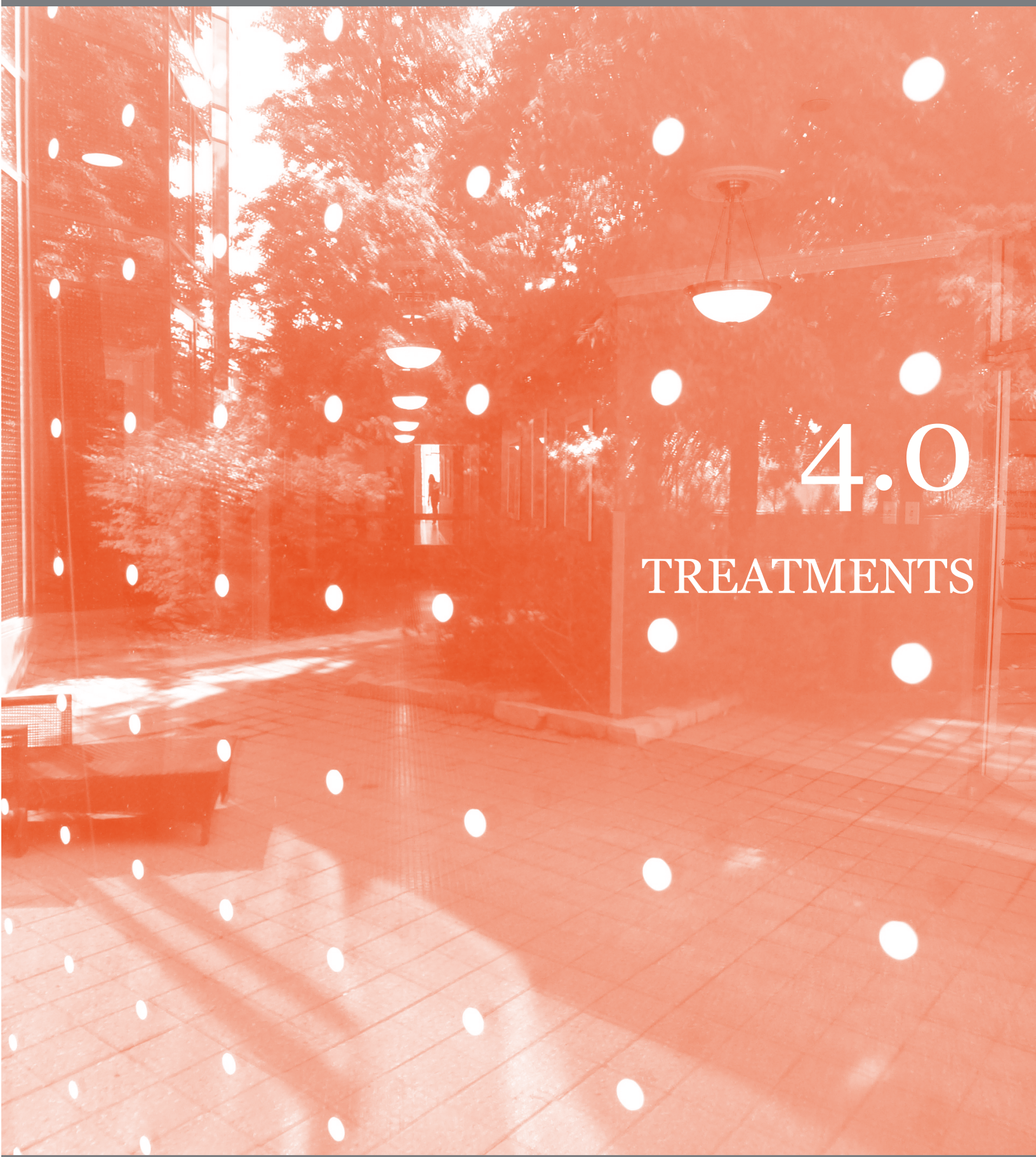


4.0

TREATMENTS

4.0 TREATMENTS

Researchers studying BWCs have applied two different experimental techniques. The first technique includes the placement of glass panes in the edge of a field adjacent to successional deciduous forest and shrubs (e.g. Klem 2013). In this experiment, birds fly freely through the vegetation, striking panes which are not seen and avoiding panes that are visible to them. The number of collisions is then assessed, by comparing results for treated and untreated panes. The birds' behaviour when approaching the panes is also observed. The second technique is to release birds into a long room (such as a trailer) where light is provided only by windows at the far end. In this case the bird is given two options; one treated pane and one untreated pane. The birds must make the decision to fly at one or the other. The behaviour of the birds approaching the panes is then recorded. Information is also derived (though usually informally) from statistics gathered before and after treatment of buildings. Other studies have compared strikes on buildings with different areas of glass and amount of adjacent vegetation (e.g. Gelb & Delacretaz 2009; Hager *et al*. 2013). Through this research, it has been determined that the most effective documented treatment to prevent BWCs is to make the glass visible to birds, by reducing reflection and transparency. Specifications that have been developed are shown in empirical studies and by practical experience in the GTA to reduce numbers of bird strikes by at least 80%, as recommended by FLAP Canada.

4.1 Application of Treatments

The application of bird friendly treatments must accommodate user requirements, therefore a balanced approach has been established. It would be ideal to apply treatments to all glass areas, however, in order to accommodate user needs a clear view through the glass can be permitted in some circumstances. The acceptance of treatments to improve visibility of the glass has been shown to be enhanced through leaving "gaps" that provide views. The cities of Toronto and San Francisco have found that an effective compromise is to leave 10-15% of the glass untreated. It is proposed that in the City of Markham, 15% of the glass may be left untreated, as long as it is less than 2m^2 of contiguous glass area.

Treatments in the City of Markham Guidelines are founded on best management practices (also refer to **Appendix B -** Best Practices Summary) and research.

