan to govern operations in the Altamont.

Reducing the kill entirely may not be possible as long as the wind turbines continue to operate at Altamont. However, significant progress can be made. The CEC estimates that wind operators could reduce bird deaths by as much as 50 percent within three years–the goal stated in the settlement agreement–and by up to 85 percent within six years–all without reducing energy output significantly at APWRA. These reductions could be achieved by removing turbines that are the most deadly to birds and shutting down the turbines during four winter months when winds are the least productive for wind energy, combined with some additional measures. Anecdotal data indicate there may not be a substantial improvement for Golden Eagles and there may actually be much higher mortality for bats.

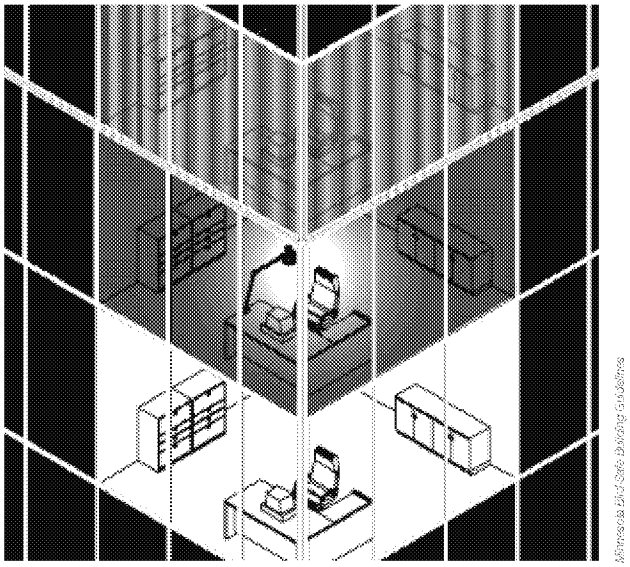
Golden Gate Audubon is working with Alameda County to ensure that the permits granted to the wind industry achieve reductions in bird mortality, in addition to other requirements that will help address the unacceptable bird kills at Altamont Pass over the long term. Pursuit of clean energy technology, when done correctly, can help reduce the risk of global warming and its impacts on wildlife.

Written by the Golden Gate Audubon Society.

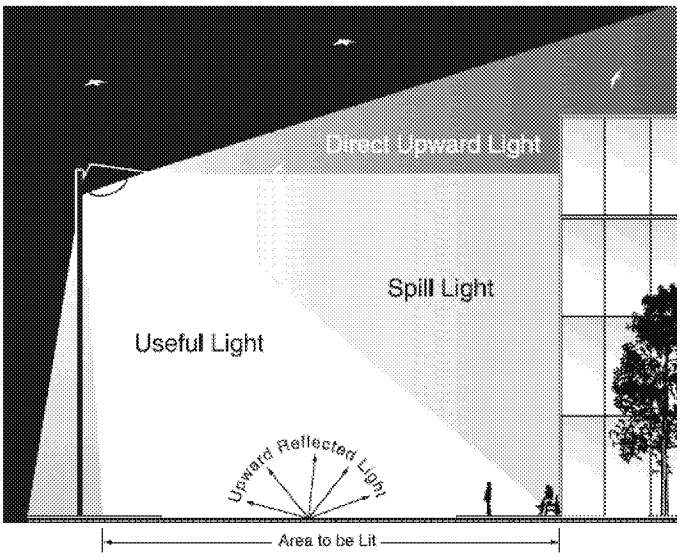
LIGHTING TREATMENTS

While the ultimate cause of collisions are invisible surfaces, light pollution can increase risk. Night migrants depend on starlight for navigation, and brightly-lit buildings can draw them off course. Once within the aura of bright lights, they can become disoriented, and may collide with buildings, or may fly in circles around the light source, until they drop to the ground from exhaustion, having expended their limited energy reserves needed to complete their migration. Architects and building owners should collaborate to address the two key lighting issues: design and operation.

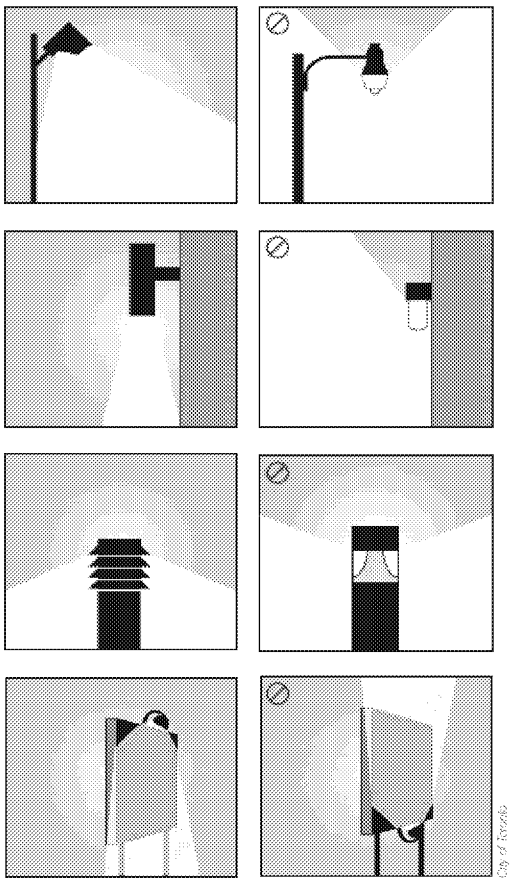
Eliminating unnecessary lighting is one of the easiest ways to reduce bird collisions, with the added advantage of saving energy and expense. As much as possible, lights should be controlled by motion sensors. Building operations can be managed to eliminate or reduce night lighting from activities near windows. Minimize perimeter and vanity lighting and consider filters or special bulbs to reduce red wavelengths where lighting is necessary. Strobe lighting is preferable to steady burning lights. Exterior light fixtures should be designed to minimize light escaping upwards. Motion detectors are thought to provide better security than steady burning lights, because lights turning on provide a signal, and because steady lights create predictable shadows.



