Temporal Environments: From Kites to Site

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Introduction

Flight has long been a source of source of inspiration and study in architecture. Le Corbusier's declaration that "The aircraft is the symbol of the new age", is a powerful statement reflecting the promise that aviation carries across design disciplines. As an architect, Le Corbusier was fascinated with both the aesthetics and function of the airplane, devoting a large part of his book *Aircraft* to their appearance and documenting a wide range of aircraft that had been developed over the first 32 years of powered flight. As a theoretician widely known for his ideas on form and function in architecture, Corbusier was particularly intrigued with the strong correlation between an aircraft's function and its form. And yet, while he saw the invention and rapid development of aircraft as pioneering technology, it was only the latest culmination in centuries of design and the scientific or systematic study of the capacity for human flight. The architectural designer's obsession with aircraft began much earlier with simpler and much more accessible forms, many of which are still being explored today both in flying instruments and representation tools such as the aerial perspective or omni-editorial optics of Buckminster Fuller's dymaxion map.

Fuller's structural and mapping work is a particularly relevant example of this disciplinary exchange between architectural, aeronautical and geographical obsession. His projects both drew on and were informed by many aspects of biomimicry, conceptual art, theoretical mathematics and also merging technology in aviation. The floating Cloud 9 habitats embraced the spatial, structural and imaginative qualities embodied in flight, while many of his other less speculative projects have had direct corollaries with bold and clear geometric and structural concepts, many of which have been explored in kite design for centuries. Long before Buckminster was exploring tensegrity and declaring that the tetrahedron was the basic structural unit of the Universe, Alexander Graham Bell was developing the tetrahedron kite as only the latest of a long line of geometric and structural explorations developed through the evolution of the kite.

This fixation at the intersection of flight and design is the premise for the workshop. The history of the kite is deeply rooted in design, architecture and as the author's discuss in this paper, may also enable a rich discussion of deeper and perhaps a more intuitive mode of contemporary site investigation. With a long legacy tied to both recreation and utility, the kite has been used for communication, scientific study, and as a landscape-scale measurement tool, yet it is the profound benefit of near-instant-flight and design realization - the act of ascending quickly and gracefully from the ground, on nothing but the wind - provided the foundation and inspiration for this short design workshop. Over the course of 14 days, students with a wide range of experience gathered together to explore and re-contextualize the

history, fascination and contemporary potential of kites, flight, site analysis and collaborative immersive design.

Reading the Site

Part of the greater Polynesian region of the Pacific, the archipelago of Hawai'i is one of the last places kites are found before making their relatively late appearance in Europe. Despite being only 10,000KM2, the Hawaiian Islands are home to the world's largest active volcano, the highest sea mountain and one of the few land masses in the world that is growing larger everyday. Its ecology contains 4 out of the 5 Köppen climate zones, providing a major opportunity for architects and designers to learn more about global environmental conditions. This geographical isolation also presents a set of key challenges. The significant distance to other land masses, relatively compact size and densely clustered urban development mean that everything on the islands is intensified and highly pronounced. That particular spatial and cultural situational awareness, and that proxemic embeddedness has led to a legacy of heightened environmental intelligence. Pacific islanders have had to develop extraordinary practices to thrive in otherwise inhospitable ocean territories. The islands were not always the rich paradises of modern convenience we know them to be today. Islanders are renowned for their navigation skills, but they also created ingenious water and agricultural management strategies and technologies in the lands they colonized. They invented and developed many unique technologies to improve living conditions.

Figure 1. Ki'i pohaku (petroglyphs) of kites in Volcano National Park, Hawaii Island. Date unknown. Photo by Donald MacGowan

There is evidence of the use of kites going back nearly a millennia as illustrated in petroglyphs on Hawaii Island. Kites were (and in some cases still are) used to fly out large fishing lures, thereby extending the limited casting range from early fishing equipment. That ancestral knowledge of the coastal ranges around the Hawaiian Islands is pervasive today as well, with a vast local lexicon in the near shore waters and beaches, from surfers to fishermen, sailors to more recreational beach-goers. Language and knowledge of these dynamic systems pervades and transcends much of the island's ecology, society and culture. The microclimates - winds, solar exposure, heat, moisture, humidity - are pronounced and easily perceptible by anyone paying much attention to even subtle variations from one moment to the next.

