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## **A TREND TO BE REDUCED: “MORTALITY OF BIRDS BY COLLISIONS WITH BUILDINGS IN URBAN AREAS”**

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A Research Paper by:



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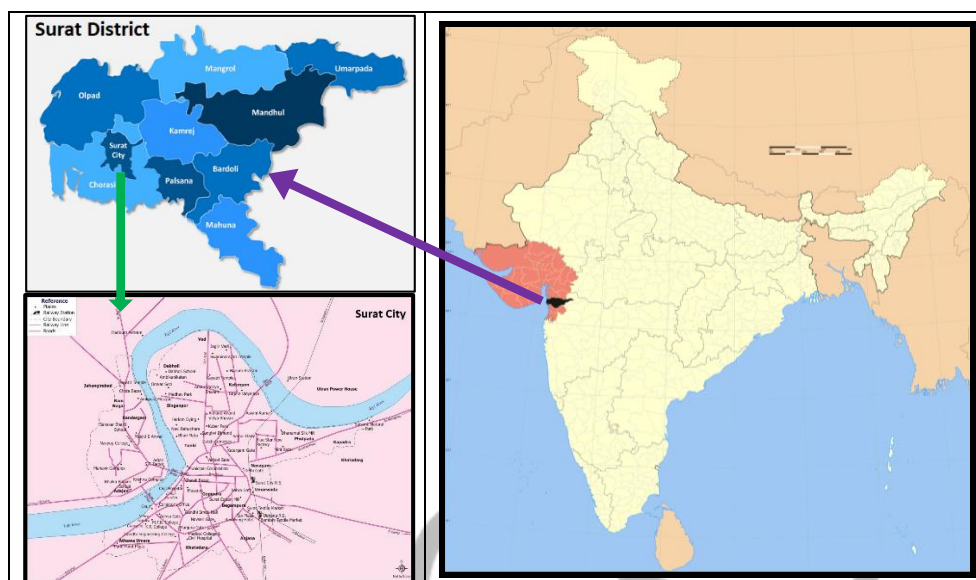
## ABSTRACT:

**Human activities have a profound effect on ecology at large and bird species in particular due to destroying of their natural habitat. Human activities like agriculture, mining, and urban development has resulted in loss of forests, plains and other natural resources. Cutting of forests, trees, shrubs has reduced potential natural habitat including wetlands for many bird species especially in India with varied biodiversity. Window strikes are among the top three human-related cause of bird deaths, along with cats and habitat destruction. As a result of urbanization and population growth, cities are expanding vertically intruding into the bird fly paths and destroying their natural habitat. This is causing increase in threat of bird-window strikes. People in India are hardly aware of this issue. There should be rules and acts to address this issue, this paper is an attempt in this direction to make law makers, institutions giving permissions to buildings aware of this issue and suggesting measures of mitigating such incidents based on best practices around the globe.**

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## Introduction:

Surat is second largest city in the western Indian state of Gujarat. Located at the mouth of the Tapi River (also known as Tapi), once it used to be a large seaport. It is now the commercial and economic centre in South Gujarat, and one of the largest urban areas of western India. Surat is hub of textile and diamond cutting industry, in fact 90% of the diamonds produced world over are polished here. It is one of the most dynamic cities of India recording one of the fastest population growth rates due to immigration from various part of Gujarat and other states of India because of employment opportunities. Native Suratians are well off and business minded and hard labour works are offered to migrant labour. Thus, Surat is a cosmopolitan city with amalgamation of various cultures of India.



Source: [https://commons.wikimedia.org/wiki/File:Gujarat\\_district\\_location\\_map\\_Surat.svg](https://commons.wikimedia.org/wiki/File:Gujarat_district_location_map_Surat.svg),  
<https://www.sketchbubble.com/en/presentation-surat-map.html>,  
<https://maps.newkerala.com/Surat-city-map.php>

Figure 1: Surat in India

Surat will be the world's fastest growing city from 2019 to 2035, according to a study conducted by The Economic Times. The metropolitan area population of Surat<sup>1</sup> in 2021 was 7,490,000, an increase of 4.24% CAGR from 2020. To maximise the space for commercial and residential growth, there is an increase in high-rise buildings. In the south west zone and west zone, the construction of high-rise buildings is vigorous.



Source: [https://commons.wikimedia.org/wiki/File:Vesu\\_Bharthana,\\_VIP\\_Road.jpg](https://commons.wikimedia.org/wiki/File:Vesu_Bharthana,_VIP_Road.jpg)

Figure 2: Vertically expanding concrete jungle in Surat

<sup>1</sup> Referred [www.metrotrends.net](http://www.metrotrends.net) website for data for Surat's population level and growth rate.

## Bird Collision in Surat:

On 4<sup>th</sup> of February, 2022 there was an incident of Bird Collision<sup>2</sup> on the exterior glass of green building of “The Surat District Co-Operative Bank” located in Athwagate, Surat, Gujarat. This caused death of 27 Rosy Starlings.

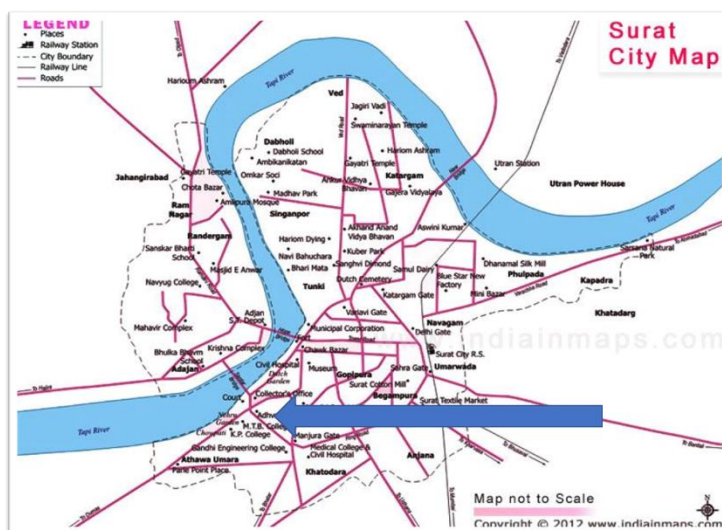


Figure 3: Location where the bird collision Incident occurred in Surat



Source: <https://indianexpress.com/article/cities/surat/35-birds-die-after-crashing-into-glass-shield-of-surat-high-rise-7757582/>

Figure 4: View of the building and the carcass of birds which died due to collision with building

<sup>2</sup> The Times of India dated 5-Feb-2022 article titled “Surat building’s glass wall rings death knell for Rosy Starlings”.

The incident has astonished many researchers, ornithologist, bird lovers in the area, including the general public. These birds are the winter migrators from Eastern Europe and North Asia. They're commonly seen in the vicinity of River Tapti and the building is also located at a distance of 1 km from the River.

