2018

Bird-Safe Standard for Federal Government Buildings

A Synthesis of Bird-Friendly Guidelines and Standards

By FLAP Canada

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Background

FLAP Canada was contracted by the Canadian Wildlife Service (CWS) to review and synthesize bird-friendly building guidelines and standards from North America and abroad. The best practices of each of these guidelines and standards have been extracted to form the *Bird-Safe Standard for Federal Government Buildings*. Many scientific papers were also examined and have contributed to the Standard. FLAP Canada proposes to work with the CWS to implement the proposed Standard for federal buildings across Canada.

The following bird-friendly guidelines and standards from the following jurisdictions and associations were reviewed and assessed: Toronto, Markham, San Francisco, San Jose, Portland, State of California, State of New York, the US Fish and Wildlife Service, Aubudon Minnesota, American Bird Conservancy, New York City Audubon, FLAP Canada, US Green Building Council and the Swiss Ornithological Institute.

1. Definitions

1.1. **Building Façade** – Any structural element of a building that could pose a specific risk to bird collisions. These would include but not be limited to: windbreaks, shelters, sound barriers, railings, linkways, lobbies, corners, alcoves, atria, alleyways, open top atria and courtyards, curtain walls, etc.

1.2. **BirdSafe® Risk Assessment System** – FLAP Canada's online risk assessment methodology determines the level of collision risk each building façade poses to birds: Low, Moderate, High-Risk or Lethal. This system takes into account the myriad, complex factors that affect how a bird may be deceived by a built structure, including polished materials and light emissions.

1.3. **Bird-Safe –** A building that achieves a high safety standard for bird-building collision mitigation.

2. Executive Summary

2.1. Purpose of the Standards

2.1.1. Unlike most anthropomorphic issues effecting bird populations, collisions with the built environment are a relentless concern that not only threaten the sick and/or old birds but also the healthy and young.

2.1.2. While species that are plentiful may not presently be threatened by collisions with built structures, if the trend continues, there will definitely be a steady decline in bird populations. Species that are threatened or endangered show up on building collision lists (Ogden 1996, Klem 2010, Loss et al. 2014) and may even become extinct if no action is taken.

2.1.3. Strategies that improve the urban design quality or sustainability of the built environment will contribute to more bird-safe cities and, in turn, reverse the decline in both numbers and species of birds.

2.1.4. Annual kills at high-risk structures are foreseeable and avoidable (*Klem, 2009, Klem 2015*).

2.1.5. There is clearly both an opportunity and a need in Canada to develop a single standard for the reduction of bird collisions with human built structures.

2.1.6. This document synthesizes building guidelines and standards for bird-friendly design across North America (Refer to Appendix A - Bird-Friendly Guidelines and Standards). The objective is to draw on these models in order to produce a Standard document that effectively addresses the bird collision issue.

2.2. The Issue

2.2.1. Windows and Other Polished Materials

2.2.1.1. Some birds are well-adapted to urban life, and they may remain there as year-round residents. Others are migratory, passing through cities southward in autumn to their wintering grounds, then returning northward in spring to establish territories in summer breeding grounds. The concept of glass is foreign to birds. They do not perceive glass, as sometimes happens for humans. The reflectivity and/or transparency of glass creates a lethal illusion of a safe passage. Birds have not evolved in the presence of built structures and are therefore not programmed to deal with the threats they present. Currently, the only way to ensure that birds avoid colliding with built structures during the day is to provide visual cues as part of a building design or markers on reflective and transparent surfaces.

2.2.2. Light Pollution

2.2.2.1. The other issue related to bird-building collisions is light pollution. Lit structures, spots and floods, whether from internal or external sources, can disorient birds during their nocturnal migrations, which can result in injury or death caused by exhaustion or collisions. Disorientation can increase exponentially during inclement weather such as rain or fog. While mass mortalities at tall illuminated structures such as skyscrapers, monuments and emission stacks have received the most attention, mortality is also associated with ground level lighting during inclement weather. Collisions are not the only issue. Birds circle in an illuminated zone, becoming disoriented and unwilling or unable to leave (*Ogden 2006*). The birds become exhausted and are likely to succumb to lethal collision or fall to the ground, where they are at risk from predators.

2.2.3. Declining Populations

2.2.3.1. There are distinct challenges for birds living in or flying through cities. Over 40 years of research has documented that built structures and windows are a top killer of wild birds in North America (*Banks 1979; Ogden 1996; Hager et al. 2008; Klem 1989, 2009, 2015; Gelb and Delacretaz 2009,Machtans et al. 2013*, *Loss et al. 2014*, *Loss et al. 2015*) While single-event collisions of a flock of birds are dramatic, the bulk of bird deaths result from the cumulative effects of an individual bird mistaking glass for a safe flight path. Conservative estimates in studies of lone bird strikes reveal that there are up to 10 bird deaths for each glazed building per year across the United States (*Klem 1990*, *Machtans et al. 2013, Loss et al. 2014, Loss et al. 2015*). Poorly designed buildings kill hundreds of birds per year (*Hager et al. 2008*). In the Greater Toronto Area, there are around 1,000,000 registered structures which means that based on 1 to 10 birds being killed by each structure, there can be 1,000,000 to 10,000,000 birds killed each year.

2.2.3.2. In North America, building collision fatalities may account for as many as 1 billion birds killed annually (*United States Fish and Wildlife Service 2002; Klem 1990a, Machtans et al. 2013, Loss et al. 2014, Loss et al. 2015*). Dr. Daniel Klem Jr., the leading expert on bird-window collisions, found that these strikes indiscriminately kill some of the healthiest birds in each species. "From a population standpoint, it's a bleeding that doesn't get replaced," he states. He estimates that between one and five percent of the total migratory population die in window crashes annually (*Klem, 1990a*). Many of these are endangered or threatened species whose populations are already declining due to habitat loss, toxin loads, and other severe environmental pressures.

