Nocturnal Artifact

Section I: Evaluation method of urban areas as potential resources for symbiotic landscape between human, insect and pipistrellus abramus and computational design system of it.

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1.0 - Introduction

The research of Nocturnal Artifact can be considered focused on two main aspects; first the evaluation and identification or urban areas and conditions as potential resources for better developments and secondly their developments into an optimized landscape and integrated design proposal. Through analysis of how the city is planned and developed we can identify sites with potential to be further developed through their surrounding environmental conditions. Typologies of spaces can be identified through Tokyo of where when multiple conditions come together they create potential for successful sites to be developed.
An example of how we can identify these sites proposed through the research of Nocturnal Artifact is through the perspective of the Japanese house bat (Pipistrellus Abramus). The unique perspective provided through animal ethology is so valuable, because of its ability to provide us of complete new perspectives of the city. Especially through the perspective of animals that have adapted as well as the Japanese house bat has to its urban life in Tokyo (Osawa 2016). Where we may see limitations such as rivers as boundaries, animals such as the Japanese Pipistrelle may see them as habitats or highways to move around the city.

As observed in the surveying research of amateur biologist; Takumi Miyamoto (2016) these bats will often be attracted to the most neglected locations such as an underside of an expressway, above a man built canals, or the dark unused banks of rivers. It is often the conditions that make these space unattractive to people such as the lack of light, proximity to water, lack of wind and amount of insects such as mosquitoes are exactly the conditions which will provide bats with potential for their foraging and roosting activities. Through understanding this intricate relationship that exist between the water, plants, insects and the bats, this research is able to identify and understand the behavior which guide the bat to those specific locations. As these conditions such as wind, shade and water come together in these various locations they form natural spaces form throughout the city; as plants are able to grow there in higher numbers than other places, they in turn attract a greater number and diversity of insects among which are the prey of the bat. These spaces outlined are most commonly found around the public parks and more specifically the river banks in the city.
This research developed through Grasshopper a method through which we are able to quantify the site conditions such land usage, green spaces and water sources which allow us to estimate, by measuring these parameters together; the bat “attractiveness” ratio of the area. Once the site identified a design system was developed as a way to incorporate human behavior into the symbiotic landscapes we create. The design however goes beyond simply integrating the biodiversity of the landscape it actually contributes to enhancing said biodiversity in increasing the quality of the landscape for not only the humans but also insects and Japanese house bat within the site.

2.0 - Site selection

The research behind Nocturnal Artifact begins with scanning the city and identifying and selecting these sites with the appropriate conditions to be further developed into natural symbiotic environments. As we use our system to analyze parts of the city that are already attracting the Japanese Pipistrelle we do not analyze elements individually but rather their relationships and ratio to one another. It is those relationships and possible connections between for example the river which might channel the wind in a particular way and the shade of a building through the day that when observed individually may not be considered of great potential but when these elements are brought together that is when they create situations and potential for not only better spaces for users to be designed but also better more natural environments.
Basing ourselves on suggested locations by biologist Keiko Osawa and the surveying data of “bat locations” by amateur biologist Miyamoto Takumi we can begin to identify areas with further potential to be explored; bats living in Tokyo will roost and forage around specific conditions that it needs to sustain itself; conditions such as water sources to drink, bridges for roosting under and green spaces to hunt around are amongst its biggest favorites (Funakoshi 2009).

2.1 - Current site selection method

The current method for site selection was developed from past systems to be able to extract, measure and quantify different land usages and parameters simply from a plan. Rather than having to survey every single location where bats are observed which would be equal to the vast majority of Tokyo this research proposes an easier way to asses a location more simply. From a satellite image our script quantifies based on rgb colour the various existing land usage visible on the picture, doing so we are able to compare the amount and orientation of land usage such as green spaces in relation to water sources as well as identify bridges and other infrastructure.