REDUCE: UNNECESSARY INTERIOR LIGHT

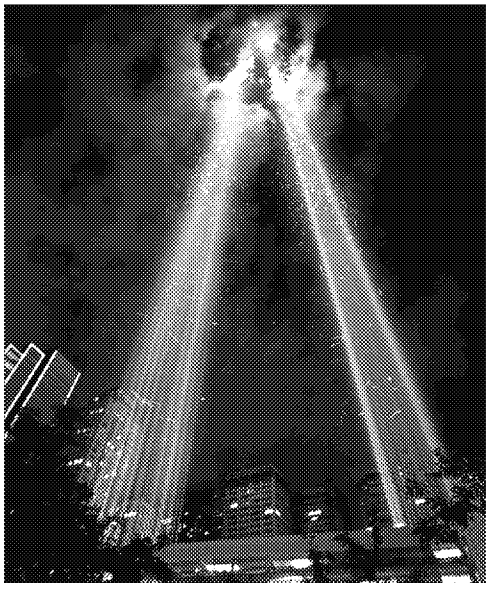


REDUCE: UNNECESSARY EXTERIOR LIGHT



City of Toronto

PREFERRED DISCOURAGED



The Tribute in Light - Downlight (c) 2010 Jon de Guzman http://jondeguzman.com

LIGHTING DESIGN

The built environment should be designed to minimize light pollution including: light trespass, over-illumination, glare, light clutter, and skyglow while using bird-friendly lighting colors when possible (*Poot et al. 2008*).

- **Avoid uplighting**
- **Avoid light spillage**
- **Use green and blue lights when possible**

LIGHTING OPERATIONS

Unneeded interior and exterior lighting should be turned off from dusk to dawn during migrations: February 15 through May 31 and August 15 through November 30. Rooms where interior lighting is used at night should have window coverings that adequately block light transmission, and motion sensors or controls to extinguish lights in unoccupied spaces. Event searchlights are strongly discouraged during these times.

Several cities, including San Francisco, have launched citywide efforts to reduce unneeded lighting during migration. In addition to saving birds, these "Lights Out" programs save a considerable amount of energy and reduce pollution by reducing carbon dioxide emissions. The savings for a building can be significant. One participating municipal building in the Toronto Lights Out program reported annual energy reductions worth more than $200,000 in 2006.

Lights Out requires that building owners, managers, and tenants work together to ensure that all unnecessary lighting is turned off during Lights Out dates and times (during spring and fall migration February 15th through May 31st and August 15th through November 30th). Best practices for lighting include turning off unnecessary lights after dusk and leaving the lights off until dawn. If inside lights are needed, window coverings such as blinds or drapes should be closed.

LEFT: The white streaks are the time-exposed paths of birds attracted to, dazed by, and circling within the columns of light. Many succumbed to exhaustion and perished without completing their migration. Lights Out policies do not allow the use of searchlights during the Spring and Autumn migration periods for this reason.

III. Bird-Safe Requirements and Guidelines Across North America

When discussing human-caused threats to birds, the US Fish and Wildlife Service reports "that the incidental, accidental or unintentional take of migratory birds is not permitted by the Service and is a criminal violation of the Migratory Bird Treaty Act" but that the Service first attempts to work with industries and individuals who unintentionally cause bird death before pursuing criminal prosecution (*US Fish and Wildlife Service 2002*).

Several major cities are addressing the issue through local legislation.

- **Chicago:** In July of 2008, Cook County, Illinois, which includes Chicago, passed an ordinance requiring that all new buildings and major renovations incorporate design elements to reduce the likelihood of bird collisions. This ordinance established Chicago as the first major jurisdiction with a requirement for bird-safe elements. Other nearby local jurisdictions, such as Highland Park, are also following suit with new bird-safe architecture requirements.

- **Toronto:** This effort has evolved from voluntary ratings and incentive program to bird-friendly construction guidelines that became mandatory at the beginning of 2010. The bird-friendly guidelines were integrated into Toronto's local Green Development Standard, required for nearly all new construction. In addition, the City of Toronto offers an acknowledgement program that offers incentives to developers and building owners and managers who implement the Bird-Friendly Development Guidelines. Once a development has been verified by City staff as "bird-friendly", the City provides the owner with an original print by a local artist and the building may be marketed as "bird-friendly." A bird-friendly designation could give these buildings a competitive advantage by identifying these features to an increasingly environmentally concerned and aware marketplace. Toronto also has had great success with their Lights Out program which has been in effect since 2006. (See images on page 36.)

- **Minnesota:** As of 2009, the State of Minnesota requires that all state owned and leased buildings turn off their lights at night during migration. As of June, 2011, bird-safe building criteria are being developed for incorporation into the State of Minnesota Sustainable Building Guidelines.

- **Michigan:** Since 2006, the governor of Michigan has issued an annual proclamation, declaring "Safe Passage" dates during spring and fall migration, when buildings managers are asked to turn off lights at night.

- **Nationally:** In April 2011, Congressman Mike Quigley introduced a bill (*H.R. 1643*) into the U.S. Congress that, if passed, would mandate bird-friendly construction practices for federal buildings.

NY Bird Safe Building Guidelines

IV. San Francisco's Bird-Safe Requirements

It is clear from studies done throughout the U.S. and Canada that certain building and landscape configurations can be especially dangerous to birds. These sites present heightened risks for collisions and necessitate requirements, which are included in Section 139 of the Planning Code, Standards for Bird-Safe Buildings.

The following bird-safe measures apply in San Francisco.

Structure and/or siting characteristics that present the greatest risk to birds are called "bird-hazards" and include:

1 Location-related hazards

2 Building feature-related hazards

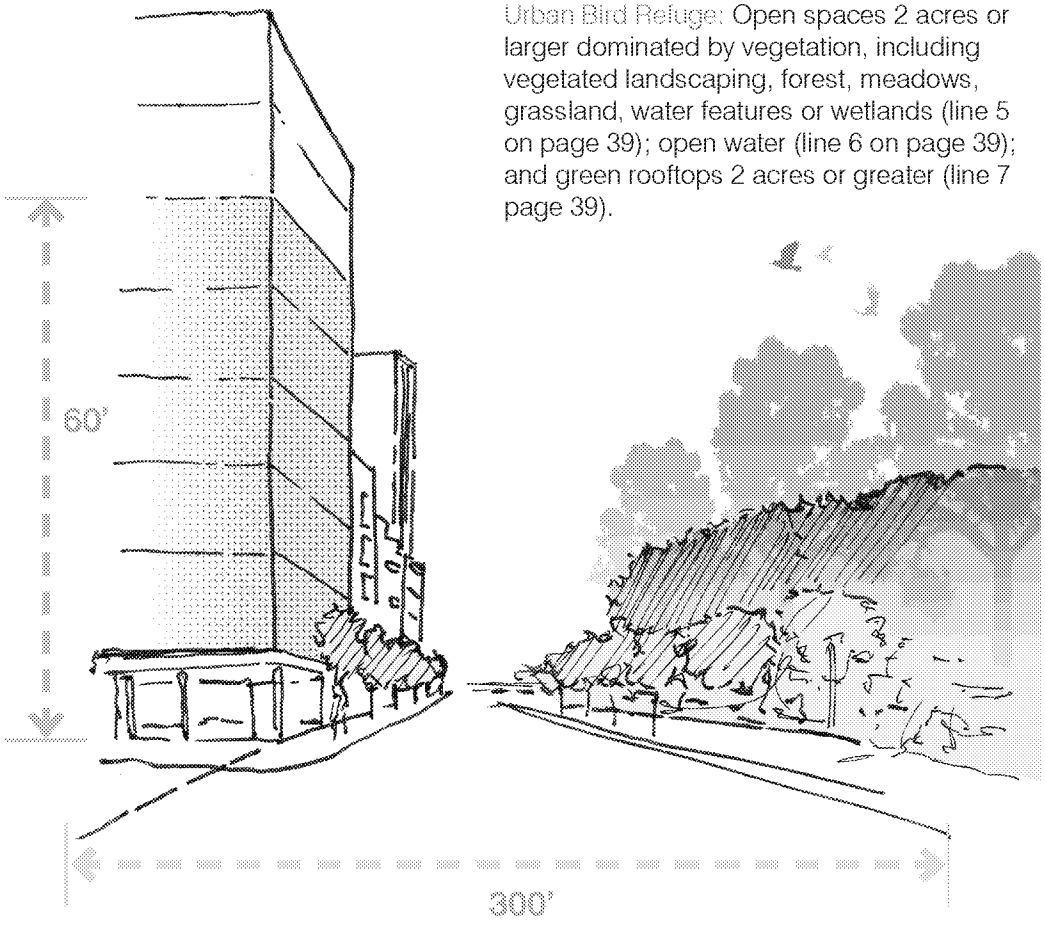
1 Requirements for Location-Related Hazards

What is a "location-related" hazard?

Location-Related Hazard: Buildings located inside of, or within a clear flight path of less than 300 feet from an Urban Bird Refuge (defined below) require treatment when:

- New buildings are constructed;
- Additions are made to existing buildings (Note: only the new construction will require treatment); or
- Existing buildings replace 50% or more of the glazing within the "bird collision zone" on the façade(s) facing the Urban Bird Refuge.

Bird Collision Zone: The portion of buildings most likely to sustain bird strikes. This area begins at grade and extends upwards for 60 feet. This zone also applies to glass façades directly adjacent to large landscaped roofs (two acres or larger) and extending upward 60 feet from the level of the subject roof.

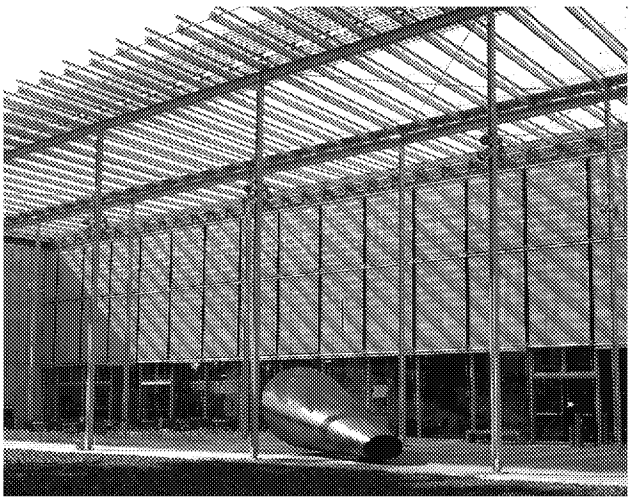


Urban Bird Refuge: Open spaces 2 acres or larger dominated by vegetation, including vegetated landscaping, forest, meadows, grassland, water features or wetlands (line 5 on page 39); open water (line 6 on page 39); and green rooftops 2 acres or greater (line 7 page 39).

What requirements apply to a "location-related" hazard?

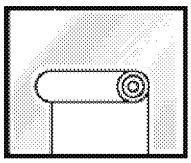
Treatment of Location-Related Hazards. Buildings located inside of or within a clear flight path from an Urban Bird Refuge shall implement the following applicable treatments for façades facing an Urban Bird Refuge.

- Façade Treatments: Bird-Safe Glazing Treatment is required such that the Bird Collision Zone consists of no more than 10% untreated glazing. Building owners are encouraged to concentrate permitted transparent glazing on the ground floor and lobby entrances to enhance visual interest for pedestrians.
- Lighting Design: Minimal lighting shall be used. Lighting shall be shielded. No uplighting shall be used. No event searchlights should be permitted for the property.
- Wind Generators: Sites should avoid horizontal access windmills or vertical access wind generators that do not appear solid.*

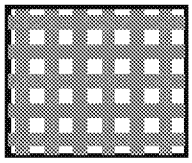


ABOVE: The California Academy of Sciences uses external screens 24 hours per day during spring and fall migration to reduce bird/building collisions.

Solution: Visual Noise



Solution: Use of plastic films, diachroic coatings and tints on facade



Solution: Screen / scrim / fritting

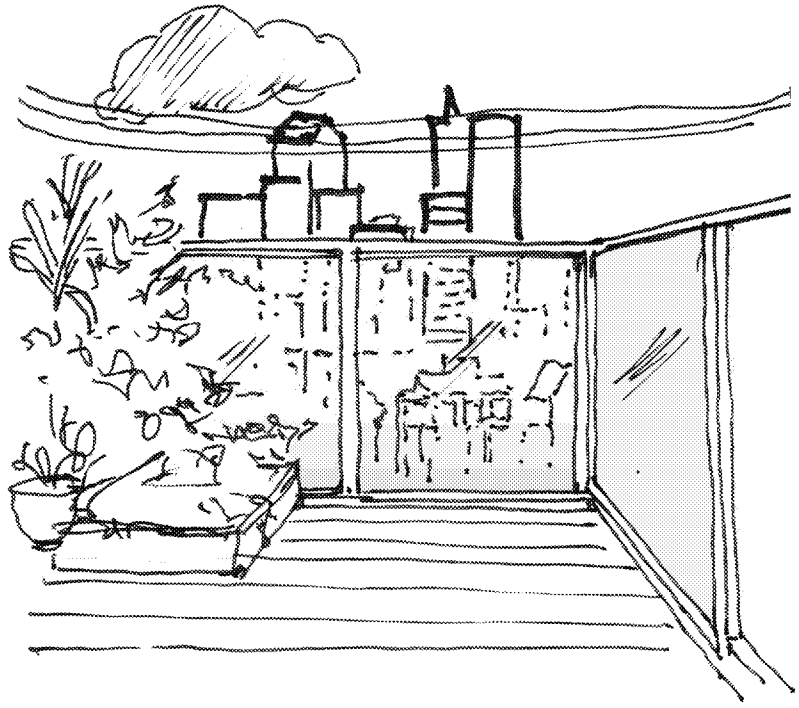
* The Planning Commission adopted a policy that would prohibit nonsolid or horizontal-axis wind generators via Resolution No. 18383. However, Ordinance No. 199-11, as adopted by the Board of Supervisors, does not expressly prohibit specific types of wind generators. Instead, the Planning Code requires that proposals for wind generation undergo individual project review to evaluate their specific risk to birds.