16m Zone of Protection

The recommendation to treat areas up to a height of 16m, which is applied in several jurisdictions including the City of Toronto and comes fr**o**m several recent findings:

- The buildings where the largest numbers of bird collisions occur are those that are next to the tallest vegetation; and,
- The average size of mature trees in the GTA is not 12m, but 16m.

The City of Toronto has recently changed its standards to reflect that the height of treatment for new City-owned buildings or major additions must be 16m (City of Toronto 2013). The City of Toronto is looking into changing its guidelines to reflect this in 3 years (Mesure 2013 pers. comm.).

In some circumstances, there is potential for vegetation to reflect in windows higher than 16m; for example, when a natural area adjacent to a building is on a slope. In this case, the height of the vegetation potentially reflected at approximately 91m from the building should be used to guide the height of the treatment. For example, if the height of vegetation reaches 20m at a distance of 90m, the façade would have to be treated up to 20m.

The primary treatment standard is based on a minimum standard for visual cues developed by Dr. Daniel Klem Jr. and incorporated into most of the published guidelines.

It states simply that to minimize bird collisions visual marker spacing on clear or reflective surfaces on a structure should not exceed 5cm (2 inches) on the horizontal plane or 10cm (4 inches) on the vertical plane. Refer to **Figure 4-1**.

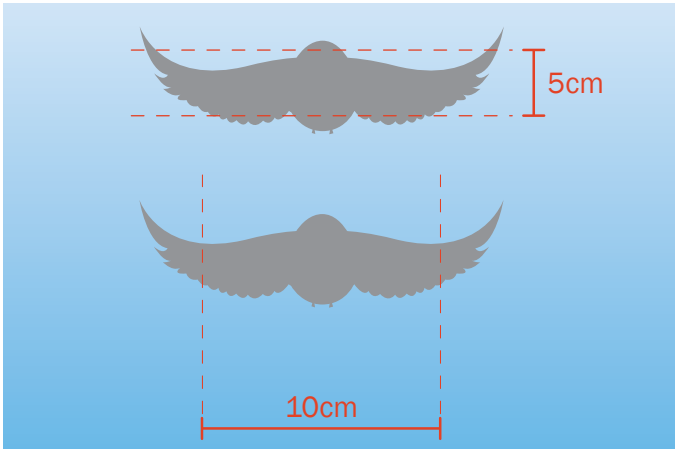


***Figure 4-1**: Minimum standard for visual cues/markers developed by Dr. Klem*

Primary treatments hold to this standard. Secondary treatments are those which allow some flexibility in window design, and have been shown to be somewhat effective in making glass more visible to birds, but do not meet the standard for primary treatments.

Figure 4-2 illustrates the circumstances under which primary and secondary treatments apply, and where no treatment is required. The diagram shows the area on a façade up to 16m in height as the area where reducing the potential for bird strikes must be considered. For 85% of glass area, primary treatment is required. Up to 15% of the glass can be left without primary treatment. However, it is recommended that a secondary treatment be applied to glass area larger than $2m^2$, as these represent the areas with the highest risk of BWCs.