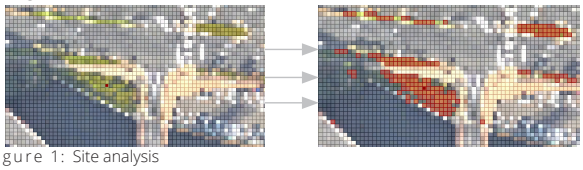

Figure 1: Site analysis

2.2 - Potential sites

While still limited the site selection analysis already allows to identify and analyze different types of typologies that arise from the urban planning of Tokyo around the rivers. We identified for this research three different sites presenting three very different typologies; which although they exist within very different context present similar parameters. These parameters which already attract bats when brought together are believed through our landscape optimization process explored in Section II by Ratnar Sam and the design optimization presented in this paper to be able to be developed into better symbiotic environments for insects animals plants and humans. The three sites presented in this research which were further researched are; Ichigayatamachi, Shin Kounann Bashi and finally Suidobashi.
Suidobashi is an example of how a man made river may come in conflict with the surroundings and treated as a foreign element with which the surroundings do not interact. This was selected as the main site for our case study and development of a prototype proposal as it is a good example of how many conditions which would normally be considered independent from one another such as the expressway, river, bridges and commercial land use can intersect each other within such a small area and together bring the right conditions for a greater potential.

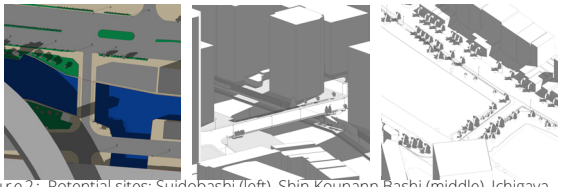

Figure2: Potential sites; Suidobashi (left), Shin Kounann Bashi (middle), Ichigaya-machi (right)

2.3 - Post selection analysis

Once a site has been selected due to having potential with its surrounding elements to be further developed; a more in depth analysis of these influencing parameters is conducted. Elements such as the shade, surrounding temperature, day and night light condition and wind patterns can be considered as results from the master planing of each site; however if properly analyzed and understood these can be brought together through our system to enhance further our symbiotic environment proposal.

- Shade analysis ran on each site allows the simulation to assign plants according to when and how much sun they need throughout the three periods of bat activity from April to October (Kimitake Funakoshi, 2009). This is further explained in Section II by Sam.
- Thermal analysis: Should the plants be allocated the same way we have been doing through our optimization process but also based on the local temperature around the site it would become more efficient to predict their growth and behaviour across the year.
- Illumination analysis post site selection allows us to further understand the impacts of local human behavior on site. The analysis allows us to understand how both sun and artificial light is being received on site. This is important because depending on the type and amount of artificial light; this may have negative effects on both humans animals and insect health. Understanding which types of artificial lights are used and how they illuminate the site and surroundings allows us also to predict insect and animal behavior; the modification of these can drastically change which species use the site and where these are located.

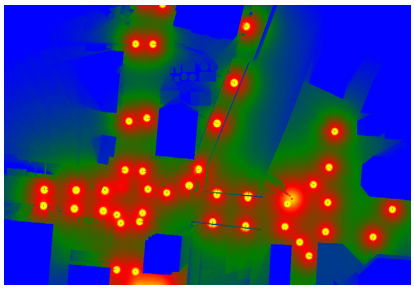

Figure3: Illumination analysis of the Shin Kounann Bashi site at night

- Wind flow analysis is possibly the most important post site selection analysis along with the shade analysis for the development of the landscape. Through the way these areas are developed wind conditions are often highly impacted and modified sometimes by being enhanced while other times they are diminished. Wind flow analysis demonstrates how the surrounding urban conditions to a site such as the gaps between the buildings or the river are able influencing wind behavior by channeling the wind and increasing its velocity on the site. Such simulations are possible by running wind flow analysis based on the monthly wind averages which allow us to determine the most common wind flow tendencies on a site. The importance of wind however is in its ability to influence every single agent within the symbiotic network may it be the plants, insects, bats or humans. However while wind may have positive effect on human behavior it has negative effect on the local insect and bat behaviors which will avoid strong wind areas. However it is because of this ability to influence all aspects of the symbiotic environment that the wind was actually used in the design system so to be harnessed and used in ways to integrate human behavior as well as improve the quality of the symbiotic landscape.