Mapping on Location

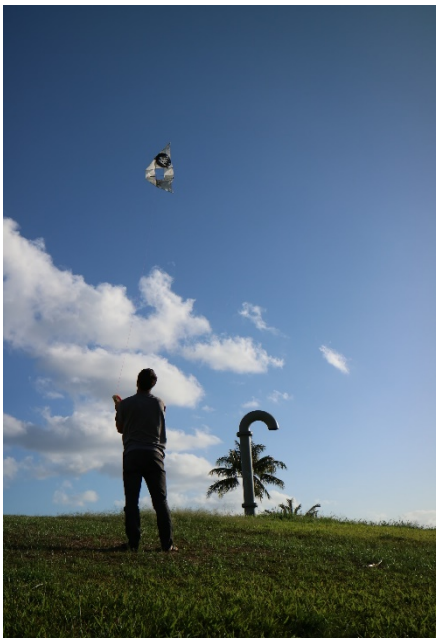

Figure 2. Delta being flown at a high line angle. Hill park site. ***Photo by Author.***

Traditional site observation techniques segregate and confine the many complex layers and conditions of place to singular, static abstract moments. Mapping deliberately constrains the range of possible subjects into focus, which can also restrict the holistic engagement of the broader problem/issue/challenge, and thus limit a fuller comprehension of the place/site. That same ability to scan a space to better comprehend its nature may also feed the false perception of site and place being static, or simply there to receive an imposed object, simultaneously reducing the ability to understand one's synthetic place within it. The inherent nature of data collection isolated from experience is not a given, however. Immersive opportunities can reveal not only a more holistic conception of the environmental conditions of a site, but the interconnectivity and relationships between fluid conditions; each changing and operating across their own boundaries of time.

Using unfamiliar methods of site observation to engage a wide range of interaction with complex site conditions supported a deeper and more pronounced connection to site, space and the evolving conditions of time - many of which are reciprocating and regular, but tied to their own periods and intervals. Students not only engaged with machinery and new modes of time- (the launch of the kite, for example) but the temporal nature of space and environment.

A range of sites was selected for this studio to explore key variations. Four locations on Oahu were used for the design studio: North Shore beach, South Shore beach, South shore hill park and a downtown urban location. Initial ground based observations. The constraints and conditions of each site were carefully evaluated for initial kite design and development. These were updated and compared throughout the studio based on new observations made while flying in them.

In a recent critical essay about common reductive definitions of place and context, Julia Czerniak wrote that "to think about landscape is to think about site." This is a useful point for several reasons, but particularly because the landscape is complex and dynamic, full of richness and nuance, and a *"site"* is all too often oversimplified into strictly economic or political spheres of influence and classification. A parcel of land, a zone for placement of structures, a district for new codes or policies, etc. Her ostensibly obvious suggestion is anything but, in her words, "…for the *potential* of site in landscape design is often overlooked." She outlines this argument in a series of contemporary case-studies and describes the difficulty with which design students and professional tend to approach site. "Most designers quite successfully embrace a site's conventional characteristics, such as its highly valued ecologies, views, and terrain, but only a few creatively address a site's contemporary challenges, such as remediating its brownfields. An even smaller number draw from a site's specific organizational systems, performative agendas, formal languages, material palettes, and signifying content for use when generating landscape design work." She's calling out designers for perpetuating an aesthetics-based or surface-level practice of ornamentation, rooted in private-scale garden design, and amounting

to more of a form of civic decoration than the restorative and ameliorative art and science that it can be when conceived of properly.