2 Requirements for Feature-Related Hazards

What is a "feature-related" hazard?

Building Feature-Related Hazard: Certain potential bird traps are hazardous enough to necessitate treatment, regardless of building location. A building-specific hazard is a feature that creates hazards for birds in flight unrelated to the location of the building. Building feature-related hazards include free- standing clear glass walls, skywalks, greenhouses on rooftops, and balconies that have unbroken glazed segments 24 square feet and larger in size. (See citywide bird-safe checklist, lines 19-22 on page 39). These features require treatment when:

- New buildings are constructed;
- Additions are made to existing buildings (Note: only the new construction will require treatment).



LEFT: These windows are an example of a feature-related hazard.

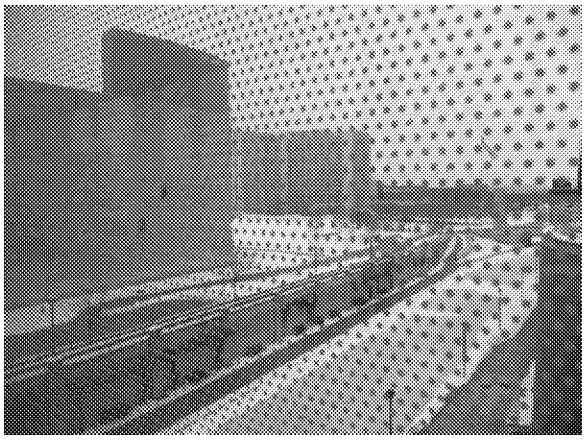
What requirements apply to a "featured-related" hazard?

Treatment of Feature-Related Hazards - Regardless of whether the site is located inside or adjacent to an Urban Bird Refuge, 100% of building feature-related hazards shall be treated.

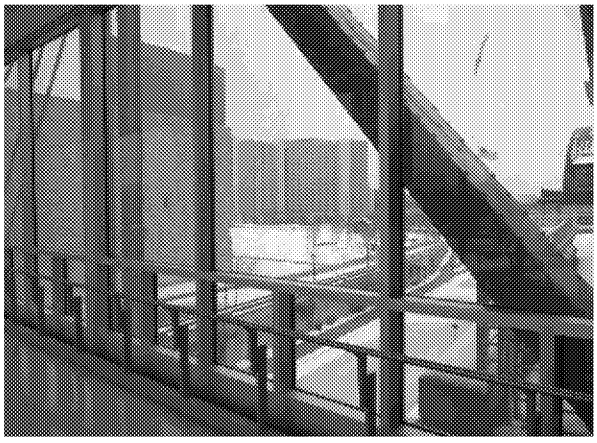
Image courtesy of Lights Out NYC

LEFT: A transparent glass skywalk poses a "feature-related" hazard.

LEFT: This skywalk was intentionally treated with fritting by the Indiana Museum to avoid creating a "feature-related" hazard.



RIGHT: The fritting maintains transparency for pedestrians.



Images courtesy of Lights Out NYC

The Details: Exceptions and Specifications

Exceptions: Certain exceptions apply to the aforementioned controls.

1) Treatment of Historic Buildings. Treatment of replacement glass façades for structures designated as City landmarks or within landmark districts pursuant to Article 10 of the Planning Code, or any building Category I-IV or Category V within a Conservation District pursuant to Article 11 of the Planning Code, shall conform to Secretary of Interior Standards for Rehabilitation of Historic Properties. Reversible treatment methods such as netting, glass films, grates, and screens are recommended. Netting or any other method demonstrated to protect historic buildings from pest species that meets the Specifications for Bird-Safe Glazing Treatment stated above may also be used to fulfill the requirement.

2) Exceptions for Treatment of Location-Related Hazards for Residential Buildings within R-Zoned Districts.

- *Limited Glass Façade:* Residential buildings less than 45 feet in height within R-Districts that have an exposed façade comprised of less than 50% glass are exempt from new or replacement glazing treatments, but must comply with feature-related and wind generation requirements below.

- *Substantial Glass Façade:* Residential buildings within R-Districts that are less than 45 feet in height but have a façade with a surface area of more than 50% glass, must provide glazing treatments for location-related hazards such that 95% of all large, unbroken glazed segments that are 24 square feet and larger in size are treated.

3) Other Waivers or Modifications by the Zoning Administrator. The Zoning Administrator may either waive requirements for Location-Related Hazards or Feature-Related Hazards or modify the requirements to allow equivalent Bird-Safe Glazing Treatments based upon the recommendation of a qualified biologist.

Photo courtesy NY Audubon

A New York volunteer examining a window casualty.

Glazing Treatment Specifications: Bird-safe glazing treatment may include fritting, netting, permanent stencils, frosted glass, exterior screens, physical grids placed on the exterior of glazing or UV patterns visible to birds. To qualify as Bird-Safe Glazing Treatment, vertical elements of the window patterns should be at least 1/4 inch wide at a maximum spacing of 4 inches, or have horizontal elements at least 1/8 inch wide at a maximum spacing of 2 inches (*Klem 2009.*)

V. Recommended Actions and Bird-Safe Stewardship

Public Education and Outreach Partnerships

The Planning Department will partner with the Golden Gate Audubon Society to conduct outreach on bird-safe building practices. Staff will work collaboratively to increase awareness of bird/building issues, and disseminate educational materials on design and treatment options. A public education effort will proactively increase awareness of the issues and strive to make bird safety practices a part of the construction lexicon within this highly urbanized area. Developers, architects, planners, property owners, businesses, city residents and youth groups are encouraged to contact the Department about educational programs. Curriculum will include education about the standards for bird-safe buildings and exploring citizen involvement of monitoring bird/building collisions as well as general advocacy for bird conservation.