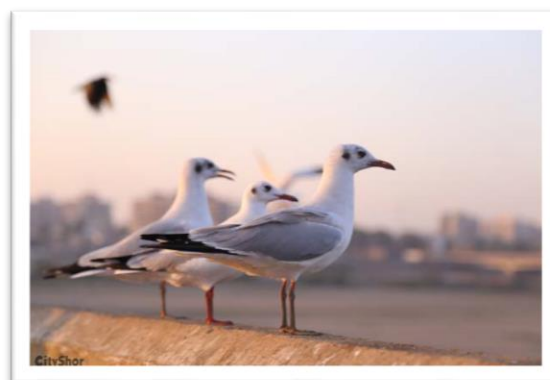
Such incidents occur as birds do not understand that glass reflections of trees or sky are not real. They can't see that there is a reflecting (mirror) barrier in their way.

### Migratory Birds of Surat:

Many green areas and wetlands in Surat are haven for migratory birds<sup>3</sup>. At the beginning of February every year, over few thousand exotic birds migrate to Lake Gaviyar, Surat travelling long distance from across the globe. Bird watchers are swarming on Lake Gaviyar to watch them. As Government has made wire fencing around the lake to protect them, the migratory birds live here fearlessly. As winter begins, migratory birds of different species visit Surat abundantly. Tapi River, as well as Gaviyar Lake, are few of the favourite habitat for these exotic migratory birds. Several species of birds such as Siberian Cranes, Siberian Seabirds, Brown Headed Gulls, Greater Flamingo, Ruff, Black Winged Stilt, Blue Throat, Brahmini, Espre, Harriers, Eagle, Coot, Exotic Duck, Lark, Vijayan (Piyasan), Showller (Gayno), Pintail (Singper), Gargeni (Chetva), Cotton Teal (Girja), Common Teal (Small Murghabi), Spotboil Duck (Tilali duck), Common Pochard (Gray Karchiya) visit Surat on a regular basis. Surat also hosts guests in Migratory Bird Species from countries such as Kazakhstan, Austria etc.

Mr. Snehal Patel, President of the Surat Nature Club, an ecologist working in the field of environmental protection in southern Gujarat, says that birds come to southern Gujarat mostly from northern Europe and icy regions like North Asia, Siberia. In winter, as the reservoirs there get frozen. So, because of the favourable environment and food available in many places in South Gujarat, they are attracted to come here in winter. There are several freshwater reservoirs in southern Gujarat. There are also islands such as Aliya Bet of Bharuch along the banks of the Dumas and Hajira. A large number of Migratory birds have their presence in the reservoirs and on the islands, due to the availability and the attraction of enough food. At present, the Great Flamingo birds are found living along the banks of the Tapi River, according to Mr. Snehal Patel. Greater Flamingos are also late in Departure (returning to their original habitat) when they find adequate food and a suitable environment here.

Hotspots in Surat where migratory birds seen are weir-cum-causeway, Jehangirpura bridge, Tena village, Tena village near Mahadev temple, Gavyiar lake, Suvali beach, Kunkni village, Ambhata village, Narthan Olpaad, Dumas beach, Magdalla, Umara.



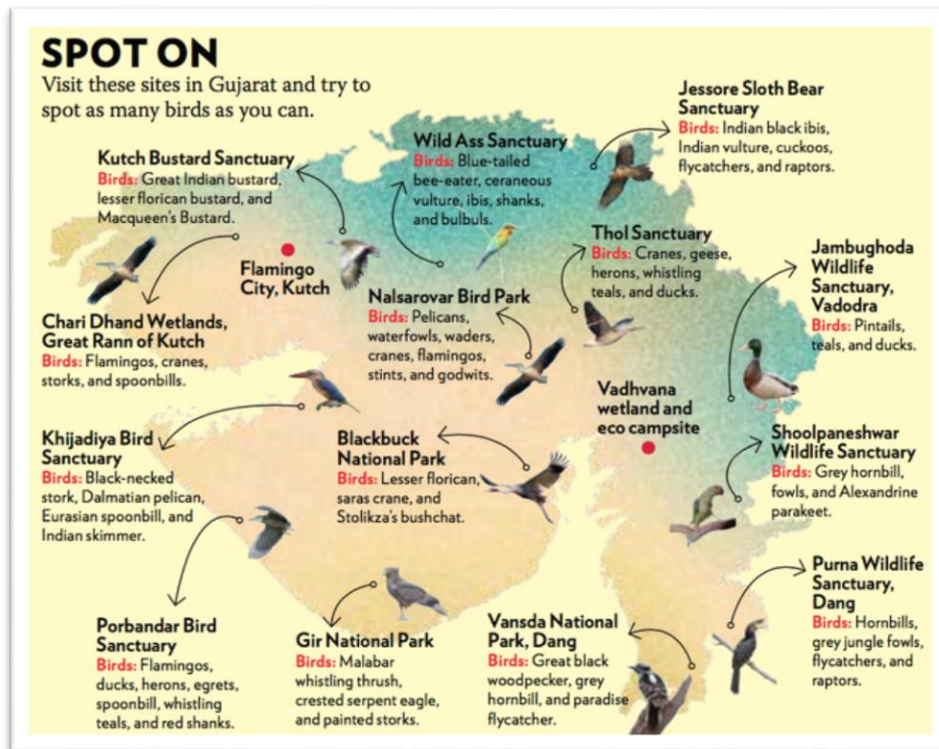
Source: <https://www.cityshor.com/surat/justarrived-watch-seagulls-turning-surtis-this-winter/>

Figure 5: A view of Migratory Birds in Surat

<sup>3</sup> See the <http://journoviews.com> for more information about Surat's migratory birds.

### Migratory Birds in Gujarat:

In addition to Surat, there are a number of sites in Gujarat state where migratory birds visit annually, the details are presented in the following figure.



Source: <https://www.tripoto.com/gujarat/trips/bird-sanctuaries-in-gujarat>

Figure 6: Map showing location of migration and types of migratory birds in Gujarat

### Threats to Birds by urban infrastructure:

Birds are threatened<sup>4</sup> by high rise buildings, communication towers, aircrafts and other human-related activities and structures; estimates vary from about 3.5 to 975 million birds a year are affected in the North America alone. The largest source of human-related bird death is due to glass windows, which kill 100–900 million birds a year. Research shows that 54-76 percent of window collisions are fatal. BirdLife International's 2018 report found that about 40 percent of the world's avian species are in decline, with 13 percent vulnerable or endangered. Birds face threats from habitat loss, pollutants, cats, and climate change in addition to collisions.

<sup>4</sup> See the en.wikipedia.org for more information about Bird Conservation.



