

Bird-Friendly Glass Design Strategies

Introduction

Clear and reflective architectural glass in residential and commercial structures in urban, suburban, and rural landscapes can be a passive invisible killer of birds worldwide. Our collective evidence reveals that clear and reflective windows of all sizes in commercial and residential applications are theorized to be invisible to potentially all birds due to what have been defined as fly-through conditions, reflected habitat conditions, or black-hole effect. The amount of glass and associated vegetation that attract potential victims best explain the number of casualties at any specific building.

Bird collisions occur at all times of the day, in every season of the year, and under all-weather conditions^{1, 2, 3, 4}.

Over the last decade, increased media attention has attracted the interest of a growing public and building industry professionals such as glass manufacturers, architects, developers, and landscape designers. As few as ten years ago there was little science behind what consisted as bird-safe products available to architects.

Today, there are many products tested and marketed as bird safe. Research on bird-glazing collision prevention has guided the development of bird friendly building design. Science informs us how to transform clear and reflective architectural glass into barriers that birds will see and avoid.

Glass that is visible to and avoided by birds is bird safe and therefore bird friendly. This document is intended to provide guidance for installation such as curtain walls, railings, fins and other exterior glazing.

Definitions

Acid etch visual marker — a marker created by a process whereby hydrofluoric acid washes across the surface of the glass, creating a smooth, non-porous surface. The acid etch process does not affect visible light transmittance and can create a variety of patterns. Acid etch visual markers are provided on the exterior surface of glass.

Avoidance Index (AI) — the percentage of trials that birds fly away (avoid) from a test sample rather than towards the test sample out of total flights in research testing.

Black hole effect — also known as “passage effect”; a condition in which glass can appear black due to lighting conditions and create the appearance of a cavity or passage through which birds can fly.

Film — a material applied to the exterior surface of glass. Perforated or non-perforated film can be used without alteration (raw) or be printed with decorative patterning.

Fly-through condition — a condition created when architectural elements provide birds with a clear line of sight to sky or vegetation on the other side.

Fritted glass – glass manufactured with a ceramic-based paint fused to its surface.

Glass surface Orientation / Designation – the numerical identification of a specific glass surface relative to the exterior surface of the assembly. The first surface is the exterior surface with each consecutive glass surface identified in order from exterior to interior with the last (highest number) surface being on the interior of the assembly. This identification can be used to indicate the surface of glazing on which visual markers are applied, as shown in Figure 1.

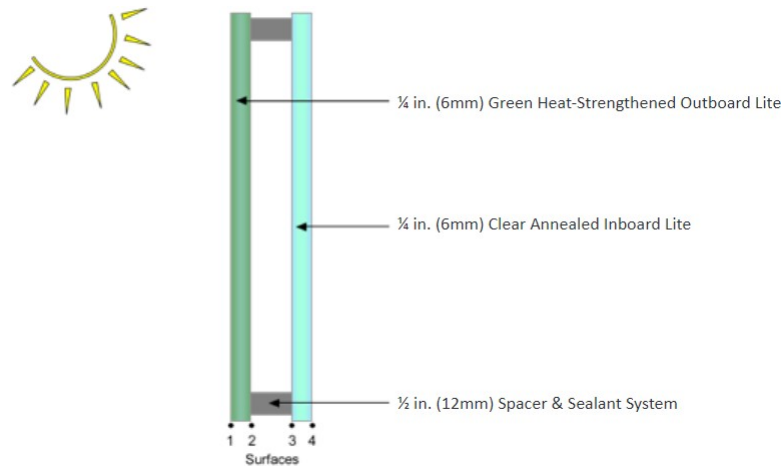


Figure 1
Glass Surface Orientation

Note: As an example, in the case of regular double-pane insulating glass units (IGUs), there are four surfaces: the first surface is on the exterior, followed by the second and third surfaces and, finally, the fourth surface, which is on the interior of the building.

Light pollution – the increased illumination and temporary fluctuations in lighting produced by artificial sources such as building lights, street lights, or vehicles.