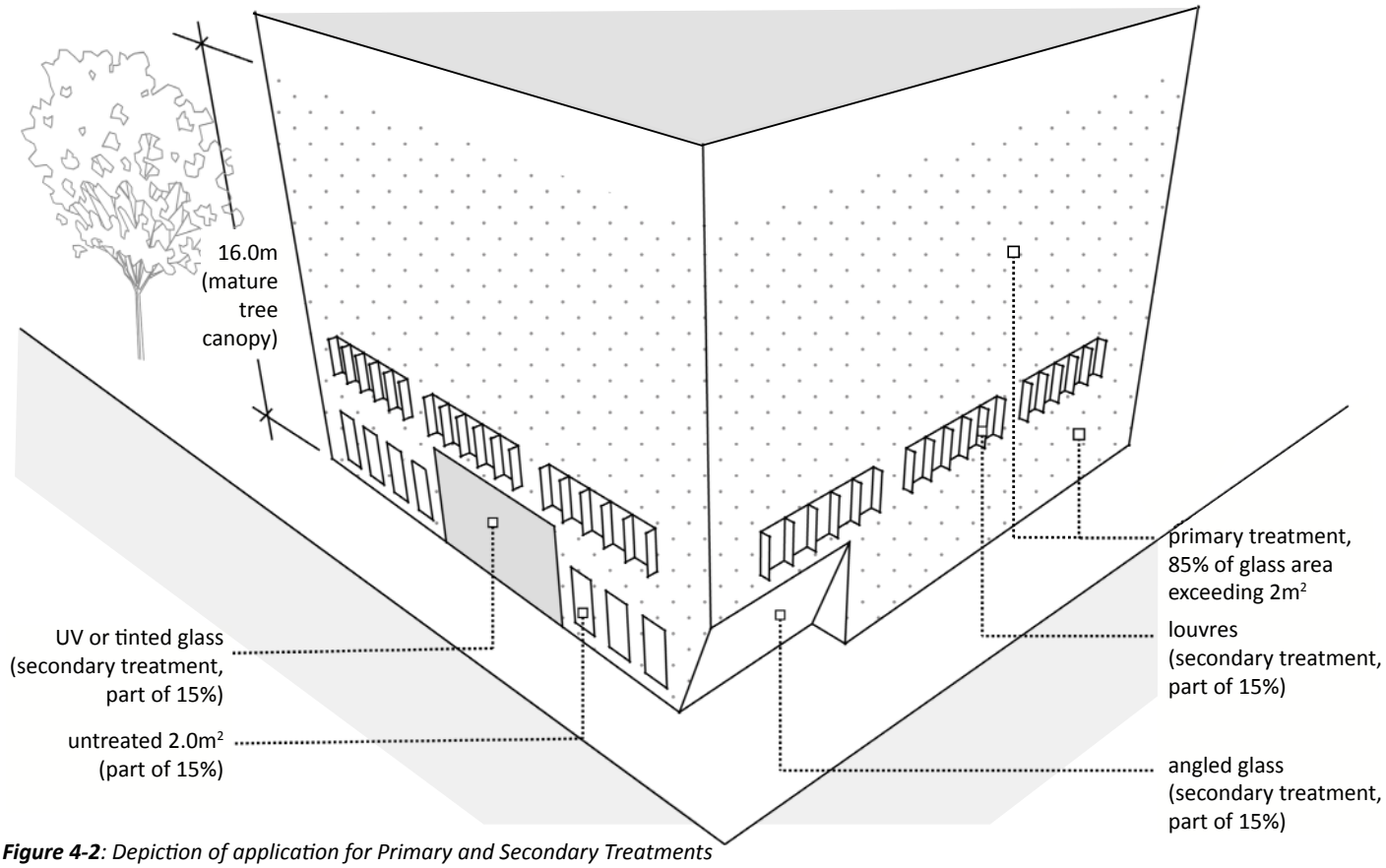


***Figure 4-2**: Depiction of application for Primary and Secondary Treatments*
Graphic by Wallman Architects

2m² rule

There is evidence that buildings with smaller areas of glass and smaller windows are involved in fewer collisions than buildings with larger areas of glass and larger windows. One study found that in an urban landscape, windows of more than 2m² are more likely to be involved in collisions than windows of less than 2m² (Gelb & Delacratez 2009). Contiguous areas of glass no bigger than 2m² can be left untreated. The opportunities to apply secondary treatments to these areas are dependent on site conditions and can be discussed during the development approval process. Heritage buildings will not generally require treatment, as long as they are largely built of brick and other non-reflective and non-transparent materials, and have only small glass windows (generally less than 2m²). Additions with contiguous areas of glass that exceed 2m² should be subject to treatments similar to other glass buildings. It should be noted that BWCs can occur on smaller windows under certain circumstances.