Source: <https://abcbirds.org/blog/truth-about-birds-and-glass-collisions/>

Figure 7: Birds collected by Melissa Breyer under the glassy World Trade Center towers from the morning of September 14, 2021 in New York

According to Mr. Smithsonian, a researcher, building storey wise bird collisions can be described as below.

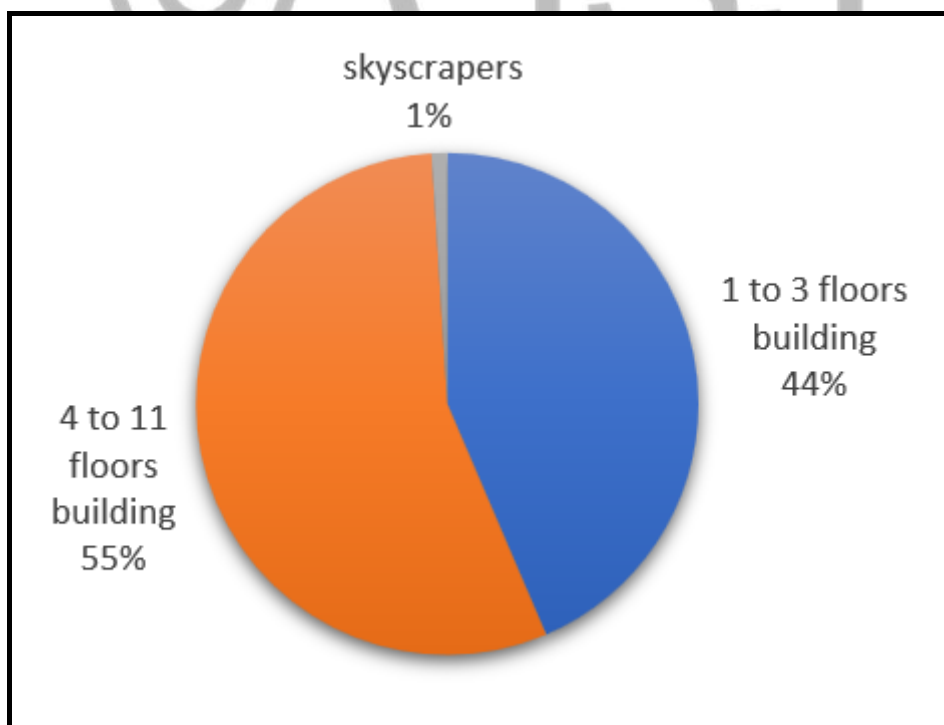


Figure 8: Bird Collisions Building number of floors wise

The pie chart shows the details of number of floors against the bird collisions. It is evident from that the maximum collisions 55% occurred in building of 4 to 11 floored building followed by building of 1 to 3 floors 44% while skyscrapers account for about 1%. It can be inferred that skyscraper have a very

minor impact on the bird collisions, as the birds fly at lower height in search of food, thus low height buildings are found to cause a lot of bird collisions (99%).

Not only birds are beautiful and interesting creatures, but birds also have impact on Nation's economy. The United States Fish and Wildlife Service has reported that birdwatchers contribute \$36 billion (INR 2,74,12,81,200) annually to the United States economy and birds naturally provide billions of dollars-worth of pest control, benefitting farmers and consumers.



Source: <https://audubonportland.org/our-work/rehabilitate-wildlife/being-a-good-wildlife-neighbor/birds-and-windows/>

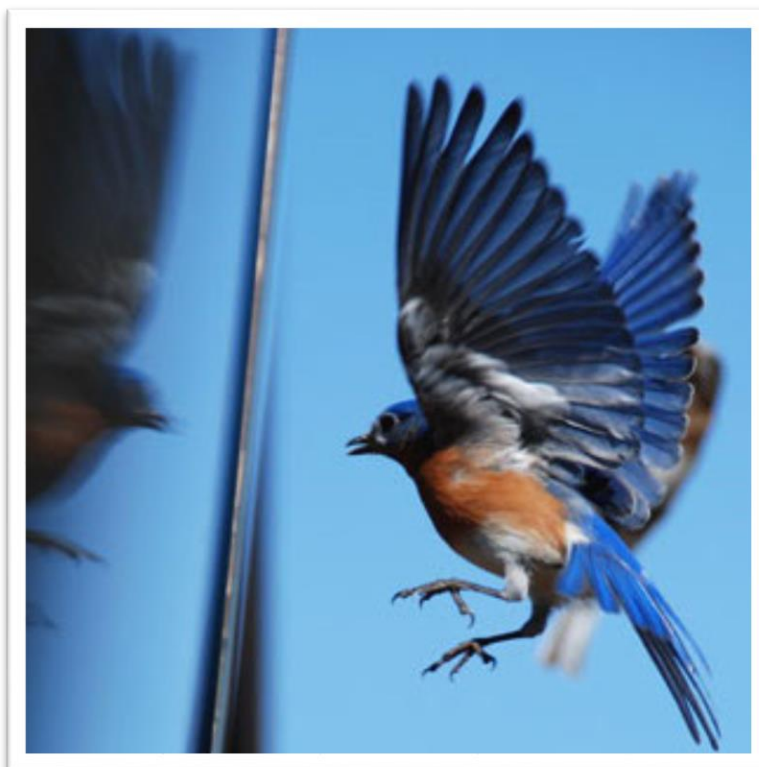
*Figure 9: Imprint of bird collision on a glass surface*

Above photo shows the imprint of the bird on the glass window surface due to collision, it is difficult to imagine the impact of bird collision that is causing their death.

India is constantly expanding at a staggering pace with a huge demand for commercial & residential spaces. In 2021, urban population for India was 35.4%. Due to land scarcity, the cities are growing vertically. There is enough demand for high-rises for both residential and commercial spaces, which increases the risk of collisions of birds. According to the National Audubon Society's Mr. John Rowden, bird collisions increase 19 percent for every 10 percent increase in glass area.

Advanced HVAC (Heating, ventilation, and air conditioning) system is now been a necessary part in newly built buildings. Nowadays, in India most of the commercial buildings are centrally air conditioned. These buildings are made up of heatproof glass which absorbs the heat from sun and regulate the temperature inside the building, hence are dark coloured of with reflecting surface. These glass buildings can be beneficial and aesthetically attractive but it is dangerous for the birds.