2.2.3.3. Juvenile residents and migrants of all ages, not familiar with the urban setting, face the greatest risk of injury or death from the hazards of the city environment. Songbirds, already imperiled by habitat loss and other environmental stressors, are at double the risk; they are threatened both by illuminated buildings when they fly at night and by daytime glass collisions as they seek food and shelter among urban buildings.

2.2.3.4. Researchers have documented hundreds of thousands of building collision-related bird deaths across North America during migration seasons. Over 225 bird species are included in this toll. That is a quarter of the species found in North America. Scientists have determined that bird mortality caused by collisions with structures is "biologically significant" for certain species (*Longcore et al. 2005, Loss et al. 2014, Loss et al. 2015*). 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.

2.3. **Why Birds Matter**

2.3.1. Birds contribute to the diversity of plant life through pollination and seed dispersal. Birds also control insect outbreaks and create important nesting cavities for other species. They help rid the world of disease through scavenger "clean-up" services. Finally, birds help shape our culture, provide important economic benefits, and serve as important indicators for scientists about the state of the environment.

2.4. **History**

2.4.1. In Toronto, the issue of nighttime bird-building collisions was identified shortly after the Toronto Dominion Centre was completed in 1967. Founded in 1993, the Fatal Light Awareness Program (FLAP), was the first organization in the world to address the bird-building collision issue. In 1997, FLAP and World Wildlife Canada developed the first lights out initiative: the *Bird-Friendly Building Program*. In 2006, the *Lights Out Toronto!* public awareness campaign was launched by the City of Toronto and twelve stakeholders, including Environment Canada, providing solutions to both nighttime and daytime bird-building collisions.

(http://flap.org/pdfs/lot_brochure.pdf). This was followed by the development of the City of Toronto's *Bird-Friendly Development Guidelines* in 2007.

2.4.2. Since then, a multitude of guidelines and standards have been developed or are being developed by various governments and associations around the world. These include: Mississauga, Markham, Vancouver, Calgary, Vaughan and Ottawa in Canada and San Francisco, Minneapolis, Chicago and New York in the US to name a few (Refer to Appendix A – Bird-Friendly Guidelines and Standards). In addition, these initiatives are supported by Canadian professional associations such as the Ontario Association of Architects (Refer to Appendix G - OAA Open Letter: Bird-Friendly Design).

3. Bird-Safe Standard for Federal Government Buildings

3.1. To minimize the number of bird deaths associated with buildings owned or leased by the Federal Government, it is recommended that government agencies implement these measures:

3.1.1. All federal buildings must meet section Section 32(1) of the federal *Species at Risk Act* (SARA); for buildings in Ontario, Section 14(1) of the *Environmental Protection Act* (EPA) (Refer to Appendix B - Laws Protecting Birds);

3.1.2. Any building façade that poses a Lethal or High-Risk threat of bird collisions using a proven risk assessment system (Refer to Appendix C - Bird Collision Risk Assessment System) shall implement one of the effective treatments (see Appendix D - Strategies to Reduce Bird Collisions) to mitigate the problem;

3.1.3. Since all glass poses some threat to bird collisions, facades that pose a lesser risk may also be considered for a mitigation treatment;

3.1.4. Address the high collision zone: this area begins at grade level and extends upwards for 16 metres or to the height of the mature tree canopy, whichever is greater. Landscaped roofs and terraces are to follow the same mitigation strategy as grade-level facades;

3.1.5. A building that contains a transparent passageway or corner, or configured in a way that allows birds to see through glass to habitat or sky shall use measures described in Appendix D;

3.1.6. Any glass in a handrail, a pavilion, a gazebo, a bus shelter, an overpass or any other auxiliary structure shall use measures described in Appendix D;

3.1.7. Any glass located adjacent to an atrium or a courtyard containing a water feature, plants or other material attractive to birds shall use measures described in Appendix D;

3.1.8. For existing or proposed clear glass corridors, skyways, walkways, or courtyards, use bird collision mitigation measures described in Appendix D.

3.1.9. Strategy shall take into consideration mitigation treatments that are already present on a particular façade;

3.1.10. Interior and exterior lighting, except where full operation of building lighting is deemed as necessary by the individual department, shall be appropriately shielded and minimized from 11 p.m. to 6 a.m. each day, especially during spring and fall migration (March through May and August through mid-November);

3.1.11. The department shall reduce the lighting of existing public buildings to the extent practical by using automatic control technologies, including timers, photo sensors, infrared detectors and motion detectors;

3.1.12. Each federal government building, whether owned or leased, shall meet the standards outlined in this document to the extent practical as determined by the individual department;

4. Ineffective Bird-Building Collision Deterrent Strategies

4.1. As collisions with the built environment became more prevalent as a threat to birds, addressing this threat was first thought to be achieved by repelling birds from the source of danger (see below 4.2 *Daytime Strategies for Existing Construction*). These techniques, once thought to be effective, have been proven to have little to no mitigating effect. The proliferation of municipal guidelines and standards and the 2013 ground-breaking legal precedent case in Ontario (Refer to Appendix B – Laws Protecting Birds) sparked the demand for effective commercial solutions. These technologies were at first scarce resulting in many standards pointing to less-effective solutions.