15% rule

It is proposed that in the City of Markham, primary treatment is not required for 15% of the glass. Secondary treatments are preferred for areas without primary treatment; and there is some flexibility in the secondary treatment design. Within this 15%, areas of contiguous glass less than 2m² can be left untreated. The 15% would generally be applied primarily to retail window surfaces or building areas where the internal building function requires unimpeded views.

The application of secondary treatments to the remaining 15% is site specific and can be discussed during the development approval process. A cautious approach should be used with designing windows less than 2m² so that they do not create an illusion of a throughway to areas of habitat.

Certain configurations of glass are at very high risk to birds, especially glassed-in courtyards or atria adjacent to gardens and water features that attract birds. Glass that is highly transparent with vegetation on both sides can be especially lethal to birds. In these circumstances primary treatments should be applied.

Canopies, awnings and overhangs that create external building shade have been suggested as a viable treatment in some jurisdictions, as found within **Appendix B -** Best Practices Summary. According to FLAP Canada they have proven to be inefficient and therefore we have not included them as a treatment.

The treatment of windows to reduce the risk of Bird-Window Collisions may be a consideration taken by the development industry to obtain LEED credits. Refer to **Appendix B** for further information.

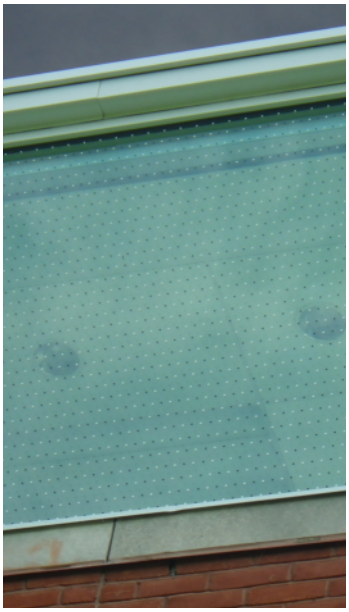
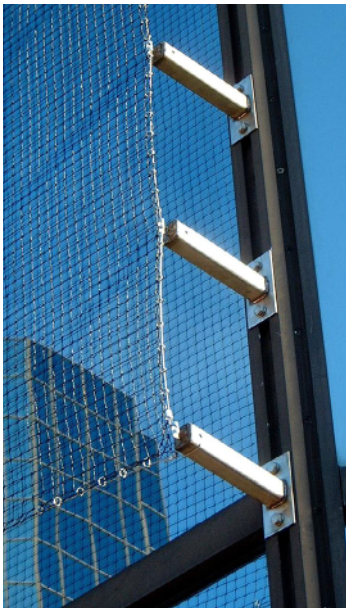
4.2 Primary Treatments

The following treatments shall be addressed as part of the Site Plan review process. Primary treatments would generally be applied on 85% of contiguous glass area greater than 2m² and within 16m from finished grade. The goal of these treatments is to reduce the risk of BWCs by approximately 80%, as recommended by FLAP Canada.

Primary treatments are those that adhere closely to the patterns that have proven to be most effective: a highly visible pattern that follows the rule of maximum 5cm untreated space on the horizontal plane and 10cm untreated space on the vertical plane.