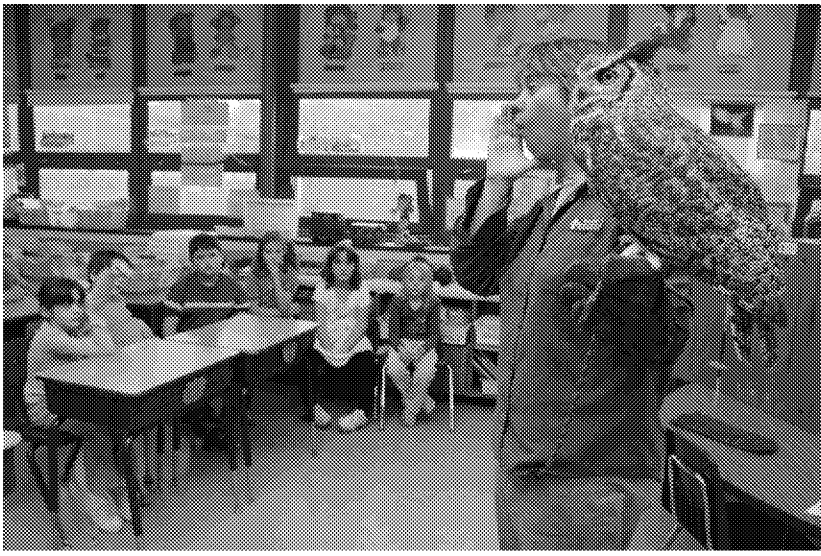


Photo courtesy Jessica Weinberg, http://www.jessicaweinberg.com/

Building Owner Bird-Safe Stewardship

Owners of new buildings and buildings proposing major renovations with a façade of greater than 50% glass are encouraged to evaluate their building against the Bird-Safe Building Checklist (pages 38-39) and provide future tenants with a copy of this document. Although requirements only apply to the most hazardous conditions, building owners and architects can become more aware of potential hazards and treatments. With the support of building owners who help educate future tenants, the people of San Francisco would become better educated about ways to enhance bird safety.

Building owners can help make their buildings safer by evaluating the risks of their buildings and retrofitting buildings with known hazards. Engaging in conservation measures outlined in this guide and granting access to collision monitoring groups help to address the issue and increase our understanding.

Encouraged Treatments

The following treatments are encouraged to enhance bird safety, in addition to meeting requirements:

- → Expanding treatment outside of the Bird Collision Zone: bird-safe treatments on building façades above the minimum height requirements.
- → Other window treatments: latticework, grilles and other devices, both functional and decorative, outside the glass or integrated into the glass spacing requirements;
- → Placement of trees or tall shrubs: should be located directly adjacent to glazing (with 3 feet) to slow birds down on approach, or placed far enough away to avoid reflecting canopies in the glazing.

Building Tenant Education

Some of the most effective treatments for making buildings bird-safe are those that require the cooperation of building owners and tenants. For this reason, the City should continue to use and should expand a "carrot"-based system to widely encourage participation in bird-safe efforts. San Francisco's existing Lights Out for Birds Program seeks to educate residents and provide recognition of voluntary bird-safe measures. Since 2008, the City has urged building owners and managers to turn off unnecessary interior and exterior lights. Twenty-two of the City's forty-four tallest buildings have been asked to participate.

To raise bird-awareness of building occupants, building owners may supply tenants with copies of this booklet. Building occupants can help make buildings bird-safe through the following good practices:

- Interior plants should be moved so as not to be visible from the outside.
- Consider limiting nighttime building use by combining motion operated light sensor with daytime cleaning services. This combination will reduce light pollution and increase energy conservation.
- Where interior lighting is used at night, window coverings should be closed to block light transmission adequately.
- Consider seasonal migration needs. Unneeded interior and exterior lighting should be turned off from dusk to dawn from February 15 through May 31 AND August 15 through November 30.

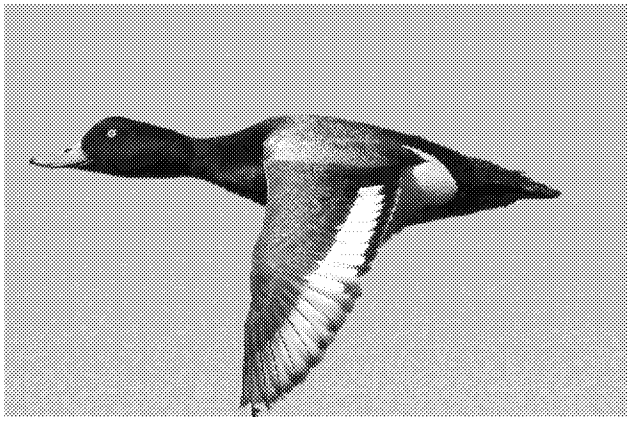


Photo by Robert Lewis

Greater Scaup

Photo by Robert Lewis

Western Sandpiper

Bird/Building Collision Monitoring

Project Safe Flight in Manhattan has collected and documented over 4,000 dead and injured birds since 1997. In 2009 the Chicago Bird Collision monitors recovered more than 6,000 dead or injured migratory birds from more than 100 different species. In Toronto, Fatal Light Awareness Program (FLAP) volunteers patrol Toronto's downtown core in the early morning hours rescuing live birds and collecting the dead ones since 1993. In the summer of 2010, the Oregon Zoo funded a six-week sunrise study of Portland's newest and tallest buildings where volunteers collected dead and injured birds. Audubon Minnesota has collected over 3000 birds of 110 species from monitoring efforts between 2007-2011.

Aside from regular collection of injured or dead migratory birds throughout the City by San Francisco Animal Care and Control staff and bird group volunteers, the only large bird/building monitoring program currently being conducted by the California Academy of Sciences, read more on page 14 (*Flannery 2011)*. Additional regular monitoring of the hazard in San Francisco is needed to help in the evaluation of local conditions and refinement of appropriate controls. Collaborations between building owners and bird-research groups should be encouraged to help increase our understanding of San Francisco's unique conditions. With the publication of this document, the City calls for more local research to help achieve the goal of better characterizing the problem on a local level, as well as for testing of new bird-safe technologies that could be utilized along with those that are already available.

CONTACT THE SAN FRANCISCO BIRD-STRIKE HOTLINE TO REPORT BIRD-STRIKES

Report injured birds found outside of buildings by emailing ***safebirds@goldengateaudubon.org*** or by calling **Golden Gate Audubon Society** at **(510) 843-6551** with the following information:

Date:

Time:

Address including cross streets:

Location details:

Species of bird, if known:

Male or female, if known:

Adult or juvenile bird, if known:

Condition of bird:

Did you see or hear the collision?
If so, please provide a description:

Weather:

Please email a photo of the bird and building, if possible. If the bird appears to be injured, call **San Francisco Animal Care and Control** at **(415) 554-9400** and record the date and time you called.