4.2. Examples of Ineffective Bird-Building Collision Strategies

Daytime Strategies for Existing Construction	Daytime Strategies for New Construction
• Single window decals • Drawn interior drapes and blinds • High-pitch frequency devices • Noise makers and canons • Birds of Prey recordings • Terrorize balloons	1. Shadowing: • Opaque overhangs • Awnings • Exterior sunshades 2. Muted Reflection • Angled facades • 2nd and 3rd surface of glass markers i.e. frit, film, print • Tinted/coloured glass • Automated interior blinds

5. Examples of Effective Bird-Building Collision Deterrence Strategies

Requirements	Effective Strategies
1. Bird Friendly Glazing • Incorporate visual markers to treat facades on new and existing exterior glazing identified as lethal or high risk to bird collisions (including balcony railings, clear glass corners, parallel glass and glass surrounding interior courtyards and other glass surfaces) • Refer to Appendix D – Item 2.1 **2. Architectural Strategies** • Incorporate building integrated features to mute reflections on glass surfaces • Refer to Appendix D – Item 2.2 **3. Lighting Controls and Design** • Install motion sensors or an auto shutoff system with a maximum 30-minute vacant period. • Refer to Appendix D – Item 5	1. Visual Markers: • Etched glass • Fritted glass • Films • Digital printing • Silk screening • Cords, strings and cables • UV Coatings 2. Architectural Features: • Exterior screens • Channel Glass • Shutters • Grilles • Louvers 3. Lighting Controls & Design • Exterior lighting should be limited to areas where lighting is needed for safety and security • Prevent horizontal light emissions • Motion sensors or an auto shutoff system • Up-lighting to be prevented or eliminated

Appendix A

Bird-Friendly Guidelines and Standards

The proposed *Bird-Friendly Standard for Federal Government Buildings* is a synthesis of the most in-depth and widely-referenced bird-friendly guidelines and standards:

Toronto, ON

Toronto Green Standard, Tier 1 v. 3 For Residential Apartment Buildings Greater Than 4 Storeys and All Industrial, Commercial and Institutional Buildings – Dec 5, 2017
https://www.toronto.ca/wp-content/uploads/2018/03/8f44-City-Planning-TGS-V3-4-storey-res-and-all-non-res.pdf

Toronto Green Standard, Tier 1 v. 3 City Agency, Corporation & Division Owned Facilities – Dec 5, 2017
https://www.toronto.ca/wp-content/uploads/2018/03/8f91-City-Planning-TGS-V3-CADG-.pdf

Bird-Friendly Best Practices Glass - July 2016
https://www.toronto.ca/wp-content/uploads/2017/08/8d1c-Bird-Friendly-Best-Practices-Glass.pdf

Best Practices for Effective Lighting – April 2017
https://www.toronto.ca/wp-content/uploads/2018/03/8ff6-city-planning-bird-effective-lighting.pdf

Markham, ON
Bird Friendly Guidelines – January 2014
http://www2.markham.ca/markham/ccbs/indexfile/Agendas/2014/Development%20Services/pl140204/Bird%20Friendly%20-%20Appendix%20A%20-%20Guidelines.pdf

San Francisco, California
Standards for Bird-Safe Buildings – July 14, 2011
http://sf-planning.org/standards-bird-safe-buildings

San José, California
Bird-Safe Building Design Standards – 2014
http://sanjoseca.gov/DocumentCenter/View/35638

Portland, Oregon
Resource Guide for Bird-friendly Building Design – July 2012
https://www.portlandoregon.gov/bps/article/446308

Audubon Minnesota
Bird-Safe Building Guidelines – May 2010
http://mn.audubon.org/sites/g/files/amh601/f/05-05-10_bird-safe-building-guidelines.pdf

US Green Building Council
LEED Credit: Bird Collision Deterrence - 2009
https://www.usgbc.org/credits/core-shell-existing-buildings-healthcare-new-construction-retail-nc-schools/v2009/pc55

State of California
Green Building Standards Code: Bird-Friendly Building Design – July 1, 2012
https://www.documents.dgs.ca.gov/bsc/calgreen/mastercalgreennon-resguide2010_2012suppl-3rded_1-12.pdf

State of New York
The Bird-Friendly Council Act - 2017
http://www.assembly.state.ny.us/leg/?default_fld=%0D%0A&bn=A3410&term=&Summary=Y&Actions=Y&Votes=Y&Memo=Y&Text=Y

American Bird Conservancy and New York City Audubon
Bird-Friendly Building Design – 2015
https://abcbirds.org/wp-content/uploads/2015/05/Bird-friendly-Building-Guide_LINKS.pdf

Swiss Ornithological Institute
Bird-Friendly Building with Glass and Light – 2013
https://www.otop.org.pl/uploads/media/bird-friendly_building_engl.pdf

FLAP Canada
BirdSafe® Building Standards for Mitigating Daytime Bird-Window Collisions – version 2018
BirdSafe® Building Standard for Mitigating Nighttime Bird-Building Collisions – version 2018
Refer to Appendix D.

US Fish & Wildlife Service
Reducing Bird Collisions with Buildings and Building Glass Best Practices – July 2016
https://www.fws.gov/migratorybirds/pdf/management/reducingbirdcollisionswithbuildings.pdf

Urban Bird Treaty
Glass and Building Bird Collision Information
https://www.fws.gov/migratorybirds/pdf/grants/UrbanBirdTreatyBuildingandGlassCollisionInformation.pdf

Appendix B – Laws Protecting Birds

In February 2013, judge Melvyn Green of the Ontario Court of Justice set a legal precedent in a ruling that provides migratory birds protection under two important laws:

Section 14(1) of Ontario's *Environmental Protection Act* (EPA)
Under the EPA, light, a form of radiation, is considered to be a contaminant if it is emitted and causes an adverse effect, such as death or injury to animals. Reflected light from windows has been found by the Ontario Court of Justice to be an emission of radiation, and a violation of the EPA if it kills or injures a significant number of birds.

