

ACKNOWLEDGMENTS:

THIS THESIS PROJECT IS DEDICATED TO MY WIFE ZEZE FOR ALL HER HARD WORK AND SUPPORT IN HELPING ME ACHIEVE A MASTERS DEGREE IN ARCHITECTURE. IT WOULD NOT HAVE BEEN POSSIBLE WITHOUT YOU.

I WOULD ALSO LIKE TO THANK MY DAUGHTER, ALESSANDRA, FOR JUST BEING YOU. SPECIAL THANKS TO MY PARENTS AND GRANDPARENTS FOR HELPING MAKE THIS HAPPEN.

I LOVE YOU ALL,
ROBERT

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ABSTRACT

Eco travel and eco lodging are growing in popularity among travelers today, with this comes an opportunity for architects to design and build sustainable projects for the people that visit these often times fragile environments. People can fall in love with an areas natural beauty only to see the areas beauty taken away from through poor development. This thesis will look at maintaining and even enhancing a coastal area in a foreign country. Designing and building in a foreign country poses several challenges from language, to zoning and administrative procedures, etc., yet at the same time provides a bevy of unique opportunities from materials that are distinctive to a particular area of the world, local construction techniques, available land, etc. This thesis will endeavor to comprehend how to utilize solar and wind to design an ecologically sustainable kiteboarding resort on the coast in Brazil for the purpose of relaxing and enjoying life. The design will make every effort to utilize techniques that foster harmony with the land as well as the local economy. Brazil is not an easy place for a foreigner with no experience to set up a business, so effort will be made to try to find and examine potential land mines along the road to setting up a successful business that would be able to: design, purchase land, develop upon the land, effectively work with a crew to construct the project, sell/market, then finally have a stake in the management of the resort.



THESIS PAPER

Eco-resorts are popping up all over the world in remote locations with pristine natural conditions, yet the natural conditions of the site are rarely used in the construction of these resorts by the architect/designer. The chosen site of this thesis is located on the northeast coast of Brazil, about three degrees below the equator in a small, quickly growing town of Cumbuco, Ceara, Brazil. Cumbuco was chosen because it is a world renowned kiteboarding location based on its warm water, miles of open beach, and constant wind. Cumbuco is a favorite area for Brazilians and for many Europeans, as there are direct flights from Europe to Fortaleza, Ceara. This thesis project will investigate building materials and program a kiteboarding eco-resort in Cumbuco using the site for: construction materials, job creation, and energy production. Only about fifteen to twenty percent of the site will be developed with structures and the rest will be devoted to plantings. The site will produce food for consumption. Kite wind turbines and photo voltaic panels will gather electricity. The amount of generated electricity will have a direct effect on the amount of structures allowed on the site. The site will not contain more structures than can be accounted for in the production of electricity.

The thesis project will be an example of how to incorporate and utilize the assets the site provides that are typically not used in designing an eco lodge. Hitesh Mehta a former landscape architect states in his book *Authentic Ecolodges*:

“After ten years of research, interviews with architects, eco-consultants, developers, operators, many indigenous communities, and feedback from stakeholders in the ecotourism industry, I developed the following definition: An ecolodge is a two- to seventy-five room, low impact, nature based, financially sustainable accommodation facility that helps protect sensitive neighboring areas; involves and helps benefit local communities; offers tourists and interpretive and interactive participatory experience; provides a spiritual communion with nature and culture; and is planned, designed constructed, and operated in an environmentally and socially sensitive nature” (Mehta 10).

Most books use the term eco lodge and eco resort interchangeably. For instance in *Jungle Luxe* the Daintree “Eco Lodge” on page 124 is referred to on the next page as a “resort.”

Eco tourism is a form of tourism where tourists may stay at eco resorts because tourists are interested in experiencing nature. The eco resort is opposite of a typical American chain type of hotel. For example, in a chain establishment individuals crave similarity, or a connection to the establishment of lodging, in the form of one stay is essentially the same as any other stay at the chain lodging. Conversely, individuals in contemporary times are choosing to travel a bit more off the beaten path to places that offer things that are unique to the site and will not be the same experiences, with an expected pattern of similarity like in a chain hotel. Justin Henderson the author of *Jungle Luxe* states on page eleven when delving into the idea:

There are other key distinctions between conventional lodging and the concept eco-lodges.

To a large extent, in conventional lodging the standard of excellence is a predictable, uniform experience-the philosophy that ‘the best surprise is no surprise’ promoted by chain hotels and restaurants. Eco lodges, on the other hand, celebrate diversity, and the goal for guests is discovery and enlightenment, and all manner of personal challenge-intellectual, physical, cultural, and even spiritual. This embrace of diversity represents a positive evolution toward a higher consciousness (Henderson 11).

Eco resorts offer an escape or adventure, so that tourists can return to life after their vacation, revived and refreshed because experiences at an eco lodge invigorate one on many levels. Chain hotels are built with standard materials in a copycat fashion to economize on costs and to maximize profitability; this paper will examine how to use materials from the site with non typical construction techniques creating a low impact upon the land in creation of the eco resort.

Kiteboarding will be a key programming aspect of the project but, because there needs to be more programming than just kiteboarding at the site to keep families or groups of people entertained, kiteboarding will not be the sole attraction. Kiteboarding is a physically demanding adventure sport, so it is easy to assume that everyone that visits the site will not kiteboard. The project will need more for a family or group of people to do in the form of onsite entertainment at the eco resort to be an attractive option for people to reside at for several days or weeks at a time. Some options being considered are a diving school, cooking classes, zipline rides, gardening classes, kiteboard and kite building classes, hiking, bike riding, sailing, day trips, capioera, and fishing to name a few. To entertain those that do not want to take part in kiteboarding other activities will be offered so that everyone can find something to do.

Generally, it is difficult to reconcile calling the resort “ecologically” sustainable because of the airline fuel required to bring people to the site. This thesis will focus on being sustainable

within the site. This being acknowledged though, there is still a need for the eco resort in Cumbuco because if low impact architecture is not implemented in Cumbuco the area will surely develop with larger resorts. The chosen site for this thesis is actually owned by a group from Spain with intentions of a 1,400 room resort. The area is growing and will continue to expand as Cumbuco is in close proximity to a major city. The most desirable aspect of this area of Brazil is a world famous kiteboarding coast that will surely gain more of the world's attention with the "World Cup in 2014 and the Olympics in 2016 coming to Brazil" (Hurley). The chosen site is next to a large sprawling chain resort of approximately 500 units, The Villa Gale. The Villa Gale consists of several structures that are laid out orthogonally with no regard for sun and wind patterns. The materials chosen for the 500 unit resort have no direct correlation to the Cumbuco site as materials were not produced on the site. Yet they are called an eco resort.

Precedent studies that were looked at for this project were in close proximity to the ocean and sand. However, none of the studies used sand as a construction material. An eco resort in Bora Bora does use the ocean for cooling. Wind is also present next to the ocean in predictable amounts and directions, though typical eco lodges on the ocean will have another form of cooling that needs generated electricity to operate. In Pakistan, a precedent study in Hyderabad Sind demonstrates how wind can be incorporated in the architecture to provide cooling that is ecologically sustainable:

From April to June, temperatures range above 120 degrees F, lowered by an afternoon breeze to a pleasant 95 degrees. To channel wind into every building 'bad-gir,' windscopes are installed on the roofs, one to each room. Since the wind always blows from the same direction, the position of the wind scopes is permanently fixed (Rudofsky 113).

This technology for cooling in West Pakistan has been used for over five hundred years. By

looking at what the site has to provide naturally, then incorporating materials from the site into the construction and design process one can provide the most environmentally sound project. Wind is a driving force for the eco resort in Cumbuco because wind is constant and predictable. Fortaleza already has large wind turbines on the ocean placed directly on the water front. For this eco resort, wind gathering systems are envisioned off of the water in an effort to open up the water for the guests. Wind turbines invented in California by Doug Selsam are desirable and appropriate to the project (Selsam). The type of wind turbine would be attached to a helium balloon, in essence, that has wind turbines connected to the line anchoring the helium balloon to the ground. The helium balloon could easily be changed from its designed shape that resembles a blimp to the shape of a large kite on this project. By changing the shape to make it resemble a kite it would be used as advertising alerting passersby of the site. Instead of a large billboard or sign the eco resort would be noticeably marked at a distance as a site with a large kite flying in the air, yet on closer inspection one would notice the wind turbines attached to the balloon that will be responsible for producing more electricity than the site will require. Combining ideas of the past, such as using the wind to the site's advantage like in Pakistan, and technologies of the present, for example in the form of the wind turbines, will be a reoccurring theme with the eco resort.

Furthermore, a combining of bamboo and carbon fiber are to be experimented with in the thesis. The reasons for combining these particular materials are based off of research on several fronts. One is part of the programming of the project will include manufacturing of the boards and kites used for kiteboarding. A key element in manufacturing the boards is carbon fiber. For constructing the kiteboards a series of videos by Brokite proved to be a valuable resource (Hansen. , Hartung. Brokite). The carbon fiber provides strength, durability, and flexibility, all while maintaining a light weight to the board. Lightweight strength, durability, and flexibility are

all attractive aspects of a board riders are looking for. By using slicing techniques a board is cut into five stringer sections, then each section is wrapped with an individual piece of carbon fiber. There is a large amount of carbon fiber placed in an individual board; this is allowed using a technique of cutting the board to accept the carbon fiber. In addition with the carbon fiber on the site for the board construction, will be bamboo, which grows rather easily in Brazil. There are one hundred thirty seven types of bamboo in Brazil (guadaubamboo.com). “Bamboo is not a tree, but a grass that may attain a height of eighty feet” (Rudofsky 126). Because bamboo is like a grass in the sense that it grows very fast, bamboo must be grown and harvested responsibly on the site because it will not be allowed to take over more space than is predetermined for construction purposes.

Programming will take care of how the bamboo will be grown, harvested, and used for construction. Bamboo will be grown for specific purposes, for example bamboo grown in phase one will be used for construction in phase two. Bamboo loses strength for construction purposes after twelve years, so bamboo will be programmed not to be left to grow over twelve years. Bamboo has many uses from food to structures and will be used as such on the project. Plantings and landscaping on the site will take up the majority of the site’s space. Plants that are native to the region such as pineapples and cashews will be grown and used on site for the guest’s consumption in the restaurants. Other plants, that will occupy a large area of the property that are not native to Brazil, will be grown on site because the chosen plants have a history of doing well in Brazil’s climate such as coconuts and banana trees (tradewind.com). Through programming only about fifteen to twenty percent of the site will be developed with actual structures. The site will maintain a natural undeveloped vibe away from the lodging and beach. The site will be constructed in a way to economize impacts of development and construction.

For example if sand must be excavated for a structure, then excavated sand will be used in construction in the form of an earth bag retaining wall. By producing building materials on the site and using what already exists, the site will be programmed through a controlled phasing of development to be able to build with what exists.

The first phase of development will consist of:

- producing more power than is necessary for the site
- the kiteboarding school
- lodging that is retractable over the ocean
- a restaurant
- security huts
- roughly twenty five percent of the manufacturing on site that produces the boards, kites, and sand bags
- approximately thirty five percent of the landscaping
- family friendly activities

The eco resort will lead by example in phase one, by producing more electricity than it needs with the installation of self launching, self flying wind gathering kite turbines. More kite turbines will be installed then the eco resort needs upfront. In a simple gesture; the eco resort will show all of the other “eco lodges” what can be through the power of designing with the natural elements and technology combined.

Another interesting design component to be developed in phase one will take place

on the security huts. Technology will be infused with the onsite manufacturing and onsite available natural materials. The security huts will be constructed out of sand bags. That is a simplification of what the security huts will be, but the huts will be constructed using bags filled with a sand cement mix allowing for the structures to be built not of bricks that would have to be hauled to the site. “The essential material in building with bags is, of course, the bags themselves. Most commonly the bags used are made of polypropylene or burlap” (Kennedy). Burlap was considered for the project, but polypropylene is more similar in nature to kite material. The sand bags will be coated with a two part stucco finish that is typical to Brazilian vernacular only there will be some twists as to the coloring and texture of the stucco finishes that have already taken place in the first half of the thesis year (Chesnut, Patel p202).

Phases two and three will expand upon what is laid out in the first phase of the development. More lodging will be added for guests to stay in. The lodging will be added when more people stay there and the lodging becomes well known. Lodging will stop at around seventy five units. Residential sites will be made available for purchase after some time has been allowed for landscaping and infrastructure to be in place. Bamboo will not be available for construction purposes for at least three years, but will be grown on the residential sites for purposes of constructing the residences. Two more restaurants will be added to accommodate the added guests and residents. The landscaping will be totally installed within ten years and need to be maintained fulltime by workers employed at the eco resort. The plantings will produce food for the site as well as activities such as hiking and gardening for the guests to enjoy. The manufacturing will be running at one hundred percent creating boards and kites for guests and non guests. The resort will be allowed to develop as materials for construction are available on the site.

This thesis project started out to be an ecologically sustainable kiteboarding resort and has now evolved into an eco resort/residence. The process began looking at kiteboard construction involving boards and kites. This led to research and a series of studies and investigations in materiality. At the beginning of the process eco tourism/lodging was investigated, leading to discoveries in lodging above the water, and ways of gathering wind or water for cooling. The process was also open to construction materials. Combining materials that could be assembled on the site, such as a fabric that could be formed using sand as building materials, would be quite advantageous because it would address several of the design goals set forth to achieving an eco resort/residence. Goals that are to attempt to be achieved are: designing with buildings on only fifteen percent of the land, provide jobs, respect to energy usage and consumption, direct community involvement, and profitability. Through these principles this project will attempt to be what a chain lodge is not.

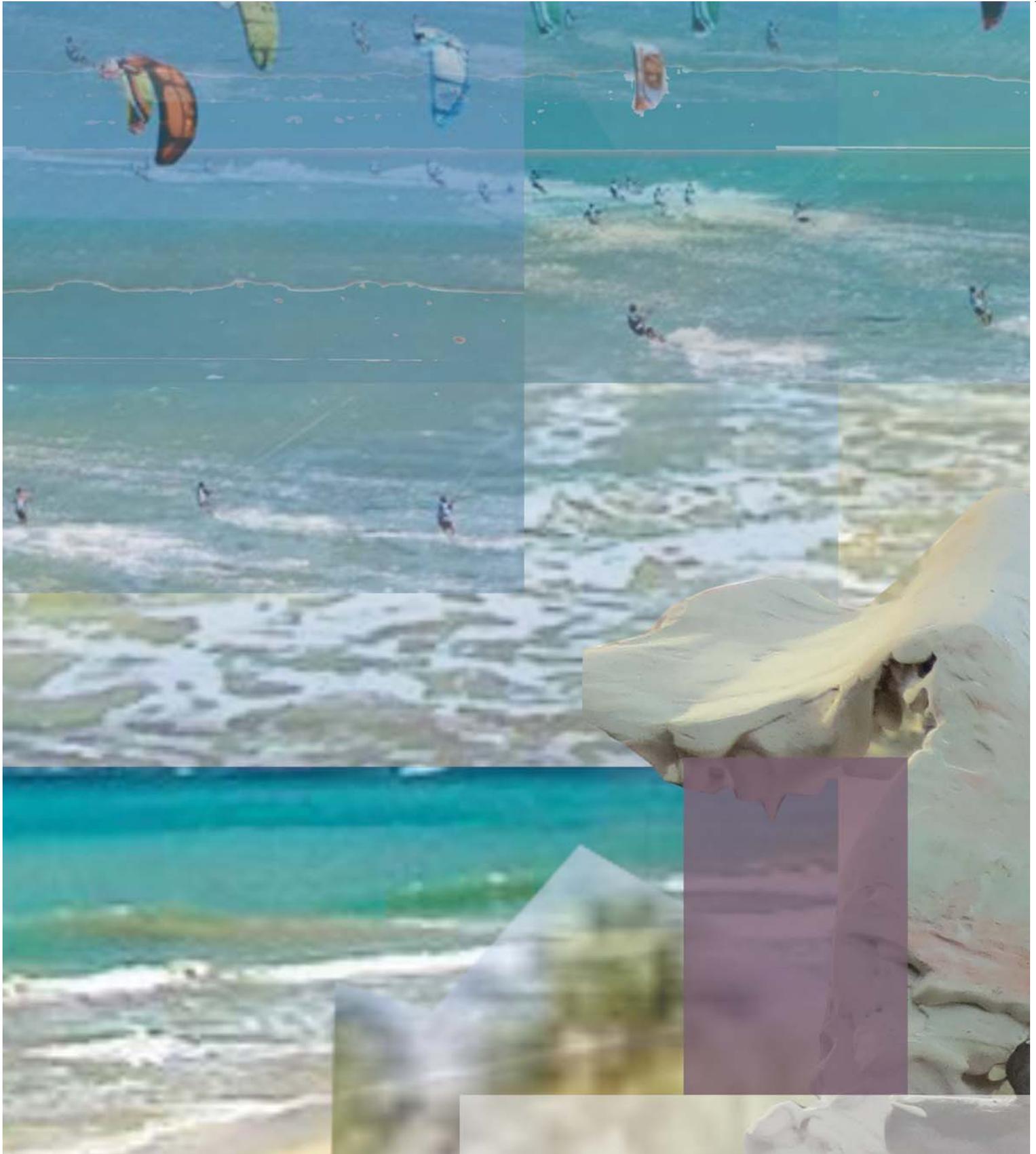
Speculative builders and developers construct the majority of tropical resorts; eco-tourist accommodations is produced by an uncoordinated industry; and little real research is carried out and even less acquired knowledge is passed on. Very little effort (if any at all) is related to the important design criteria and considerations such as climate aspect, ventilation, insulation, or specific needs related to different uses. Most resorts are poorly sited and poorly designed to cope with the climactic conditions of the tropics. Generally, effort is spent on style, features, frills, and extras, without any understanding of the actual tropical design requirements (Bromberek 93).

One distinct difference of this design and a typical accommodation is the limited amount of land to be developed with structures. Instead of building places to stay for the night from one end of the property to the other end, this project is attempting to limit the structures' impact on the land.

This project will also produce more energy than needed using what the site is giving naturally infused with technology in the form of wind and solar. Technology will be explored in the process, as the component of the thesis to be examined in the greatest detail, with the construction of the floatable retractable architecture and the sand bag construction. Construction of the two contrasting types of architecture, one that can float, and one that is buried in a sand dune may have more in common than one may realize before all is said and done in this thesis process. Bamboo, sand, carbon fiber, fabric, and other materials may be used in both of these types of construction at the end of this process. Further investigations into the construction process will be conducted to determine if this is possible or not. As architects there is a responsibility to the land, often ignored for the sake of the almighty dollar, this project is examining a route that will make an effort at making the land useful in several fronts, creating a responsible architecture.

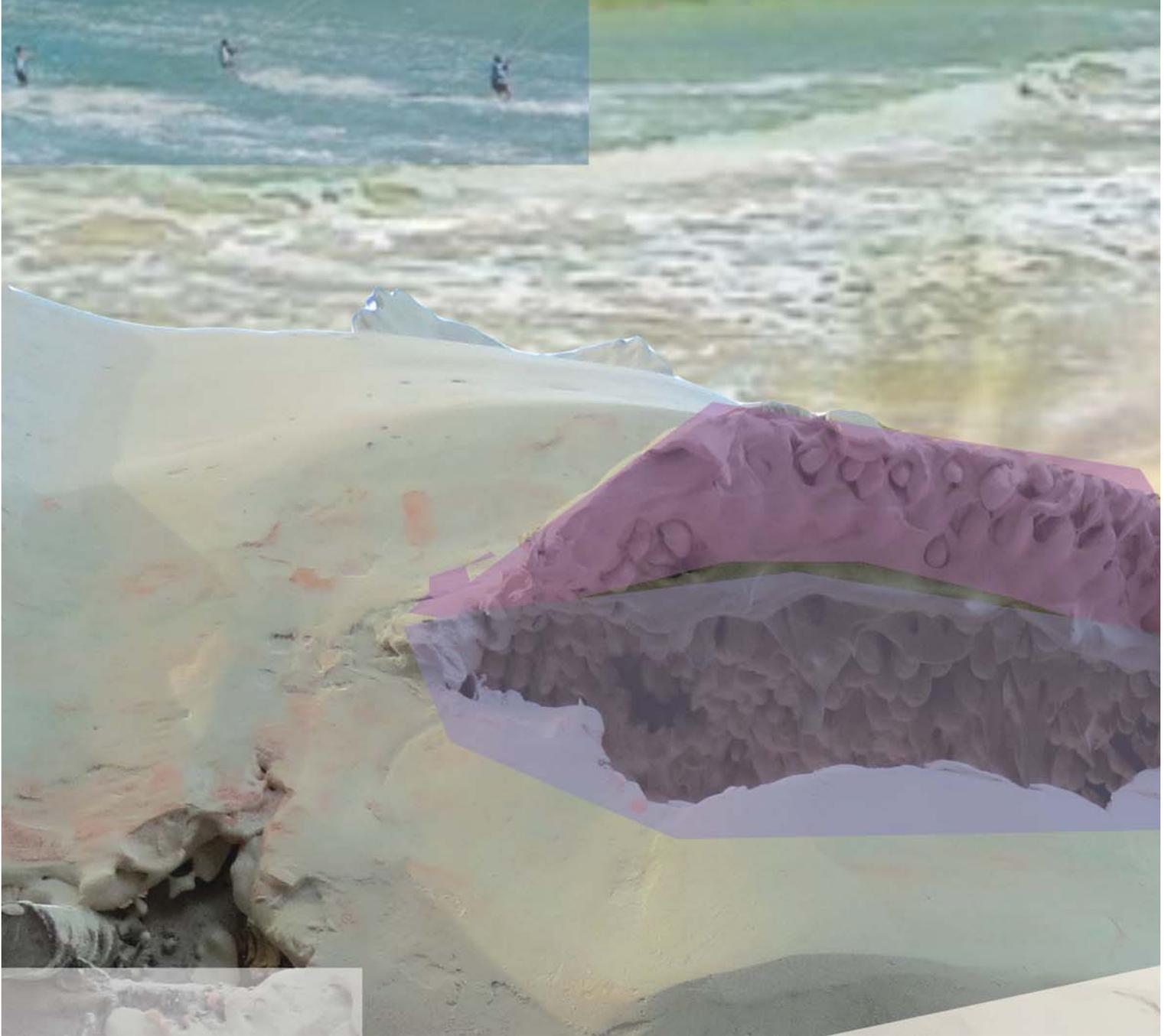
Project

This project is an eco resort on the coast in Cumbuco, Brazil, Ceara with the intent of being a world class kiteboarding destination where kiteboarders from around the world will come to enjoy the beauty of Brazil along the coast of the Atlantic Ocean. The project will endeavor to make boards and kites at the site. Manufacturing of boards and kites will be one way to create jobs at the site. Other jobs will be created through construction at the site and landscaping. The resort will require workers for guest services such as food, maintenance, housekeeping, managerial, etc. Another goal of the project aside from job creation is electricity creation in the form of wind turbines and solar photo voltaic panels. The project has as a goal to be off the electrical grid and produce all the necessary electricity on site for the project.





Model in Cumbuco site.

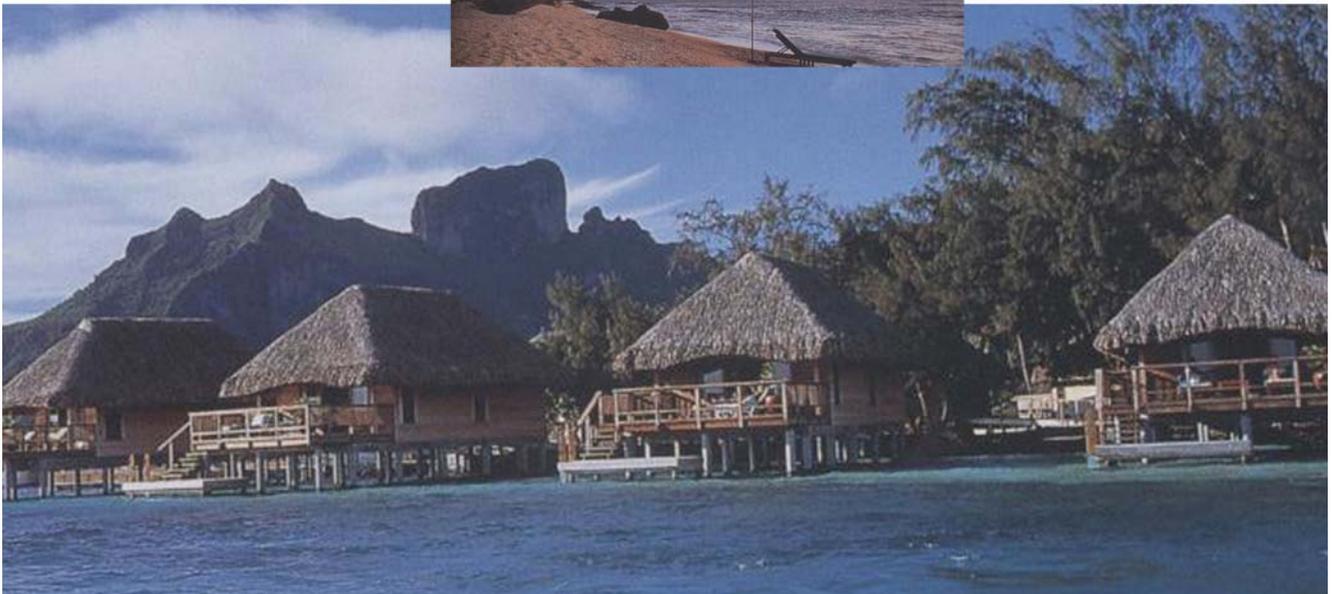


Models of several forms for resort architecture.



Precedent Studies

**Resort in Fiji, Namale Resort.
(p 128 Henderson) Top.
Eco-resort in Bora Bora
(p118) Below.**



Precedent studies investigated resorts located in French Polynesia, Hyderabad Sind West Pakistan, and Jamaica, West Indies. The studies were investigated because of their involvement or interaction with nature. Hotel Bora Bora located in Bora Bora, French Polynesia is “Small in scale, low in rise, nestled quietly among trees, along a beach, even over water, the hotels appear magically in tune with their sites. (Henderson p118).” Whereas Hyderabad Sind’s site uses innovative ways to cool their structures gathering wind as the people of the region for generations. “Although the origin of this contraption is unknown, it has been in use for at least five hundred years (Rudofsky p113).”