Louver – a manufactured product for architectural, aesthetic, or mechanical applications that can be used to prevent bird access. Slats or fins are spaced at regular intervals in a door, window, or other building opening to allow air or light to pass through.

Reflected habitat condition – a condition in which the reflected image in glass is undisturbed and blends with the surrounding habitat (i.e. sky, vegetation)

Threat factor (TF) – the percentage of trials that birds fly towards a test sample rather than control in research testing. Calculated as $TF = 100 - AI$.

Ultraviolet (UV) marker – a patterned coating or marker on the surface of glass that makes it visible to birds.

Visual marker – a solid physical design element on the surface of glazing material that makes it visible to birds.

Possible Solutions/Mitigation Strategies

Creating Visual Markers

Research has shown that birds begin to perceive buildings and houses as objects to be avoided when the distance between features or patterns on the glass is approximately 11 inches (28 cm), with the most effective pattern distance at 4 inches (10 cm), edge-to-edge or less. The denser the pattern the more effective it becomes in projecting itself as a solid object perceived by birds.

The following glass and glazing products can help minimize bird-related injuries by creating visual markers:

- Etch
- Frit
- Film
- Decals
- Fenestration patterns of vertical and horizontal mullions
- Decorative grilles and louvers
- Artwork
- Ultraviolet (UV) patterns

Making architectural glass safe for birds is responsible bird-friendly building design practice. The application of markers that are visible to birds and humans or visible to birds only spaced 50 mm (2 inches) vertically or 100 mm (4 inches) horizontally on the outer pane of a window, with markers ideally located on or adjacent to the outer glass surface, will reduce bird-window collisions. Products following these prescriptive rules have been repeatedly shown to reduce collisions in an effort to help eliminate bird strikes. Products may be tested in order to verify the potential contribution to a bird friendly design. The results of testing can provide documented third-party results of threat factor (the lower the better) of a particular glazing solution.

Muting Reflections

Muting reflections is an important strategy in glass facade design. Strategies to mute reflections include:

- Angled glass
- Awnings and overhangs
- Sunshades
- Screens, grills or mesh
- Shutters
- Louvers
- Window film

Dimming Artificial Lights at Night

The bright artificial lights found in metropolitan areas attract and disorient migrating birds. In cities throughout North America a program such as “Lights Out” may be effective in reducing bird deaths.

Existing legislation⁷

International treaties, provincial and state regional laws, county, city and other municipal ordinances and zoning regulations directly and indirectly address preventing bird fatalities resulting from window strikes. Interpretive

ambiguity and opposing court judgments have rendered international legislation to protect birds from human threats confusing and uncertain. International legal agreements continue to be a viable option to force action to prevent bird-window collisions, but without clear directives, the current trend is the drafting and adoption of regional and municipal legislation to address the issue.

The most prominent international bird protection legal agreements relevant to avian mortality at windows are the *Migratory Birds Convention Act* (MBCA), *Species at Risk Act* (SARA) for Canada; their equivalents the *Migratory Bird Treaty Act* (MBTA), *Endangered Species Act* (ESA) in the United States (US), and the *Birds Directive of the European Commission* in the European Union (EU). For North America regionally, protecting birds from windows is justifiably authorized under the *Endangered Species Act* (ESA) as applied in the province of Ontario, the *Ontario Environmental Protection Act* (EPA), and the *B3 Program* (Building, Benchmark, and Beyond) in the state of Minnesota.

As of the date of publication of this document, the following legislation exists within North America as a means of deterring bird collisions.

A nationwide US federal *Bird Safe Buildings Act of 2019* (H.R. Bill 191)⁷ is pending legislation currently under congressional consideration. This bipartisan supported bill would require public buildings incorporate bird safe building materials and architecture. New York City passed a bill effective December 2020 that will update the building code to require bird-friendly glass up to 75 feet above grade and on any structure above a green roof on new buildings and on future renovations where all exterior glazing is replaced. Similar state laws are pending in Maryland, Washington, District of Columbia (DC), and Cook County, Illinois. Although regional legislation almost exclusively is directed to retrofitting, remodeling and new construction of government buildings, the hope is that mandatory bird-safe government practices will serve as a model and example to stimulate the same practices for private structures.