Section 32(1) of the federal *Species at Risk Act* (SARA)
Provides protection against the killing or harming of endangered or threatened species.

Background information on the precedent setting case, *Podolsky v. Cadillac Fairview*:
https://www.ecojustice.ca/how-losing-in-court-is-still-a-win-for-migratory-birds/

It is now an environmental offence to kill birds with buildings, Dianne Saxe
This article incudes Judge Green's ruling:
www.siskinds.com/envirolaw/cadillac-fairview-prosecuted-killing-birds-mirrored-buildings/

Appendix C – Bird Collision Risk Assessment System

1. *Regional, Local* and *Building Related Factors*

1.1. Birds in urban areas are attracted to habitat that offers food and shelter. This is true throughout the year for wintering and breeding residents and in-passage migrants during spring and fall. Thus, environmental features in urban landscapes positively influence both the numbers and types of birds.

1.2. Quality habitat affects bird-window collisions whereby mortality occurs as birds attempt to fly through what appear to be reflections of, or clear passages to, open space and vegetation in or adjacent to windows (Gelb and Delacretaz 2009, KIem et al. 2009, Hager et al. 2013). Local features explain window strikes better than distant habitat patches (Hager et al. 2013).

1.3. Risk of collisions is also affected by the amount of windows in a structure and the number of fatalities increases with the increasing levels of sheet glass in buildings (KIem et al. 2009, Hager et al. 2013).

1.4. Indeed, bird-window collisions are driven both by quality habitat and buildings with an abundance of windows and each of these factors is patchily distributed across the urban landscape resulting in strong spatial variation in mortality. That is, buildings with high levels of sheet glass that are found within green space will exert the highest risk and risk will decrease as levels of windows and habitat decrease.

1.5. The combinations of environmental and structural features affect collisions, and therefore separate proportions need to be assigned among the three daytime categories. *Building Related Factors* are assigned the highest weight since structural features appear to drive collisions more than any other factor based on our experience and in the context of the literature. *Local Related Factors* are nonetheless important and the literature continues to indicate that local attributes affect collisions more than regional features. It is important to note: bird collisions occur when *Building Related Factors* are present, even when *Regional* and *Local Related Factors* are absent. The application of a Standard Risk Assessment System needs to suggest that the proportions assigned to each category explained the number of bird-window collisions on a multitude of test buildings.

1.6. A Bird Collision Risk Assessment System identifies the risk that birds will be attracted to and collide with a particular façade. The numbers of birds that are picked up below a particular façade are not an accurate reflection of the actual birds that collide with a structure. Many birds are seriously injured but fly away only to succumb to their injuries later (Klem 1990b, Veltri and Klem 2005). Injured birds that do not fly away seek the cover of vegetation planted below or near windows; these casualties are hidden from human observers. Moreover, scavengers are very effective at removing victims from an area before they are found by people (Klem et al. 2004, Hager et al. 2012).

1.7. A risk assessment system should consider all the relevant factors that attract birds to a particular façade and identify the threat of birds colliding with it. One example of a proven assessment system was developed by FLAP Canada, the *BirdSafe® Risk Assessment System*. It measures regional, local and building related risk factors for both daytime and nighttime collisions. These include:

2. Risk Factors

1. Daytime Attraction Factors

1.1. Region Related Factors influencing the number of birds in the vicinity >100m (>328 ft) from building

1.1.1. *Vegetation*

1.1.2. *Water Body Features*

1.1.3. *Topography - Natural Bird Migration Routes, Stopovers*

1.2. Local Related Factors influencing the number of birds in the vicinity <100m (<328 ft) from building

1.2.1. *Adjacent Vegetation and Water Features*

1.2.2. *Landscape corridors*

1.3. Daytime Threat Factors

1.3.1. Building Related Factors influencing the potential for collisions

1.3.1.1. *Design Traps i.e. funnels, corridors*

1.3.2. Properties of Polished Surface

1.4. Nighttime Attraction Factors

1.4.1. Region Related Factors influencing the number of birds in the vicinity >100m (>328 ft) from building

1.4.1.1. *Natural Bird Migration Routes, Stopovers*

1.4.2. Local Related Factors influencing the number of birds in the vicinity <100m (<328 ft) from building

1.4.2.1. Building proximity to influencing factors

1.4.3. Building Related Threat Factors influencing the potential for collisions

1.4.3.1. Lighting

Appendix D – Strategies to Reduce Bird Collisions

BirdSafe® Building Standard for Mitigating Daytime Bird-Window Collisions

For Glass and Other Polished Materials

NEW & EXISTING BUILDINGS	
Marker Surface	Apply visual markers to the first (exterior) surface of glass to disrupt the transparency and reflectivity of glass.
Marker Density	Visual markers patterns should not have reflective or transparent openings larger than 5 cm apart vertically and/or 5 cm horizontally.
Marker Contrast	Markers must stand out in contrast to transparent or reflective exterior surfaces under varying daylight conditions.
Marker Size	The diameter of a marker is to be no less than 6 mm.
Marker Coverage	Markers are to cover exterior glass surfaces up to 16 metres above grade or to the top of the mature tree canopy, whichever is greater.
Shaded Façades	Glass beneath overhangs and awnings are to be treated with visual markers.
Recessed Façades	Glass behind treated single pane panels are to be treated with visual markers (e.g. windows behind balcony railings).
NEW CONSTRUCTION	
Single Pane Glass	Visual markers are to be applied to both exposed surfaces of single pane glass (e.g. transparent railings, sound barriers, wind brakes).
Marker Coverage	Markers are to cover *entire* exterior glass surfaces up to 16 metres above grade or to the top of the mature tree canopy, whichever is greater.
Fly-through Conditions	Design features that create fly-through conditions are to be treated with visual markers on all exterior glass surfaces (e.g. windbreaks, shelters, sound barriers, railings, link-ways, corners).
Spandrel Glass	Use non-reflective opaque spandrels.
Building Envelope	Provide at least 60% of the exterior surface of the building as non-reflective opaque materials.
EXISTING BUILDINGS	
Determine Façade Risk	Existing buildings to undergo a risk assessment that follows this standard's methodology by each building façade to determine bird collision potential (e.g. FLAP Canada's *BirdSafe® Risk Assessment System*). Any façade that receives a high-risk or lethal rating must implement this standard.
Performance Requirements for Retrofit Products	
Quality Assurance	Use qualified personnel skilled in the installation of the chosen visual marker(s), having a minimum of 2 years proven experience of installation of similar material.
Product Warranty	Ensure that the manufacturer's exterior surface application product warranty against deterioration is a minimum of 6 years. The marker material must facilitate removal without damaging the glazed and/or polished materials.
Sample Installation	To verify the strength of visual marker contrast and its aesthetic effects, construct a sample installation to verify selections.

Definitions

- **BirdSafe® Visual Marker**: a pattern of any shape that meets a certain density, uniformity, size and contrast that is etched into or applied onto the first surface of glass.
- **Contrast**: a striking difference in the colour and tone of two or more shapes in juxtaposition or close association.
- **Façade**: any structural element of a building that could pose a specific risk to bird collisions.
- **Fly-through conditions**: where transparent corners of glass and/or parallel glass provide a clear line of sight to birds.
- **Polished Materials**: smooth and shiny surfaces that reflects the surrounding environment (e.g. steel, stone, plastic).
- **Spandrel Glass**: mirrored, tinted or opaque glass used to conceal building components such as columns, floor slabs and HVAC systems located between areas of vision glass.

Specifications

- When applying UV treatments, ensure these patterns reflect 20-40% over the 300-400 nanometer wavelength and that the UV coating be applied to the first surface of glass.
- Any polished material adjacent to green roofs or vegetated terraces are to be treated with visual markers up to 16 metres above grade or to the top of the mature tree canopy, whichever greater.

First Surface Treatment Strategies

Applied to Glass

- Channel glass
- Etched glass
- Fritted glass
- Films
- Digital printing
- Silk screening
- UV coating

In Front of Glass

- Screens
- Shutters
- Grilles
- Louvres
- Cords/cables
- Living walls
- Netting

BirdSafe® Building Standard for Mitigating Nighttime Bird-Building Collisions

NEW & EXISTING BUILDINGS

Interior Lighting

- Turn off all lights in unused interior spaces.
- Draw blinds when interior spaces are occupied, i.e. work stations.
- Turn off non-security overhead lighting in occupied spaces.
- Encourage the use of desk lamps at work stations.
- Human safety and building security lighting should be isolated to areas as the law and code requires.
- Switch to cleaning of interior spaces during daylight hours.
- Dim lights from 11pm to 6am in public areas, i.e. lobbies, atria, retail, etc.
- Install motion sensors or an auto shutoff system with a maximum 30-minute vacant period.

Exterior Lighting

- Install only shielded, downward directed fixtures.
- Exterior lighting fixtures are limited to grade level.
- Lighting should be limited to areas where required for safety and security.
- Prohibit spots, floods and advertising lighting during bird migration months: March through May and August through mid-November.

1. Bird Deterrent Guidelines

1.1. To avoid a window collision, birds simply need to be cued or warned that a barrier exists. Whether glass is clear or reflective, markers on the glass must not only be visible to birds in all lighting conditions but be spaced such that birds do not attempt to fly between the markers. Architectural solutions must be visible and not an attraction to birds. Architectural features include any deterrent that is not applied to the glass.

1.2. To prevent nighttime collisions, internal lighting needs to be turned off during spring and fall migration seasons (March through May and August through mid-November). Exterior light should be minimized or at least pointed downward during bird migration.

2. Examples of Effective Daytime Strategies

2.1. Visible Markers on the Glass

2.1.1. Marker Requirements

2.1.1.1. Cover the entire glass surface with visual markers from grade to 16 metres high or to the top of the mature tree canopy, whichever is greater;

2.1.1.2. To effectively disrupt the window's reflectivity or transparency, apply visual markers to the first (exterior) surface of the glass;

2.1.1.3. Ensure chosen visual marker(s) meet the *BirdSafe® Building Standards for Mitigating Daytime Bird-Window Collisions* (see above*)*;

2.1.1.4. Visual markers must have high contrast from clear or reflective exterior surfaces and be visible under varying light and weather conditions. The more contrast between pattern elements the more effective the deterrence (Rossler et al. 2015).

2.1.1.5. Balcony railing and interior courtyards with clear glass should also be treated.

2.1.1.6. Windows adjacent to green roofs should also be treated up to 16 metres high or to the top of the mature vegetation from landscaped feature;

2.1.1.7. The size of an individual marker should be 6 mm or greater.

2.1.2. Marker Treatments

2.1.2.1. **Ceramic Frit and Acid Etching**

2.1.2.1.1. These applications are preferred as a more permanent treatment, but other treatments are also acceptable.

2.1.2.2. **Exterior Film**

2.1.2.2.1. Exterior films applied directly to the glass are less permanent but can be an effective visible marker. The lifespan of exterior film will be less than the operating life of the sealed glass. It is most commonly used in retrofit situations.