Photo by Eddie Bailey

A 2008 San Francisco pilot study discovered a Green Heron in the Downtown area. Further monitoring may reveal other unexpected neotropical migrants passing through the City's dense core.

Lights Out for Birds San Francisco

The Golden Gate Audubon Society, Pacific Gas and Electric Company and the San Francisco Department of the Environment administer "Lights Out for Birds – San Francisco." This voluntary program helps building owners, managers and tenants save energy and money while protecting migratory birds. Lights Out for Birds asks participants to turn off building lights during the bird migration (February through May and August though November each year).

"Participants in the Lights Out for Birds program can save natural resources, money, and birds by turning off lighting after dusk each evening and leaving lights off until dawn," said Mike Lynes, Conservation Director for Golden Gate Audubon. "Over 250 species of birds migrate through San Francisco in the spring and fall, and many that migrate at night can become confused by the City's lights and collide with tall buildings and towers. The Lights Out for Birds program can reduce bird deaths while cutting energy costs and saving participants thousands of dollars each year."

The North American Bird Conservation Initiative—a joint effort of federal agencies and nonprofit conservation organizations—released the "2009 State of the Birds" in which it reported that the majority of migratory birds in North America are suffering significant population declines due to human-induced causes, including habitat loss and collisions. In addition to window treatments to reduce daytime collisions, effective Lights Out programs can help stem these population declines.

Participants in the Lights Out for Birds program also gain significant financial benefits. Building operators and tenants have reported significant savings on energy bills as a result of participation—one business in Toronto reported a savings of $200,000 in 2006. In 2010 Mayor Gavin Newsom announced energy efficient retrofit funding for 2,000 small to mid-sized businesses and 500 homes. By installing timers or motion detectors and turning off unnecessary lights, building owners and operators can significantly reduce their energy bill. Reduced energy consumption decreases overall greenhouse gas emissions, which is essential in the effort to combat climate change.

San Francisco was one of the first cities to implement a Lights Out program in 2008. Now over 21 cities in the US and Canada have a Lights Out program. Conservationists hope that the program extends to every major city in North America, to save birds, energy and money.

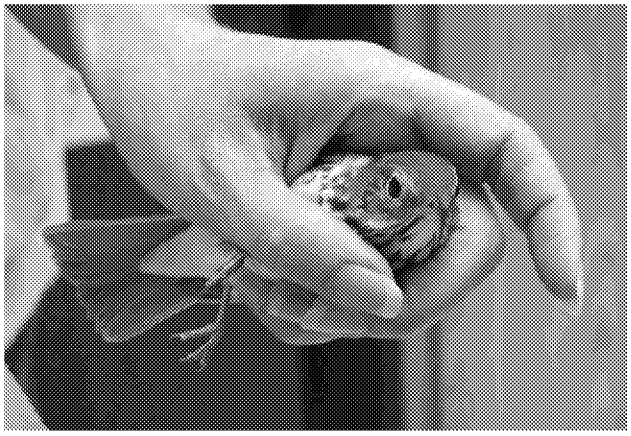
Photo of 2008 Lights Out Toronto by Dick Hemingway via WWF-Canada.

Toronto's established Lights Out Program creates a dramatic change in the skyline appearance. As San Francisco's program spreads we should be able to see seasonal changes as our skyline lights up in non-migratory months and dims down during migration.

Building owners, managers and tenants interested in an energy evaluation and current rebates should contact the San Francisco Department of the Environment or a PG&E representative. For more information on how to participate in the program and to learn about local bird populations and how to help, contact the Golden Gate Audubon Society at (510) 843-6551.

PARTICIPANTS IN SAN FRANCISCO LIGHTS OUT FOR BIRDS

101 California Street
Allsteel Inc.
Barker Pacific Group, Inc.
New Resource Bank
Pacific Gas and Electric Company
San Francisco Department of the Environment
Tishman Speyer



ABOVE: Rescued thrush resting safely in the hand of a Chicago Bird Collision Monitor volunteer.

Photo: Willowbrook Wildlife Center
http://www.chicagoaudubon.org/images/21-02rescuedthrush.jpg

Beyond Requirements: Voluntary Treatments and Acknowledgment

San Francisco building owners who implement Bird-Safe treatments are strongly encouraged to seek recognition under the City's new Bird-Safe Building Certification and Acknowledgement Program. Buildings which avoid creating hazards or implement bird-safe treatments as identified in this document would be acknowledged by the City and could be marketed as such. Three levels of certification will be offered:

Bird-Safe Building:
The building meets the minimum conditions for bird-safety. This level focuses on ensuring "bird-hazards" and "bird traps" are not created or are remedied with bird-safe treatments.

Select Bird-Safe Building:
The building meets all of the minimum requirements; commits to "lights out" practices during migratory seasons; reduces untreated glazing beyond the requirements; and commits to educating future building occupants.

Sterling Bird-Safe Building:
This is the highest level of Bird-Safe Building certification possible. The building meets all of the conditions of the other certification levels, plus the building reduces the amount of glass on the façade, avoids or treats additional hazards—beyond the requirements, and features year-round best management practices for lighting.

The program will be administered by the Planning Department. Buildings that qualify will be awarded plaques and public recognition through the City's website and outreach materials. To find out if your building qualifies for Bird-Safe Certification, fill out the attached Bird-Safe Building Checklist on pages 38-39 of this document and contact the Planning Department at (415) 558-6377.

VI. Bird-Safe Building Checklist

Use of this checklist: This checklist serves three purposes: 1) assessing risk factors and determining risks which must be addressed by the requirements; 2) increasing awareness of risk factors that are de minimis and don't require treatment; and 3) evaluating buildings for certification as a bird-safe building.

1 REQUIREMENTS FOR THE MOST HAZARDOUS CONDITIONS: The conditions that warrant special concern in San Francisco are designated by red-shaded boxes. These red boxes indicate prohibited building conditions or conditions which are only permitted if the glazing is installed with bird-safe glazing treatments. If the project combines a glass façade with a high-risk location ("location-related hazard", line 5-7), glazing treatments will be required for the façade(s) such that the amount of untreated glazing is reduced to less than 10% for the façade facing the landscaping, forest, meadow, grassland, wetland, or water. If a project creates a new bird-trap or "feature-related hazard" (lines 19-22) or remodels an existing feature-related hazard, bird-safe treatment will be required.