Source: <https://howtoconserve.org/2016/03/25/how-to-prevent-bird-window-strikes/>

*Figure 10: Bird attempting to go through the glass*

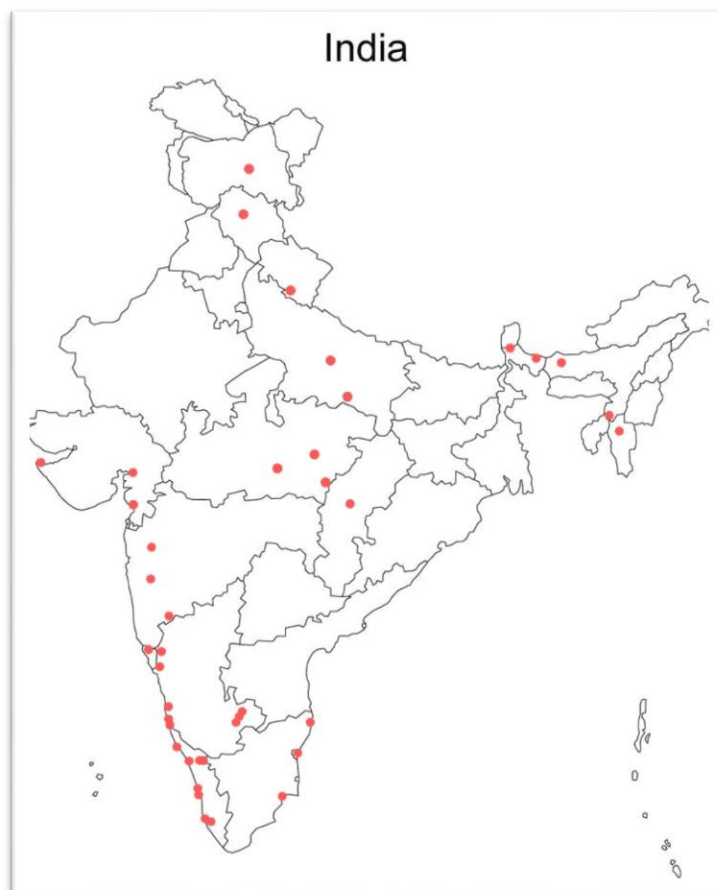
On long-distance migrations, birds don't really look where they are going<sup>5</sup>? And why should they? Large structures above the ground appeared only recently. "Only in the past 100 years have there been these tall structures" says Mr. John P. Swaddle, Professor of Biology College of William and Mary. "There's no reason birds should be looking ahead. Birds evolved to look down for navigation and foraging", he adds. Their eyes sit to the side of their heads and angled down, giving them a field of view below and to the side, not to the front. Some large birds, including a few eagle species, even have a blind spot directly in front of them. Migrating birds also make themselves as aerodynamic as possible when flying long distances, and many migrate in low light conditions where they would have difficulty seeing up ahead anyway.

#### Bird Collision Observed in India:

According to the data collected by Mr. Peeyush Sekhsaria, Mr. Ashwin Viswanathan and an organization ResQ Pune states that there have been 112 observations of bird collisions.

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<sup>5</sup> See [www.pbs.org](http://www.pbs.org) for blog about birds and buildings collision



Source: <https://www.youtube.com/watch?v=tvehENG58Sc>

Figure 11: Bird collision spots across India

It is evident from the above figure that the collisions happened from all over India, mostly along coastal areas with water sources and greenery. The collisions may have taken place because of presence of glazed buildings and history of bird migration at these places. As such there is no particular regional pattern in the observations. It may be seen that 22 of the spots are located in urban settlements on sea coasts immediately after entering the land after migration from sea side, while rest of the 17 spots are mid land settlements with water bodies in the vicinity. Thus it may be noted that the migratory birds encounter glazed building immediately after reaching after reaching land side after migration thus resulting 56% collisions near sea coasts while rest are major midland urban settlements with waterbodies nearby.

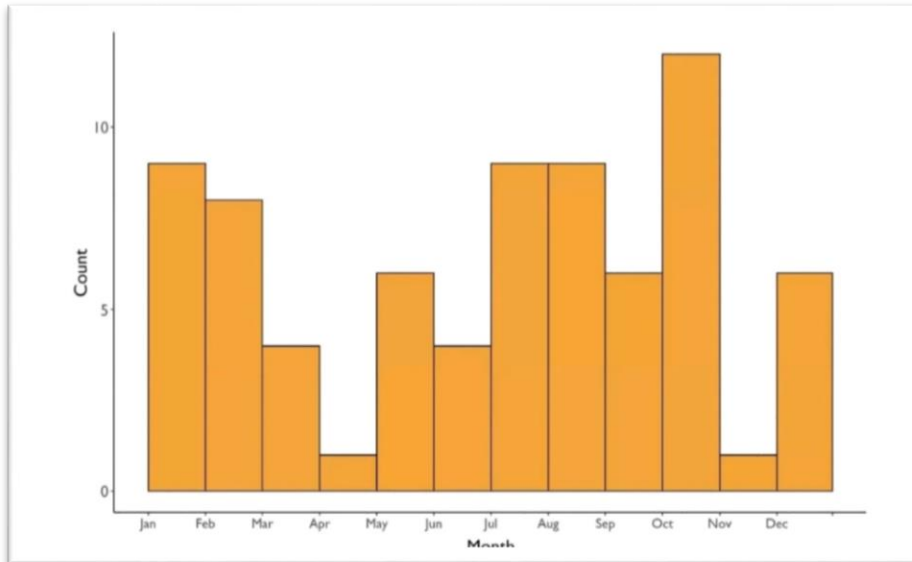
The data for this study is collected with the help of different sources the details are presented in the following Table.

Table 1: Distribution of Bird Collisions according to the source

Sr. No.	Source	Number of collisions
1	Facebook	29
2	iNaturalist	7
3	eBird	35
4	ResQ Pune	11
5	AARC Banglore (Avian and Reptile Rehabilitation Centre)	26
6	Personal Communication	4