2.1.2.3. **Other Treatments**

2.1.2.3.1. Many other first surface treatments such as silk screening, digital printing, etc. can also be effective but lifespan may vary.

2.1.3. Marker Size

2.1.3.1. The size of a marker can increase or decrease its effectiveness to deter birds. The larger the marker, the more noticeable it becomes to a bird. Markers less than 6 mm are not recommended.

2.1.3.2. Marker patterns have infinite aesthetic combinations that provide the opportunity for each application to be unique.

2.2. Examples of Architectural Strategies

2.2.1. Awnings and Overhangs

2.2.1.1. The presence of awnings, balconies and recessed windows were once thought to serve as a bird-window collision deterrent by reducing the amount of visible glass and providing less opportunity for reflecting neighbouring vegetation and sky. However, this method proves to have a nominal collision reduction ratio and as such is considered far less effective than visual markers applied directly to glass.

2.2.2. Exterior Screens, Grilles, Shutters and Sunshades

2.2.2.1. Many buildings that are considered good examples of bird-friendly design have achieved this by virtue of incorporating unique architectural elements that provide clear visual cues for birds to avoid without impacting views from the interior of the building. Decorative facades that wrap entire structures can reduce the amount of visible glass and thus the threat to birds. Netting, screens, grilles, shutters and exterior shades are commonly used elements that can make glass safer for birds. They can be retrofitted on an existing building or integrated into the design of a new building and can significantly reduce bird mortality.

2.2.3. Netting

2.2.3.1. Netting placed at least 3 cm from glass surface has also been used successfully to treat historic buildings, where it's critical to maintain the original character of the building. Though netting demonstrates effective results at collision mitigation, the disadvantages from adopting this strategy far outweigh its advantages. The following table is based on the opinions of professional institutions that have attempted to adopt netting for bird collision mitigation:

Netting as a Bird-Window Collision Deterrent	
Advantages	Disadvantages
• can be installed on a seasonal basis re: bird migration seasons • when installed correctly, netting can be less visually obtrusive than other bird deterrent methods	• typically requires custom design which can be costly • threatens buildings' structural integrity by having to be fastened to a façade increasing potential for ongoing maintenance • birds can become ensnared if the netting isn't taut enough • airborne debris can become entangled in the netting • thrill seekers have been known to vandalize and/or attempt to climb the netting • urban wildlife prone to climbing have also been known to scale the netting • when the expanse of glass at a structure is significant, it forces netting to be stretched over a long distance requiring the netting to be set back far enough from building façades to achieve tautness. This creates an obstruction for pedestrians.

2.3. Other Effective Strategies

2.3.1. Select glass with a reflectivity of less than 15% that is opaque in appearance.

2.3.2. Install screening

2.3.3. Remove polished materials in the landscape

2.3.4. Locate indoor plants out of view from the outdoors.

3. Examples of Ineffective Strategies

3.1. Interior Blinds, Drapes and Screens

3.1.1. Interior blinds installed behind windows have been used as a means of deterring bird collisions on the assumption that they provide sufficient visual markers to make a window appear as a solid object. Unfortunately, the exterior surface of glass can still be reflective under certain lighting conditions, thereby hiding blinds or drapes that might be drawn behind the glass. Additionally, there is no mechanism to ensure or require that blinds be utilized by the tenant during the migratory seasons and/or that the building owner or manager will require this of their tenants. Due to these facts, blinds are not accepted as a suitable strategy.

3.2. Tinted and Coloured Glass

3.2.1. The exterior surface of the glass can still be reflective under certain lighting conditions and therefore tinted glass is not an acceptable option or deterrent strategy. Additionally, there is no definitive evidence that tinted glass has a positive effect in reducing bird collisions.

3.3. Bird Decals

3.3.1. It has been a popular belief that large opaque silhouettes of birds of prey will deter other birds from frequenting an area. This is not the case. Commonly used bird of prey silhouettes have been tested experimentally and found to be largely ineffective. Birds will avoid hitting the decal if it is applied on the exterior surface of the window but may still hit glass beside the decal if it reflects vegetation or sky. To be effective, decals would have to be applied on a window in a pattern that meets the *BirdSafe® Building Standard for Mitigating Daytime Bird-Window Collisions* (see above).

3.4. Low Reflectance Glass

3.4.1. Mirrored glass is the most reflective of all building materials and should be avoided in all situations. Lower reflectance glass (less than 15 percent reflectance) may reduce collisions in some situations but does not actively deter birds. It also can create a see-through effect. Low-reflectance glass on its own is not considered a treatment and must be coupled with visual markers to be considered bird-friendly.

3.5. Angled Glass

3.5.1. 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. Generally, the desired angle for effective treatment is 20-40 degrees. These angles are difficult to maintain for large buildings but may work in low-scaled buildings with a limited amount of glass (*Ogden 1996 and references therein; and Klem et al. 2004*).

4. Evolving Technology

4.1. Ultraviolet (UV) Coating

4.1.1. Birds visually perceive ultraviolet (UV) electromagnetic waves, but humans do not. Current evidence indicates that contrasting pattern elements of UV-reflection and UV-absorption effectively prevent bird-window collisions (Klem 2009, Klem and Saenger 2013). The effective patterns consist of a minimum of 20% UV-reflection area (stripe) over 300-400 nanometers (nm) wavelength h range adjacent to 100 or near-100% UV-absorption area (stripe). Sheet glass with UV patterning to deter bird strikes is currently in development by a few glass manufacturers. At this time, only one manufacture offers a sheet glass product to deter bird-window collisions that reduces the risk of a strike by 57-83% (AviProtek T, Walker Glass Company, Montreal QE).