2 INCREASING AWARENESS: Owners of buildings with a façade of greater than 50% glass (lines 9 -10) are strongly encouraged to evaluate the building against the checklist and to help provide future tenants with copies of this guide. Use this checklist to evaluate design strategies for building new structures and retrofitting existing buildings throughout the City. This checklist summarizes conditions that could contribute to bird mortality and will help to identify the potential risks. Interested neighborhood groups and trade associations are encouraged to contact the Department for suggestions on how to proactively increase awareness of the issue and make bird safety practices a part of the construction lexicon.

3 VOLUNTARY RATINGS: Project sponsors interested in submitting a project for "Bird-Safe Certification" may use this form. The Department will partner with local artists to produce appropriate artwork and/or plaques to acknowledge those who actively seek to reduce bird collisions on their property. The ratings system will create tiers certification to recognize projects that meet minimum requirements as well as those projects that exceed the requirements.

RISK ASSESSMENT LEGEND:

Potential Risk Factors: These shade indicate factors that may present hazards to birds. Note: actual risks vary greatly depending upon building and site-specific variables.

GRAY: This shade indicates potential increased risk. NOTE: *The net assessment of total risk varies with the combination of building factors. While every building in San Francisco will present some element of risk to birds, only combinations with "red" boxes present a risk level necessitating bird-safe treatments.*

RED: This shade indicates prohibited conditions or conditions which are prohibited unless bird-safe treatment is applied.

CERTIFICATION LEGEND:

Bird-Safe Building Certification and Acknowledgement: Buildings which avoid creating hazards or which enhance bird safety with treatments identified as effective in this document would be acknowledged by the City and could be marketed as such. This document proposes three levels of certification by the City. Certification is determined by applying the checklist criteria.

By checking all of the boxes for one (or more) of these colors on the Bird-Safe Building Checklist (page 39), a building owner is eligible to apply to the Planning Department for Bird-Safe Building Certification.

YELLOW:
Bird-Safe Building
The building meets the minimum conditions for bird-safety. This level focuses on ensuring "bird-hazards" and "bird traps" are not created or are remedied with bird-safe treatments.

GREEN:
Select Bird-Safe Building
The building meets all of the minimum requirements; commits to "lights out" practices during migratory seasons; reduces untreated glazing beyond the requirements; and commits to educating future building occupants.

BLUE:
Sterling Bird-Safe Building
This is the highest level of Bird-Safe Building certification possible. The building meets all of the conditions of the other certification levels, plus the building reduces the amount of glass on the façade, avoids or treats additional hazards—beyond the requirements, and features year-round best management practices for lighting.

BIRD-SAFE BUILDING CHECKLIST

Using the key on the prior page, complete this checklist as a guide to help evaluate potential bird-hazards or eligibility for Bird-Safe Building Certification.

		QUESTION		YES	NO
MACRO-SETTING (PAGE 12, 16)	1	**Is the structure located within a major migratory route?** (All of San Francisco is on the Pacific Flyway)			
	2	**Is the location proximate to a migratory stopover destination?** (Within 1/4 mile from Golden Gate Park, Lake Merced or the Presidio)			
	3	**Is the structure location in a fog-prone area?** (Within 1/2 mile from the ocean or bay)			
MICRO-SETTING (LOCATION-RELATED HAZARD) (PAGES 13, 18, 28-29)	4	**Is the structure located such that large windows greater than 24 square feet will be opposite of, or will reflect interlocking tree canopies?**			
	5	**Is the structure inside of, or within a distance of 300 feet from an open space 2 acres or larger dominated by vegetation?** (Requires treatment of glazing, see page 28)			
	6	**Is the structure located on, or within 300 feet from water, water features, or wetlands?** (Requires treatment of glazing, see page 28)			
	7	**Does the structure feature an above ground or rooftop vegetated area two acres or greater in size?** (Requires treatment of glazing, see page 29)			
GLAZING QUANTITY (PAGE 6)	8	**Is the overall quantity of glazing as a percentage of façade:** (Risk increases with amount of glazing)	**Less than 10%?**		
			More than 50%? (Residential Buildings in R-Districts must treat 95% of unbroken glazed segments 24 square feet or greater in size if within 300 feet of an Urban Bird Refuge.)		
	9	**Will the glazing be replaced?**	**More than 50% glazing to be replaced on an existing bird hazard (including both feature-related hazards as described in lines 19-22 and location-related hazard as described in lines 4-7)?** (Requires treatment see pages 29 and 31.)		
GLAZING QUALITY (PAGE 6, 7)	10	**Is the quality of the glass best described as:**	**Transparent** (If so, remove indoor bird-attractions visible from outside the windows.)		
	11		**Reflective** (If so, keep visible light reflectance low (between 10-20%) and consider what will reflect in the windows. Note: Some bird-safe glazing such as fritting and UV spectrum glass may have higher reflectivity that is visible to birds.)		
	12		**Mirrored or visible light reflectance exceeding 30%.** (Prohibited by Planning Code.)		
GLAZING TREATMENTS (PAGE 18-21)	13	**Is the building's glass treated with bird-safe treatments such that the "collision zone" contains no more than 10% untreated glazing for identified "location-related hazards" (lines 4-7) and such that 100% of the glazing on "feature-related hazards" (lines 19-22) is treated?**			
	14	**Is the building's glass treated for required "bird hazards" (as described in line 13) *and* such that no more than 5% of the collision zone (lower 60') glazing is untreated but not for the entire building?**			
	15	**Is the building glazing treated (as described above in lines 14 and 15) *and* such that no more than 5% of the glazing on the exposed façade is left untreated?**			
BUILDING FAÇADE GENERAL (PAGE 6, 18)	16	**Is the building façade well-articulated (as opposed to flat in appearance)?**			
	17	**Is the building's fenestration broken with mullions or other treatments?**			
	18	**Does the building use unbroken glass at lower levels?**			
BUILDING FEATURE-RELATED HAZARDS AND BIRD TRAPS (PAGE 6, 30-31)	19	**Does the structure contain a "feature-related" hazard or potential "bird trap" such as:**	**Free standing clear-glass walls, greenhouse or other clear barriers on rooftops or balconies?** (Prohibited unless the glazing is treated with bird-safe applications.)		
	20		**Free standing clear-glass landscape feature or bus shelters?** (Prohibited unless the glazing is treated with bird-safe applications.)		
	21		**Glazed passageways or lobbies with clear sight lines through the building broken only by glazing?**		
	22		**Transparent building corners?**		
LIGHTING DESIGN (PAGE 19, 29)	23	**Does the structure, signage or landscaping feature uplighting?** (Prohibited within 300 feet of an Urban Bird Refuge)			
	24	**Does the structure minimize light spillage and maximize light shielding?**			
	25	**Does the structure use interior "lights-out" motion sensors?**			
	26	**Is night lighting minimized to levels needed for security?**			
	27	**Does the structure use decorative red-colored lighting?**			
LIGHTING OPERATIONS (PAGE 19, 24-25)	28	**Will the building participate in San Francisco Lights Out during the migration seasons?** (February 15-May 31 and August 15- November 30th) To achieve "sterling" certification the building must participate in year-round best management practices for lighting.			
OTHER BUILDING ELEMENTS (PAGE 23)	29	**Does the structure feature rooftop antennae or guy wires?**			
	30	**Does the structure feature horizontal access wind generators or non-solid blades?**			
CONSENT (PAGE 34)	31	**Does the building owner agree to distribute San Francisco's Bird-Safe Building Standards to future tenants?**			