FIgure 3 and 4. Box kite being flown on north shore beach site (right) and Delta kite on South Shore (left). ***Photo by Author.***

She problematizes this oversimplified misreading of site, further arguing: "The convention of equating sites with building lots - available parcels bound by legal demarcation is driven by property ownership - as opposed to understanding [sites] as large complex landscapes relational networks of artifacts, and organizations and processes that operate at diverse spatial and temporal scales. Design strategies for a building lot, 0ne scale of site, expand enormously when conceptualized in relation to other, nested scales of reference, like the neighborhood, city, and region of which the site is a part." The case she makes recenters focus away from reductive classifications of the land for the sake of short-term profits, for instance, and instead embraces a more nuanced and refined approach that values the broader connections, larger scales and systems of interrelated networks and reinforces an intuitive understanding of nature.

Our students know innately that built and natural systems are connected. They spend most of their time outside in Hawai'i for a number of very good reasons. They surf and can therefore read subtle patterns in the water. They know the tides, the minute differences in direction or speeds of the wind and how the reefs below shape the direction and velocity of an incoming roller. They possess an intuition about the land. Hawai'i's State Motto: *Ua mau ke ea o ka 'āina i ka pono*, translates to "the life of the land is preserved in righteousness", reflecting a core tenet of Hawaiian culture. It is believed that once a building is built, it becomes inextricably linked to the land or 'aina, which is more accurately defined as *that which feeds*. The built thing is sacred and part of that landscape in perpetuity, connected simultaneously to that place and to all other places. Adding to an historical Germanic variation of the word *landschaft* which that signifies a "unit of human occupation" and more precisely describes landscape as a dynamic system of socio-cultural and ecological interrelations, its etymological counterpart *landskip* reduces landscape to a simple pictographic or scenic view, such as a Roman fresco, or to one of two possible orientations of a picture. "To be landscape then, in all its complexity, designers must consider how a landscape looks: its appearance, image and representational concerns."

The projects briefly discussed here suggest provocative ways to do so - not as second thoughts or after effects, but as early integration and iterative material feedback. A dialog between the kite and the

students occurs, largely modeled as a consequence of a deeper awareness of the peculiarities of the site.

The Workshop

> *"I believe that in the form of structure now attained the properties of strength, lightness and a steady flight have been united in a remarkable degree"*
>
> AGB "Tetrahedral Principle in Kite Structure" in The National Geographic (1903)

The term *kite* refers to the geometric condition of a quadrilateral, a shape seen in the silhouette of oldest and most familiar 'diamond' kites. Many modern kites were developed for utilitarian purposes and with new materials- incorporating cells, modules and complex three dimensional structural systems- and today kite design geometry is as much a spatial exercise as a planar one.

Figure 5. The studio explored four kite typologies, each differentiated by their spatial and structural characteristics. Kite typologies right to left: diamond, box, cellular. **Photo by Author.**

A tightly defined curricular framework for the course was developed to provide opportunities to make parallels between the projects and architectural study during the limited time of the workshop. Dialog with the students about the formal and spatial aspects they were already familiar with from their architectural studies were linked to the functional necessities embedded in functional kites.

Many of the student participants were already adept model builders and they were able to utilize their model making construction skills. At the same time, they were faced with the new challenges brought about by the forces imparted on the kite. At its simplest, a flying kite is being pulled in two directions, and free body diagrams helped illustrate to the students these and other forces as they developed appropriate structural and connection methods.

Figure 6. Box kites were built at a range of scales. Photo by Author.

The students quickly realized that because the surfaces of the kite all receive forces (lift) when flying, the static (not flying) state of the kite can not be used to evaluate the effectiveness of a design. Especially with many larger constructions, many kites are rather flexible and soft while on the ground, but when flown become very rigid. At rest a kite may sag and even be difficult to move by hand (point loaded) but when flying will completely change in both form and strength. The initial response to this by the students was to design very strong static structures, however the implications of constructing a very stiff, rigid structure, especially at larger scales, meant that the weight of the kite would dramatically increase. As they developed their understanding of the design to flight realities of the projects they found new solutions and were able to focus on designing for the flying state instead. We paralleled this with dead and live loads in architectural design, though students also found that there could be significant spatial and geometrical changes between a sitting and a flying kite.