5. Examples of Effective Nighttime Strategies

5.1. Lighting Controls and Design

5.1.1. Birds migrating at night may be drawn to urban areas by artificial light, especially during inclement weather. The artificial light may confuse and disorient the birds, causing birds to collide with buildings and other structures, or become exhausted and highly vulnerable to predators. The harmful impacts of interior and exterior lighting can be mitigated through lighting controls and design.

5.2. Interior Lighting

5.2.1. Should be shut off from 11 p.m. to 6 a.m.
5.2.2. Window coverings such as blinds or drapes should be installed and drawn.
5.2.3. Install motion sensors or an auto shutoff system with a maximum 30-minute vacant period.

5.3. Exterior Lighting

5.3.1. The following lighting control practices should be implemented during spring and fall bird migration periods: March through May and August through mid-November:

5.3.1.1. Up-lighting to be prevented or eliminated by attaching cut-off shields for streetlights and external building lights.
5.3.1.2. Exterior lighting should be limited to areas where lighting is needed for safety and security.
5.3.1.3. Minimize the intensity and duration of illumination
5.3.1.4. Use shielded and downward directed light
5.3.1.5. Install low pressure sodium lighting in sensitive environments, otherwise high pressure sodium lamps or warm white LED lights.

Appendix E - OAA Open Letter: Bird-Friendly Design Apr 12, 2016

Ontario Association of Architects

April 12, 2016

Open Letter: Bird-Friendly Design

On the occasion of Bird Impact Reduction Day, the Ontario Association of Architects (OAA) wishes to add its voice to the current conversations surrounding bird-friendly design in Ontario.

As the self-regulating body of Ontario's architects, the OAA is dedicated to promoting and increasing the knowledge, skill and proficiency of its members, and to administering the *Architects Act* in order that the public interest may be served and protected. Bird-friendly design strategies are a valuable part of any design and our members play an important role in minimizing the impact of buildings on wildlife.

According to the Fatal Light Awareness Program (FLAP), the estimated number of migrating birds killed in North America annually in collisions with buildings ranges from 100 million to 1 billion birds. Collisions with buildings are a leading cause of death of migratory birds, second only to habitat loss. More recently, the deaths of over 30 birds caused by collisions against an elevated second floor walkway at Ottawa City Hall has brought the importance of bird-friendly design strategies to public attention.

Wildlife collisions with buildings are caused by a numerous factors including site specific conditions, landscaping, habitat destruction, glazing design, building illumination, among other factors. Making informed design decisions can have significant impact on mitigating bird collisions; architects, landscape architects, developers, clients and users all play a role in helping reduce the negative effects of these factors on wildlife.

We have witnessed in the past few years significant progress towards bird-friendly design strategies, including the development of bird-friendly design guidelines and policies in individual cities such as the City of Markham and the City of Toronto. However, we believe it is important to work with all stakeholders and experts, including architects, to produce a single province-wide standard for bird-friendly design which could be incorporated into the Ontario Building Code, ensuring efficacy, feasibility and consistency across the province.

In addition, while building code changes will ensure bird-friendly design standards are followed in new buildings and those undergoing significant renovation, it is equally important to address existing buildings with a high rate of bird collisions. In these cases we must go beyond building code requirements by taking retroactive measures to mitigate these collisions and the loss of wildlife.

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It is also important to emphasize the significance of supporting ongoing research on this topic, including the development and identification of design strategies and products that are truly effective in reducing wildlife collisions. Whether it is design elements such as glazing design or user-based factors such as artificial light use, we must continue to explore ways to reduce the negative impact of buildings. Work done by existing advocacy groups such as FLAP are an important resource as we move towards wildlife-friendly design, and we encourage our members and the public to learn more about this topic.

The existing research and strategies must also be coupled with a well-considered public education strategy to ensure architects and the public are aware of the tools and strategies available. Public education must also ensure clients have an understanding of cost implications of the different solutions, ensuring budgets and expectations are clear from the beginning. With informed architects, landscape architects, developers, clients, and users, we can create a long lasting culture of change.

As always, the OAA remains committed to working with the Province, cities, and different stakeholder groups on issues relating to built form, including the development of wildlife-friendly design. Through our Sustainable Built Environment Committee (SBEC), we will continue to examine the situation and work with allied organizations in increasing the knowledge, skill and proficiency of our members on this important issue.

Sincerely,

Toon Dreessen, Architect
OAA, FRAIC, AIA, LEED AP
President

Appendix F - Properties of Glass

1. Birds and Glass

1.1. The two primary hazards of glass for birds are reflectivity and transparency. Glass is everywhere and is one of the least recognized, but most serious, threats to birds; one that is increasing as humans continue to expand the built environment across the planet. Glass is invisible to birds and to humans, but both can be alerted to its presence. Unfortunately, most birds' first encounter with glass is fatal. They collide at full speed when they try to fly to the sky, plants, or other objects seen through glass or reflected on its surface. Studies of strike injuries document one out of two strikes result in an outright death (Klem 1990a). The cause of death is a variety of internal injuries, the principal of which is head trauma, hemorrhaging within and around the brain. A bird can be killed outright after striking a window from leaving a perch just a meter or more from the glass surface. Unknown are the numbers of birds that completely recover after leaving a collision site, but the types of injuries casualties sustain indicate that very few are able to survive (Klem 1990b, Veltri and Klem 2005). Moreover, collision victims have become a convenient alternative food source for local predators (e.g. gulls, crows, racoons, cats, skunks, squirrels, chipmunks), scavenging their bodies shortly after collisions occur (Klem et al. 2004, Hager et al. 2012). These scavenging occurrences make it extremely challenging to document the problem.