Precedent Studies Hotel Bora Bora



Hotel Bora Bora
(p119 Henderson)

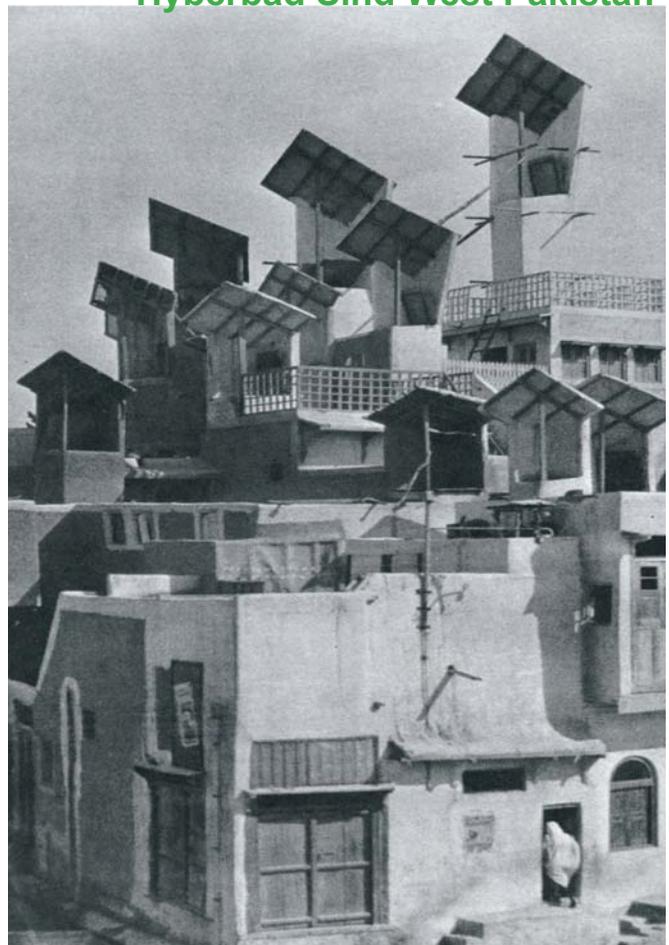
Hyderabad Sind is an example of a successful vernacular technique using the wind for cooling. The people of this area did not need a weather person to know which way the wind blows and have incorporated angled roof apparatus' to cool their structures. "To channel the wind into every building, 'bag-gir,' windscoops, are installed on the roofs, one to each room. Since the wind always blows from the same direction the position of the windscoops is permanently fixed. In multi storied houses they reach all the way down, doubling as intramural telephones (Rudofsky p114)."

Using the wind for several purposes makes sense if it is there just waiting to be used. With the windscoops in Hyderabad Sind temperatures are lowered dramatically. "From April to June, temperatures range above 120 degree F., lowered by an afternoon breeze to a pleasant 95 degrees.

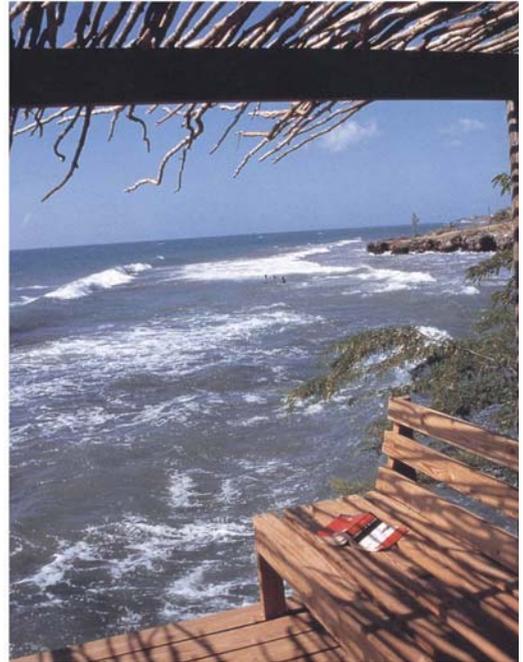
Hyderabad Sind
(p 115 Rudofsky. A)



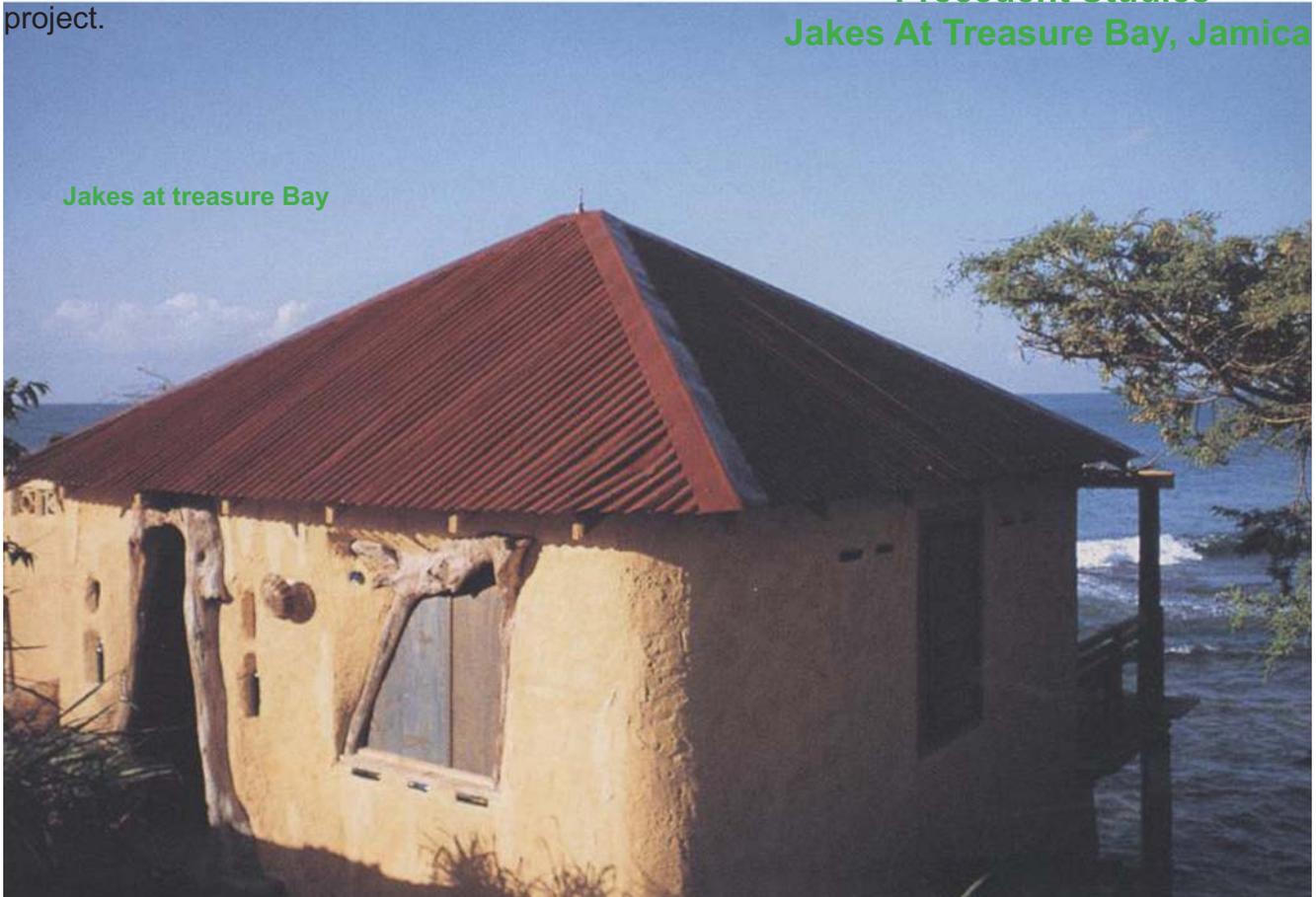
Precedent Studies
Hyderabad Sind West Pakistan



Jake's at Treasure Beach located in Jamaica, West Indies is not a chain type resort. It was designed and built by the resorts owners the Henzell's. They are not architects, yet they are creative and incorporate the site. "Seapuss, one of the other cabins, is a simple little box of a building with a red zinc roof and a wooden deck practically in the sea. But it has a story, too. A hurricane blew down a pimento tree that once grew on the spot; the wood from that tree was incorporated into the window and door frames on the back side of the cabin. The tree did not provide straight-grain two--by-fours-by any stretch, but rather than cut the wood to fit a rectilinear shape, Henzell shaped the window and door to accommodate the irregular shapes of the wood (Henderson p37)." Materials from the site are used decoratively and structurally on the project.



Precedent Studies
Jakes At Treasure Bay, Jamaica



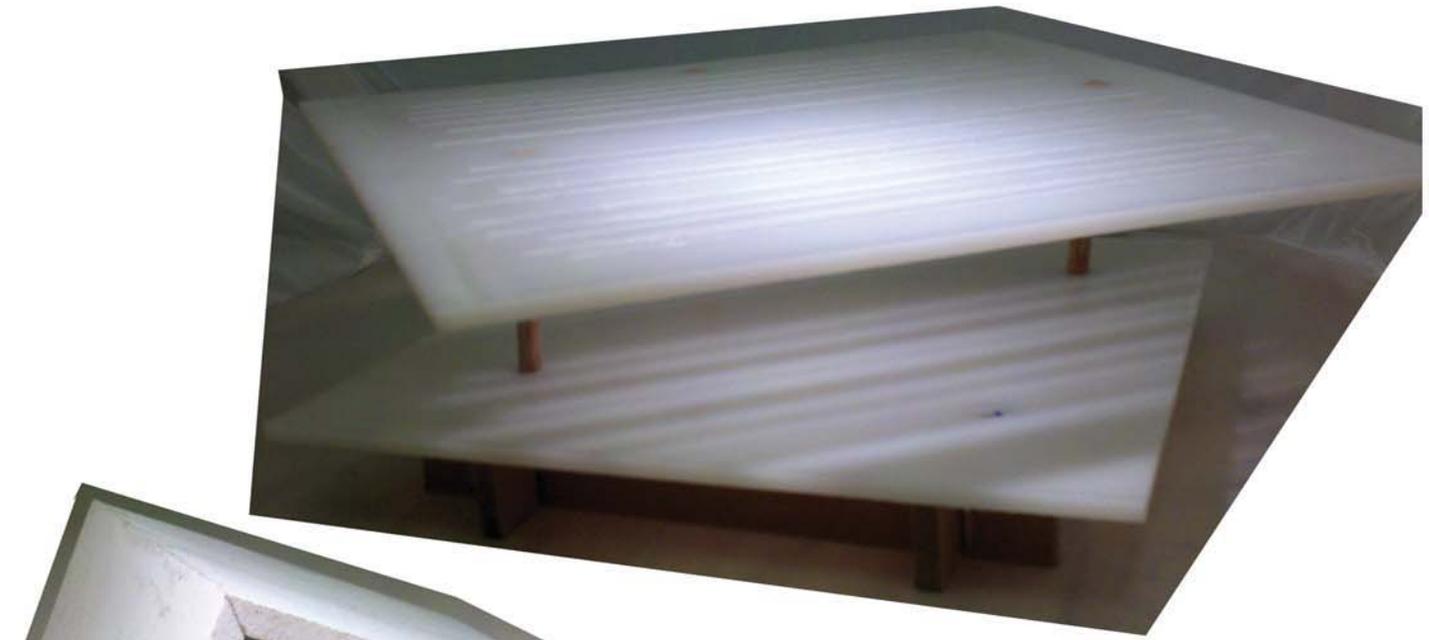
Jakes at treasure Bay

The hotel Bora Bora is not the only lodging above the water in French Polynesia. There is the Sheraton Moorea Lagoon Resort and Spa in Papetoai, Moorea, French Polynesia completed in 2001. As well as the Bora Bora Nui Resort and Spa located in Motu Toopua, Nunue-Bora Bora atoll, French Polynesia completed in 2003 (Bromberek p162, 171). Zbigniew Bromberek's book 'Eco-Resorts planning and Design For the Tropics' examines the resorts energy uses, construction techniques, and water management. At the Sheraton Moorea Lagoon and Spa Bromberek notes:

"The over-water bungalows and, to a lesser degree, beach bungalows take advantage of the moderating impact of the ocean on the resorts microclimate, They are elevated and fully exposed to cooling winds and breezes, and their lightweight structures quickly lose any heat gained during the day. ...Unfortunately, the vast majority of holidaymakers staying at the resort prefer to trust the air-conditioning system provided in each bungalow rather than its ingenious design. This makes resort operations prohibitively expensive since their design is inappropriate for air-conditioning. It also makes the outdoor environment of the resort less inviting as the air is filled with the muffled sound of working AC units (Bromberek p169)."

Precedent Studies Sheraton Moorea Lagoon Resort

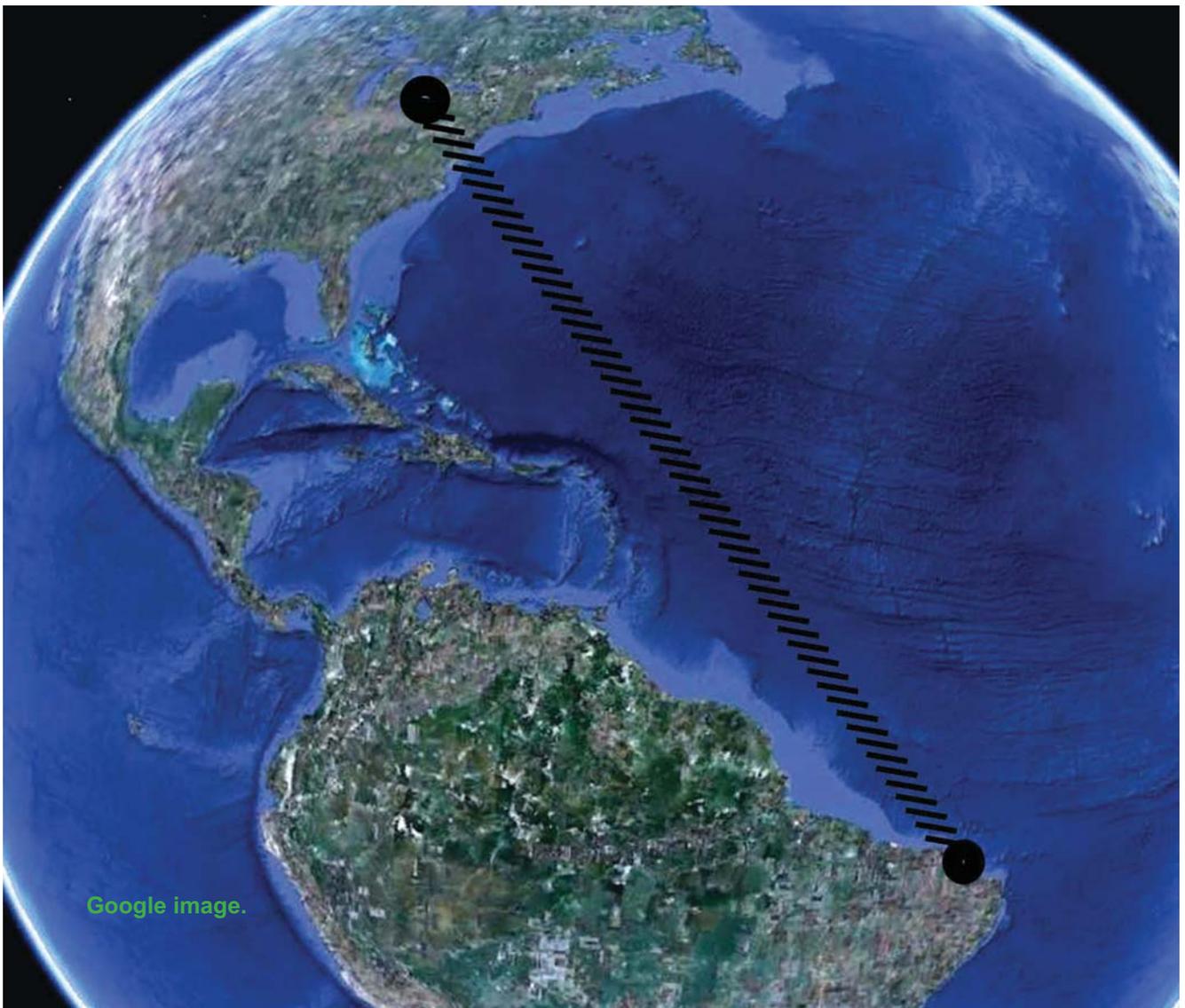




Early models, forms and textures.



Site Selection



Cumbuco, Brazil was chosen as the site because it is a kiteboarders paradise. The site offers warm water and constant wind, which are reasons why this is a world famous kiteboarding area drawing visitors from around the world. The site is approximately twenty five minutes by car from a large city of about 2.5 million people. Fortaleza is the major city, which contains an international airport making the site attractive to visitors from Europe and elsewhere, though there are no direct flights form the U.S. to Fortaleza. Fortaleza is the fifth largest city in Brazil, as well as the capital of the state of Ceara. The area has a wet and dry climate tropical climate with the temperature when hottest around 86 degrees and when coolest at about 81 degrees for averages during the daytime.



Site visit to Cumbuco Brazil.

Photo Zeze T. Jess

Cumbuco, Brazil, which is near Fortaleza, is not an area with the same feel of an urban area. Cumbuco still feel like a small town. Upon a site visit there in 2006 I observed a much friendlier group of people than in Fortaleza. Cumbuco is mentioned in Arnold's Brazil Guide for Foreign Investors, when describing the positives of Fortaleza "Beautiful beaches in surrounding towns including Canoa Quebrada and Cumbuco." (Arnold's pg 94)



Site visit to Cumbuco Brazil.
Kiteboarding lesson with
instructor Daniel.
Photo Zeze T. Jess

The site chosen offers plenty of area for advanced to beginners to kiteboard. Beginners can learn from more advanced riders as there are opportunities for lessons or just watching more experienced riders on the water. There are miles of open beach available for beginners to learn doing downwinders. Downwinders are easier for beginners because one only has to be able to stand on the board and fly the kite. Downwinder is simply a term for riding one direction (the direction the wind is going) on the water, then flying the kite to shore and either walking the kite back to the starting point or being picked up by a vehicle and driven back to the starting point. Kiteboarders with more experience can go upwind or downwind effortlessly. The miles of open beach, warm water, sunshine, and constant wind make Cumbuco a dream spot to learn kiteboarding. In general this area is a tropical paradise in many respects and kiteboarding is just another enjoyable thing to do in Cumbuco, as one can also fish, dive, enjoy the nightlife, eat local cuisine, lounge on the warm beach drinking caprihinas, enjoy the slow pace of life, or even venture into the city for a few hours.



Site visit to Cumbuco Brazil.
Kites facing the wind stay on
the beach.



Site visit to Cumbuco Brazil.
Kite lesson with observer
watching on shore.

Other sites along the northeast coast of the Atlantic in Ceara were also considered, though ultimately Cumbuco was selected as the best site because of its popularity and proximity to Fortaleza. Kiteboarding as an adventure sport can take place anywhere there is wind and water essentially, though Cumbuco stood out above the other sites because the community there is accepting and appreciating kiteboarding as an industry. Other sites considered were Jericocora, Baleia, and Canoa Quebrada all three in the same state as Cumbuco, Ceara. Jericocora is several hours by car from the international airport in Fortaleza.



Google images.

Site Analysis

Site model made of wood, saw dust, plaster, dura bond drywall mud, and acrylic paint.

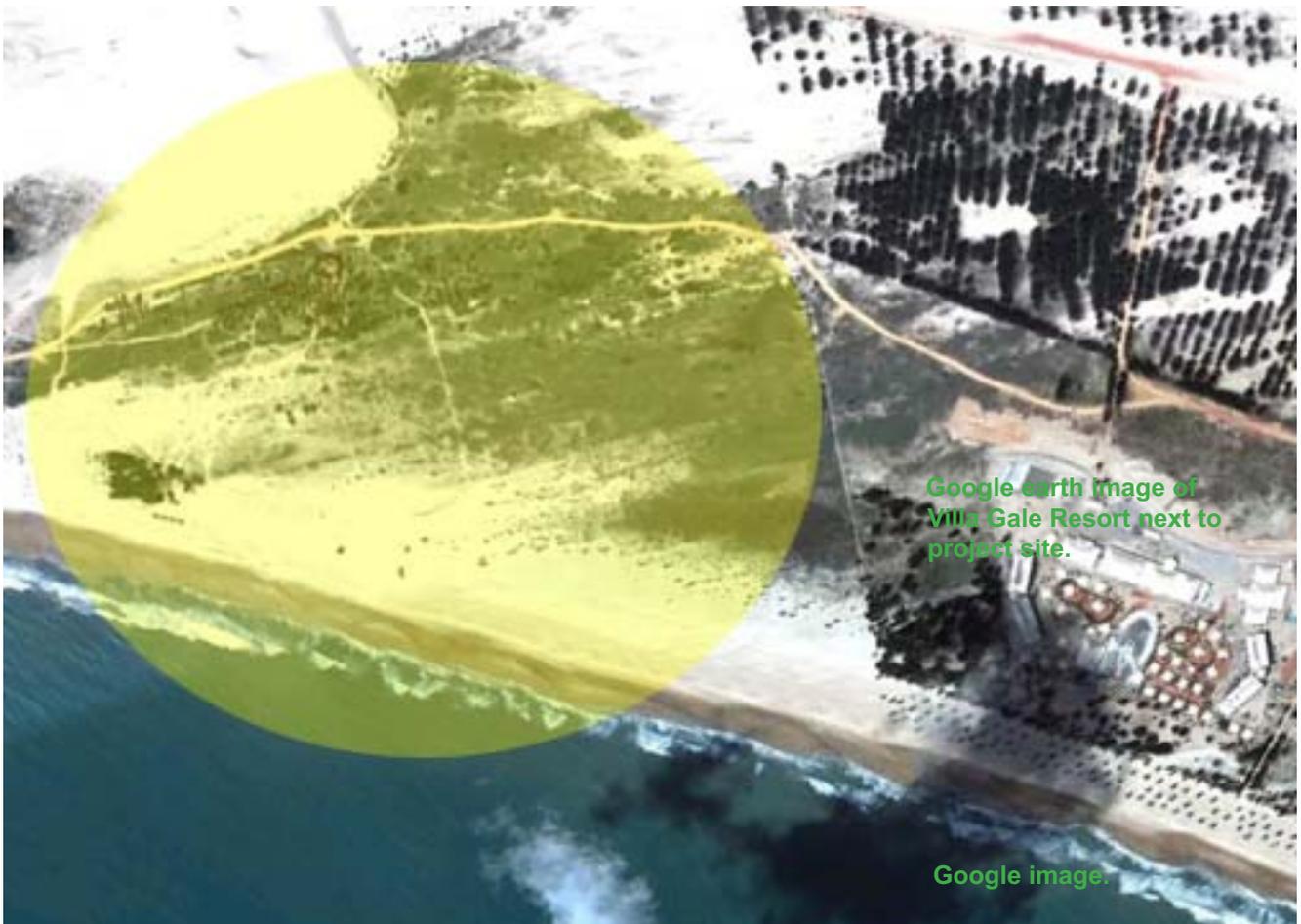


The site is located in Northeastern Brazil in the town of Cumbuco in the state of Ceara. It is a small fishing village that is growing in size because of its close proximity to Fortaleza, and natural beauty. The chosen site is next door to a large resort called the Villa Gale. The Villa Gale has approximately five hundred rooms along with restaurants and spas, pools, etc. The Villa Gale does not exactly fit into the surroundings rather it appears placed unto the site.



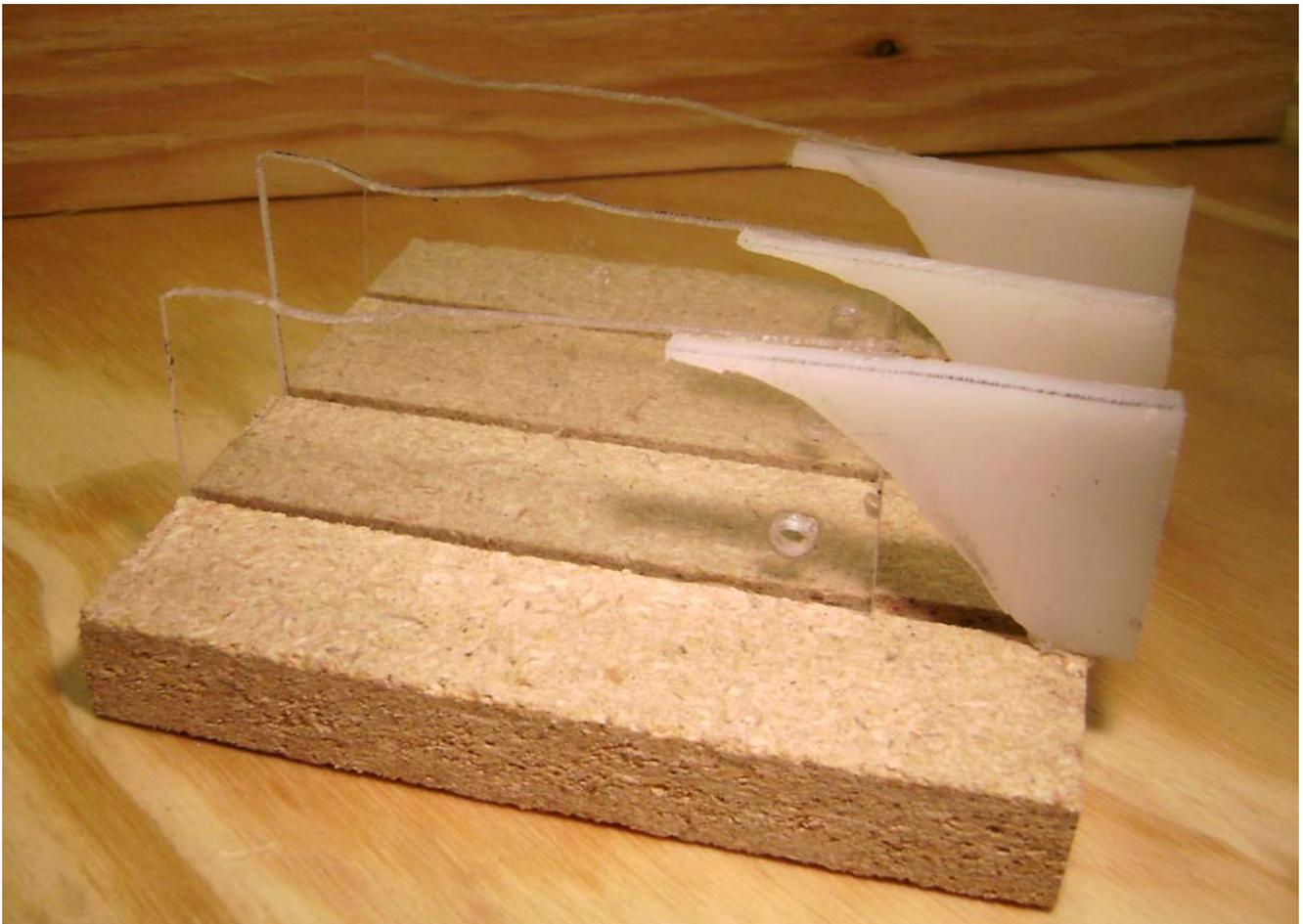
Google earth image of Villa Gale Resort next to project site

The site is located in sand basically as the site is a sand dune with vegetation. Constant wind is nearly always present at predictable times of the day and sunshine is constant as the site is approximately three degrees below the equator. This area will surely gain even more popularity in the coming years as the “World Cup in 2014 and the Olympics in 2016 coming to Brazil” (Hurley). This site is the only large tract of land left coming out of Fortaleza as the coast is being gobbled up by developers.