The materials, tools, kite typologies and flying sites were all selected in advance in order to concentrate student explorations on construction, structures and flight control. As the students became more familiar with designing and building the kite structures they were able to start flying them and making changes to alter and attempt to control the flight characteristics of their kites. Simple changes, like moving the bridle point, led to larger changes, such as modifying the sail area, location, adding weight. Through this process they were able to control the kites and fly them according to desired criteria. Adjustments impacted the height, line angle and even the direction from the pilot allowing students to position their projects strategically around the sites, and adapt to the changing environmental conditions and weather over the course of the workshop.

Methodology

The workshop was divided into phases, with subsequent days/phases devoted to construction, site observation and flight testing. During the first phase students worked individually while developing iterations of kites in four categories. After constructing one per instructor provided specifications, they were asked to modify it and then design their own. The majority of this work was done through drawing and physical model making in order to help them develop a tactile sense of the machines they were constructing. In the second week the class was split into two groups, each tasked with designing their own large scale cellular kites. Each team established their own design and flight goals based on earlier explorations and studies, and at this point were encouraged to use design software in conjunction with

drawing and model making skills to support the work. Team one devised a modular system based on the tetrahedron in which small, identical, tetrahedrally shaped components were linked together to form a rigid, space-frame like truss. The second group took a more traditional design approach and focused on developing a complete and comprehensive design based on box kite modules.

Figure 7. Bowed diamond/ Eddie kites on day 2. ***Photo by Author.***

Figure 8, 9, 10. Cellular tetrahedral kite module being tested (Left), assembled (Middle), and flown (Right). ***Photo by Author.***

The studio concluded by taking all of the projects out to one site, and kites were flown throughout the day and into the night with a variety of adjustments and equipment to experiment with. Some were fitted with cameras, and after dark were flown with lights and glow sticks. The students spent all day on site, into the evening, and as the kites performed in various ways - some pure successes, some challenges or failures - were able to observe their work as an index of change-over-time. That dynamic sense of the place and of the architecture of the kites within the place was central to discussion among

students. Many anticipated how the Kites would respond to optimal conditions, but their assumptions were quickly transformed when they encountered the less predictable testing environment.

Conclusion: the correlations between site, object and observation

> *"The bird's eye view… man will make sure of it to conceive new aims. Cities will arise out of their ashes." (Corbu, Aircraft, image 9)*

The design experiments developed in this workshop allowed students to explore a wide range of design skills including site research, materials study, fabrication and assembly techniques. Complexity was established in the design process through the incorporation of many factors, rather than the complexity of singular details. The physical constraints imparted on design in this workshop helped students find the correlations between the physical world and spatiality: aesthetics became tied to physical conditions both in the design of the object itself, and in the environment they were designed for. The speed and cyclical nature of the workshop- designing, flying, redesigning- also encouraged students see the design process as one of constant development, testing and refinement. Students gained analog and digital fabrication skills tied to machines subject to real world forces and that must function and operate (as opposed to model building and structural/operational speculation). Parametric design tools utilized in the development of the kite systems (geometry).

Essential for its operation, the anchoring of a kite to the ground provides a firm, uniquely tangible connection between the site, the operator and (most often) the designer. In using the kite to explore the unique urban and rural environments of Hawaii, it became an integral component of landscape's conception and subsequent formation. As discussed, many of the local student participants already had a innate and heightened sense of many of the environmental conditions that the kites engaged, both subtle and pronounced - wind, sun, water, topography, etc. Those often overlooked or invisible ecological forces are already part of local students vocabularies, having grown up in a place with such a strong connection to the sea, and such a distinct set of environmental issues. Through an immersive and experiential grounding to materiality, context and design process, the participants of the workshop were able to leverage this intuitive knowledge and also help the design students re-contextualize it within a specific set of architectural and landscape constraints. Through a deliberate combination of the creative and the technical, participants were simultaneously exposed to the dynamic environment, foundational principles of design thinking and a renewed interest in the broader project of making.

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