Guidelines have been developed to assist in the implementation of each of the four treatments listed below:

1. **Integral/Applied Coverings – Stripes**
2. **Integral/Applied Coverings – Dots**
3. **Integral/Applied External Coverings – Netting**
4. **Frit and Etched Patterns**


Primary Treatment 1: Integral/Applied Coverings - Stripes

GUIDELINES

1. **Apply treatment on 85% of contiguous glass area greater than 2m^2 and within 16m from finished grade.**
2. **Treatment may be applied to both retrofit or new buildings.**
3. **Horizontal stripe treatment shall be at a maximum spacing of 5cm on centre.**
4. **Vertical stripe treatment shall be at a maximum spacing of 10cm on centre.**
5. **Stripe should be at a minimum 6.1mm width for vertical and a minimum 3.1mm width for horizontal.**
6. **Treatment should be applied to outer surface. Treatments applied to inner surfaces do not decrease glass reflectivity.**

NOTES

- According to American Bird Conservancy, applied coverings/adhesive films can significantly reduce the threat of BWCs.
- Vertical or horizontal that cross at different angles (as shown below) can provide considerable latitude for interesting designs.
- Treatment should be considered in the context of the internal building function. Stripes and other patterns should be contrasting enough to be visible to birds
- At the Earth Rangers Centre for Sustainable Technology (LEED gold certified) in the GTA, decorative window film has been applied to achieved a LEED Innovation credit.
- Where views are imperative (such as at-grade commercial or retail uses), the 15% rule may be applied.

Photo by North-South Environmental Inc.

Photo by FLAP Canada

Primary Treatment 2: Integral/Applied Coverings - Dots

GUIDELINES

1. **Apply treatment on 85% of contiguous glass area greater than 2m^2 and within 16m from finished grade.**
2. **Treatment may be applied to both retrofit or new buildings.**
3. **Dot size shall be minimum 5mm.**
4. **Dot colour shall be of high contrast in relation to the background.**
5. **Dot spacing shall be maximum 5cm on centre.**
6. **Treatment should be applied to outer surface. Treatments applied to inner surfaces do not decrease glass reflectivity.**

NOTES

- Dots appear to be less effective than stripes (Mesure 2013 pers. comm.) but may be more acceptable to building users. Application should be considered in the context of the internal building function.
- Designs such as squares, triangles, etc. may be used.
- Insulation value of materials used for patterns should be considered.
- Where views are imperative (such as at-grade commercial or retail uses), the 15% rule may be applied.

Photo by North-South Environmental Inc.

Photo by North-South Environmental Inc.

Primary Treatment 3: Integral/Applied External Coverings - Netting

GUIDELINES

1. **Apply treatment on 85% of contiguous glass area greater than 2m² and within 16m from finished grade.**
2. **Treatment may be applied to retrofit conditions.**

NOTES

- There is a potential for birds to become trapped behind the netting.
- Where views are imperative (such as at-grade commercial or retail uses), the 15% rule may be applied.
- Netting should be placed a few centimetres distance from the glass so that birds that fly into the netting do not hit the glass - the distance will vary depending on the netting material used.

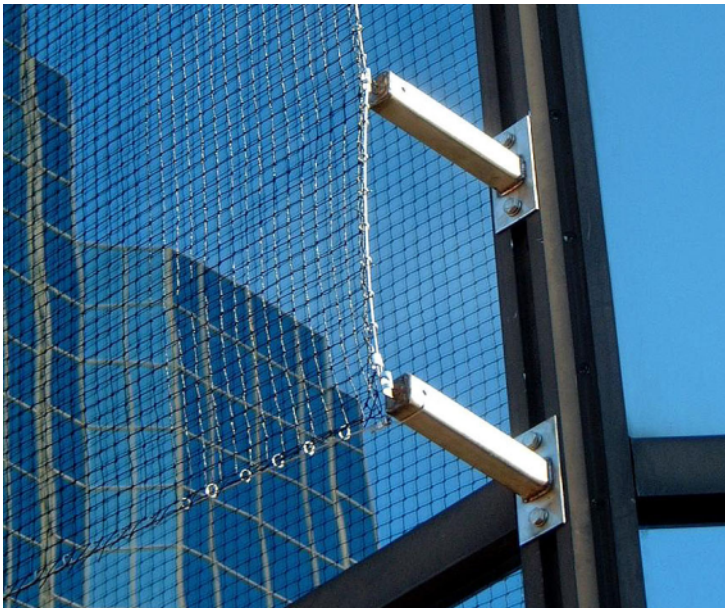


Photo by FLAP Canada

Primary Treatment 4: Frit or Etched Patterns

GUIDELINES

1. **Apply treatment on 85% of contiguous glass area greater than 2m^2 and within 16m from finished grade.**
2. **Apply treatment to new buildings.**
3. **Treatment should be applied to outer surface. Treatments applied to inner surfaces do not decrease glass reflectivity.**
4. **Treatment colour should be in colour of high contrast (depending on the background, this could be light or dark).**

NOTES

- Frit patterns prevent birds from seeing reflective glass as open sky or inviting habitat.
- Glass areas can sometimes change colour due to lighting. White can be less successful as a bird deterrent due to lighting change during different times of the day (ABC). However, white can be used in conjunction with other colours to produce a bi-coloured effect to increase effectiveness.