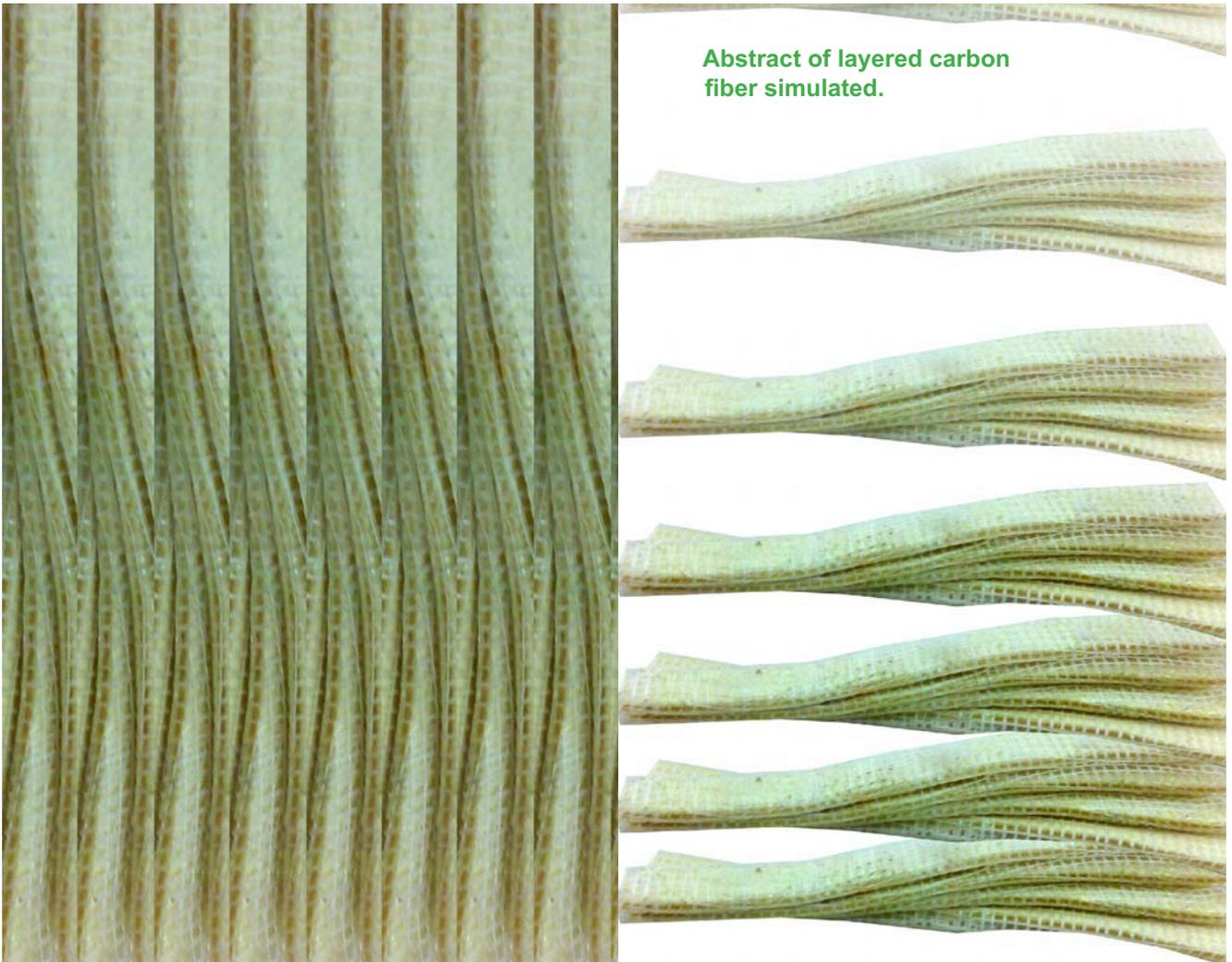


This model is the spark that ignited the idea for earth bag construction because it starts to look into what is at the site. By building with material from the site the amount of energy used to produce building material is greatly diminished. For example it, the sand is already at the site, so it would not need to be shipped to the site like bricks used on typical projects in the area.

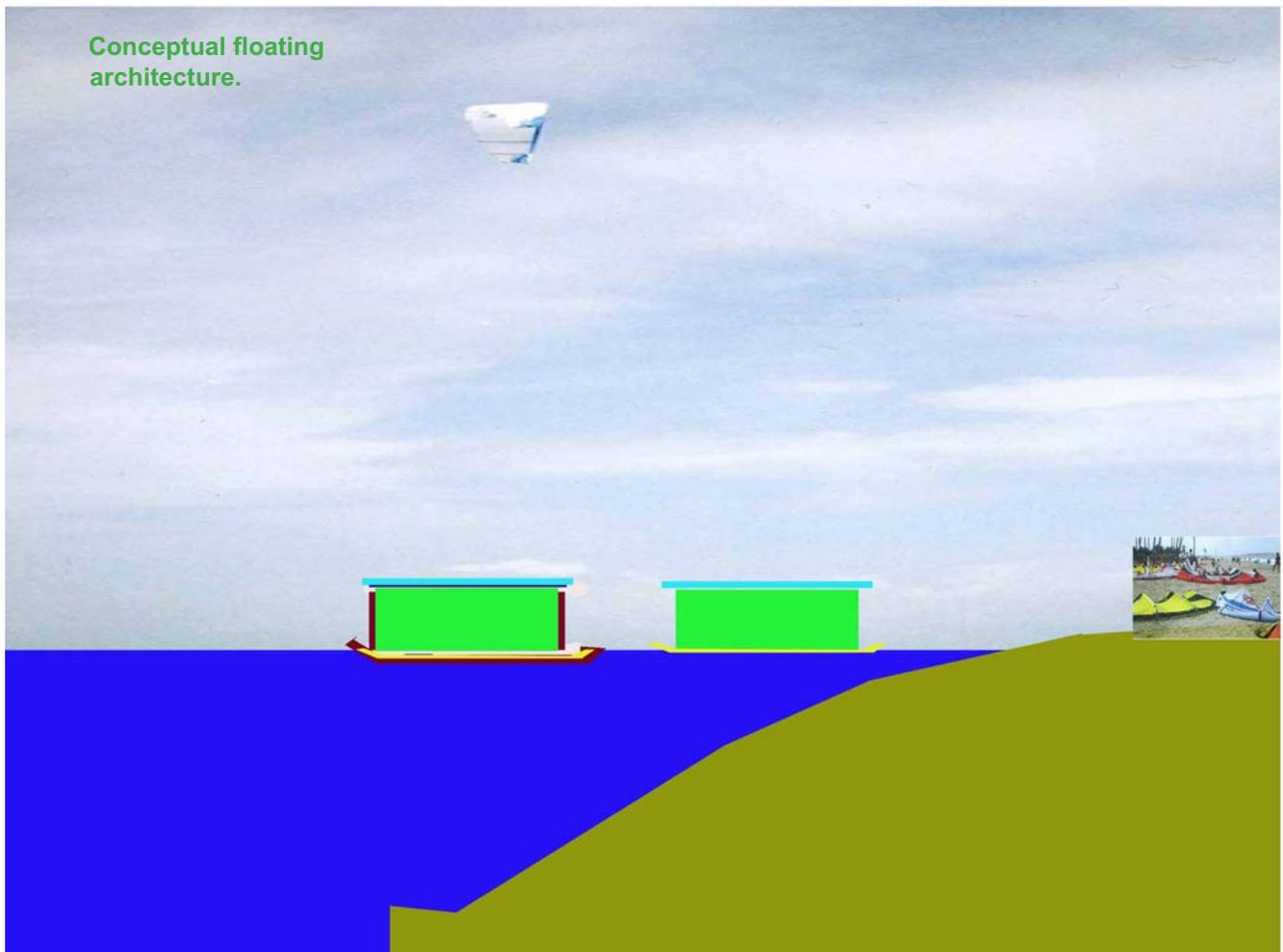
**Abstract site model of
Atlantic Ocean and sand
dunes.**



Conceptual design ideas



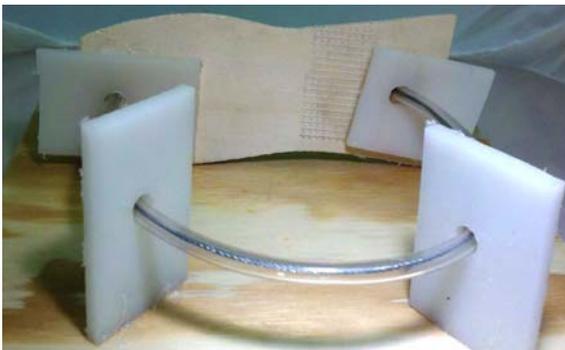
Conceptual ideas for the project include floating architecture on the Atlantic Ocean, solar and wind gathering to produce all on site power required to operate, earth bag construction, bamboo with carbon fiber construction, and plantings or landscaping on the entire site for purposes of conservation and food production. The floating architecture will provide a place to stay over night on the water. This will allow visitors to stay at the resort and be on the water at night, then the architecture would be moved onto the shore during the day to allow the water space to be used for play during the day in the form of being usable space for kiteboarding. If the floating architecture is movable the space on the water will provide a unique setting to all guests on the site as they will be allowed to enjoy the space on the water day and night. By providing a usable space on water for day and night activities guests will not only stay and play on the water, but also be in tune with the natural setting that is so unique to the coast of Brazil. The idea for floating architecture is based off of precedent studies specifically a costal resort that provides



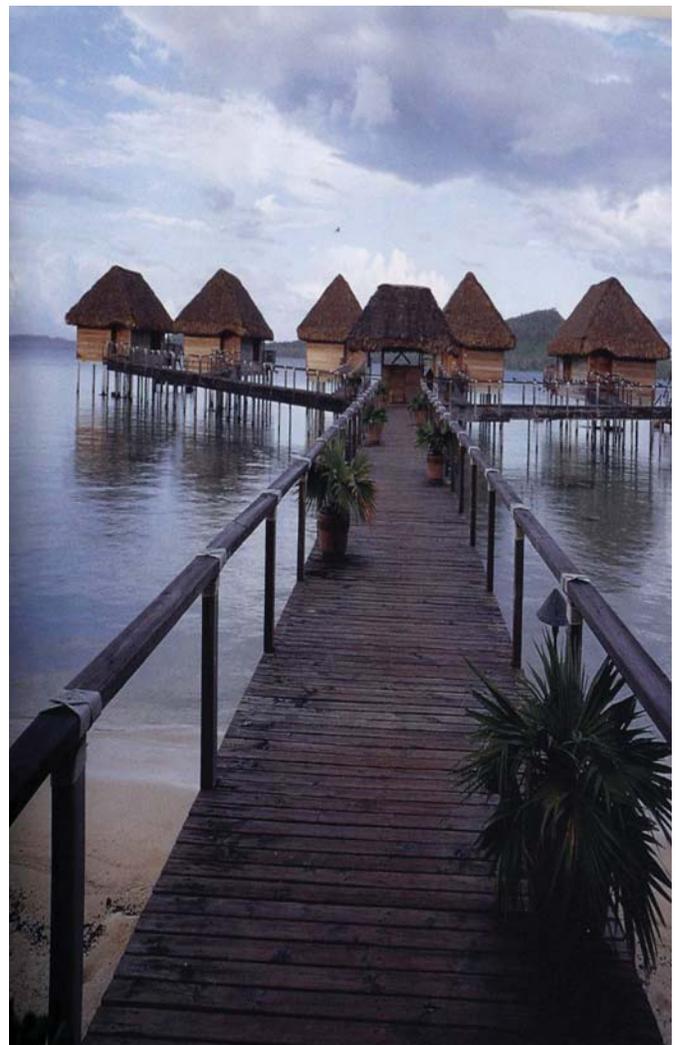
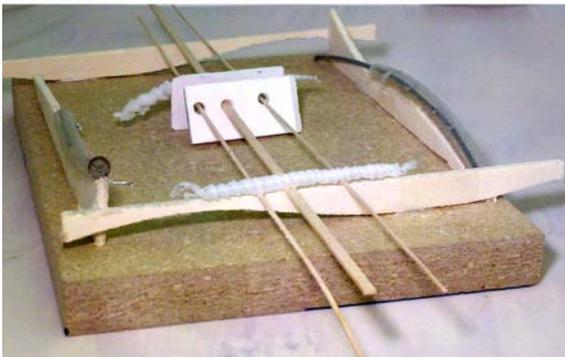
Conceptual sand bag architecture based off of Nader Kahili's work.



lodging in Bora Bora, French Polynesia that is permanently fixed above the water. The eco lodging provided at Bora Bora is inspirational to this project because the lodging there allows guests to enjoy a resort setting with all the necessary amenities of a luxury resort. While the lodging is fixed in place on the water in Bora Bora, there is not a kiteboarding aspect to the resort as there is for the proposed Cumbuco resort. Currently there are no precedent studies where the architecture is floatable and movable for the purpose of kiteboarding. The floating architecture is envisioned to be built on site and operated through nature in the sense that solar and wind will deploy and retrieve the structures to shore as needed. Conceptual models below relate a link between wind power and structure that can be investigated further in the development of floatable architecture.



Conceptual models made while doing precedent studies

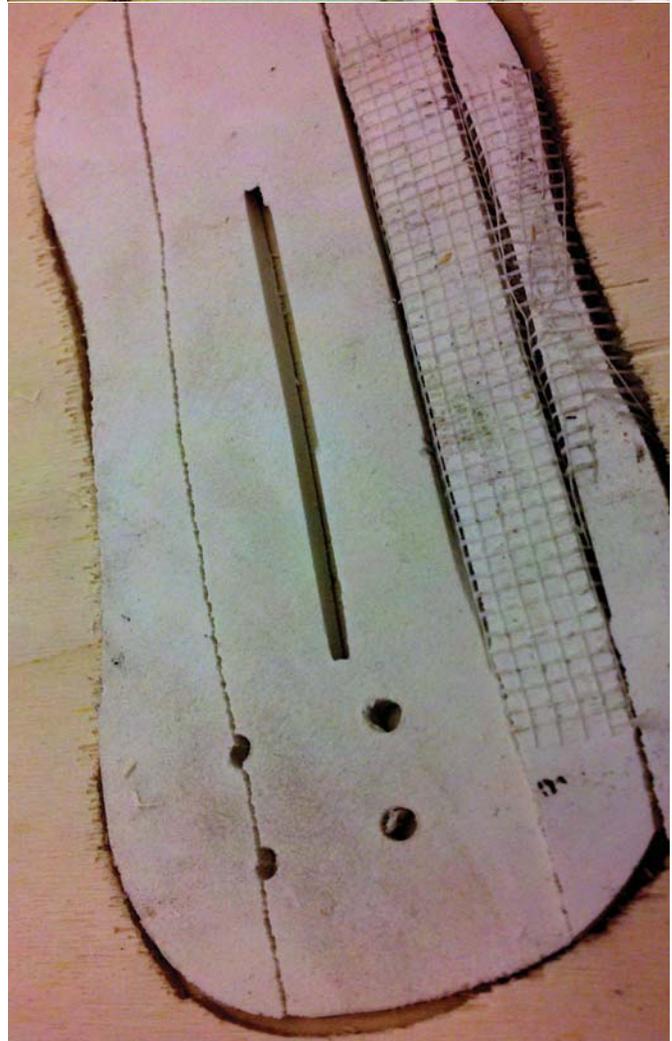


Solar and wind gathering for the project are crucial because most architects today do not incorporate these into their structures or projects. This could be for a variety of reasons such as solar and wind power are arguably technologies not deemed reliable. For this project, conceptually, as the designer attempting an ecologically sustainable resort it is only responsible to design in a way that is respectful of the land and environment. Any architect can design a typical structure that abuses the environment for a resort with the specific goal of strictly chasing money, but the plan for this resort is to do good for the environment as opposed to just less bad. This will be figured out how to be done as the site provides constant wind at a predictable direction. Sun is also present almost constantly as the site is only three degrees below the equator. Because solar and wind gathering are only paid lip service and not actually taught in the incredibly expensive educational process outside sources will have to be analyzed. Fortaleza a large city roughly twenty five minutes by car from the site already has some large wind turbines in the city on the ocean, yet the resort next door to the site contains no wind power or solar. If designers continue to ignore what the site provides to them naturally the world will be stuck with architects that are good at making pretty pictures that are best suited to be wall paper and not designed structures that are advanced using today's best technologies or even inventing their own technologies to satisfy necessary environmental concerns.



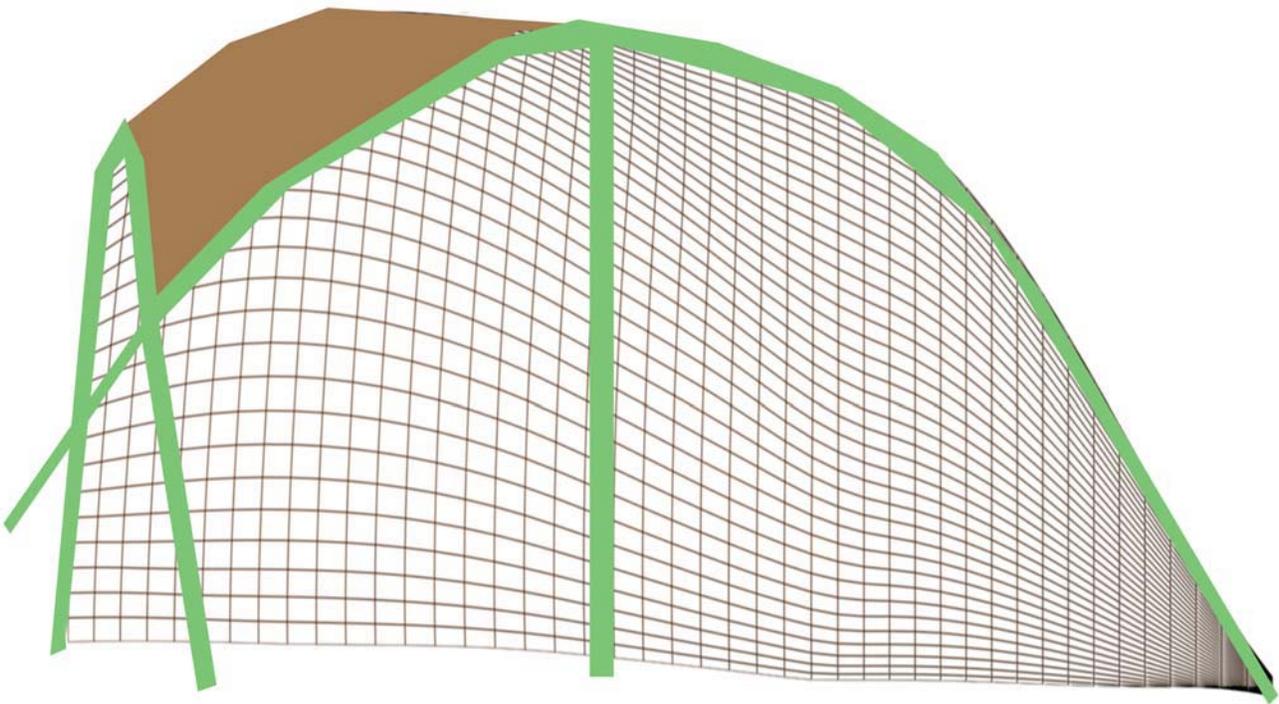
Bamboo is conceptually going to be used in construction of structures in conjunction with carbon fiber for added strength. Bamboo is not a new construction material to the region of Brazil being designed for, but infusing bamboo at particular joints for strength is a new idea. Bamboo could be produced on site given that there is a large area of land on site that can be directed to producing bamboo for the dual purpose involving construction and greenery to the site. Materials that could be produced on site allows much less of a carbon footprint on the world. It is not uncommon to use materials on a construction site that are produced thousands of miles from the site, then brought in to produce a structure. This project will plan when and where construction will be and coordinate construction within a timely manner of when bamboo can be used at optimum strength. Carbon fiber will be used on site in the production of kiteboards. Kiteboards will be sold to guests as well as others in the area. By having a shop on site with the ability to fabricate kiteboards as well as the kites, the site will be able to provide jobs as well as job materials.

Conceptual models influenced by floating architecture and construction of kiteboards using techniques such as the nine finger cut for wrapping fiber shown by Brokite @brokite.com. Brokite builds kiteboards in the United States and incorporates carbon fiber to make strong, lightweight kiteboards.



The site provides another useful resource conceptually that is abundant and already being used in some parts of the world: sand. Sand has been used in the form of an aggregate in concrete around the world for all to have seen. With the site being used to produce kites used in kiteboarding, it is a natural fit to sew bags for earth bag or sand bag construction. Bags can be sewn to form a multitude of forms to create structures that could be rapidly reproduced, as well as bags could be sewn to create unique one of a kind sculptural structures out of sand mixed with a cement type aggregate. This would create jobs in the production of the bags, the construction of the structures, maintenance of the structures.

Conceptual model
influenced by Shoji Yuh
using split bamboo and
concrete.



Conceptual model with bamboo and fabric.



Construction Materials

Site showing Atlantic Ocean, roads, and natural vegetation.

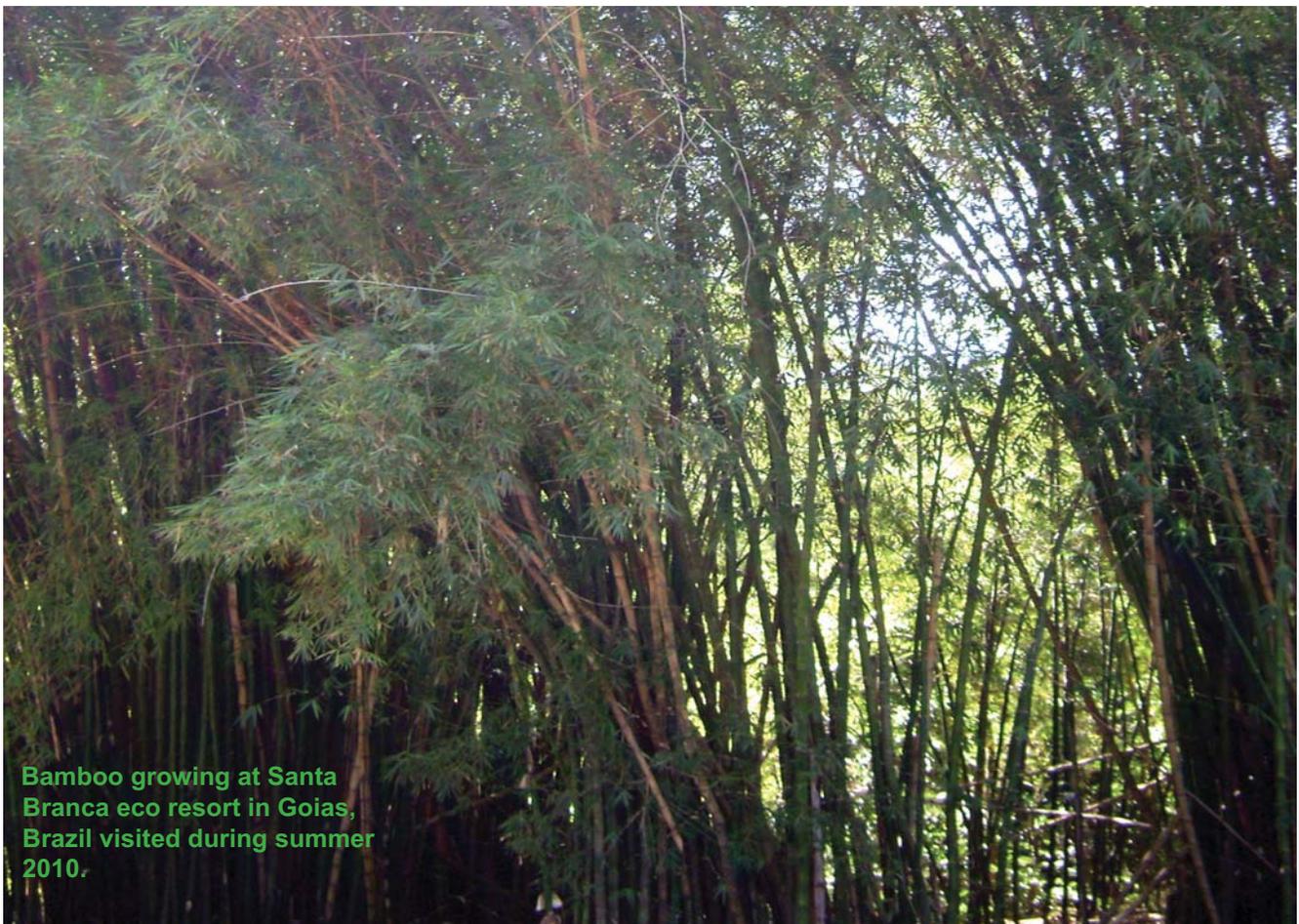


Google image.

Materials for the project are to be directly related to the site in the sense that some will be materials from the site, some will be produced on site, and others will be produced and fabricated on site. The local vernacular is commonly bricks coated with a two part stucco cementitious finish, while this is a nice way to construct this thesis aims to prove materials can be more from the site. For example, bamboo grows readily in the area and can be used in construction in Brazil.