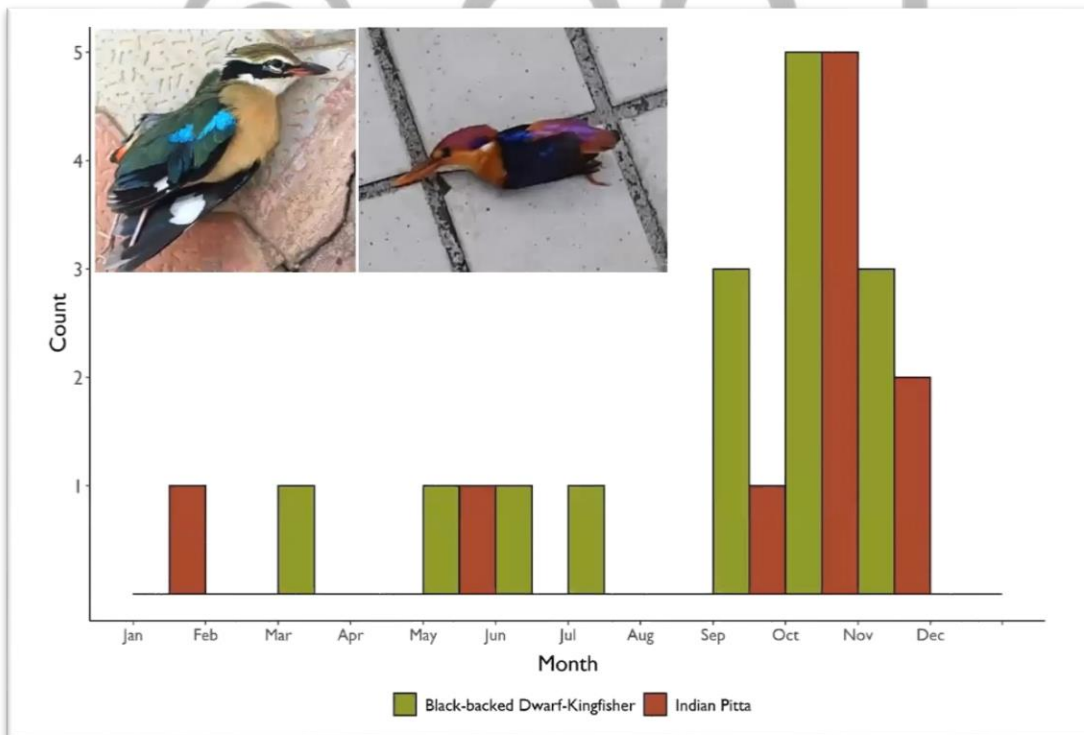
About 51 migratory bird species found in India, only 4% of bird species have been reported to collide with buildings. There are also rare birds like Malayan Night Heron, Long Tailed Broadbill and Rufous-Bellied Eagle in this list.

Most of the collisions in North America and Europe are found to happen during migration whereas in India, there is not such a seasonal pattern other than Black-Backed Dwarf Kingfisher and Indian Pitta.



Source: <https://www.youtube.com/watch?v=tvehENG58Sc>

Figure 12: Month wise observation of all species



Source: <https://www.youtube.com/watch?v=tvehENG58Sc>

Figure 13: Month wise observation of rare species

These observation of two rare species comprises 23% of total 112 collisions (Black-Backed Dwarf Kingfisher=15, Indian Pitta=11). These collisions are most likely to occur during their autumn migration period from September to November. Other major victims include Asian Koel and Asian Emerald Dove which do not show any particular seasonal pattern.

The Green Building Concept is the order of the day, highly discussed across the world today, the Green Buildings are built to mitigate harmful effects to the environment and occupants by consuming less energy and water, reusing resources and by providing excellent indoor quality. A major factor in bird collisions with buildings is the choice of building materials. These choices are usually made by the Architect who may not be aware of this issue. The building on which the bird strike occurred in Surat in fact was a “Green Building”, **if it is not a Bird Friendly Building, then is it okay to call it a “Green Building”?**

### Mitigation Measures:

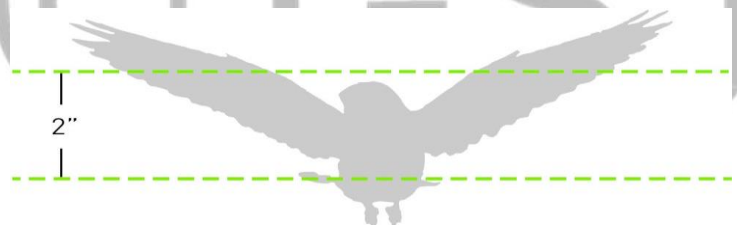
Measures to mitigate bird collisions can be divided into two parts one for new buildings under construction and other old or existing building. The Mitigation measures for each of these building types are discussed below:

- **New building**

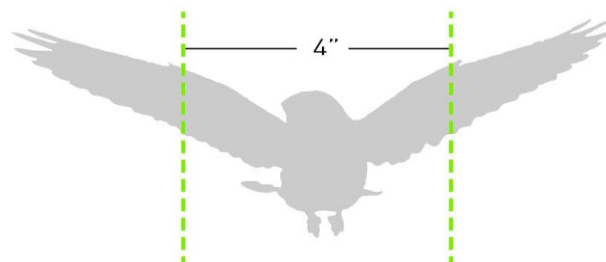
All the below mentioned techniques should be adopted for at least 90% of the exposed facade material from ground level to 40 ft. And at least 60% of exposed façade above 40 ft. should follow the following.

#### *2x4 Rule*

The Acopian Centre for Ornithology at Muhlenberg College and The American Bird Conservancy are leading the research and testing of bird friendly glazing. Their testing has shown that most birds will not attempt to fly through horizontal spaces less than 2” high nor through vertical spaces 4” wide or less. This is widely referred to as the **2”x4” rule**.



Horizontal



Vertical

Source: <https://www.gwwoinc.com/news-insights/designing-for-birds-is-not-just-for-thebirds#:~:text=Their%20testing%20has%20shown%20that,deter%2090%25%20of%20bird%20strikes.>

Figure 14: Origin of 2x4 Rule

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To be effective, the pattern must uniformly cover the entire window and consist of elements of any shape (lines, dots, other geometric figures, etc.) separated by no more than 5 cm (2 inches) if oriented in horizontal rows, or by 10 cm (4 inches) if oriented in vertical columns. These patterns eliminate bird-window collisions when applied to the outer surface of reflective panels, or when applied to any surface of multi-panel see-through windows. Greater spacing between pattern elements increases the risk of a strike. Reducing the spacing between pattern elements retains effective bird-window collision prevention. (As per Canadian Standards Association's *Bird-friendly Building Design (A460:19)* recommends 5 cm (2 inches) spacing between pattern elements, labelling such patterns as following a 2"x2" Rule).

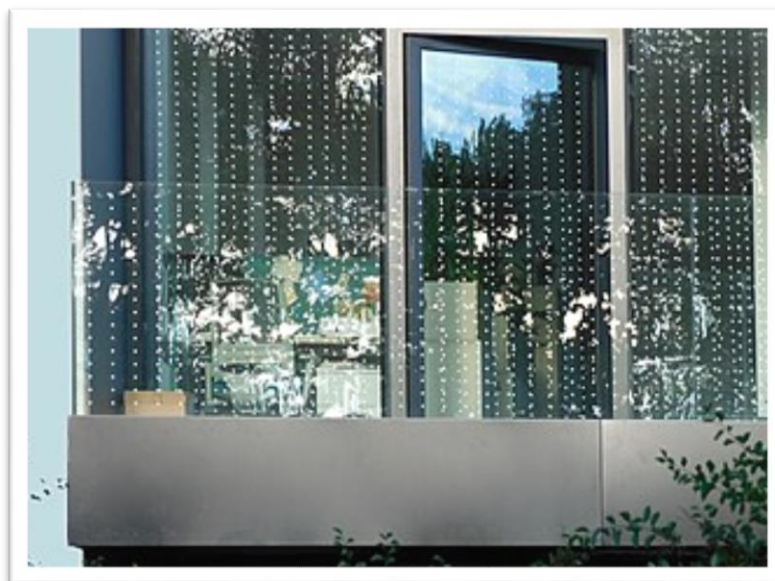
*2"x4" rule and 2"x2" rule measures are adopted by following Acts:*