Photo by North-South Environmental Inc.

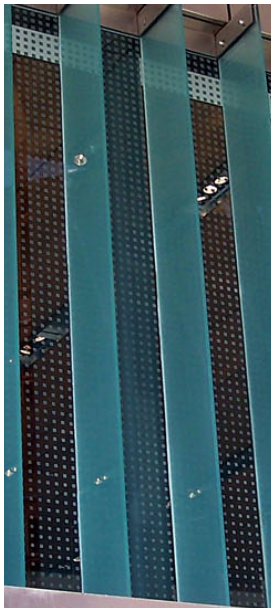
Photo by FLAP Canada

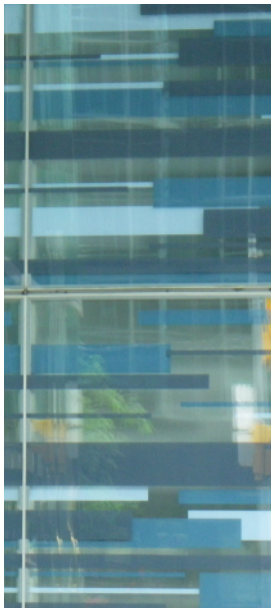
4.3 SECONDARY TREATMENTS

The following secondary treatments should be addressed as part of the Site Plan review process. It is recommended to apply secondary treatments on 15% of contiguous glass area greater than 2m^2 and within 16m from finished grade, and where views are imperative (such as at-grade commercial or retail uses), on areas without primary treatment.

Guidelines have been drafted to assist in the implementation of each of the seven treatments listed below:

1. **Internal Blinds and Shades**
2. **Louvers and External Coverings**
3. **Closely-Spaced Mullions**
4. **Tinting**
5. **Angling**
6. **UV Patterned Glass (Experimental)**
7. **Landscape Design**




Secondary Treatment 1: Internal Blinds and Shades

GUIDELINES

1. **Apply treatment on 15% of contiguous glass area greater than 2m^2 and within 16m from finished grade (areas without primary treatment).**
2. **Treatment may be applied in new and retrofit glass installations.**
3. **Treatment maybe applied to retrofit or new building design.**
4. **Horizontal blinds should have a maximum spacing of 5cm and a minimum thickness of 3.1mm.**
5. **Vertical blinds should have a maximum spacing of 10cm with a minimum thickness of 6.1mm.**
6. **Solid blinds should utilize contrasting colours.**

NOTES

- Blinds should be designed to provide as much contrast to glass as possible.
- White solid blinds generally provide lower level of contrast and may have high reflectivity depending on glass colour and lighting during different times of the day and therefore are not recommended.
- The application and effectiveness of interior blinds are dependent on building management.
- The opening and closing of blinds should be managed during bird migration periods.

Photo by North-South Environmental Inc.

Secondary Treatment 2: Louvers and External Coverings

GUIDELINES

1. **Apply treatment on 15% of contiguous glass area greater than 2m^2 and within 16m from finished grade (areas without primary treatment).**
2. **Treatment may be applied in new and retrofit glass installations.**
3. **Apply treatment to building exteriors.**
4. **Treatment should be opaque.**

NOTES

- Louvers that have the flexibility to be closed during migration periods are preferred.
- Louvers can contribute to control solar gain in interior space and have a sustainability value.
- Louvers could be designed as integrated component of building facades.
- Louvers can be in the form of screens, scrims, wire mesh, and exterior venetian blinds.
- External coverings can be in the form of roll up solar screens made of translucent polyester woven fabrics.

Photo by FLAP Canada

Secondary Treatment 3: Closely-Spaced Mullions

GUIDELINES

1. **Apply treatment on 15% of contiguous glass area greater than 2m² and within 16m from finished grade (areas without primary treatment).**
2. **Treatment may be applied in new and retrofit glass installations.**
3. **Mullions are most effective where tightly spaced and strongly contrasting. Width of mullions should be minimum 2.5cm to be effective.**

NOTES

- Mullions are generally applied to single family residential buildings and townhomes.
- Muntin bars can be incorporated to increase effectiveness.