“Bamboo reproduces almost exclusively from its rhizomes, and is extremely fast growing. Under ideal conditions, for instance, a culm of the *Guadua angustifolia* species with a diameter of 22- 24 cm (9-10 inches) will grow to its full height in 3-4 months. It can produce an incredible number of culms per hectare (2.2 acres): native to Colombia, *Guadua* and produces 7-10,000 culms per hectare, while some *Guadua* species from Brazil can produce 60,000 culms per hectare. (Adams)

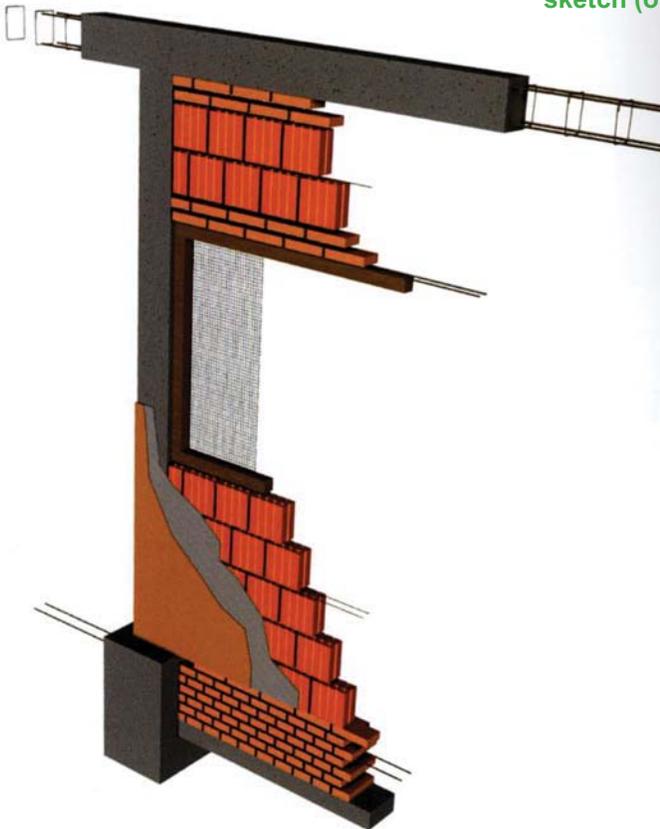
Bamboo can be grown on site to produce a plentiful, useful construction material. In conjunction with bamboo on site construction will use sand. Copious amounts of sand are available on site, as the site is essentially made up of sand dunes. This type of sand bag construction is



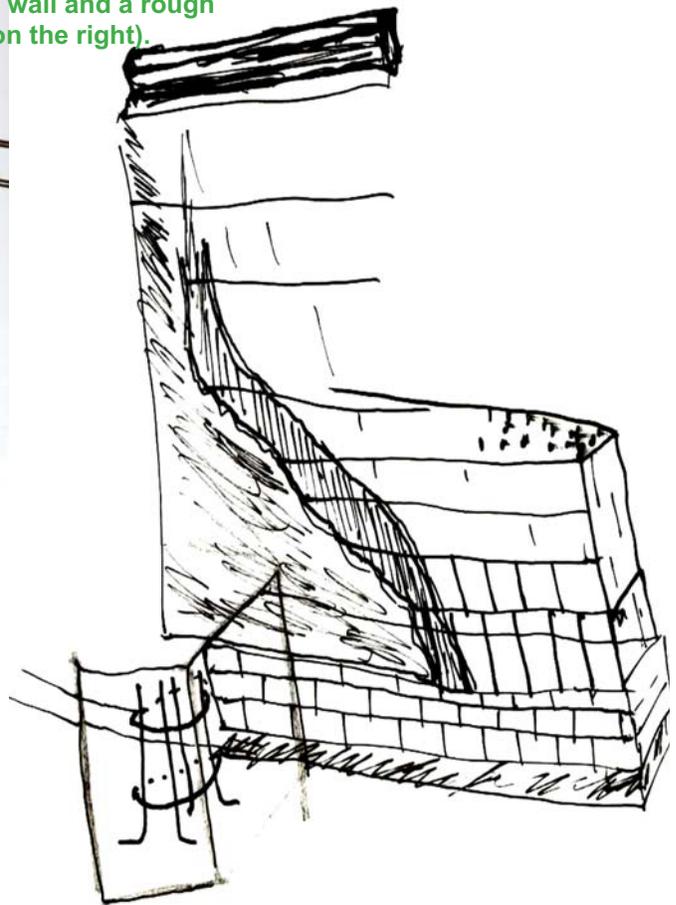
not common in the area. “A thorough historical survey of building with soil-filled sacks remains to be undertaken. Most evidence for construction using this method is anecdotal. Sacks have of course been used for many decades by military forces to create bunkers and other structures, but it’s unknown when they were first used for this purpose (Kennedy).”

With contemporary societies need to advance away from materials hauled great distances to sites for construction it makes sense to use materials that are already at the site. It is a frequent occurrence on construction project to do excavation at a job site and haul the fill dug out to be buried in a pit somewhere or use the excavated fill elsewhere if economically feasible. This technique of using fill from the site to create the structure allows there to be a significantly smaller carbon footprint.

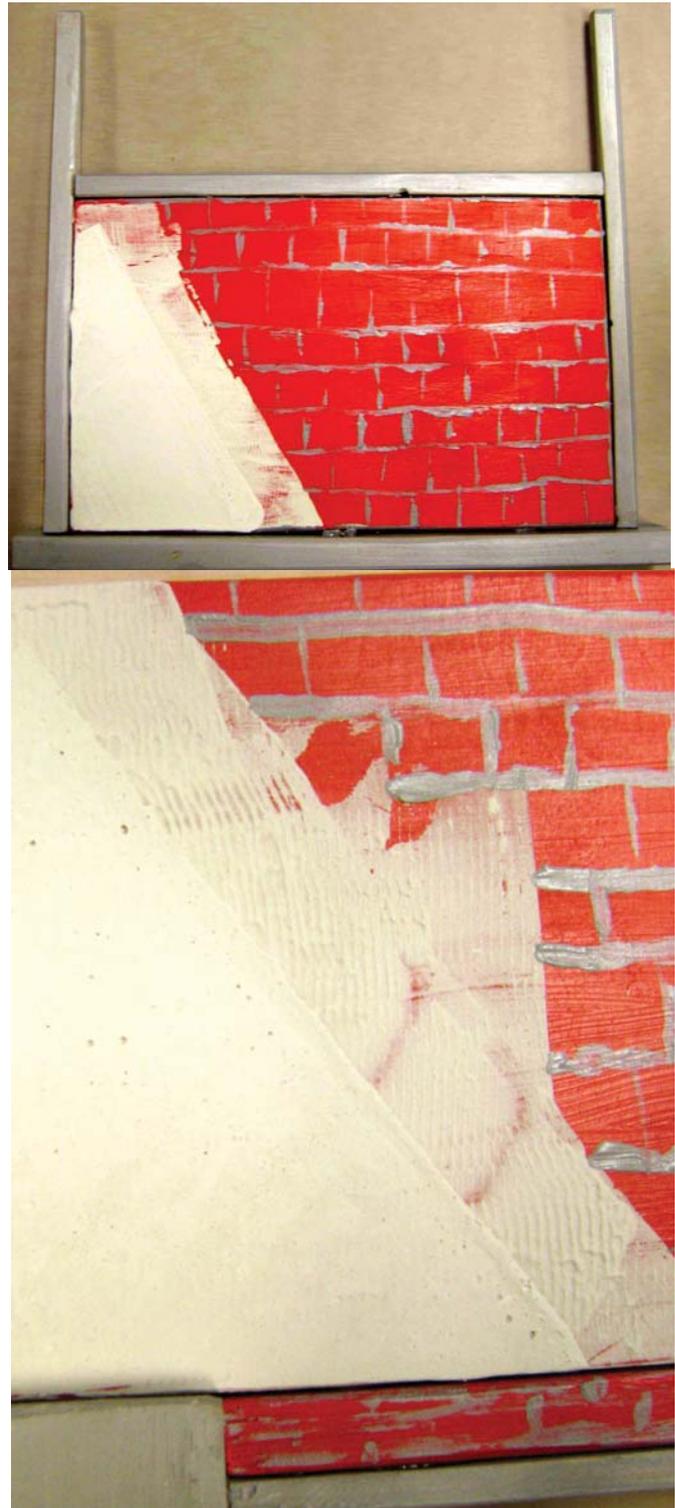
Wall section from Dichotomy 17 showing vernacular Brazilian wall and a rough sketch (on the right).



(Dichotomy 17 image p 202.)

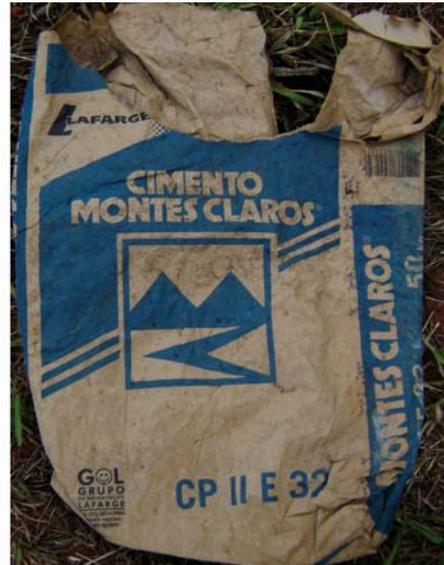


Local vernacular of a concrete poured in place footing with two #3 rebar running tied continuous through the pour, make up the base. Then it is common to go with one of two approaches to the next step which could be solid bricks with a running bond pattern on the one hand, or on the other hand it could be bricks with six or eight uniform holes in the bricks with a running bond pattern as well. Next it is typical to see more bricks laid with a running bond pattern. The bricks are coated a stucco coating system of a brown coat followed by a finish coat. The finish coat is then completed with a coat or two of paint. This system of construction can be done for multiple level structures by adding in concrete poured in place beams and columns. The beams and columns are reinforced with rebar characteristically a number three bar. This type of construction is not limited to Brazil as forms of this construction are universal around the world people use bricks and concrete.



Models of wall sections based on Dichotomy 17.

Oscar Niemeyer has been doing structures in Brazil for well over fifty years with mainly this type of vernacular style of bricks with a coating. An example of this type of construction can be seen on the Theatre in Uberlandia, Brazil still under construction (construction was actually stopped) in 2010. Poured in place concrete with bricks in filled is a simplification of what this structure is, but the point is one can purchase Lafarge cement products in Michigan or Brazil to work in conjunction with brick or blocks. The Uberlandia site, unlike the Cumbuco site, does not contain copious amounts of sand.

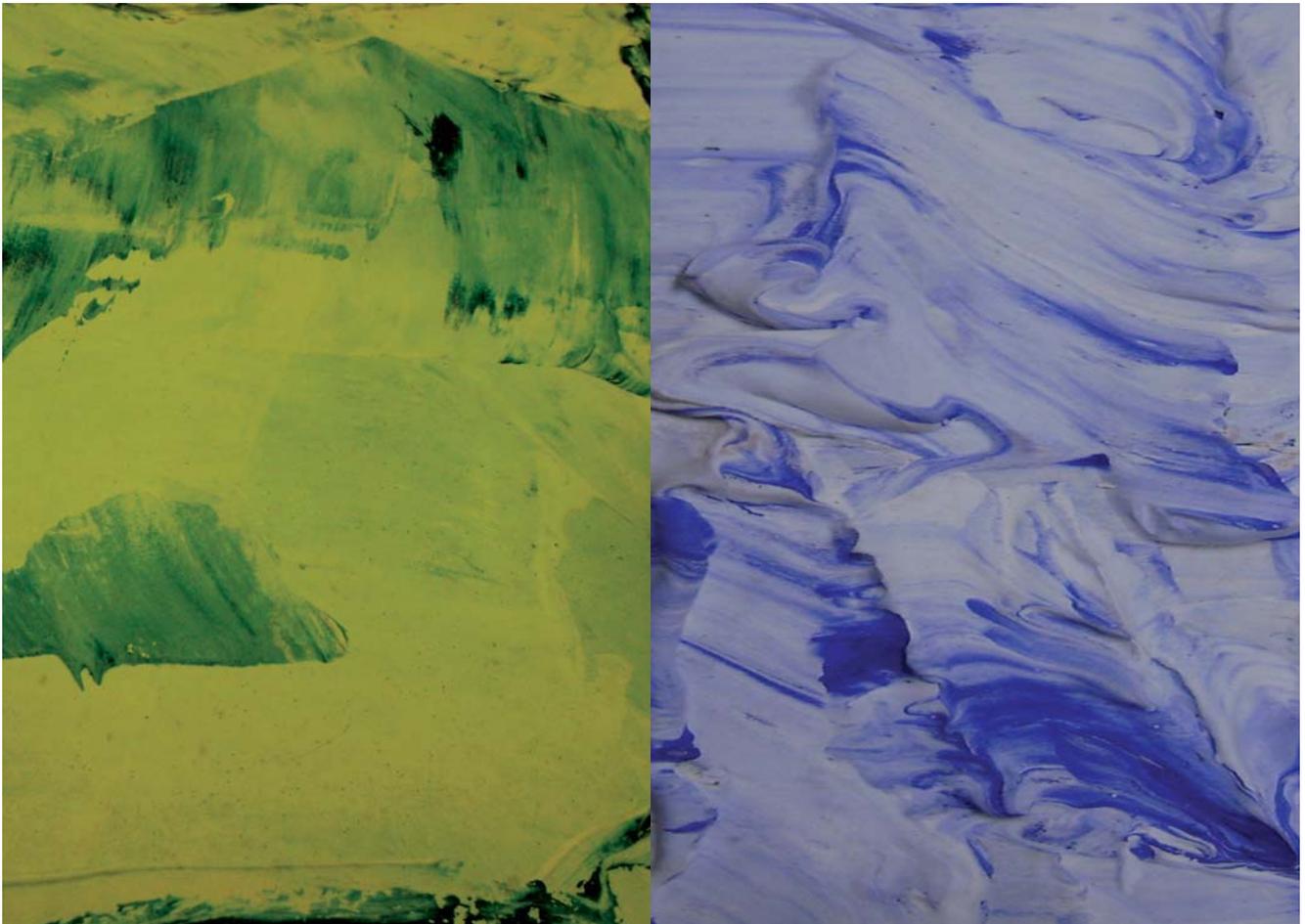


Photos from site in Uberlandia, Brazil showing block covered similar to what is shown in Dichotomy 17. This structure was stalled out in the construction process due to funding during site visit in summer 2010. Structure is a theater designed by Oscar Niemeyer. Robert J. Jess photos.



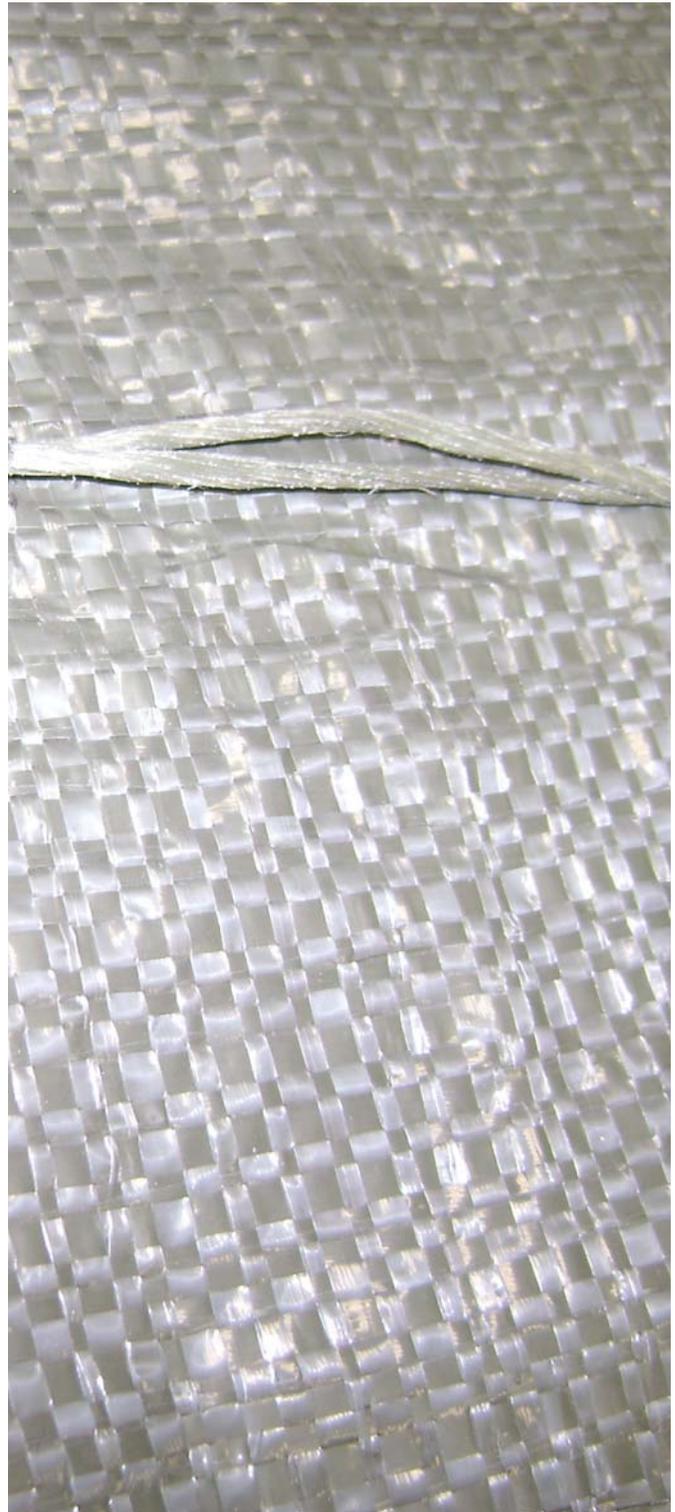
Coatings could be infused with color as well as have a sculptural quality created within the amount and texture to individualize the structures. To save a step in the process, which is painting the walls after the brown coat and finish coat; walls could be shaped with sand bag forms and coated with paint mixed in the top coatings.

Models of potential wall coverings with a color added.



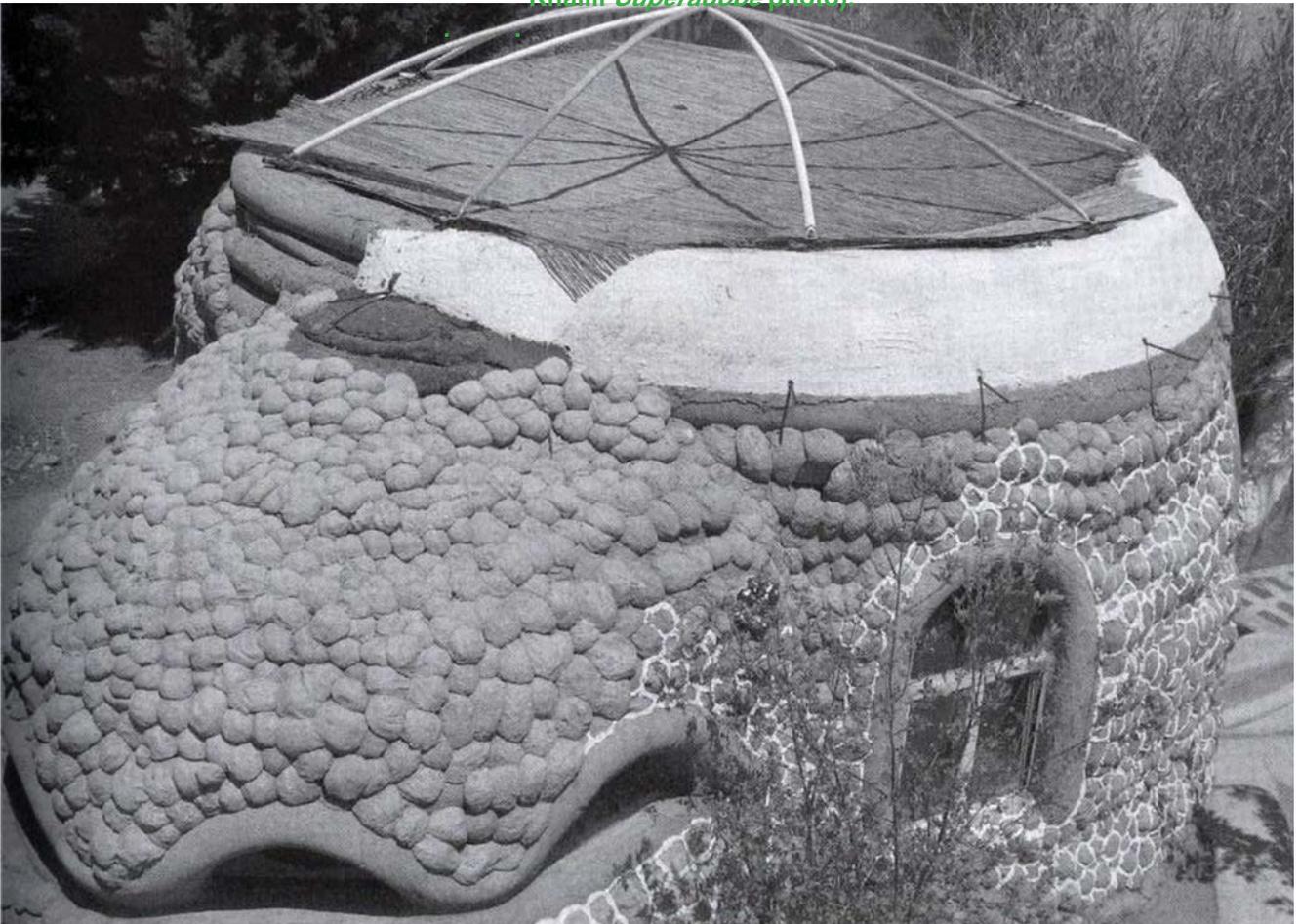
Polypropylene bags can be sewn into desired forms on site to be used in construction. “Using soil-filled sacks (earthbags) for construction has been recently revived as an important natural building technique for several reasons. It is inexpensive, using locally available site soil and polypropylene or burlap sacks, which often can be obtained free or at low cost. The technique demands few skills, and is easy to learn. In addition, building with the bags goes extremely quickly, much faster than any other earth-building technique. They are adaptable to numerous site conditions and can be used with just about any type of fill material available. When built properly, earthbags are extremely strong, and as the bags themselves are lightweight and easily transported, they are useful for remote locations or emergency shelter. Thus, it is a flexible means of construction usable in a wide range of situations to create a variety of forms and structures (Kennedy).” The reason polypropylene would be more desirable is that a stucco coating can be applied to the bag directly, whereas burlap will deteriorate with a direct coating. Burlap would require another step before coating such as mesh before coating.

Polypropylene sack.



This type of finish is shown below is from architect Nader Kahili's book *Emergency Sandbag Shelter and Eco Village* (p 199), shows a reptile type finish because it reflects the same type of texture as a reptiles scales.

Coating shows bumps or texture like a reptile (pg 199 Khalili *Superadobe* photo)

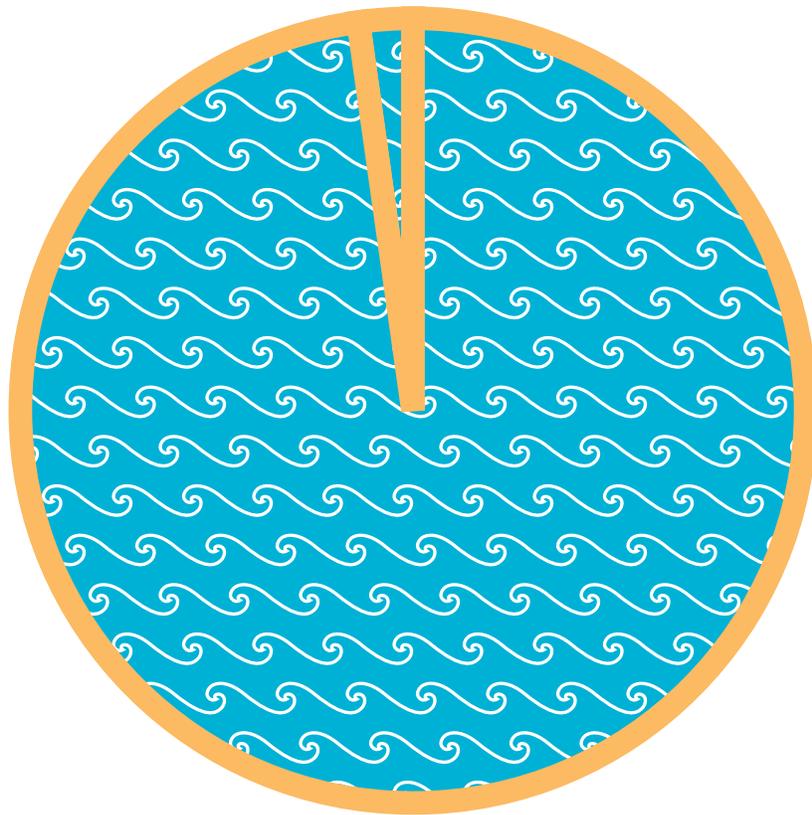




Reptile scale finish coating model based off Khalili's work.

The “..amount of energy required to produce a unit of material with a certain level of load bearing capability...” (Janseen) Steel 1,500 compared with 30Units MJ/m³ per N/mm².

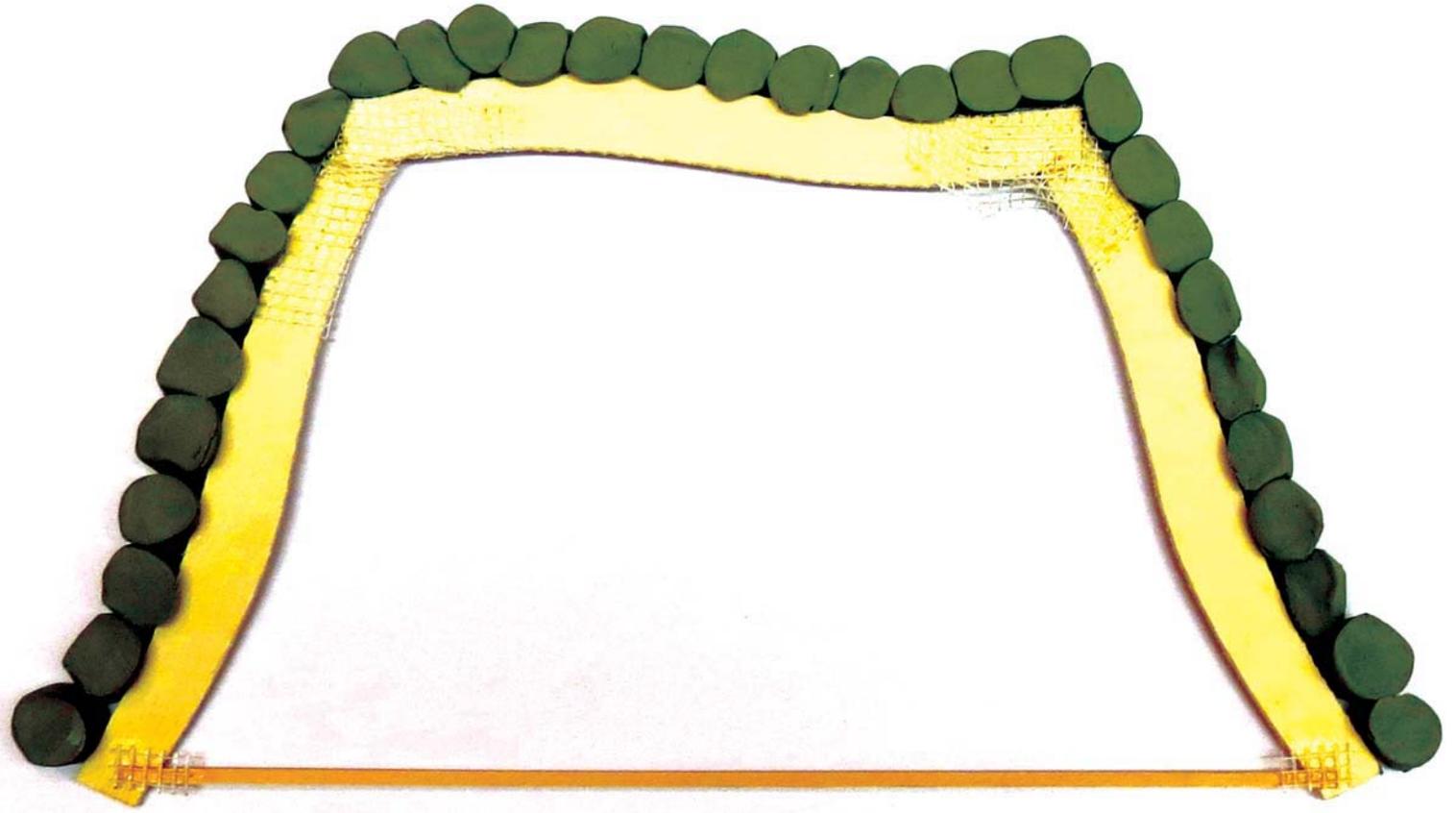
Amount of energy required to produce bamboo versus steel for construction is 1:50.