3.0 - Design process

Through wind simulation we were able to identify the main location through which the strongest wind flows were recorded during the monthly wind averages. As a location which the insects would avoid and that would provide users with a comfortable breeze it was decided to be developed into the location people could use. However while this started as the design of a path for people to walk through the site through further research and wind analysis we started to see the potential in harnessing the wind in these locations, through the design system we analyze the wind condition and modify the site topography into gathering more of the wind flowing through the site into said location. Once the wind is gathered we generate a wind tunnel through a grasshopper analysis of the wind flow pattern. The tunnel gathers the wind and through its design allows the wind to increase in velocity within its shape while protecting the outside with even lower wind speeds. This results in comfortable windy conditions within the tunnel for users while lowering wind speeds across the site for better conditions for insect and bat behaviors. As having data and environmental conditions influence each optimization process may it be the landscaping or the design it was important for us to be able to represent the wind behavior directly through the design aesthetic. As such the design process always followed a simple rule to represent the data, the higher the velocity of the wind the denser the vector lines following the trajectory would become. Starting from a direct representation of the flow lines moving through the site the design was developed into an optimization system through grasshopper able to generate a floor pattern based on the wind velocity and direction. The floor optimization was then given a second rule where velocity also decided its 3D angle giving it varying slope angles. In order to rather than just represent the wind data and rather influence and enhance it, a wind tunnel was generated through the wind data in Galapagos. The tunnel was further optimized in Karamba into a bridge shape to allow better wind capture and enhancement. In the end the final design system reflected all the previous iterations aspect in a more efficient manner where the structure was more integrated into the design and surface pattern using the same initial process of representing the velocity and direction of the wind.

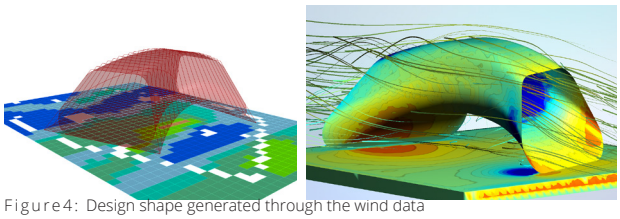

Figure4: Design shape generated through the wind data

3.1 - Structural optimization

As the tunnel design became more complex through the optimization its structure became an issue we needed to resolve. Similarly to the previous process of optimizing the surface of the tunnels we used similar methods to find ways to solve the design structurally through an aggregation structural optimization process. In order to integrate and bring the design and structure more together, we revisited the design from the start; including the actual galapagos and Karamba optimization of the shape of the design made through the wind flow on site. The generating and structural optimization was simplified into a more natural and structural shape. This shape was then optimized and analyzed both through its structural integrity and ability to capture wind in similar ways as the previous design proposal. A metal pipe skeleton is generated from the structural optimization based on the main structural members holding the shape together.

3.2 - Wind optimized surface

The wind pattern based on the flow on the outer surface is used to generate the sides and top of the surface. While the wind flowing into the shape is used to generate the floor pattern inside. This was done so to provide more accurate visualization results as well as better density for the floor for people to walk on. 4 recorded speeds are applied as different patterns for the surface; yellow, green, blue and dark blue. Yellow being the highest and dark blue the lowest wind velocity and surface pressure. This method allowed a smoother and more efficient way to place and adapt the slates to the velocity and direction of the wind. The more subtle change of velocity and direction of the wind can be experienced from any angle inside or outside of the design. The unique wind behavior of the Suidobashi site is reflected through every single aspect of the design from the location and overall shape demonstrating the behavior of the wind moving through the site to the more local behavior of the wind flow expressed through the pattern of the surface. This method of generating the design through an iterative optimization process based on wind behavior naturally generates this natural and organic design.