H.R.919 USA 2019 section 2(a)(iii); Emeryville-2020 Article 8(9-4.804); Oakland, CA, U.S.A. (2013)



Source: <https://www.gwwoinc.com/news-insights/designing-for-birds-is-not-just-for-the-birds#:~:text=Their%20testing%20has%20shown%20that,deter%2090%25%20of%20bird%20strikes.>

*Figure 15: Window glass patterns dots and line as a protective measure against Bird Collisions*



Source: <https://www.gwwoinc.com/news-insights/designing-for-birds-is-not-just-for-the-birds#:~:text=Their%20testing%20has%20shown%20that,deter%2090%25%20of%20bird%20strikes.>

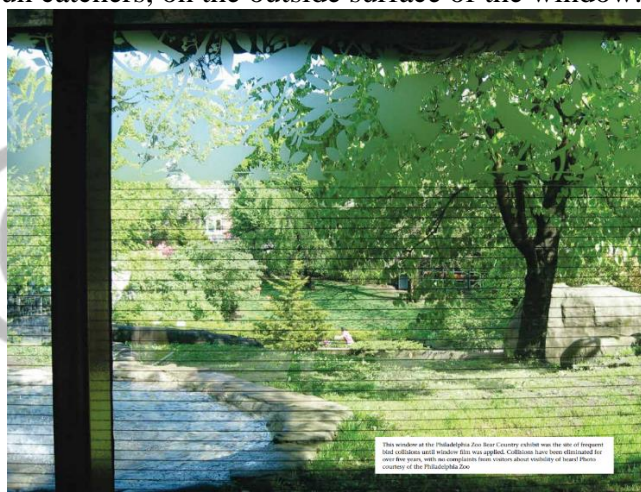
*Figure 16: Line pattern as a protective measure against Bird Collision*



Source: <https://www.haverkamp.de/en/sun-protection-film-technology/architecture/window-films/birdsafe-protection-against-bird-impacts/product/opalfilm-birdsafe>  
*Figure 17: Widows Strips as a protection measure against Bird Collisions*

### Design of Protective Measures:

Put decals, stickers, sun catchers, on the outside surface of the window.



Source: <https://www.conservationevidence.com>  
*Figure 18: Window pattern at Philadelphia Zoo*

- **One-way transparent film:**

Products such as [Collidescape](#) permit people on the inside to see out, but makes the window appear opaque on the outside. They can reduce the amount of light that comes in your window.



Source : <https://www.dreamstime.com/photos-images/gray-frosted-glass-texture.html>  
*Figure 19: Frosted glass*



Source: <https://flexfacades.com/projects/historic-ponce-city-market/>

*Figure 20: Opaque Mirror*

*Collidescape and Opaque glass panel measures are suggested in following act:*

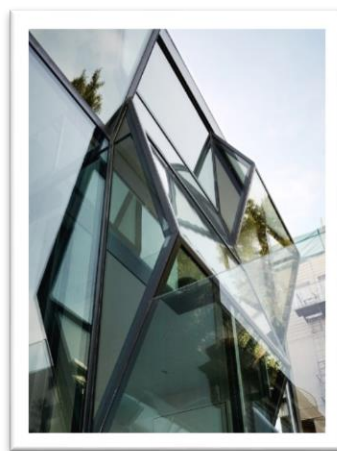
Oakland, CA, U.S.A. (2013); H.R.919 USA 2019 section 2(a)(iv)

#### *Angled Glass:*

Angled Glass In a study comparing bird collisions with vertical panes of glass to those tilted 20 or 40 degrees, the angled glass resulted in less mortality. This was because the glass reflects the ground, not vegetation. Using angled glass has become a common recommendation as a bird-friendly feature. However, while angled glass may be useful in special circumstances, the birds in the study were flying parallel to the ground from nearby feeders, hitting the glass at acute angles, with less force than a perpendicular strike.

*One-way transparent film and Angled Glass measures are adopted in following acts:*

Alameda, CA, U.S.A. (2018) 30-5.16-b-b(vii); Calgary, Alberta, Canada (2011) strategy2-guidline 8; Oakland, CA, U.S.A. (2013)



Source: <https://www.trendir.com/glass-house-zigzags-its-way-into-the-san-francisco-landscape/>

*Figure 21: Angle glass building*

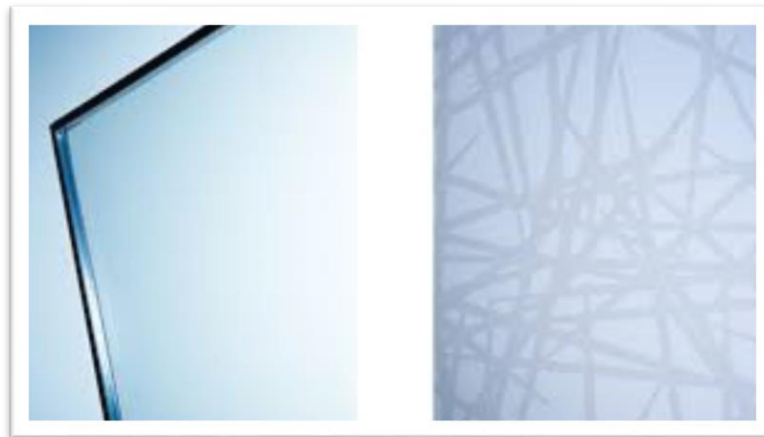
- **Ultraviolet (UV) patterned glass:**

This glass is specialist glass coating that can be applied within almost any glass unit that creates a transparent pattern on glass which is visible to birds.

Various scientific studies have shown that birds have extra sensitivity to UV light and the Ultra Violet Spectrum. Bird Protection Glass uses this and creates a transparent glass unit which contains a patterned, UV reflective coating, visible to birds.

*UV Patterned Glass measures are suggested in following acts:*

H.R.919 USA 2019 section 2(a)(ii), USA; New York city, NY, U.S.A. (2019)-4. Section BC 1403.8.1, exception 2; Alameda, CA, U.S.A. (2018) 30-5.16-b-b(vi); Richmond, CA, U.S.A. (2016) article 15.04.608.030C



Source: <https://phys.org/news/2010-08-bird-friendly-glass-spider-web-birds.html>

*Figure 22: What humans see VS what birds see*

### Measures for existing buildings

Netting, grilles, and shutters are common elements that can make glass windows and facade safe for birds on buildings of small scale. It helps to reduce collisions of bird with mirror/glass.