Models with clay representing sand bags intertwined with wood representing bamboo and mesh as carbon fiber.





Wall section model sand bag,
bamboo, and carbon fiber.

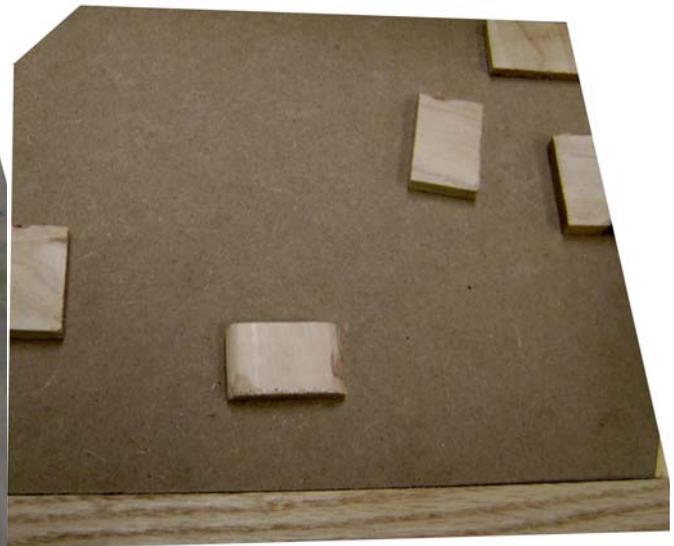


Models expressing forms to shade from the sun and capture cooling breezes off the Ocean.

Landscaping Materials



Landscaping on the site will occupy the majority of the space. Effort will be made to use landscaping materials that are suitable to the climate provided. The environment can be classified as a Caatinga. A “Caatinga is the largest dry forest region in South America and certainly one of the richest dry forests in the world. It encompasses the drier part of northeastern Brazil (Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Sergipe, Alagoas, Bahia, and northern Minas Gerais).” (Jose Maria C. da Silva). The site in Cumbuco, Ceara, Brasil will be used to grow fruits and vegetables that will be used for guests and residences on site either living on site or staying on vacation. Other vegetation grown on site will be used as a building material to be sustained for construction projects coordinated within the phased planned development. Development of the landscaping plantings will be linked directly to the phasing of the project as to be a useful resource that promotes sustainability as well as provides employment to workers from the area.



Anacardium occidentale- Cashew nut, Caju in Portugese the language of Brazil. Flowers in the summer fruits nine months later, **native** to Northeastern Brazil. Trees do better in drier climates and are drought resistant.



Annas comosus- Pineapple, Abaxacai in Portuguese. Nine months to mature, sucker shoots to produce next fruit plants like acidic soil, lots of sun and are drought resistant as well as **native** to Brazil.

2'-5'tall.
Leaves frond
and razor like.



Banana Ouro- Banana in English and Portuguese Not-native to Brazil but does extremely well in Northeast Brazil. One can find up to six varieties of bananas at a common market varying in size and color.



Cocos nucifera- Coconut in English and coco Portuguese. Origins unknown not-**native** to Brazil but does extremely well in Northeast Brazil. Produces fruit in six to ten years, likes direct sunlight and is very drought resistant.



Trees stand 80'-100' tall.
Spreads 20'-30'.



Programming

Kiteboarding School

Hotel

Residential

Wind Gathering

Solar

Landscaping

Restaurants

Security Huts

Manufacturing



A school located near the shore of the Atlantic Ocean with trained professional kiteboarding instructors with the ability to give lessons from advance to beginner kiteboarders is envisioned. The school will have space for storage of kites, boards, harnesses, lines, etc. An area for inflating kites is necessary. Lessons such as wind theory can occur inside or on the beach.



Mass model of potential kiteschool on the site on right and underside of model. Above representing methods used by Shoei Yoh.

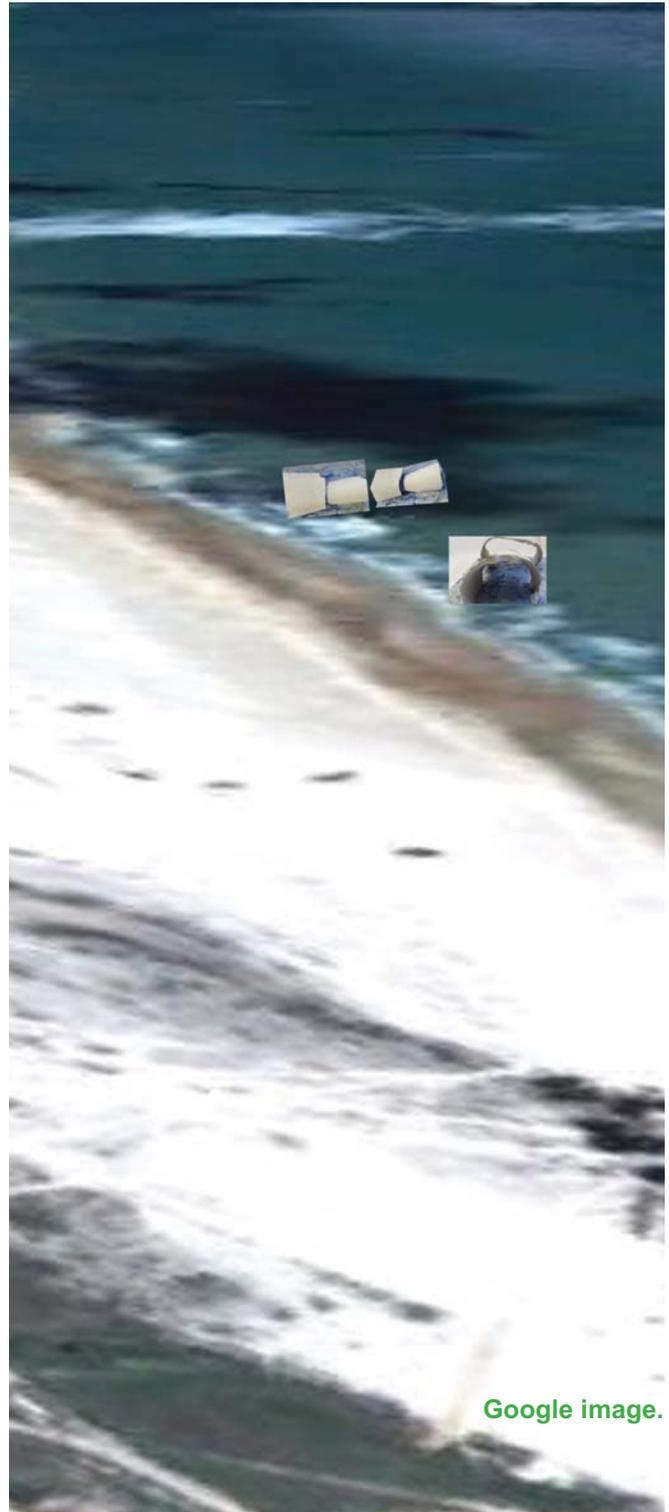


Google image.

A hotel for guests will be located on the property. The hotel will provide jobs for local residents as well as lodging. Lodging for guests will occur in two areas of the site one will be on the water and the second will be built into the sand dunes using earth bag construction. The architecture upon the water will be retractable as it will be deployed onto the water for lodging for the night, then be brought onto shore during the day. The purpose of bringing the lodging onto the shore during the day is to open the space on the Atlantic Ocean for kiteboarding during the day. This form of lodging will provide a unique experience for the guest because it affords the opportunity to stay and play on the water. Lodging on the water occurs in Bora Bora French Polynesia allowing the guest to enjoy staying on the water with essentially luxury conditions.



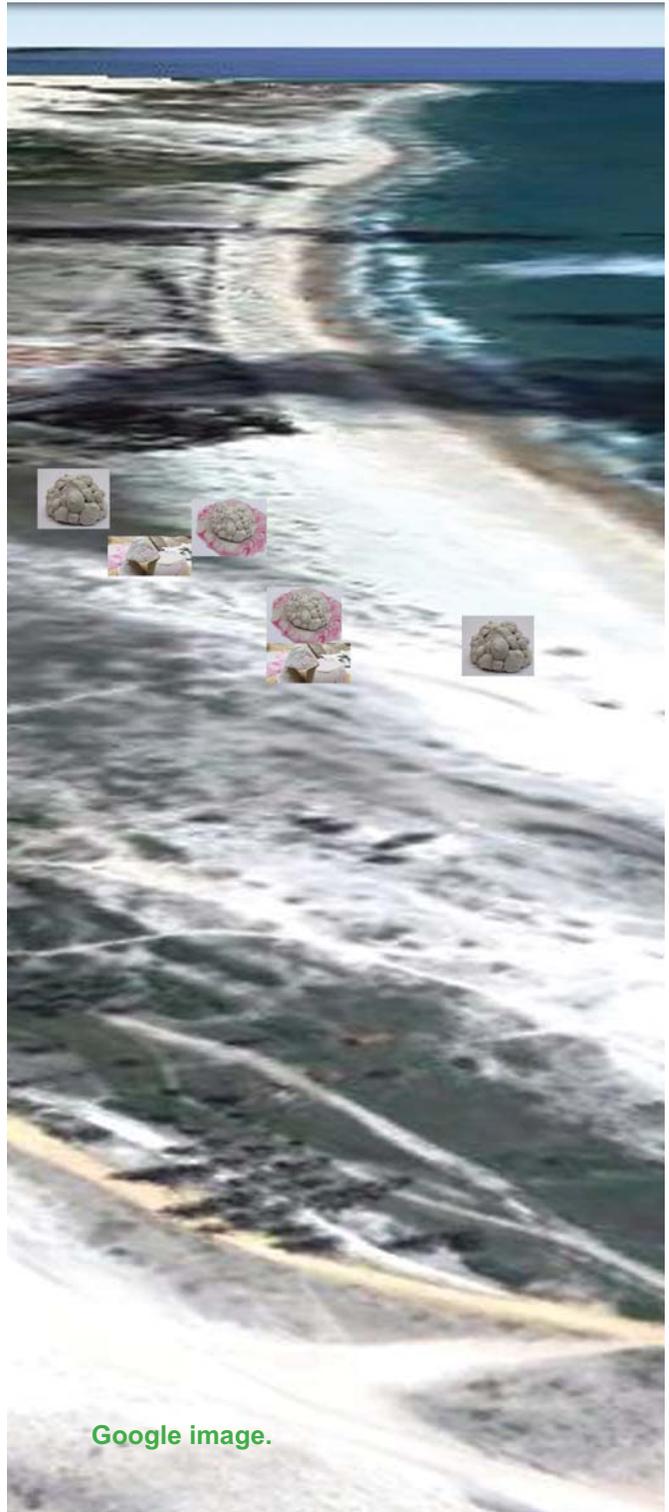
Mass model of potential floating architecture at Cumbuco.



Google image.

Residences will be constructed using materials from the site in the form of sand in the earth bag construction and will also incorporate bamboo grown on site. The earth bag construction will consist of sand from the site along with polypropylene bags assembled at the site. Efforts will be made to use as much natural material from the site as possible to produce structures for residences. The residential aspect of the project will not happen until the second phase because bamboo will be planted during phase one and ready for use in the construction process later in the project. Bamboo should be available for construction roughly three to five years into the project.

Mass models of residential units on site.



Google image.

Wind gathering will be a major source of electric production on the site. Wind on the site will produce more electricity at the site than needed at first, so the excess electricity will be sold off. As the project progresses the electricity will be rolled back into the programming of the project. Wind gathering turbines will be installed in phase one of the project to be used with the wind that is on site to create an asset. Wind is a driving force for the eco resort in Cumbuco because wind is constant and predictable. Fortaleza already has large wind turbines on the ocean placed directly on the water front. For this eco resort wind gathering systems are envisioned away from the water in an effort to open up the water for the guests. Opening up is meant in the sense that the view of the ocean will not be obstructed by towering wind turbines.

Kite turbines by Doug
Selsam @ selsam.com.
Google image.



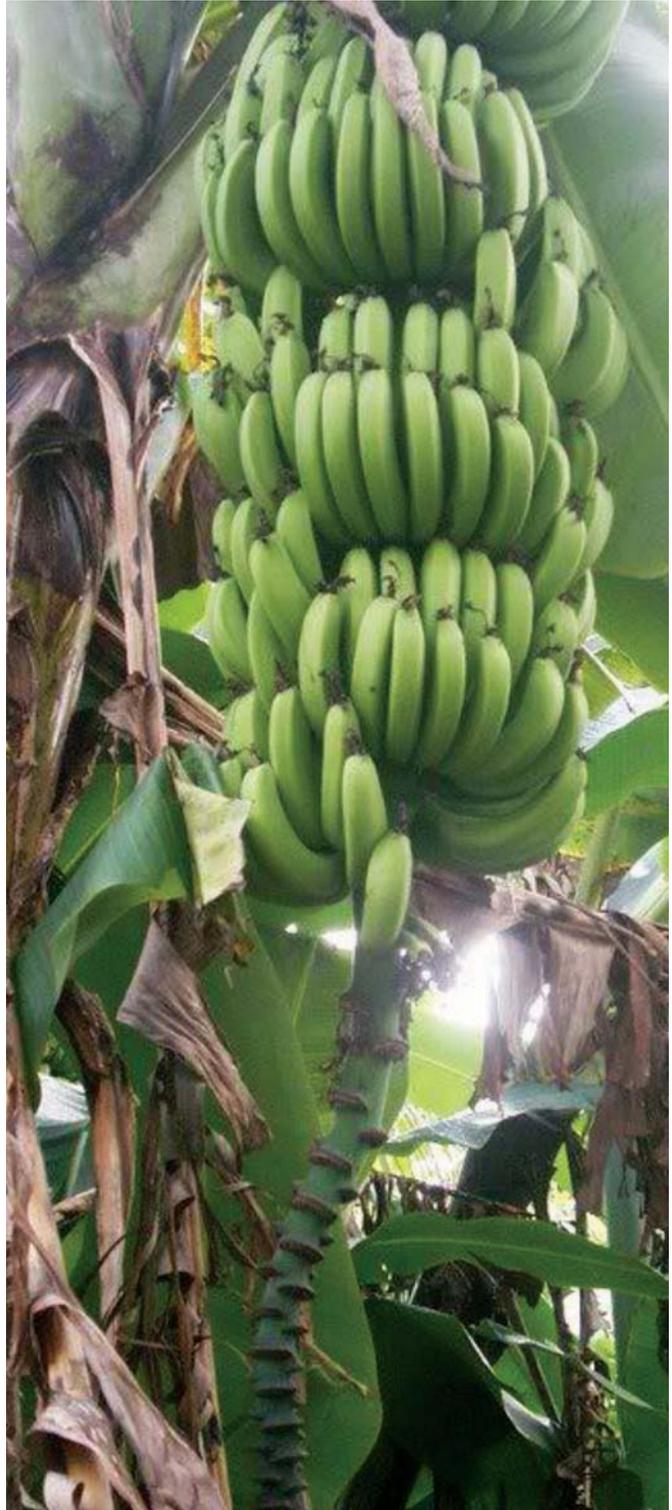
Solar on site will be used in conjunction with the wind gathering on site to produce more electricity than the project actually needs. This excess electricity will be an asset because it will allow the project to grow into what the site can produce. The project will not allow more structures than the site can accommodate based on electricity production. If the site has to import electricity then the project is a failure. Solar for electricity can be integrated into the design of structures or set apart from the structures and placed into a designed area for the explicit purpose of gathering electricity for a specific area of programming.

**Bamboo and solar house
built by Chinese students at
Tonji University. Image from
inspirationgreen.com.**



Plantings on the site will be integral to making this project successful. Landscaping will be in the form of using plants that are native to this region of Brazil combined with plants that do very well in the climate. Plants such as pineapples and cashews are native to the region and will be planted to provide for the restaurants on site as well as the residences. Plants that are not native, but do well in the area such as bananas and coconuts will be incorporated into the site.

Brazil has several species of bananas, coming in different sizes and colors.



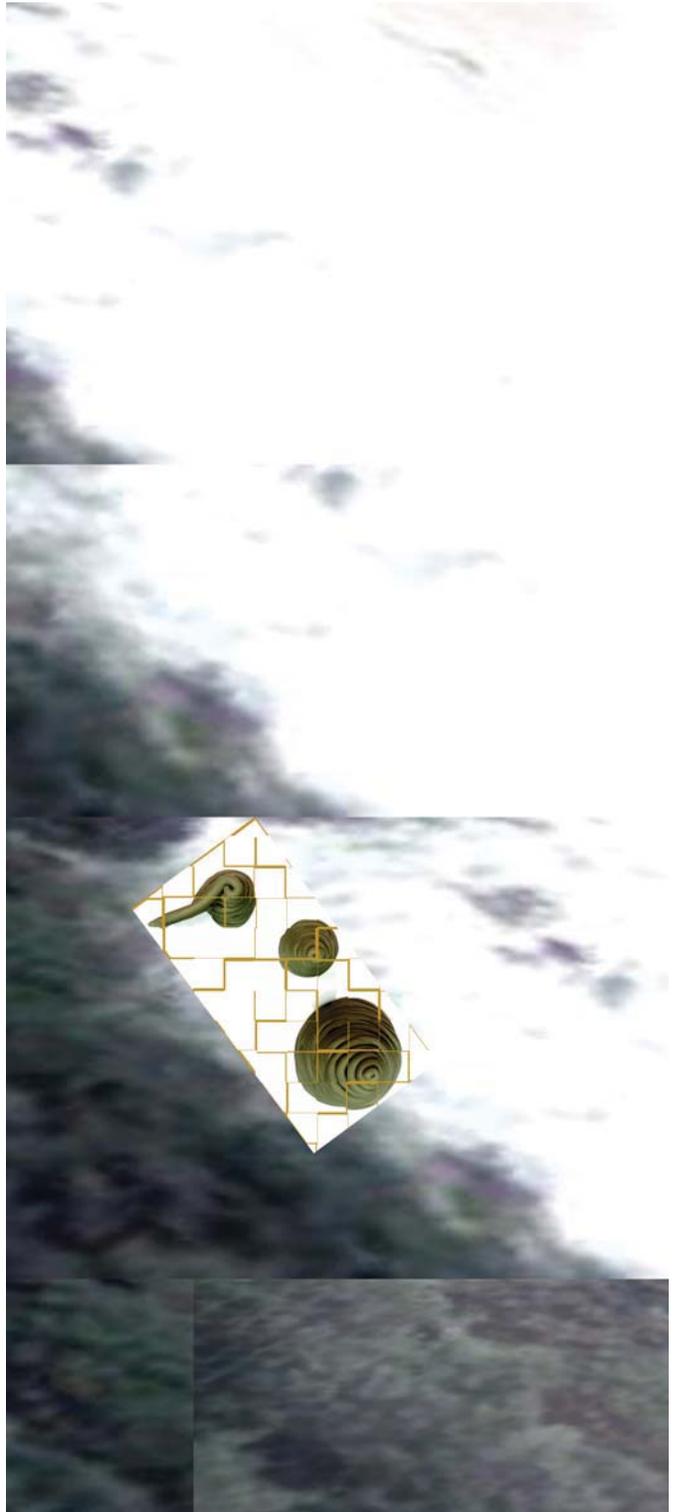
Restaurants on the site will serve fruits and vegetables produced from the site serving guests and residences of the site. The main dining lodge will be constructed using sand bag construction. Bags will be produced on site and sand will be gathered from the site. The main dining lodge will be able to accommodate the majority of people on site at one time. Other options for dining will be a beach side snack/beverage area and dine in room options.

**Main restaurant mass model
envisions restaurant
blending into site.
Google image.**



Security huts will be some of the first structures on site. There will be five huts strategically constructed on site. The huts will allow for experimentation of the earth bag construction. The huts will give guests a sense of comfort as well as help deter any individuals interested in causing harm to the site. As security huts will be first to be constructed they are to be seen from the construction stand point of view as almost like mock wall samples because they will be actual touchable walls and not just pictures. Actual walls being built will give direction as to how the construction process will proceed, yet with actual walls constructed they can be examined and it can be determined if there need to be any tweaking of the designs.

Security huts made with sand bags shown as clay mass models.



Manufacturing on site will consist of a structure containing a shop that produces kiteboards, kites, sand bags, and carbon fiber connections. The boards and kites will be directly related to guests staying at the site. There may be a package deal where lodging and equipment are included.

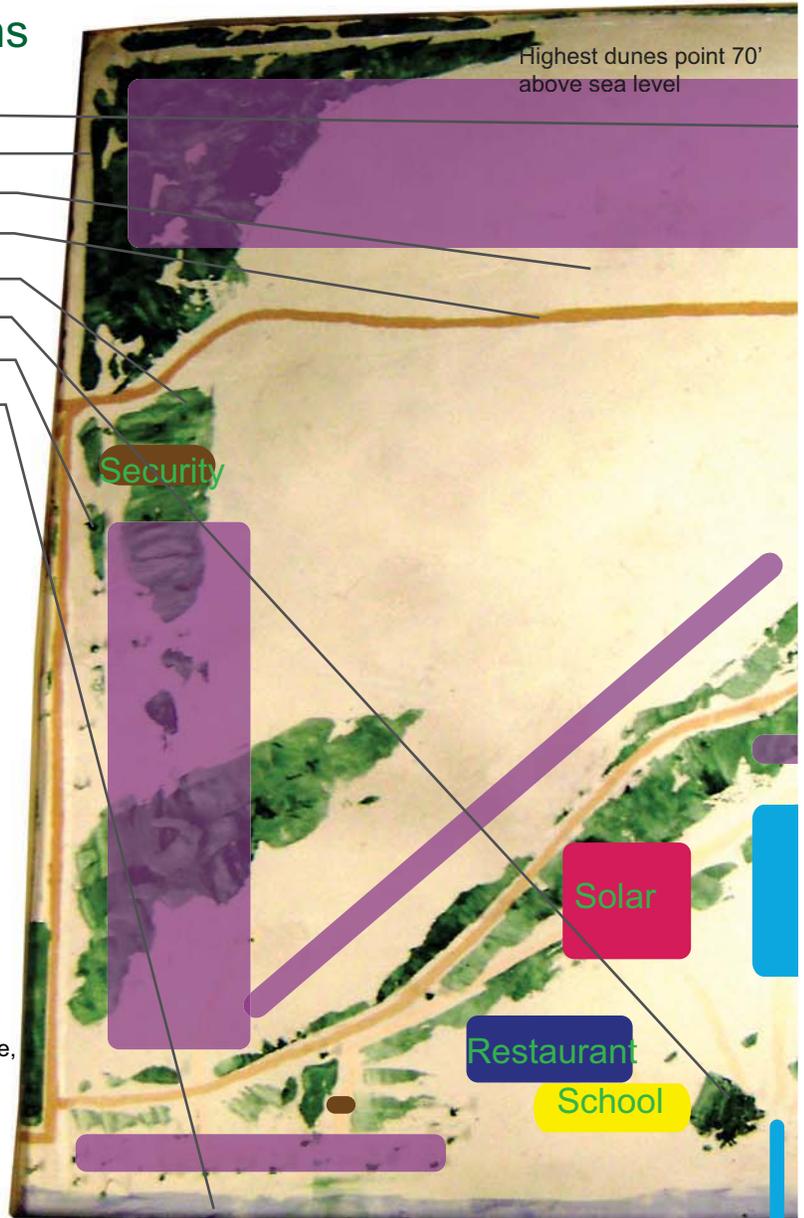
Different colors of polypropylene sacks on left sand bag construction below.



Cumbuco,

Existing Conditions

- Villa Gale Resort
- Property Lines
- Sand Dunes
- Government Roads
- Scrub Vegetation
- Existing Structures
- Banana Trees
- Atlantic Ocean
- Residences



Fortaleza, Ceara Brazil
 Population nearly two million people,
 Roughly 25 minute car ride to site



Ceara, Brazil



Programming

- Kiteboarding School ●
- Hotel ●
- Residences ●
- Wind Gathering ●
- Solar ●
- Plantings ●
- Restaurants ●
- Security ●
- Manufacturing ●





Models in site with several sand bag retaining walls.

How to set up a Business in Brazil

Setting up a business in Brazil is not as easy to do as it is in the United States of America. To set up a business in the U.S. it takes roughly six days where as in Brazil it could take several months. In fact according to <http://doingbusiness.org/rankings> Brazil ranks in 126th place for ease of doing business. This site has the United States ranked at number 4 with Singapore at number 1. Brazil is not only difficult for Americans, but anyone setting up a business. Brazil presents great opportunities as well as great perils to setting up business. For example, real estate prices have continually gone up in recent years in Brazil, where the economic recession has not been as severe as in the United States.

To set up a business in Brazil the first step is getting a card that is similar to a social security card in the U.S. called the Cadastro de Pessoas Fisicas (CPF). According to Arnold's Brazil Guide for Foreign Investors, there are three essential ways one can receive a CPF card, the easiest is to be in Brazil where one can receive a card with in about 2 days. If done out of the country it could take up to a few weeks. To retain this card a tax form must be filed every year, except the year the card is established. It is very helpful to have an accountant handle filing taxes in Brazil. If one does not speak the language it is a necessity to find a translator to help guide one through all processes as there is a high rate of corruption in Brazil. It is a good practice to use a good lawyer or accountant, as well as to interview three or more before deciding on an attorney that one is comfortable to work with.

After one has obtained a CPF it is possible to take the next step to setting up a business: getting an investment visa. This is also not a simple process for an American to do. In an ideal situation one could just open immediately, but that is not possible. As Lee points out "Obtaining an investment visa is a long and arduous journey that can take eight months or more to complete (p 12)." The process involves three steps ending with the third being actually applying for the investment visa. There are numerous differences in the process compared with the U.S., so the best advice is to have cash and hire a trusted lawyer or accountant to guide one through the process. The process is set up so that to even apply for the investment visa one has to deposit 150,000 reals (reals are Brazilian currency, like a U.S. dollar) into a bank account and leave it while the application process works out. Fees associated with obtaining the visa alone are above five thousand dollars. Then there are costs associated with



Tip: get a lawyer familiar with Brazil and interview three before hiring one.

flying back and forth to Brazil and America, as one must be in the U.S. to pick up the visa , then return to Brazil to register within a certain window of time.