Specific mandatory ordinances and zoning regulations to prevent bird-window collisions at government and commercial buildings have been adopted by the following municipalities: Mountain View, Oakland, Richmond, San Francisco, San Jose in California; Highland Park, Illinois; Portland, Oregon; and Minnesota; Markham and Toronto, Ontario. A similar *Bird Friendly Design Ordinance* (Chapter 13-150) is pending before the City Council of Chicago, Illinois.

Voluntary recommendations have been formalized in Calgary, Alberta and Vancouver, British Columbia; in the statewide California Green Building Code, and in California cities of Palo Alto and Sunnyvale; and the village of Barrington, Illinois. The drafting of each of these legislative policies have been guided by published bird-safe building design guidelines by the American Bird Conservancy, and the planning authorities and their avian conservation cooperators in the cities of Calgary, Markham, New York, Oakland, Portland, San Francisco, Toronto, and Vancouver.

In addition, The Canadian Standards Association (CSA)⁶, an international standards organization developed and published a voluntary *Bird Friendly Building Design* (CSA A460) in June 2019. This standard guide was developed in concert with North American representatives throughout the glass industry supply chain, Municipal government representatives, architects, developers as well as experts in ornithology. CSA's goal is to have this performance-based standard adopted as a bird-safe building construction approach worldwide.

LEED

The U.S. Green Building Council's Leadership in Environmental and Energy Design (LEED) green building rating system now enables architects, designers, developers, and building owners to earn credit for incorporating design strategies that reduce bird collisions⁵.

The credit is currently being tested in the LEED Pilot Credit Library, a rating system development tool that encourages new or innovative green building technologies.

Conclusion

Studies have shown that creating visual markers, muting reflections in glass facades, and minimizing light pollution are ways to create a more bird-friendly environment. There are a variety of glass and glazing solutions offered by glass fabricators and other stakeholders that will reduce bird collisions.

References

¹The Building Industry and Bird Conservation, Dr. Klem, 4 February, 2019. Accessible for download via <https://walkerglass.com/resources/bird-friendly-glass/>

²American Bird Conservancy, Dr. Sheppard: <https://abcbirds.org/program/glass-collisions/bird-friendly-design/>

³FLAP Canada: <https://flap.org/>

⁴U.S. Fish & Wildlife Service- Buildings & Glass: <https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds/collisions/buildings-and-glass.php>

Golden Gate Audubon Society Standards for Bird Safe Buildings: <https://goldengateaudubon.org/conservation/make-the-city-safe-for-wildlife/standards-for-bird-safe-buildings/>

⁵US Green Building Council LEED v4.1 Credit- Bird collision deterrence:

<https://www.usgbc.org/credits/new-construction-core-and-shell-schools-new-construction-retail-new-construction-healthca-44>

⁶CSA A-460-2019 Standard *Bird Friendly Building Design*:

https://store.csagroup.org/ccrz/ProductDetails?viewState=DetailView&cartID=&portalUser=&store=&cclcl=en_US&sku=2704646

⁷Bird-Safe Ordinances

House bill H.R.919 - Bird-Safe Buildings Act of 2019: <https://www.congress.gov/bill/116th-congress/house-bill/919/committees>

New York City: <http://www.nycaudubon.org/our-publications/bird-friendly-building-design>

<https://legistar.council.nyc.gov/LegislationDetail.aspx?ID=3903501&GUID=21B44B73-D7E1-4C55-83BD-1CA254531416&Options=&Search=>

Chicago: <https://birdfriendlychicago.org/>

San Francisco Ordinance: <https://sfplanning.org/standards-bird-safe-buildings>

Minnesota: https://www.b3mn.org/guidelines/3-1/s_5/

Toronto: <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/design-guidelines/bird-friendly-guidelines/>

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