3.3 - Construction process

The structural optimization metal pipe skeleton previously presented is added to the surface pattern of the timber slates as the main skeleton acting as the primary structure holding the design together. Metal plates are used to connect the timber slates together as the secondary structure which in turn connect back to the main skeleton. As the metal pipe skeleton was generated from the structural optimization of the same design shape as the surface it follows accurately the timber slate surface. The organic nature of the aggregation structural optimization process allows the structure to be naturally integrated into the design process blending together the surface and structure into one system. metal plates are used to connect each timber slate to its neighboring members while steel rods are run through to connect each side to the other. The structure and joints are integrated in ways they do not interfere with the visual aesthetic of the design without necessarily impacting the structural integrity.

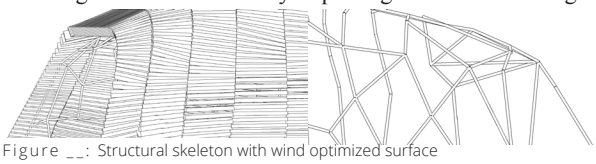

Figure __: Structural skeleton with wind optimized surface

3.5 - Symbiotic outcome

A common aspect in the development of any of the design proposals was that it was important for the design be part of the landscape and natural environment of the site. Of course this meant not only for the design to blend in but also for people to be able to appreciate and see the surrounding nature and of course bats. We therefore made sure to select thin enough timber slates and leave enough space between them for the surface not to block completely a view of the outside but rather through its varying density created from the velocity provide different perspectives of the surroundings depending on the angle and place where people stand.

3.6 - Lighting

While wind played the main role in influencing the design system and optimization it remained important for us that through the design we considered all influencing parameters and impacts from human activity on the symbiotic environment. Due to the behaviour of the bat; the site would naturally become most active and attractive during dusk and the night. However as observed through our experiments and explained by biologist Elena Patricia (2010); pipistrelles foraging as well as their health is disturbed by bright lights and will therefore avoid them when possible. We therefore through our research developed a special light for the site. Using a circuit board designed by amateur biologist Tony Messina we are able to tune a ultrasonic sensor to light up LEDs to turn on when bats are flying in the area. The brightness of the leds is not strong enough to bother the bats and the uv tone (red gradient) doesn't influence the insect behaviors. These lights are organized around the bat foraging areas. These allow visitors to come and enjoy the site at night to see the otherwise too hard to spot bats come together in their nightly foraging.

4.0 - Conclusion

The research presented in this paper builds upon these symbiotic landscapes by adding the ability for humans to become part of this symbiotic environment between plants, insects and bats without any negative impact on its ecology or symbiosis. Wind within such a fragile symbiotic environments play a major role in the behavior of both insects and bats. While being an enjoyable quality by humans during the hot days of summer during which the bat is most active, insects and bats will always avoid the windiest parts of a site. Wind can however be harnessed and controlled through topographical changes and the incorporation of built structures. We are therefore are able by harnessing the wind through a computational optimization generate a design that does not only provide more favorable for bats foraging but also for humans to be part of the symbiotic environment that exist between plants, insects and bats

Finally while the prototype for this system was on only one site we believe that with further resources we believe it would be possible to simplify the process further to generate almost automatically unique designs adapted to each of the locations identified by our system with potential to become better more efficient symbiotic green spaces.

Figure __: Final design outcome with lighting

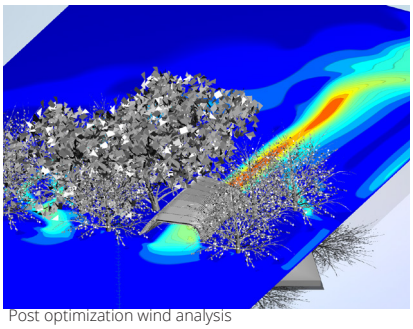

Figure __: Post optimization wind analysis

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