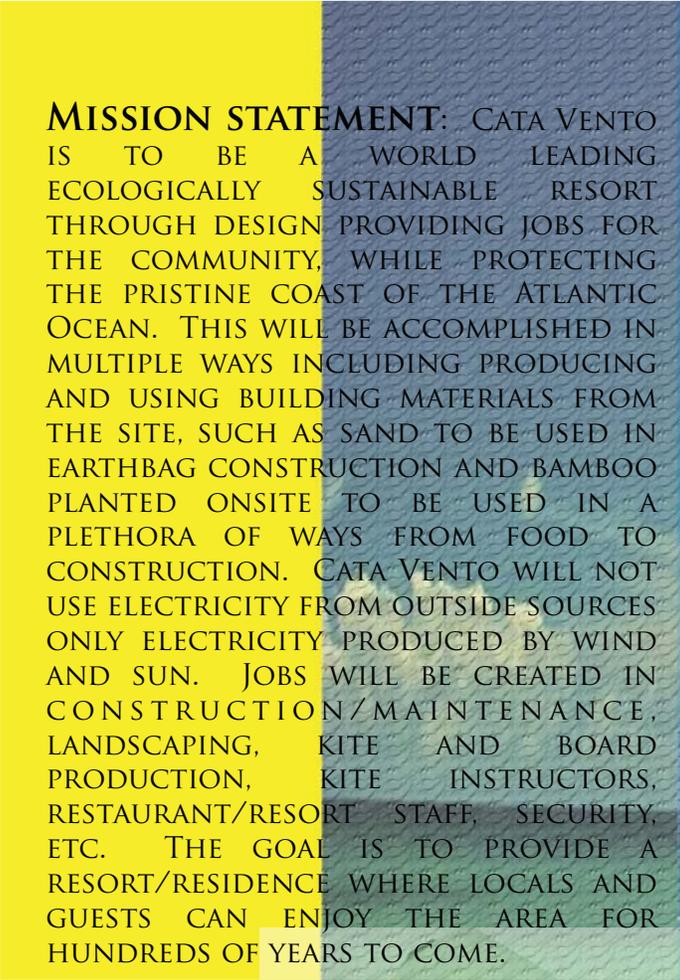
There are variations in the U.S. and Brazil in hiring workers for a business as courts tend to favor workers in Brazil. For every employee, for example in Brazil, it is law that an employer must provide employees with a meal per work day. Workers also receive basically thirteen months of pay per year for eleven months of work. Employers are allowed a trial period of employment, then are bound by law to sign the employee and then it is difficult to fire an employee without being bound to pay the employee salary for the following year. This occurs because employees once signed to work after a thirty day trial period, employees get one month of paid vacation as well as one month extra pay in December. The wages though are much lower for people paid minimum wage in Brazil compared with the U.S. The minimum wage in Brazil is set to rise to \$338.00 dollars per month in 2012 up roughly 13%. The minimum wage in Michigan is \$1,184.00 per month.

Buying real estate in Brazil is an adventure as well. The process is again best handled with an attorney or accountant that is trusted. The item most outrageous to Americans buying property in Brazil may be the Luva. In the U.S. there is not a thing in legitimate real estate that is similar to a luva. The luva is a payment, which is not exactly legal yet tolerated, whereas a buyer gives the seller a cash gift that is not a credit towards anything. For example if one were to purchase a piece of property in Rio one may have to pay the owner 200.000 reals or more based on the location. There are other laws different than in America involving real estate such as rentals. In Brazil one can stay in a rental for up to a year or more before being kicked out by the courts. The court system is slower than compared to the U.S. as well as there are many rights for those that do not own land in Brazil when compared to the United States.

Squatters can lay claim to unoccupied land.

Also, there is a rule in Brazil where one can actually take over another ones land if one is not maintaining property or using it properly. As Lee points out, "...be aware of Squatters Rights called 'Usucapiao', or adverse possession. This is a Brazilian law that allows a citizen to obtain title from the actual owner simply by using the land publicly, and in a peaceful way, without the intervention of the actual owner, who was unaware that squatters were occupying his/her property in the first place. If this occurs for a continued period of time, the squatters known as possessors, may claim the property as their own via a legal proceeding called 'Acao de Usucapiao'. The theory behind usucapiao is that by not disrupting someone else's usage of your property, you as the owner have abandoned your rights to the property, which could then be forfeited to the possessor (Lee p32,33)."

Squatters Rights could be a very interesting intervention for Detroit, but I digress. When one is purchasing land in Brazil there is great opportunity as land values have risen along with the growing economy for the past several years. This growth is projected to grow as Brazil has become an energy independent country, has several major sporting events coming in the near future, and is being discovered by more people from around the world all the time. So, if one is to venture into the real estate market in Brazil one must try to avoid as many pitfalls as possible. Avoiding pitfalls is best achievable by investigating as much as one can on their own and working in combination with a good lawyer that is familiar with such transactions. Between the luvias and other foreign concepts to Americans it should be obvious why to involve an attorney.



MISSION STATEMENT: CATA VENTO IS TO BE A WORLD LEADING ECOLOGICALLY SUSTAINABLE RESORT THROUGH DESIGN PROVIDING JOBS FOR THE COMMUNITY, WHILE PROTECTING THE PRISTINE COAST OF THE ATLANTIC OCEAN. THIS WILL BE ACCOMPLISHED IN MULTIPLE WAYS INCLUDING PRODUCING AND USING BUILDING MATERIALS FROM THE SITE, SUCH AS SAND TO BE USED IN EARTH BAG CONSTRUCTION AND BAMBOO PLANTED ONSITE TO BE USED IN A PLETHORA OF WAYS FROM FOOD TO CONSTRUCTION. CATA VENTO WILL NOT USE ELECTRICITY FROM OUTSIDE SOURCES ONLY ELECTRICITY PRODUCED BY WIND AND SUN. JOBS WILL BE CREATED IN CONSTRUCTION/MAINTENANCE, LANDSCAPING, KITE AND BOARD PRODUCTION, KITE INSTRUCTORS, RESTAURANT/RESORT STAFF, SECURITY, ETC. THE GOAL IS TO PROVIDE A RESORT/RESIDENCE WHERE LOCALS AND GUESTS CAN ENJOY THE AREA FOR HUNDREDS OF YEARS TO COME.

Mission Statement goes hand in hand with the community

Community and the project. Project and the community.

The community and the project will be integral as the site will be constructed, maintained, worked, and lived on by members of the community. The site will provide jobs to members of the community in an environmentally sound development for kiteboarders and guests. Construction techniques will be taught to members of the community and if members of the community know of a local construction technique that will work, then local techniques may be considered. Plantings will be a product of the community on staff because plantings will need maintenance forever. For some people hired, the plantings will be a source of income into retirement. Involving the community is not new in eco resorts as Dr. Brombreck points out in his book *Eco -Resorts Planning and Designing for the Tropics*.

The most important feature of the Jean-Micheal Cousteau Fiji Resort is its integration with the local community. The resort is designed to support and be supported by the local community. It draws on local building knowledge, local traditions and building materials. Design of guest units (bures) follows the design of traditional huts utilising some of their advantageous characteristics, such as very high cathedral ceilings thatched roofs. Bures are strung along the shoreline taking in breezes coming from the sea. Native vegetation provides hedges, which act as both a visual and acoustic barrier between the units (Brombreck p151).

Jobs will be a main point of interest for the community that the site will produce. The project will require construction workers, landscapers, cooks, restaurant workers, kite and board makers, managers, housekeepers, and others. Construction workers will learn techniques of sand bag and bamboo construction that will be used to produce eco luxury accommodations and residences. It is anticipated that techniques used on this project will permeate to the local community and be used to produce other projects using workers from this site. Workers may fluctuate between titles of work as someone could easily be a landscaper and construction worker. For example it would be beneficial to the project if an individual were involved in growing and harvesting bamboo, then the same person uses the bamboo for construction. If one has an intimate knowledge of the materials and the techniques involving the construction process it can only be advantageous. Design can even incorporate how bamboo is growing or conversely, bamboo can be influenced in a direction or shape to make a design easier.

Models of future community work potential with construction.



Although the planting and landscaping techniques of using materials that are local to the area or do well in the area can also permeate into the community as it will be possible to clone plants to be used for other local purposes. Other purposes can be such as planting rows of trees in areas near the resort to maintain the dunes from destructive elements. Workers on the development will be able to help out in the community to make it stronger and more environmentally sustainable. Workshops can be given to workers and community members as training on what works and why. The development will not seek to bar the community from learning landscaping and construction techniques at Cata Vento in an effort to create harmony with in the development and the local Cumbuco community so they can peacefully coexist for hundreds of years to come.



Community of models in University of Detroit Mercy School of Architecture wood shop.



Construction

Models in site with
several sand bag retaining
walls.



Construction will involve bamboo grids to form the shape of structures for the hotels and kiteboarding school on the site. Construction involving split bamboo is based off of work by the Japanese architect Shoji Yoh. Yoh constructs a grid of split bamboo on the ground, then lifts the grid in the middle. When the grid is lifted in the middle the side of the grid are allowed to droop naturally. Yoh braces the grid to support concrete which in turn allows for a flowing form of a structure based off of the form created by the split bamboo grid. For this thesis project it is planned that the bamboo would be grown on site and the concrete placed onto of the grid would be mixed using sand from the site.

Split 1x4 represents bamboo split to create grid for construction.



By splitting the bamboo to create the grid it allows strength and flexibility within the grid. Bamboo can be split with simple tools such as a machete. This splitting of bamboo is another job created by the project, as someone will have to grow, maintain, harvest, cure, and split the bamboo before it can even be used for construction purposes.

Grid with no covering.



Once the bamboo is formed into a grid it must be braced to withstand the weight applied while the concrete is curing. This is very important because if it were to fail a worker could easily be killed or harmed. There would be thousands of pounds potentially supported.

Grid with waterproof covering. Lashing tied for connections.



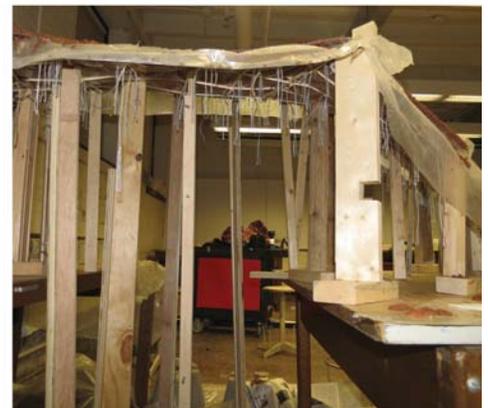
Before concrete is applied to the grid, there must be a water proof membrane separating the concrete and bamboo grid. In the case of Yoh, he then applies concrete and uses rebar for reinforcing. For the case of this model metal lathe was used. For the actual thesis project, if it were really built in Cumbuco, Yoh's example using rebar would attempt to be duplicated, but instead of using rebar for the purpose structural support bamboo would be used based off of research by Dr. Jules J. A. Janseen in Building with Bamboo. "The practice of using melted bitumen is strongly recommended, both to increase the bond (together with coarse sand, nails, coconut fibre rope, or twisted bamboos) and to protect the bamboo from alkaline attack. With these precautions, a concrete beam with a bamboo reinforcement can be designed..." (Janseen p 51). Janseen gives formulas to back up his information for bending moments, allowable stresses, and the like. To use bamboo as opposed to rebar one can still get decent strength as "...the allowable moment in a concrete beam with bamboo reinforcement is about 78 per cent compared with steel reinforcement" Janseen p 51).

Grid with covering, metal lathe as split bamboo.



Concrete, mixed with local sand for the topping would be applied in Cumbuco, with a coloring added for the effect of making the structures blend in with the surrounding landscape naturally.

Coating colored to blend into site.

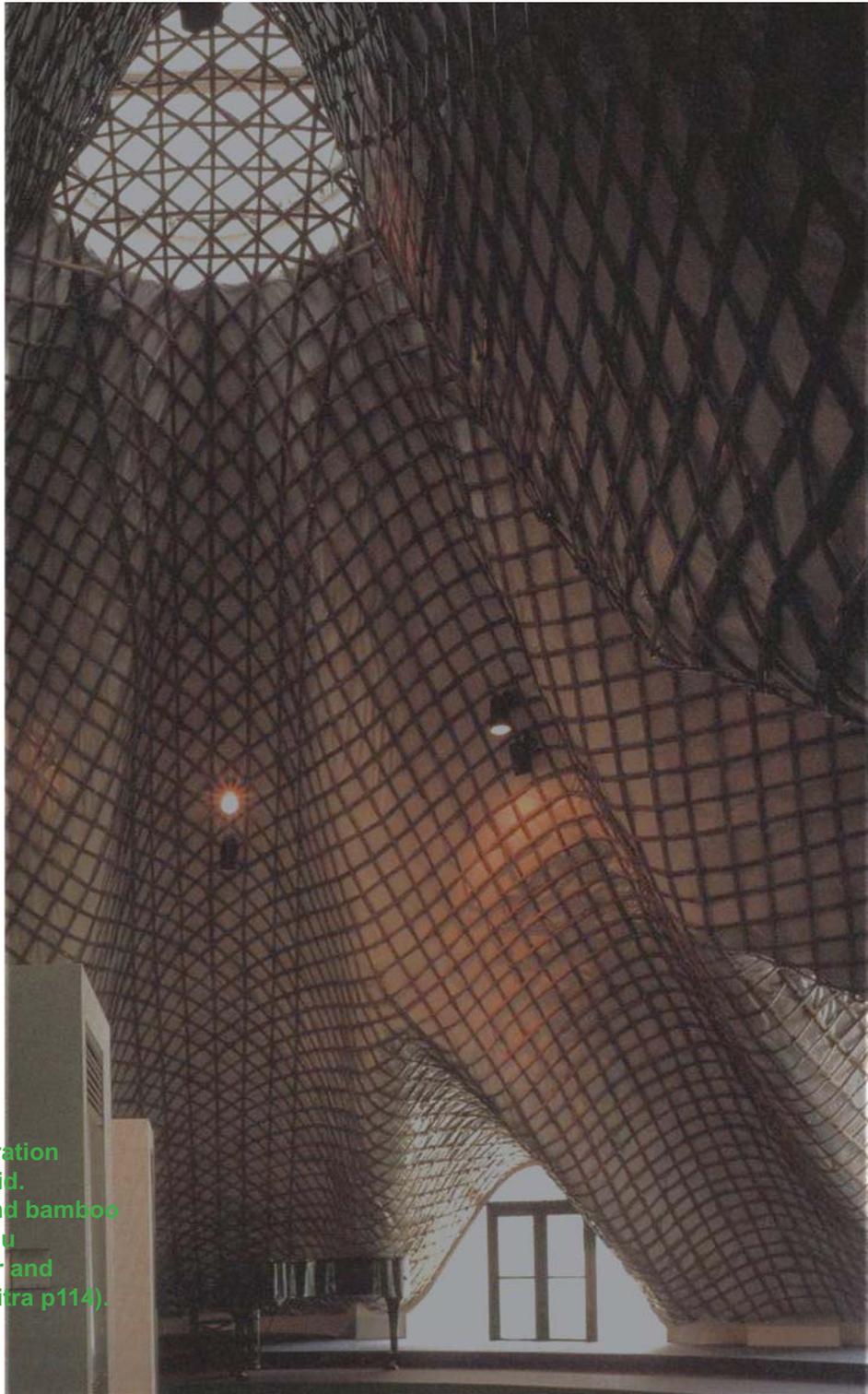


Shapes can be created using the grid and concrete method to welcome cooling breezes off of the ocean as well as to provide shade from the hot sun so close to the equator.

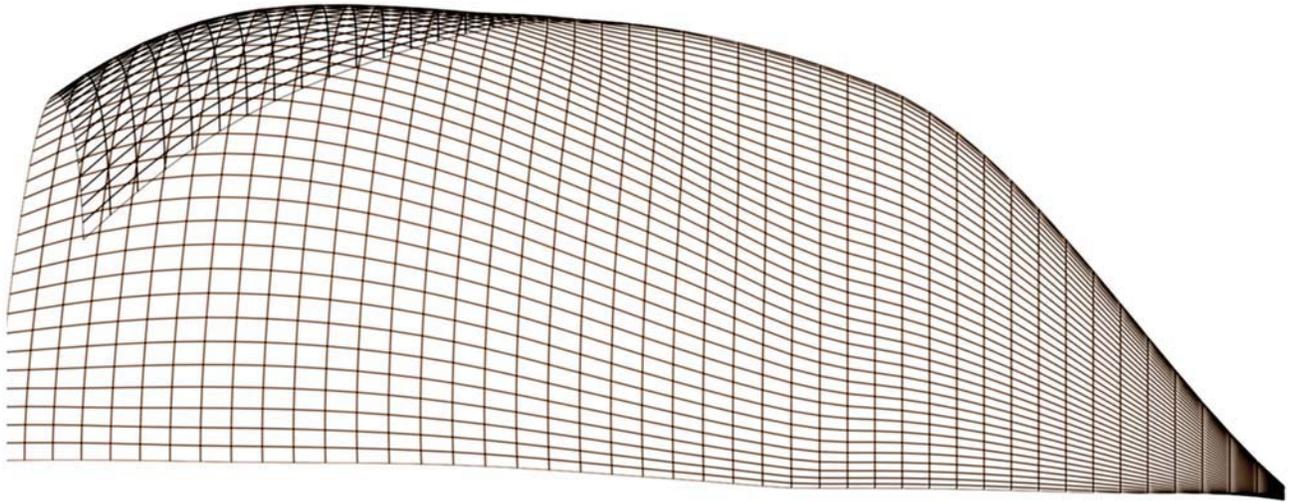


Grid with covering and supports. Model is 4'x8'.

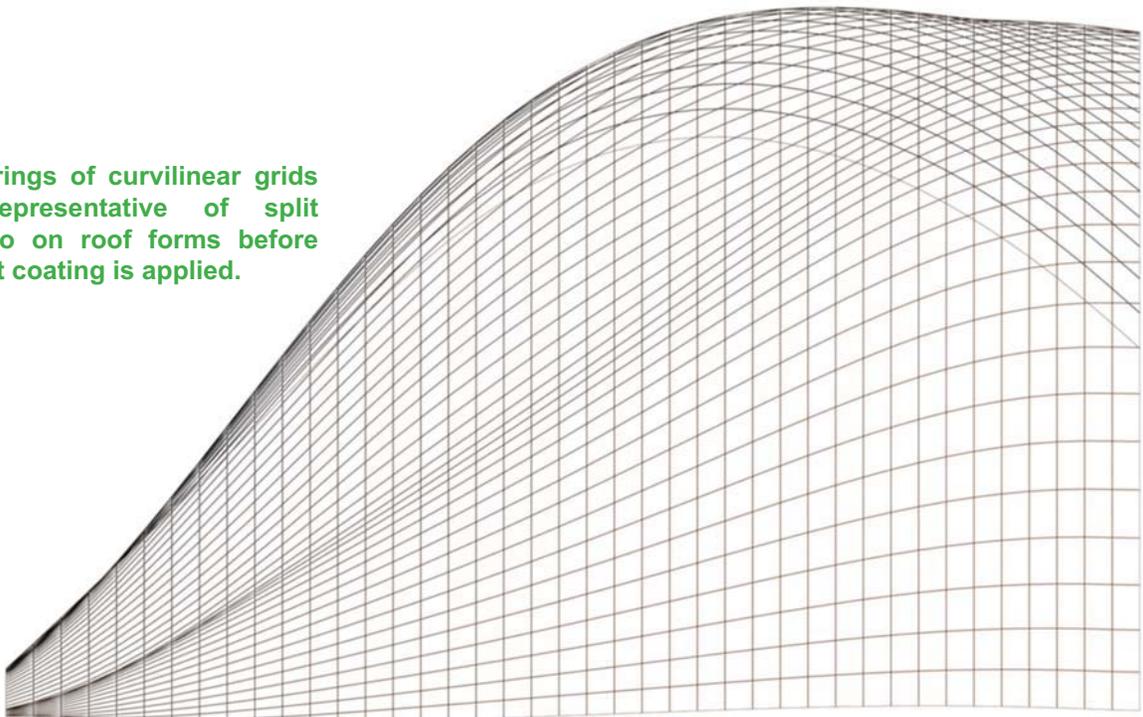




Shoei Yoh is inspiration for models with grid. Example of grid and bamboo shown here in Naiju Community Center and Nursery School (Vitra p114).



Renderings of curvilinear grids are representative of split bamboo on roof forms before cement coating is applied.

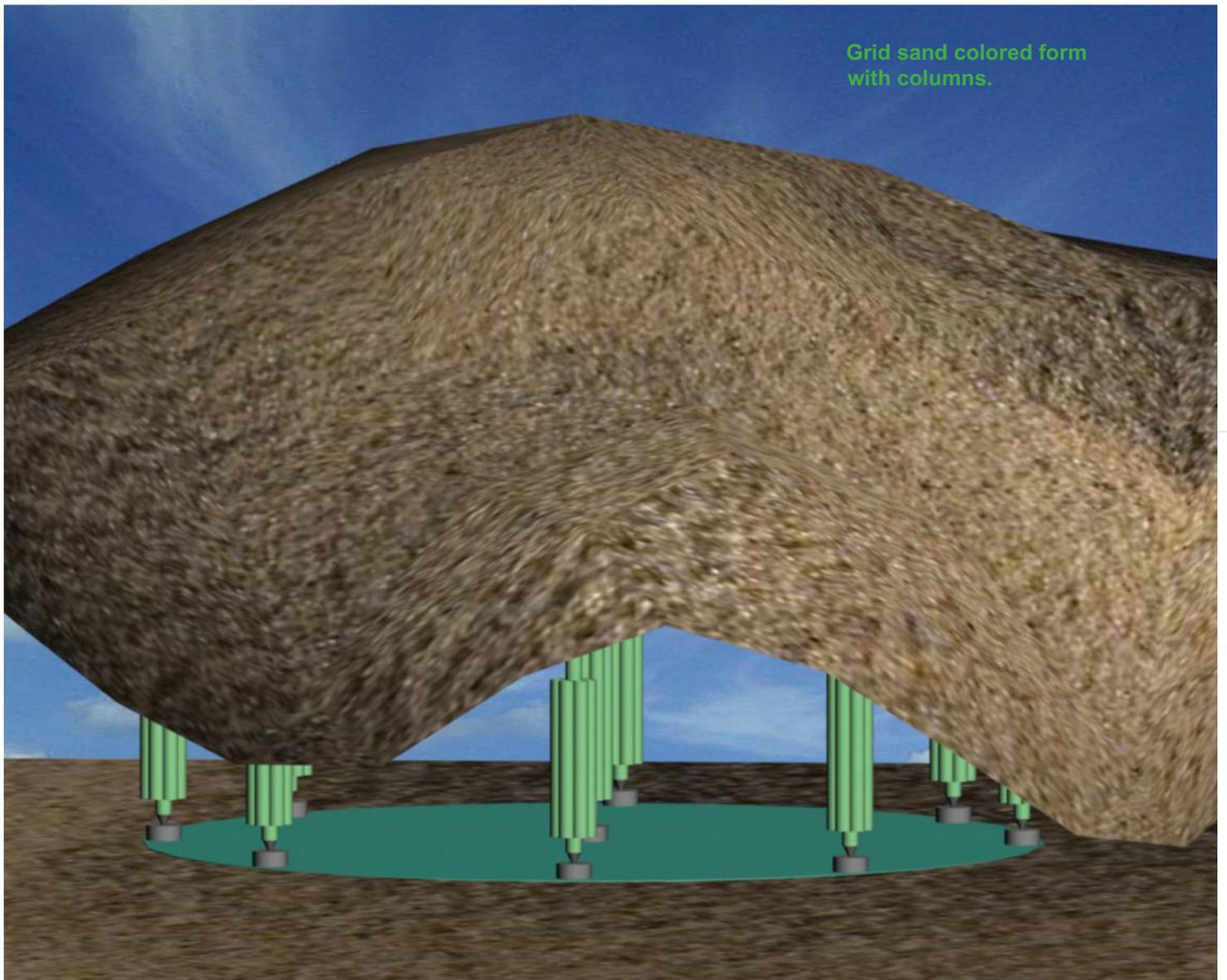




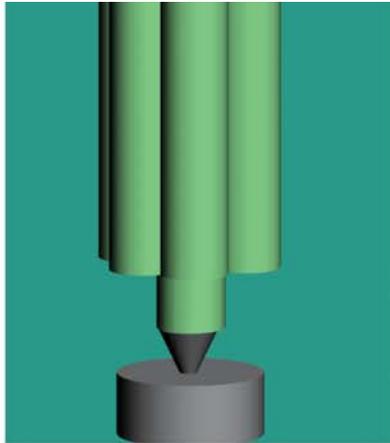
Undulating roof system
to blend into dunes at site.



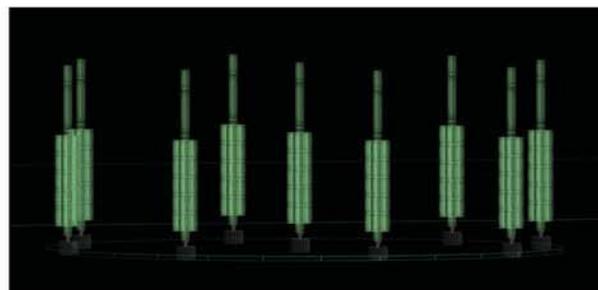
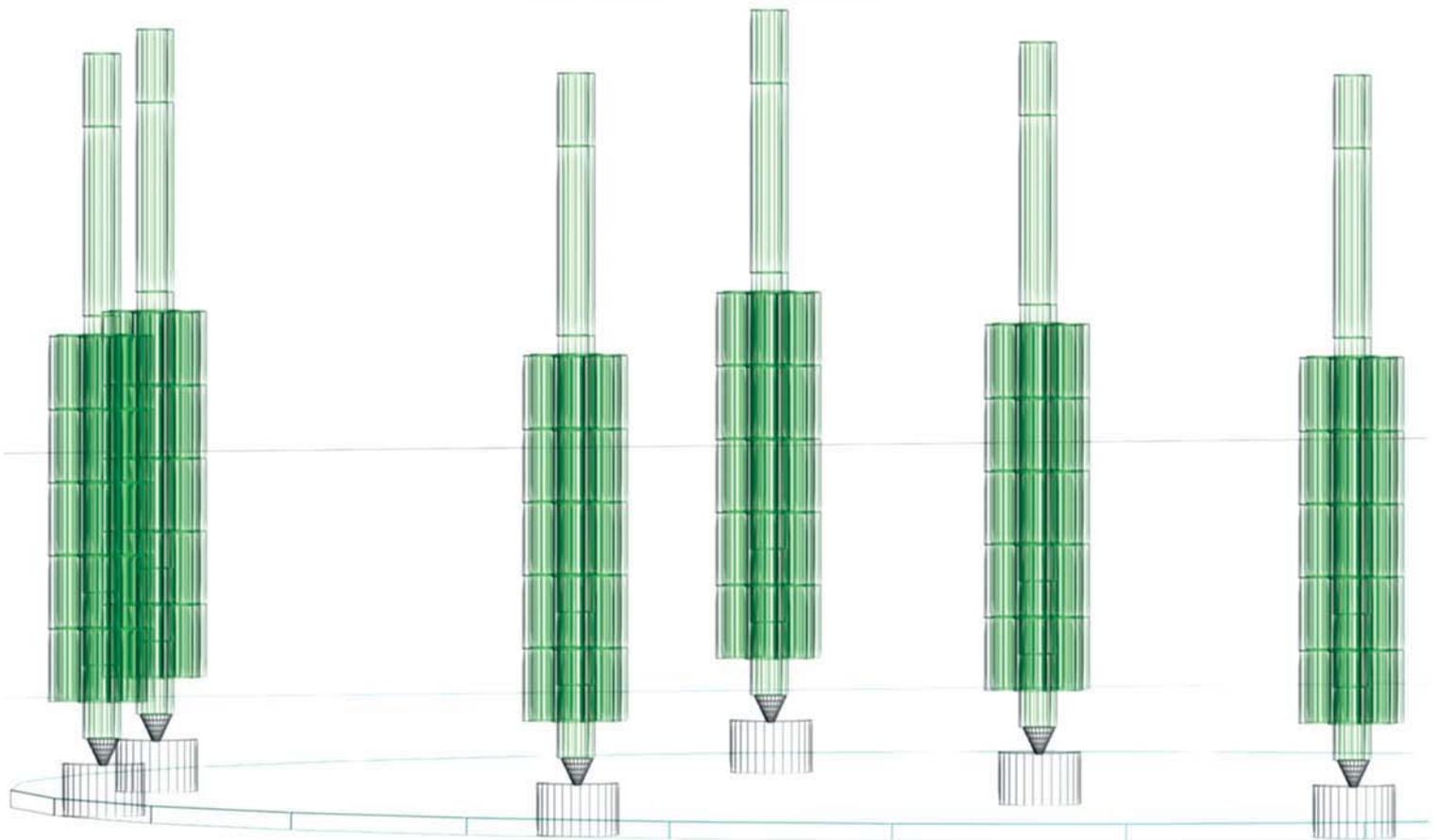
Shapes and forms are virtually endless with the bamboo grid and concrete method. For the supports columns will be fashioned in what is essentially a bundled group.