- **Netting:**

Cover the glass on the outside with netting at least 3 inches from the glass, taut enough to bounce birds off before they hit. Small-mesh netting (around 5/8" or 1.6 cm) is best suited, so that birds don't get their heads or bodies entangled but will bounce off unharmed. You can mount the netting on a frame, which is easy to install and remove.

- **Grills:**

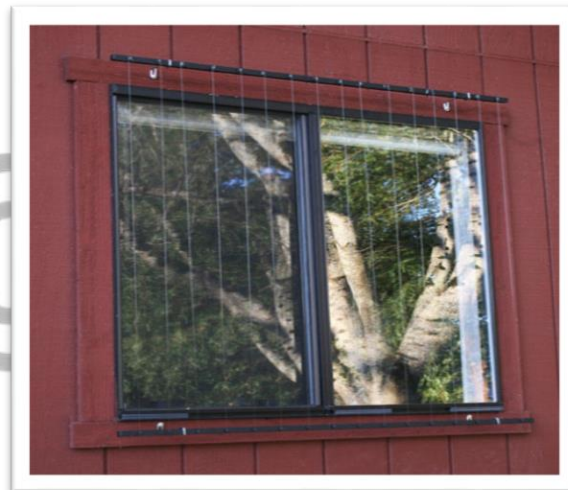
Security window grilles on the outside of the window can appear as a barrier for birds to avoid. For best results, assure that the bars or patterns do not leave gaps greater than 5 cm or 2 inches.





Source: <https://dissolve.com/stock-photo/Red-Shutters-Windows-Building-Lower-Village-Old-royalty-free-image/101-D869-78-144>

*Figure 23: Shutter Window*



Source: <https://mn.audubon.org/conservation/cords-strings-and-ribbons>

*Figure 24: Netting on window*



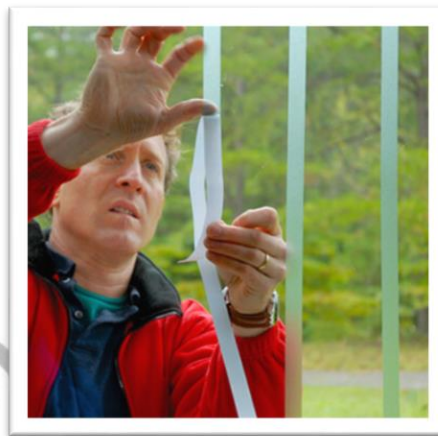
Source: <https://www.exportersindia.com/product-detail/stainless-steel-window-grills-4345604.htm>

*Figure 25: Grills on window*

- **ABC (American Bird Conservancy) Bird Tape:**

Bird Tape is available in 3-inch and three-quarter-inch width rolls. The 3-inch tape is applied in blocks in a variety of patterns, while the thinner tape is applied in parallel strips, normally vertically over the full height of the window. Because it is translucent, the tape lets birds see the glass. It is easily applied and easily removed and lasts up to four years.

Each roll covers up to 15, 24" x 32" windows (depending on application). The cost for a single roll of ¾-inch Bird Tape is \$10.95 (INR 837) and the cost of a roll of the 3-inch tape is \$12.95 (INR 990) or \$14.95 (INR 1,143) for a pre-cut roll.



Source: <https://abcbirds.org/article/new-window-tape-can-significantly-reduce-bird-collisions-at-homes/>

*Figure 26: ABC bird tape on window*

- **Preserving/Rejuvenating Natural habitat**

Our findings show that cities can help migrating birds by preserving their natural habitats like forests, trees, shrubs or creating habitat nearby water bodies by planting more trees, especially for birds migrating during spring and autumn.

Trees, shrubs provide important habitat for migratory birds during migration and the breeding season, so the presence of trees can have a strong effect on the number of migratory bird species that come to cities.

The only reason to move birds from water areas to city is due to lack of trees surrounding the water bodies. Therefore, it is recommended to

- Plant more trees and shrubs near the water bodies or wet lands.
- To prevent bird strikes, plant trees and plants around windows

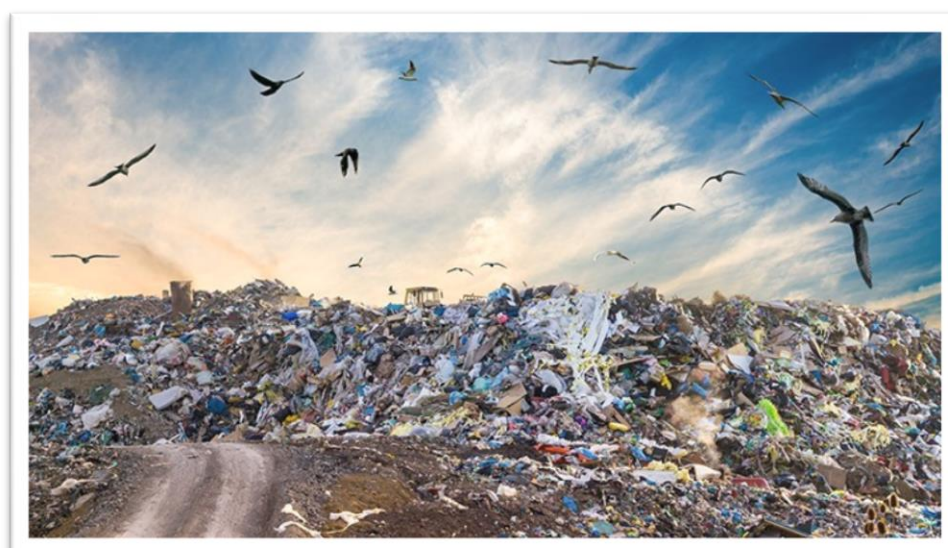


Source: <https://theconversation.com/cities-can-help-migrating-birds-on-their-way-by-planting-more-trees-and-turning-lights-off-at-night-152573>

Figure 27: A view of Migratory bird

• **Handling of food waste:**

Appropriate handling of food waste is encouraged so it is not accessible to, and does not attract, nuisance wildlife such as gulls, crows, ravens, jays, skunks and racoons. Appropriate handling includes provide adequate waste receptacles such as closing lids, emptying them regularly to avoid availability of nuisance species.



Source: [https://www.activesustainability.com/environment/waste-generation-management/?\\_adin=02021864894](https://www.activesustainability.com/environment/waste-generation-management/?_adin=02021864894)

Figure 28: Birds flying over food waste

Surat city does not have this menace, thanks to Surat Municipal Corporation, which has engaged an agency to convert organic waste into compost in 22-24 hours. It works on a pre-programmed controlled operation which reduces extra manpower & cuts 60-70 % of electricity bills. It also comes with an automatic feeding arrangement which helps in unloading of organic waste into machine through input door. Because of these initiatives, Surat Municipal Corporation is ranked No.2 cleanest city in India in 2022 Swaccha Bharat Survekshan conducted by government of India.