Photo by North-South Environmental Inc.

Secondary Treatment 4: Tinting

GUIDELINES

1. **Apply treatment on 15% of contiguous glass area greater than 2m^2 and within 16m from finished grade (areas without primary treatment).**
2. **Treatment may be applied in new and retrofit glass installations.**
3. **Tinting should consist of a strong contrasting pattern.**
4. **Tinted glass should be non-reflective.**

NOTES

- Highly reflective tints should be avoided.
- Tinting colours can be varied to increase contrast.

Photo by North-South Environmental Inc.

Tinting showing a strong contrasting pattern
Photo by North-South Environmental Inc.

Secondary Treatment 5: Angling

GUIDELINES

1. **Apply treatment on 15% of contiguous glass area greater than 2m^2 and within 16m from finished grade (areas without primary treatment).**
2. **Treatment may be applied to new and retrofit building design.**
3. **Angle glass downward 20 to 40 degrees from the vertical plane.**
4. **Angling should only be considered in concert with other treatments to reduce reflection of vegetation on glass.**

NOTES

- Angled glass may reduce the force with which birds in horizontal flight strike panes. Although glass orientation does not eliminate BWC hazard (Klem 2004), it is an effective bird-strike deterrent.
- Angling is more practical in one storey structures or at ground level in multi-storey buildings.
- The effectiveness of angled glass may be limited as birds frequently fly at angles other than horizontal (ABC).
- In some instances, angling may not reduce the reflection of vegetation on glass surfaces.

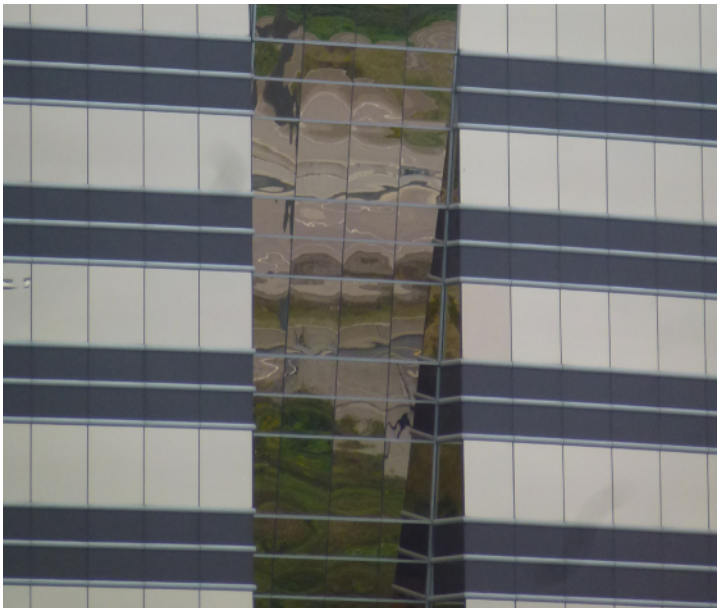


Photo by North-South Environmental Inc.

Secondary Treatment 6: UV Patterned Glass (Experimental)

GUIDELINES

1. **Apply treatment on 15% of contiguous glass area greater than 2m² and within 16m from finished grade (areas without primary treatment).**
2. **Pattern should be at maximum 5cm horizontal spacing and 10cm vertical spacing.**
3. **Ultraviolet reflectivity needs to exceed 20-40% and be adjacent to contrasting areas of UV-absorption (lower or higher) to be visible.**

NOTES

- Birds can see further into the ultraviolet spectrum than humans.
- Treatment is still in experimental stage.
- Results of experiments are promising in some cases but are inconsistent.
- If effective, UV patterned glass would be ideal for areas where views are imperative (such as at-grade commercial or retail uses).