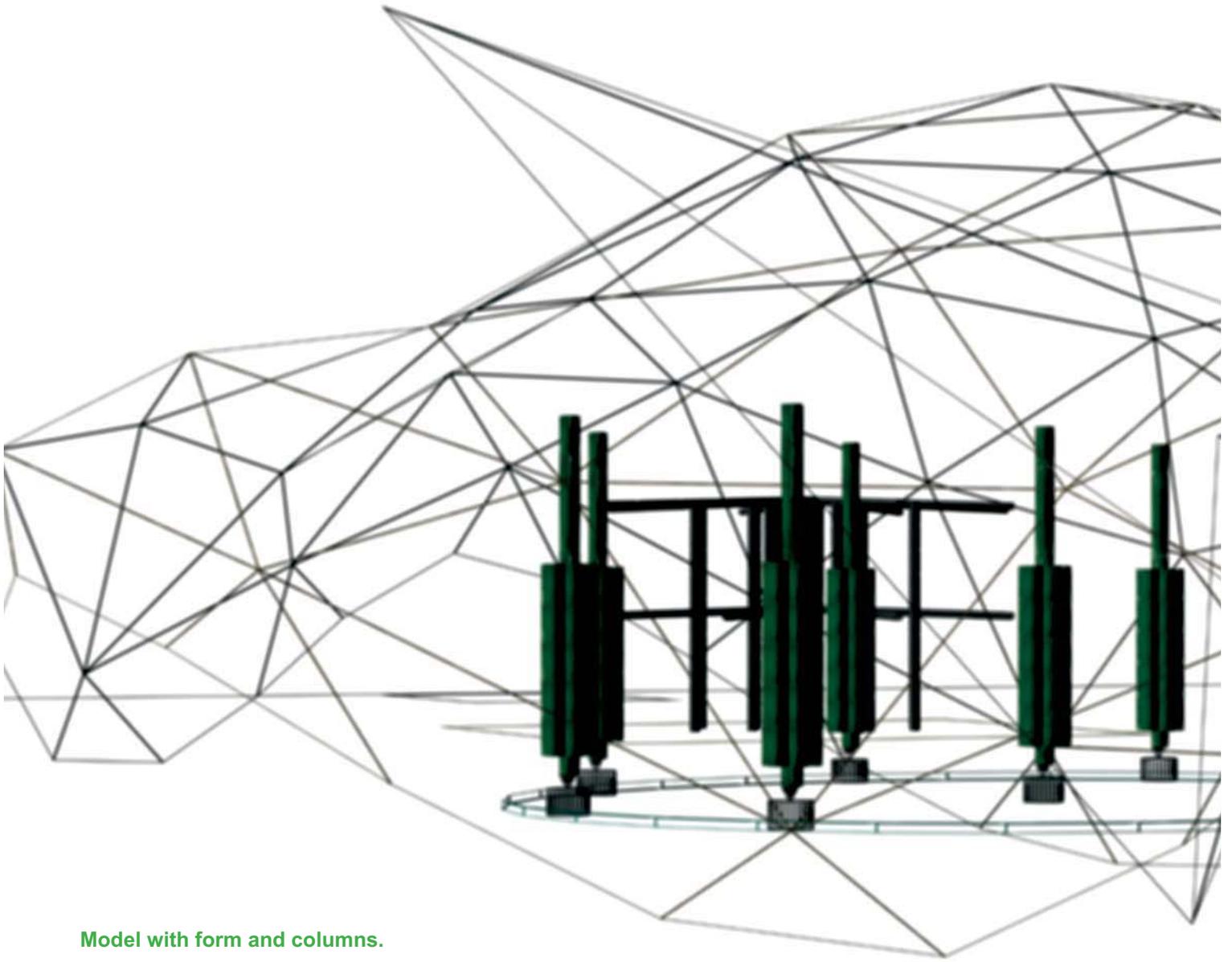


Bamboo can be connected together in a variety of ways for tied lashings to modern connection of bolts. Connected bamboo can form strong columns.

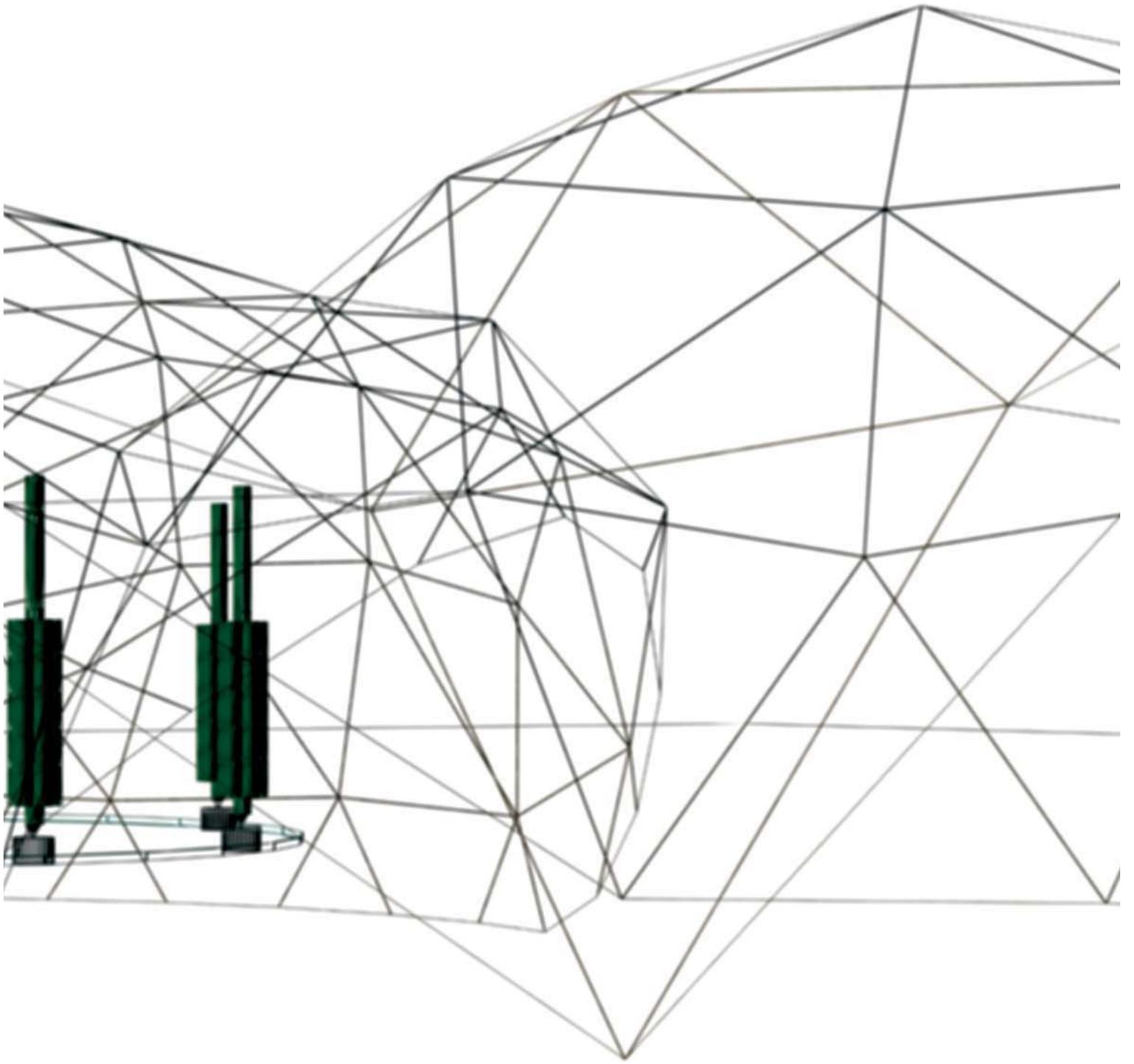


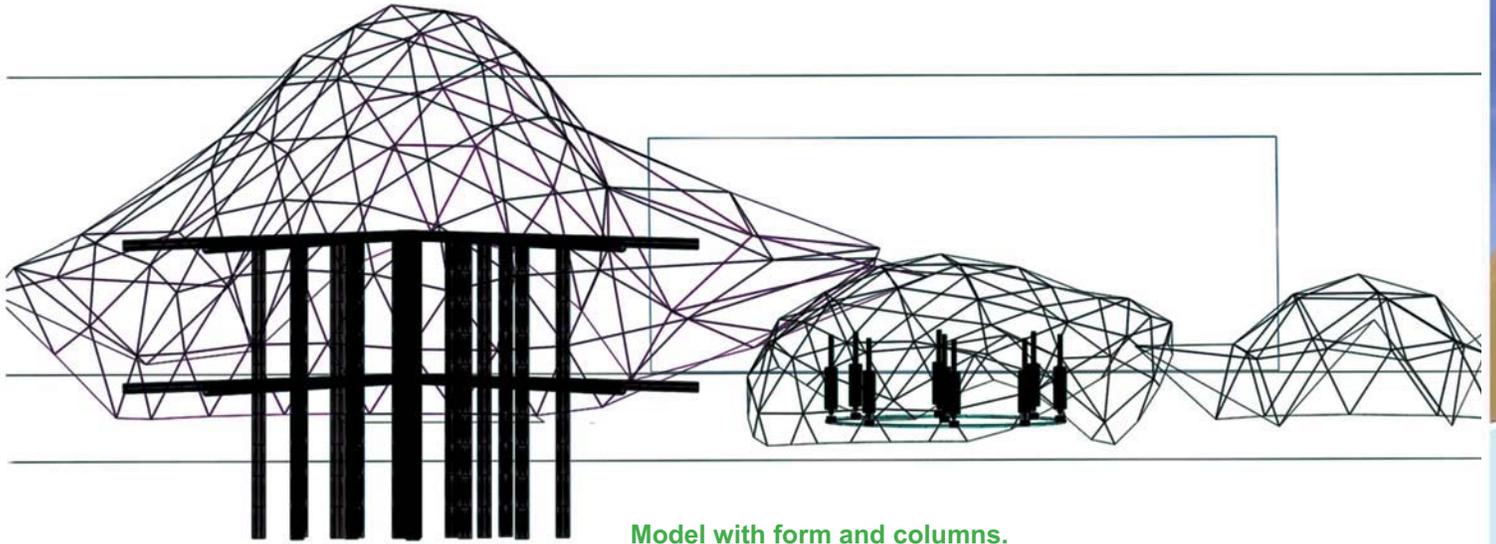
The connection at the base of model shows bamboo cane filled with concrete connected to a concrete pad. This is based off of proved jobs by Simon Valez such as the Prototype for Zeri in Columbia in 1999.





Model with form and columns.

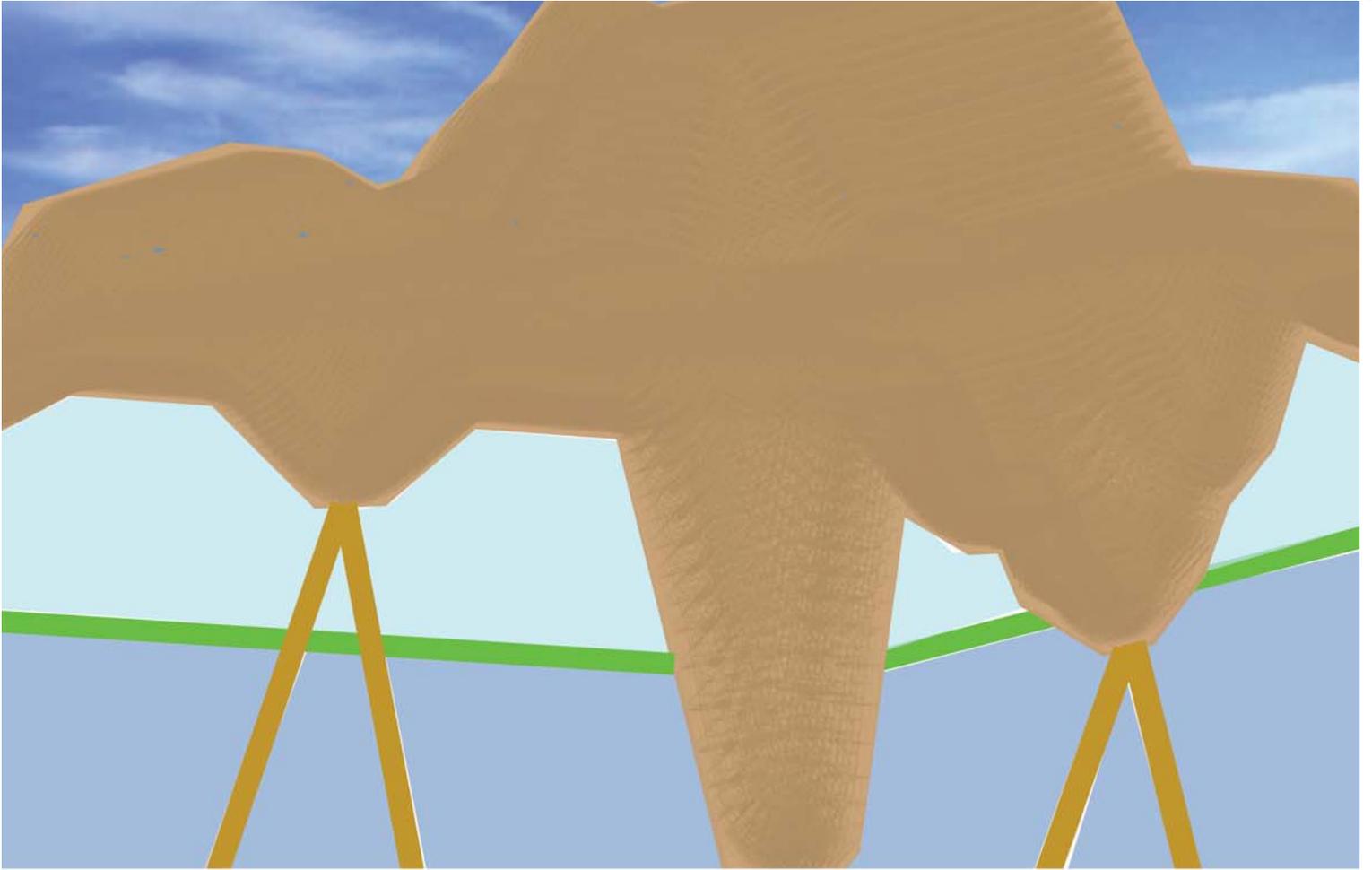




Model with form and columns.

Home by Simon Velez in France for
“low-cost housing” (Vitra p63) .



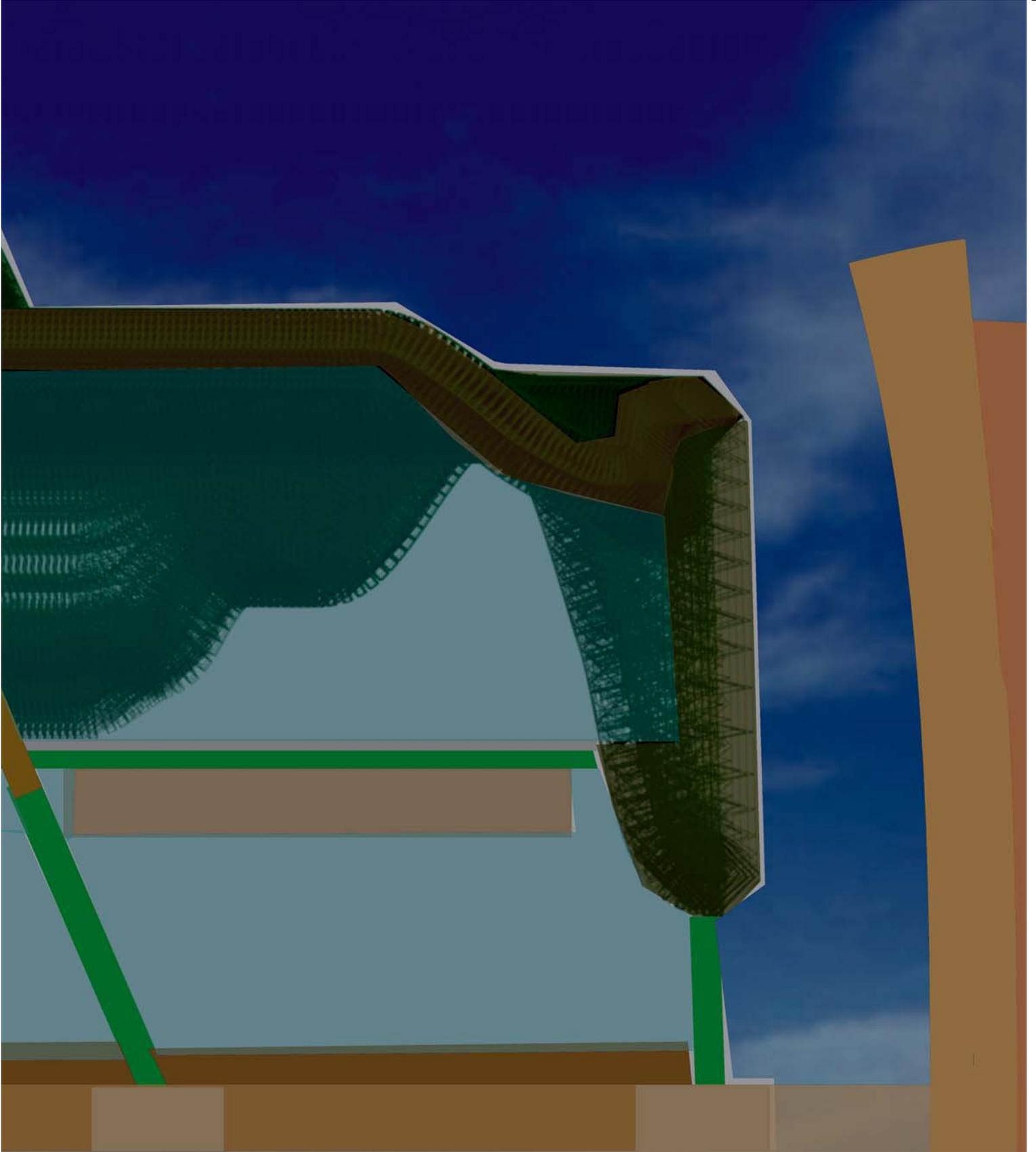


Models constructing with bamboo .

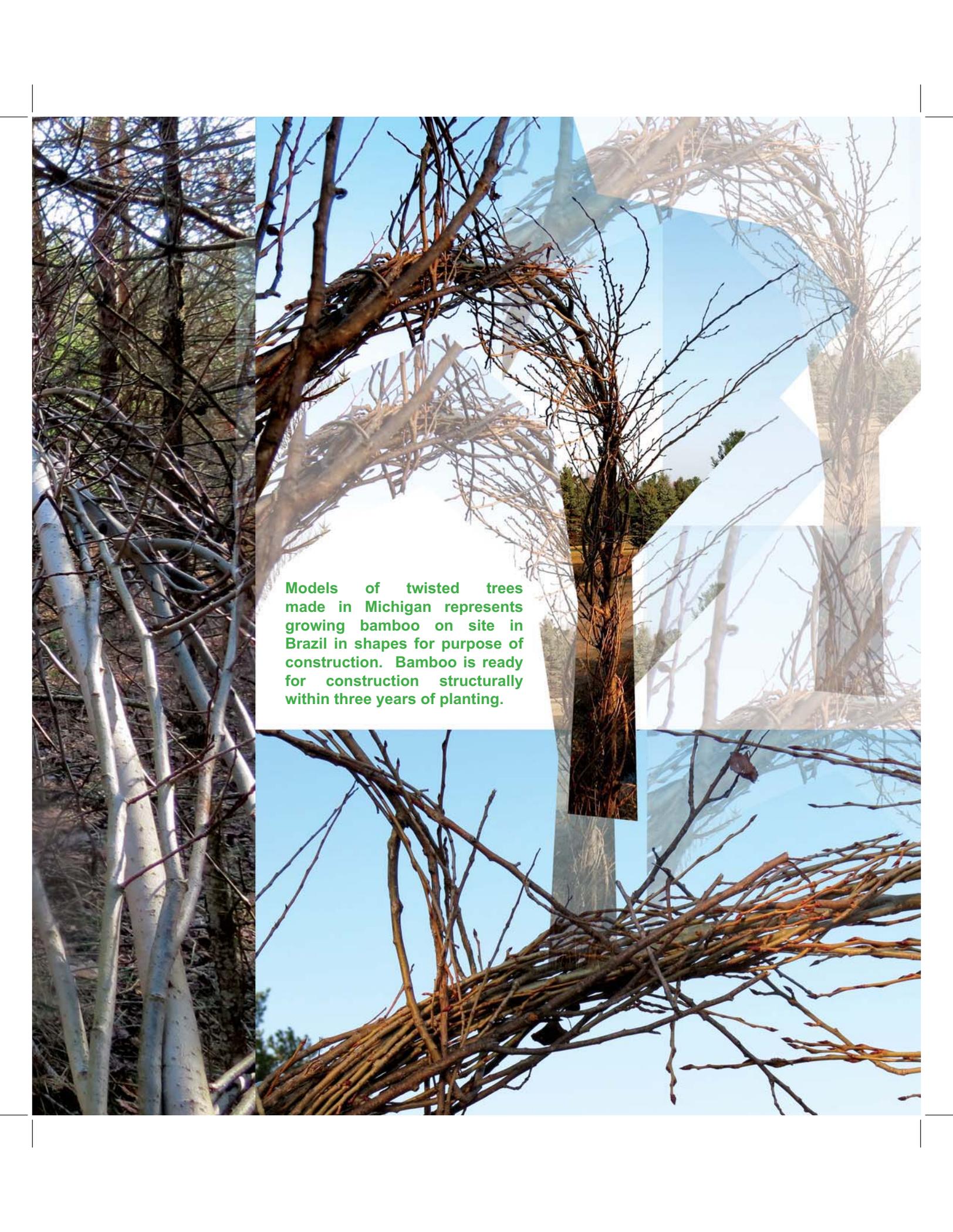


Grid, bamboo columns,
and sand bags rendering.









Models of twisted trees made in Michigan represents growing bamboo on site in Brazil in shapes for purpose of construction. Bamboo is ready for construction structurally within three years of planting.



Bamboo is reversed with the root used for support on picture on the left (Vitra p 88). The same is being mimicked on the model above.



Opposite page Robert J. Jess working in the University of Detroit Mercy School of Architecture wood shop welding metal to represent bamboo in model form.

Photo Brian Wisnewski



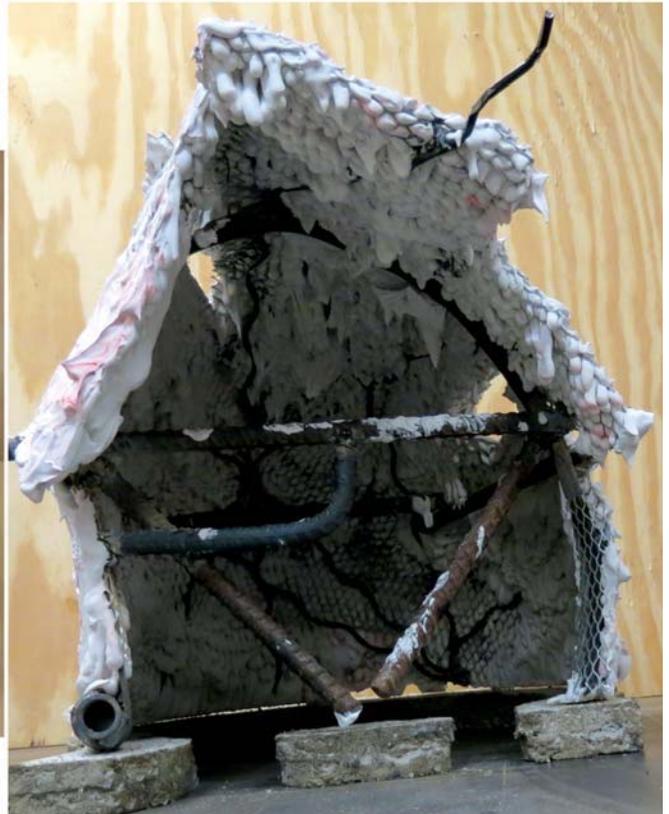


Model made of re-bar, metal lathe, and pieces of cut metal form the structure of construction here with the metal acting as bamboo grown on site. Arch is made of metal on behalf of bamboo grown and formed at the site.





Coating on bamboo would contain textures and colors. Coating of cement/sand mixture would be allowed to flow through the cured split bamboo. To cure the bamboo on site it would be cut, stored vertically to dry, then treated by smoking.