Acts promulgated, and followed in other countries regarding waste food handling are given below:

Table 2: Details of Bird Friendly Acts in various countries

Country	Bird friendly Act	Passing year
Canada	Yes	2019
United states	Yes	2019

1. Canadian Standards Association (CSA), Canada (2019)
  - Toronto, Ontario, Canada (2010)
  - Calgary, Alberta, Canada (2011)
  
2. H.R. 919 United States Act (2019), USA
  - Portland, OR, U.S.A. (2012)
  - New York City, NY, U.S.A. (2019)
  - Mountain View, CA, U.S.A. (2017)
  - Emeryville, CA, U.S.A. (2020)
  - Minnesota (State), U.S.A. (2013)
  - Washington, D.C., U.S.A. (2017)
  - ED Credit SSpc 55 Bird Collision Deterrence, version 4 (2015)
  - Madison, WI, U.S.A. (2020)
  - Alameda, CA, U.S.A. (2018)
  - Cook County (unincorporated), IL, U.S.A. (2008)
  - Highland Park, IL, U.S.A. (2020)
  - Calgary, Alberta, Canada (2011)
  - Cook County (unincorporated), IL, U.S.A. (2008)
  - San Francisco (City & County), CA, U.S.A. (2011)
  - Alto, CA, U.S.A. (2015)
  - Richmond, CA, U.S.A. (2016)
  - San Francisco (City & County), CA, U.S.A. (2011)
  - Santa Cruz, CA, U.S.A. (2019)
  - San Jose, CA, U.S.A. (2019)
  - Oakland, CA, U.S.A. (2013)

## Recommendations

In view of increased incidents of bird collisions in India, it is recommended to amend building bylaws incorporating bird friendly buildings norms as adopted in various countries to protect rare and endangered migratory birds and local birds.

### Recommended Methodology to reduce Bird Collisions:

1. Enact act at National/State level.
2. Incorporate rules and regulation those in the building byelaws of all the states and union territories.
3. Enforce the rules and regulation as per the revised Building Bye laws including bird friendly rules and regulations.
4. Bird safe criteria should also be added in Green Building concept. If the Buildings are bird friendly and the facade of the buildings is as per revised building bye laws only Green Building Certificate should be issued to the buildings.
5. Existing buildings should cover them to be bird safe by adopting the following options or a combination of them:
  - a. Layering and recessing surfaces
  - b. Angled faceted glazing that minimizes reflectivity and transparency
  - c. Louvres
  - d. Overhangs and awning
  - e. Glass Block
  - f. Bird netting
  - g. Decorative grills that allow birds to perceive the grills, together with glass behind them, as solid
  - h. Glass embedded with photovoltaic cell

Section to be added in the Building Byelaws of the state /all union territories.

### USE OF BIRD-SAFE BUILDING MATERIALS AND DESIGN FEATURES (As per H.R.919 United State Code "Bill" January 30 2019 of USA)

1. At least 90 percent of the exposed facade material from ground level to 40 feet—
  - a. shall not be composed of glass; or
  - b. shall be composed of glass employing—
    - i. elements that preclude bird collisions without completely obscuring vision, such as secondary facades, netting, screens, shutters, and exterior shades;
    - ii. ultraviolet (UV) patterned glass that contains UV-reflective or contrasting patterns that are visible to birds;
    - iii. patterns on glass designed in accordance with a rule that restricts horizontal spaces to less than 2 inches high and vertical spaces to less than 4 inches wide, commonly referred to as the '2 × 4 rule';
    - iv. opaque, etched, stained, frosted, or translucent glass; or
    - v. any combination of the methods described in this subparagraph.
2. At least 60 percent of the exposed facade material above 40 feet shall meet the standard described in paragraph (1)(a) or (1)(b).

3. There shall not be any transparent passageways or corners
4. All glass adjacent to atria or courtyards containing water features, plants, and other materials attractive to birds shall meet the standard described in paragraph (1)(b).
5. Outside lighting shall be appropriately shielded and minimized subject to security and other mission related requirements.
6. Existing buildings should cover them to be bird safe by adopting the following options or a combination of them:
  - a. Layering and recessing surfaces
  - b. Angled faceted glazing that minimizes reflectivity and transparency
  - c. Louvres
  - d. Overhangs and awning
  - e. Glass Block
  - f. Bird netting
  - g. Decorative grills that allow birds to perceive the grills, together with glass behind them, as solid
  - h. Glass embedded with photovoltaic cell



Surat City Information: <https://en.wikipedia.org/wiki/Surat>

Bird Conservation: [https://en.wikipedia.org/wiki/Bird\\_conservation](https://en.wikipedia.org/wiki/Bird_conservation)

Surat Incident: <https://timesofindia.indiatimes.com/city/surat/surat-bldgs-glass-wall-rings-death-knell-for-rosy-starlings/articleshow/89356695.cms>

Surat's Migratory Birds: <http://journoviews.com/surat-s-gujarat-are-heaven-for-migratory-birds/>

Bird Collision Facts: <https://www.pbs.org/wnet/nature/blog/bird-brained-when-birds-and-buildings-collide/>

<https://abcbirds.org/blog/truth-about-birds-and-glass-collisions/>

Bird collision data in India: <https://www.youtube.com/watch?v=tvehENG58Sc>

Surat Migratory Birds:

<http://journoviews.com/surat-s-gujarat-are-heaven-for-migratory-birds/>

BirdLife International Report (2018):

[https://www.birdlife.org/wp-content/uploads/2021/02/birds\\_and\\_biodiversity\\_targets\\_report.pdf](https://www.birdlife.org/wp-content/uploads/2021/02/birds_and_biodiversity_targets_report.pdf)

- 2"x4" Rule:

<https://www.gwwoinc.com/news-insights/designing-for-birds-is-not-just-for-the-birds>

<https://www.walkerglass.com/the-origin-and-definition-the-2x4-rule/>

- Design <https://abcbirds.org>
- Angled glass: <https://abcbirds.org>
- UV Rays: <https://www.iqglassuk.com/products/bird-protection-glass/s33212/>
- Grills: <https://flap.org/stop-birds-from-hitting-windows/>
- ABC bird tape: <https://abcbirds.org/article/new-window-tape-can-significantly-reduce-bird-collisions-at-homes/>
- Trees: <https://theconversation.com/cities-can-help-migrating-birds-on-their-way-by-planting-more-trees-and-turning-lights-off-at-night-152573>

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*Words used in the paper with meanings:*

**Entangled:** Caught in something else

**Foraging:** To go from place to place searching for things that you can eat or use

**Glazing:** Wall or window, made of glass.

**Ornithology:** The study of birds

**Mortality:** The number of deaths in one period of time or in one place

**Receptacles:** A container for putting something in

**Staggering:** Extremely surprising

**Translucent:** Allowing light to pass through but not transparent

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