1.2. Type of Glass

1.2.1. The type of glass used in a building is a significant component of its danger to birds. Mirrored glass is often used to make a building "blend" into an area by reflecting its surroundings. Unfortunately, this makes those buildings especially deadly to birds. Mirrored glass is reflective at all times of day, and birds mistake reflections of the surrounding habitat for the real thing. Many of the most hazardous buildings have mirrored glass facades. Clear glass can be reflective when covering a dark interior room, and at other times appear transparent or dark, depending on time of day, weather conditions, angle of view, and other variables. Low-reflection glass may be less hazardous in some situations but does not actively deter birds and can create a "passage effect," appearing as a dark void that can be flown through.

1.2.2. **Spandrel glass** is used to conceal building components such as columns, floor slabs and HVAC systems located between areas of vision glass, increase the area of glass on a building's envelope. This, thereby, increases the likelihood for bird collisions.

1.3. Reflectivity

1.3.1. Viewed from outside, transparent glass on buildings is often highly reflective. Almost every type of architectural glass, under the right conditions, reflects the surrounding habitat and appears attractive to birds. When birds try to fly to the reflected habitat, they hit the glass. Reflected vegetation is the most dangerous, but birds also attempt to fly past reflected buildings or through reflected passageways.

1.3.2. Even second hand light can pose a threat to birds. Darkened windows can reflect neighbouring escaping light.

1.4. Transparency

1.4.1. 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 connecting buildings, glass walls around planted atria, windows that form glass corners and exterior glass guardrails or walkway dividers are dangerous because birds perceive an unobstructed route to the other side.

1.5. Glass Relative to Building Height and Massing

1.5.1. 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.

1.5.2. Glass can appear very differently depending on a number of factors, including how it is fabricated, the angle at which it is viewed, and the difference between exterior and interior light levels. Combinations of these factors can cause glass to look like a mirror or dark passageway, or to be completely invisible. Humans do not actually "see" most glass, but are cued by context such as mullions, roofs or doors. Birds, however, do not perceive right angles and other architectural signals as indicators of obstacles or artificial environments.

1.6. Black Hole or Passage Effect

1.6.1. Birds often fly through small gaps, such as spaces between leaves or branches, nest cavities, or other small openings. In some light, glass can appear black, creating the appearance of a cavity or "passage" through which birds try to fly.

Appendix G - Building Features that Influence Bird Collisions

1. **Building Size**
   1.1. As building size increases, so typically does the amount of glass, making larger buildings more of a threat. It is generally accepted that the lower stories of buildings are the most dangerous because they are at the same level as trees and other landscape features that attract birds. However, monitoring programs accessing setbacks and roofs of tall buildings are finding that birds also collide with higher levels especially during inclement weather at night. Building height is not as great an influencing factor as surrounding vegetation.
2. **Reflected Vegetation**
   2.1. Glass that reflects shrubs and trees causes more collisions than glass that reflects pavement or grass. Vegetation around a building will bring more birds into its vicinity and reflections of vegetation correlate with more collisions. Studies with bird feeders (Klem et al., 1990b, Klem et al. 2004) have shown that collisions will be fatal when birds fly into glass from a meter (3.2 ft or more) away.
3. **Design Traps**
   3.1. Windowed courtyards and open-topped atria can be death traps for birds, especially if they are heavily planted. Birds fly down into such places, and then try to leave by flying directly towards the reflections. Glass sky walks, outdoor guardrails 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.
4. **Green Roofs and Walls**
   4.1. Green roofs provide many environmental benefits, including habitat elements that are attractive to birds. Recent work shows that well designed green roofs can become functional ecosystems, providing food and nesting for birds. However, green roof features are often located close to glass, for views onto greenspace. This poses a great threat to birds. It is particularly important that glass near rooftop gardens, green roofs and other features such as green walls be treated to be bird-friendly.
5. **Windowed courtyards and open-topped atria**
   5.1. These 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.
6. **Building Envelope**
   6.1. The overall extent of glass on the building facade is a primary focus of bird-friendly design and retrofit methodologies. The risk of bird collisions increases as the ratio of glass to solid wall increases. As well as contributing to bird collisions, extensive glazed surfaces also contribute to glare and reflection, and create unwanted heat gain. A building designed with a total window surface area of 25-40 percent relative to the entire facade (low window to wall ratio) can reduce fatal bird collisions. When coupled with passive solar strategies such as daylighting, the design can also provide high-quality light, and help reduce energy use for heating and cooling.

6.2. Amount of Glass

6.2.1. 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.

6.3. Fly-Through Conditions

6.3.1. Glass bridges and walkways, outdoor railings, free-standing glass architectural elements 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.

6.4. Building Features

6.4.1. The relative threat posed by a particular building depends significantly on the amount of exterior glass, as well as the type of glass used, and the presence of glass design traps. In a study based on data from Manhattan, New York, Dr. Daniel Klem, Jr. and colleagues (2009) found that a 10 percent increase in the area of reflective and transparent glass on a building facade correlated with a 19 percent increase in the number of fatal collisions in the spring and a 32 percent increase in fall.

6.5. Feature-Related Hazard

6.5.1. Certain potential bird traps are hazardous enough to necessitate treatment, regardless of building location. A building-specific hazard is a feature that creates dangers 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.

Appendix H – References

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