What birds see
Photo by Arnold Glas

What humans see
Photo by Aliza Baltz

Secondary Treatment 7: Landscape Design

GUIDELINES

1. **Generally, locate trees and vegetation within 3m from glass areas or further than 30m from glass areas.**
2. **Buildings fronting on public sidewalks should apply other bird friendly treatments to glass areas.**
3. **Minimize the use of vegetation that bears fruit and attracts birds adjacent to highly reflective glass.**
4. **Interior greenery should be located well away from windows.**
5. **Cluster a higher numbers of trees away from non-treated surfaces.**
6. **Place low shrubs and groundcovers adjacent to highly reflective glass.**
7. **Avoid planting trees where they reflect clearly in untreated glass.**

NOTES

- "A building that is designed to deter bird collisions will allow for most any type of site landscape design. Although the proximity and height of landscape material have shown to influence the number of bird collisions, if the building facade is designed to be 'bird-friendly', the landscape material will not reflect and cause confusion to birds." – LEED Manual
- It has been reported that it can also be effective to plant vegetation immediately adjacent to the facade so that birds cannot build up momentum before they hit the facade; however, BWCs have still been documented to occur (though less frequently) under these circumstances (Mesure 2013). A strategy of placing opaque design features between vegetation and glass to break up reflection could also be considered where circumstances permit.

Photo by The Landplan Collaborative Ltd.

4.4 Lighting Treatments

These recommendations are included in order to attempt to reduce the presence of artificial city lights which are attractive to migrating birds.

While daytime collisions are thought to be more frequent than nighttime collisions in Markham, it is likely that city lighting plays a role in attracting birds to the downtown areas where the greatest risk of collision occurs, or that it may play a role in confusing birds.

Guidelines have been developed to assist in the implementation of the treatments listed below:

1. Mitigate Interior and Exterior Lighting

Interior lighting plays a negative role in attracting birds to buildings

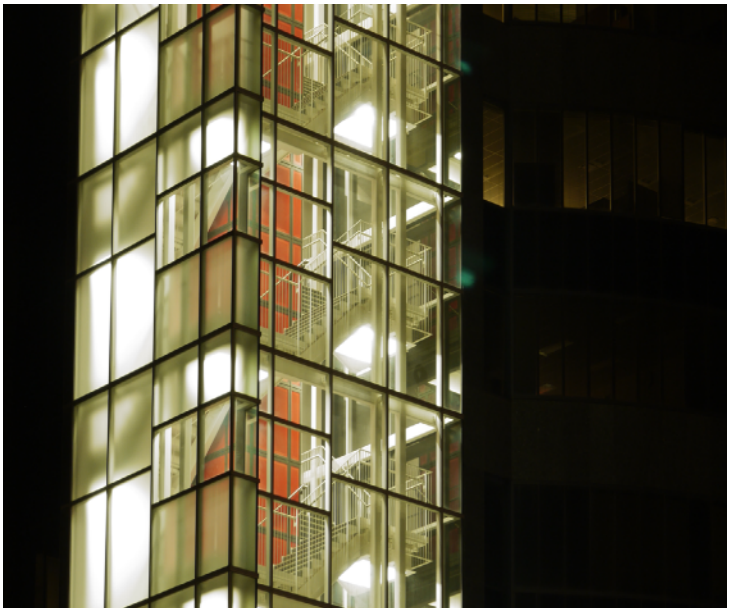
Lighting Treatment 1: Mitigate Interior and Exterior Lighting

GUIDELINES

1. **Eliminate up-lighting by attaching cut-off shield for streetlights and external building lights.**
2. **Limit lighting to areas where lighting is needed for safety and security. There should be no light spill outside the property line.**
3. **Require lights out from 11 p.m. to 6 a.m. or minimal light use during spring (March-June) and fall (August-October) bird migration periods.**
4. **Provide motion sensors or auto shutoff system with maximum 30 minute vacant period.**
5. **Avoid creating "pools" of light that could attract birds especially during inclement weather.**

NOTES

- Hundreds of bird species migrate at night. On clear, moonlit nights, they will often fly at high altitudes and, consequently, avoid possible obstructions. But artificial lights from human civilization can confuse them, especially on foggy, rainy nights or when cloud cover is low. White and red lights appear to be more disorienting and attractive to birds than blue and green light. Birds may fly toward lit structures such as skyscrapers and lighthouses. Even spotlights can "entrap" birds. They fly into the beams of light, unwilling to fly out again. Exhausted, they fall to the ground. Many birds that collide with lit structures are killed outright. Those that are injured or exhausted become easy prey to scavengers like raccoons (FLAP 2013).
- LEED Pilot Credit 55 Bird Collision Deterrence requires both interior and exterior lighting strategies that reduce light trespass. This can include manual and automated shutoff for lights, and shielding that prevents light from spilling into areas where it could attract birds.



Unnecessary interior lighting within an underutilized stairwell

Photo by North-South Environmental Inc.