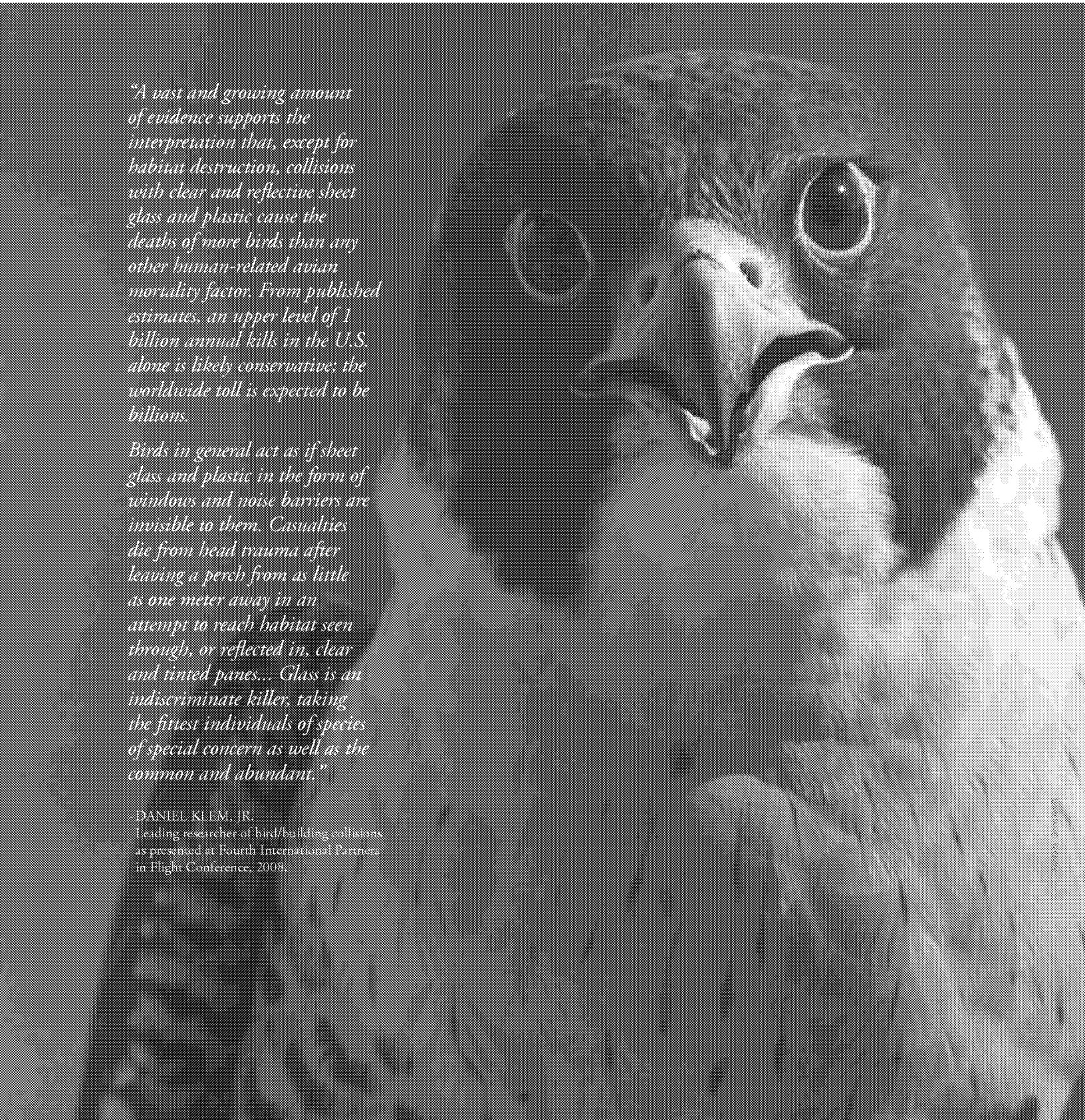
Authorized Signature X _____ **Date:** _____

Some of the birds killed by building collisions and collected during one migration season in Toronto's Financial District.

"A vast and growing amount of evidence supports the interpretation that, except for habitat destruction, collisions with clear and reflective sheet glass and plastic cause the deaths of more birds than any other human-related avian mortality factor. From published estimates, an upper level of 1 billion annual kills in the U.S. alone is likely conservative; the worldwide toll is expected to be billions.

Birds in general act as if sheet glass and plastic in the form of windows and noise barriers are invisible to them. Casualties die from head trauma after leaving a perch from as little as one meter away in an attempt to reach habitat seen through, or reflected in, clear and tinted panes... Glass is an indiscriminate killer, taking the fittest individuals of species of special concern as well as the common and abundant."

– DANIEL KLEM, JR.
Leading researcher of bird/building collisions
as presented at Fourth International Partners
in Flight Conference, 2008.



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SAN FRANCISCO PLANNING DEPARTMENT

FOR MORE INFORMATION:
Call or visit the San Francisco Planning Department

Central Reception
1650 Mission Street, Suite 400
San Francisco CA 94103-2479

TEL: **415.558.6378**
FAX: **415.558.6409**
WEB: **http://www.sfplanning.org**

Planning Information Center (PIC)
1660 Mission Street, First Floor
San Francisco CA 94103-2479

TEL: **415.558.6377**
Planning staff are available by phone and at the PIC counter. No appointment is necessary.