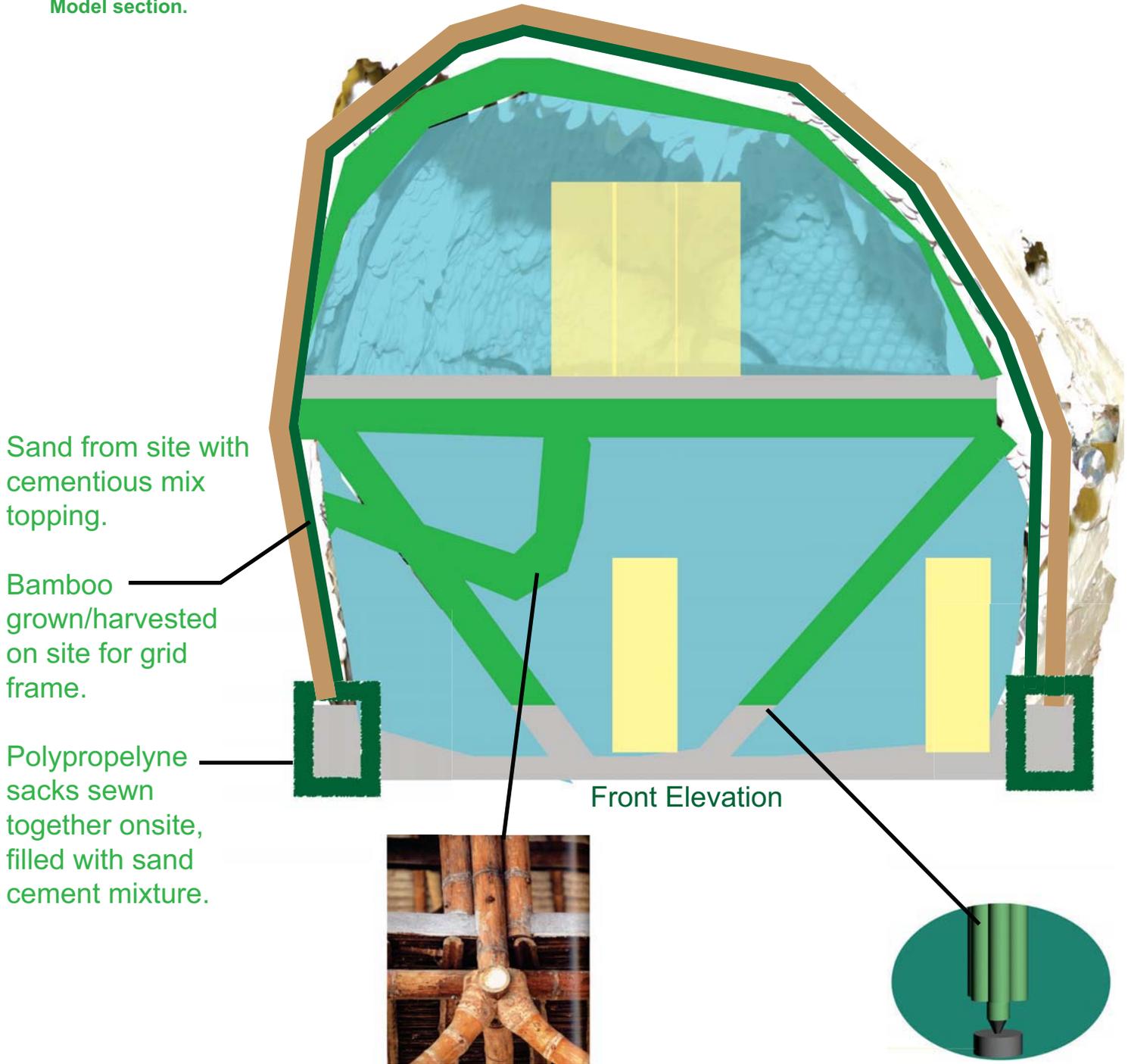


Interior coating textured like stalactite.

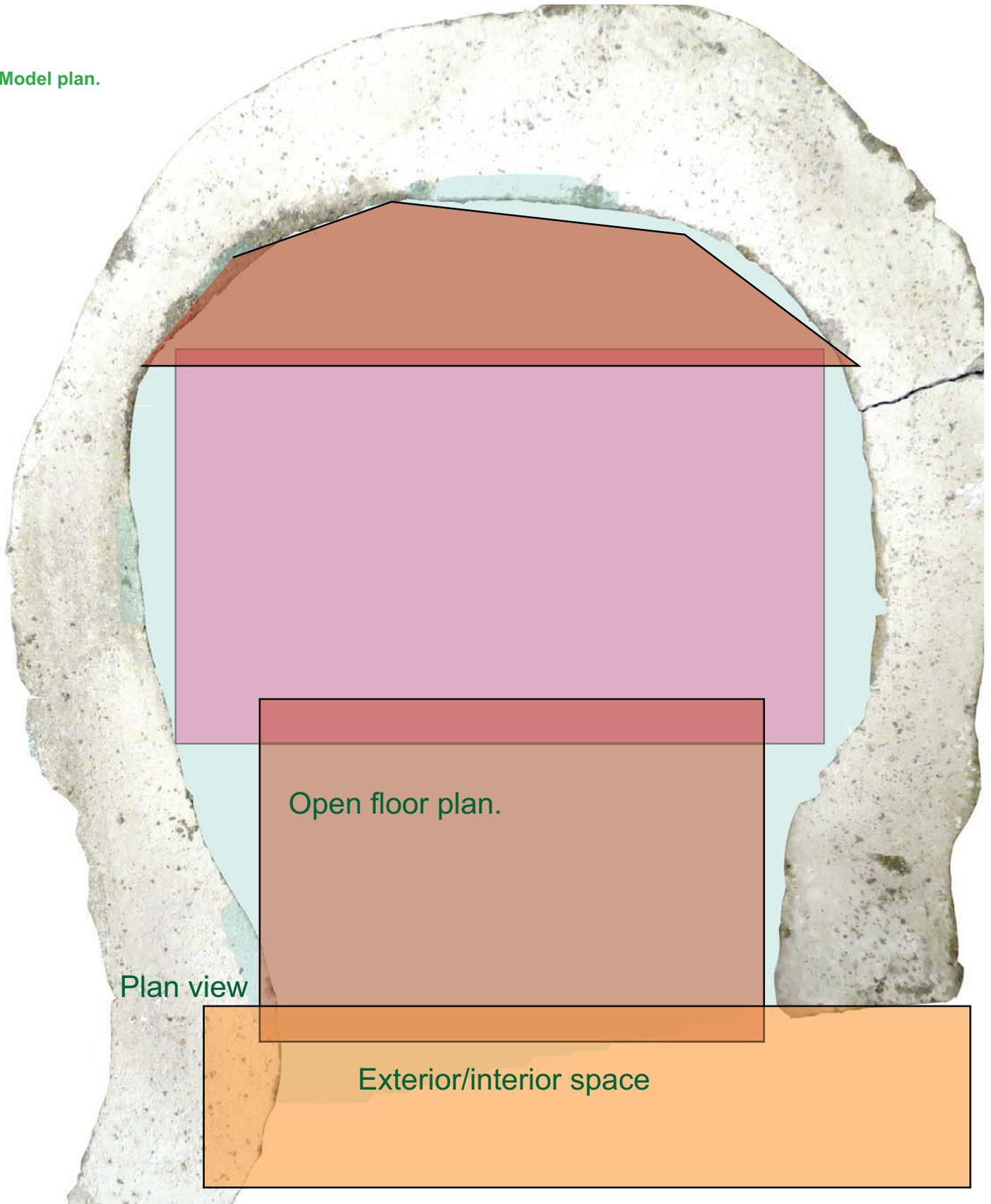


Structure is coated, with concrete footings in model in lieu of sand bags produced on site. Creating jobs in not only production of sand bags and bamboo, but also in construction/maintenance of development.

Model section.



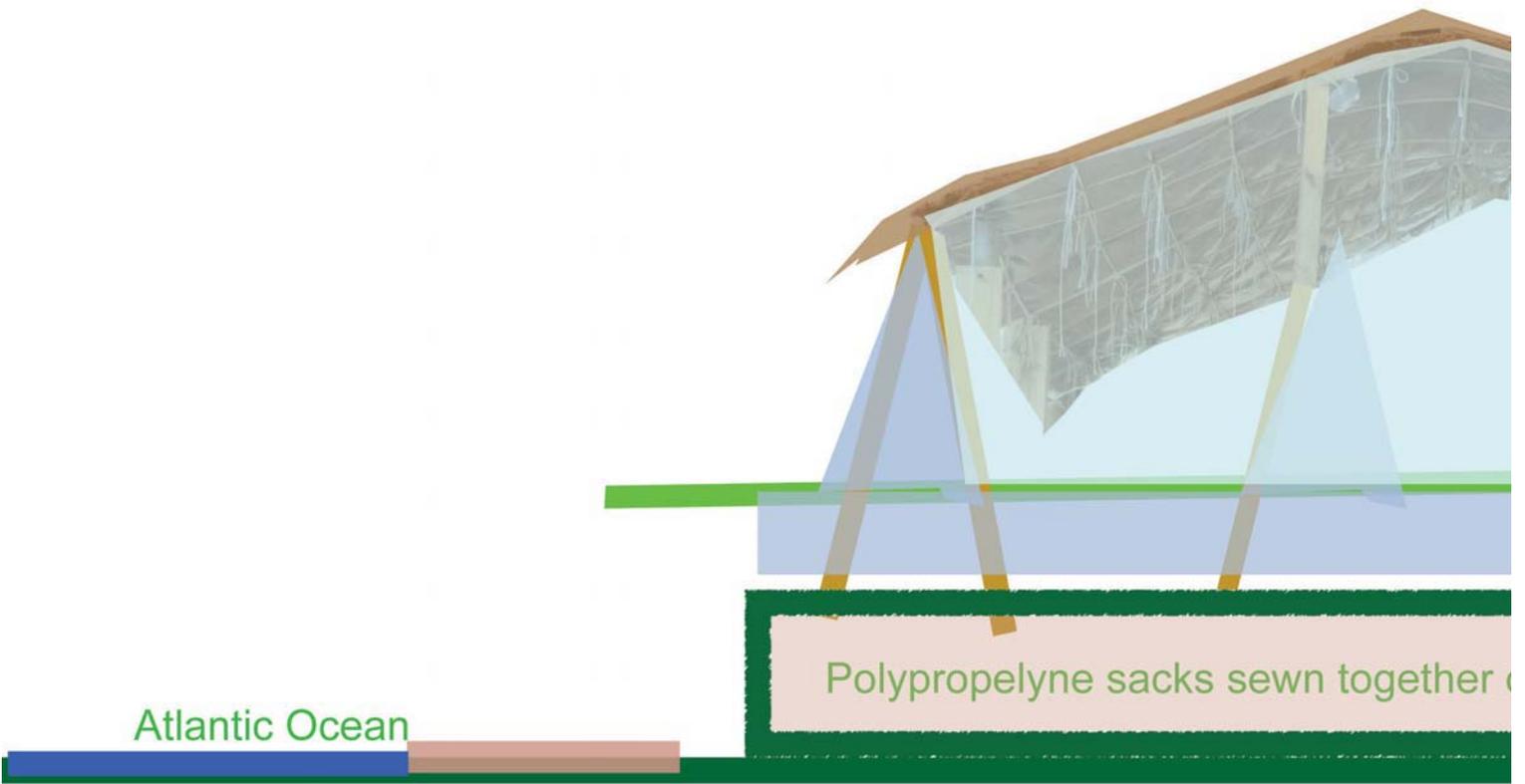
Model plan.

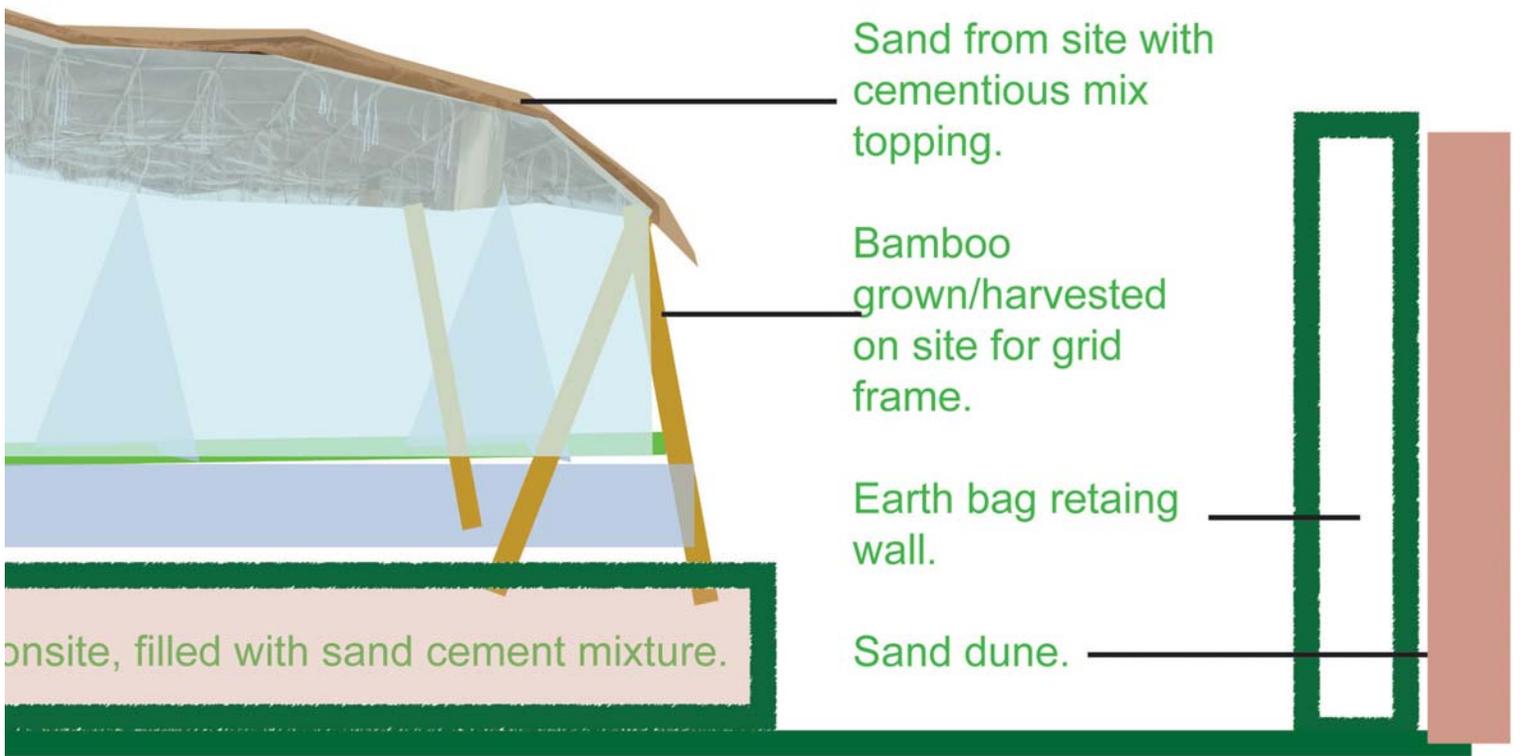


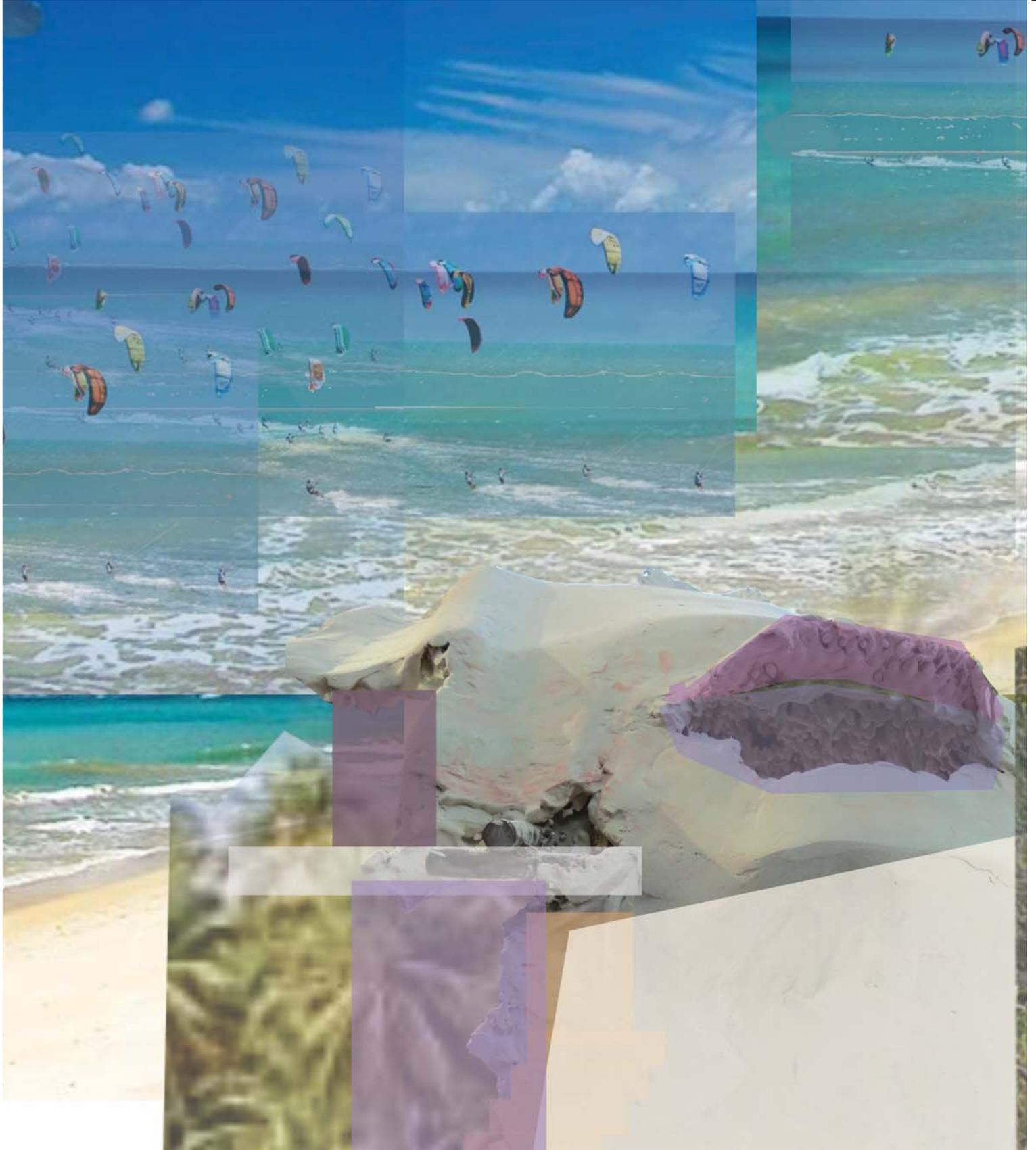
Plan view

Open floor plan.

Exterior/interior space









Marketing

Marketing for the thesis project has ventured into coming up with a name for the resort, mission statement, color palette, list of activities, location, and reasons why to go to Cumbuco. For the project to actually be successful in reality it will need a team to make it breathe. To give the resort development an identity and mission can influence future direction as the mission statement acts as a rudder for a ship. The colors chosen for the writing of Cata Vento on the pamphlet are based off of colors in the Brazilian flag and can be used throughout the resort when it is necessary to have unifying colors in design motifs from restaurant interiors to kites used for rentals in the kite school. The pamphlet highlights how Brazils economy has not and is not feeling the recession that the United States is currently in 2012, making Brazil an attractive market option to a graduating architecture student that has to learn the trade of architecture somewhere.

The image features a complex, abstract composition of overlapping rectangular blocks. The primary colors are a vibrant yellow, a muted sage green, and a deep, textured blue. These colors are layered to create a sense of depth and movement. Some blocks have a fine, repeating embossed pattern, while others are smooth. The arrangement is non-representational, focusing on color and texture. A central white rectangular area contains the text.

**Colors for marketing abstracted
from Brazil flag colors.**

CATALUNYA

BRAZIL'S ECONOMY IS GROWING AND HAS NOT EXPERIENCED THE DOWNTURN THE UNITED STATES HAS FELT THE LAST FEW YEARS DUE TO A RECESSION. REAL ESTATE PRICES IN CUMBUCCO HAVE STEADILY INCREASED IN THE PAST DECADE AND SURELY WILL INCREASE MORE IN THE NEAR FUTURE AS MORE OF THE WORLD IS EXPOSED TO THE AREA WITH THE WORLD CUP IN SOCCER AND THE OLYMPICS COMING ALL WITHIN THE NEXT FOUR YEARS. FORTALEZA IS A MAJOR CITY WITH AN INTERNATIONAL AIRPORT LOCATED TWENTY FIVE MINUTES BY CAR FROM THE SITE. DIRECT FLIGHTS ARRIVE DAILY FROM EUROPE. BRAZIL IS A COUNTRY WHERE FOREIGNERS CAN OWN PROPERTY OUTRIGHT.



ACTIVITIES

- KITEBOARDING
- DIVING
- COOKING CLASSES
- ZIPLINE RIDES
- HIKING
- LOUNGING ON THE ATLANTIC OCEAN
- FISHING
- KITE MAKING CLASSES
- KITEBOARD MAKING CLASSES
- GARDENING CLASSES
- CAPOEIRA
- ENJOY ON SITE RESTAURANTS
- EAT FOOD PRODUCED ON SITE
- SURFING
- BEACH VOLLEYBALL AND SOCCER
- MASSAGES
- ELECTRIC VEHICLES



CATA VENTO

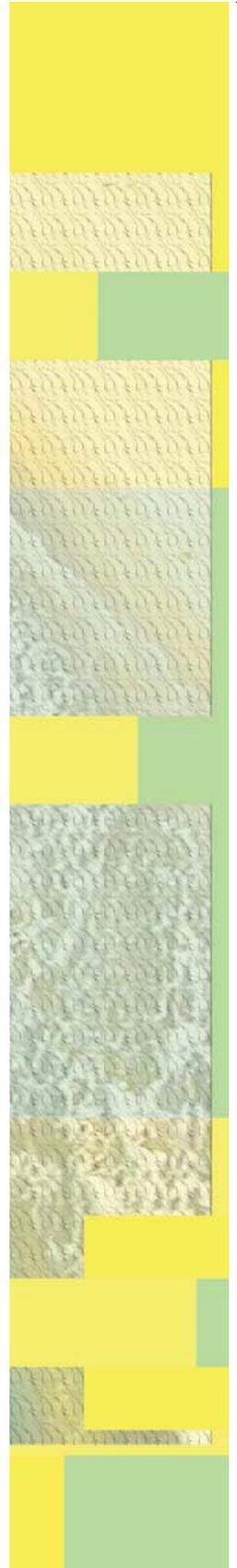
ECO-KITEBOARDING RESORT
WITH RESIDENCE OPTIONS.

LOCATED ON THE NORTHEASTERN
COAST OF BRAZIL IN THE WORLD
FAMOUS KITEBOARDING TOWN OF
CUMBUCO.

WHY CUMBUCO, BRAZIL?
-WARM WATER & CONSTANT WIND.



Outside of pamphlet to be used
in marketing of resort that mean
“Wind Catcher” in English.





Inside of marketing pamphlet. Emphasizes sites Atlantic Ocean proximity and accessibility for kiteboarding.

MISSION STATEMENT: CATA VENTO IS TO BE A WORLD LEADING ECOLOGICALLY SUSTAINABLE RESORT THROUGH DESIGN PROVIDING JOBS FOR THE COMMUNITY, WHILE PROTECTING THE PRISTINE COAST OF THE ATLANTIC OCEAN. THIS WILL BE ACCOMPLISHED IN MULTIPLE WAYS INCLUDING PRODUCING AND USING BUILDING MATERIALS FROM THE SITE, SUCH AS SAND TO BE USED IN EARTHBAG CONSTRUCTION AND BAMBOO PLANTED ONSITE TO BE USED IN A PLETHORA OF WAYS FROM FOOD TO CONSTRUCTION. CATA VENTO WILL NOT USE ELECTRICITY FROM OUTSIDE SOURCES ONLY ELECTRICITY PRODUCED BY WIND AND SUN. JOBS WILL BE CREATED IN CONSTRUCTION/MAINTENANCE, LANDSCAPING, KITE AND BOARD PRODUCTION, KITE INSTRUCTORS, RESTAURANT/RESORT STAFF, SECURITY, ETC. THE GOAL IS TO PROVIDE A RESORT/RESIDENCE WHERE LOCALS AND GUESTS CAN ENJOY THE AREA FOR HUNDREDS OF YEARS TO COME.

ACCOMMODATIONS ALLOW FOR GUESTS TO STAY ON THE WATER, AT ONSHORE, HOTEL ROOMS OR IN BEACH SIDE BUNGALOWS. ALL THREE CHOICES HAVE FAMILY FRIENDLY OPTIONS.

STAY & PLAY ON THE OCEAN.

RESIDENCES WILL BE AVAILABLE AFTER RESORT HAS BEEN OPENED FOR FOUR YEARS TO ALLOW FOR BAMBOO TREES TO MATURE FOR CONSTRUCTION.



Inside of marketing pamphlet. Emphasizes sites Atlantic Ocean proximity and accessibility for kiteboarding.

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ACCOMMODATIONS ALLOW FOR GUESTS TO STAY ON THE WATER, AT ONSHORE, HOTEL ROOMS OR IN BEACH SIDE BUNGALOWS. ALL THREE CHOICES HAVE FAMILY FRIENDLY OPTIONS.

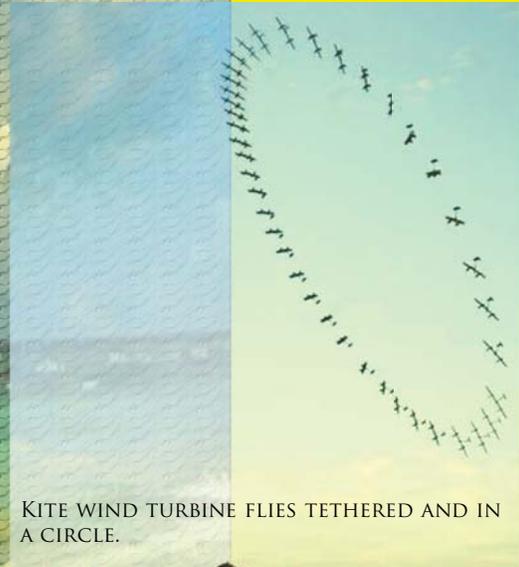
STAY & PLAY ON THE OCEAN.

RESIDENCES WILL BE AVAILABLE AFTER RESORT HAS BEEN OPENED FOR FOUR YEARS TO ALLOW FOR BAMBOO TREES TO MATURE FOR CONSTRUCTION.

FRESH FOOD PRODUCED ON THE SITE, PLANTED AND HARVESTED BY THE BY THE CREW OF CATA VENTO, CONSISTS OF CASHEWS, COCONUTS, PINEAPPLES, BANANAS, AND MORE.

ECO-KITEBOARDING RESORT WITH RESIDENCE OPTIONS.

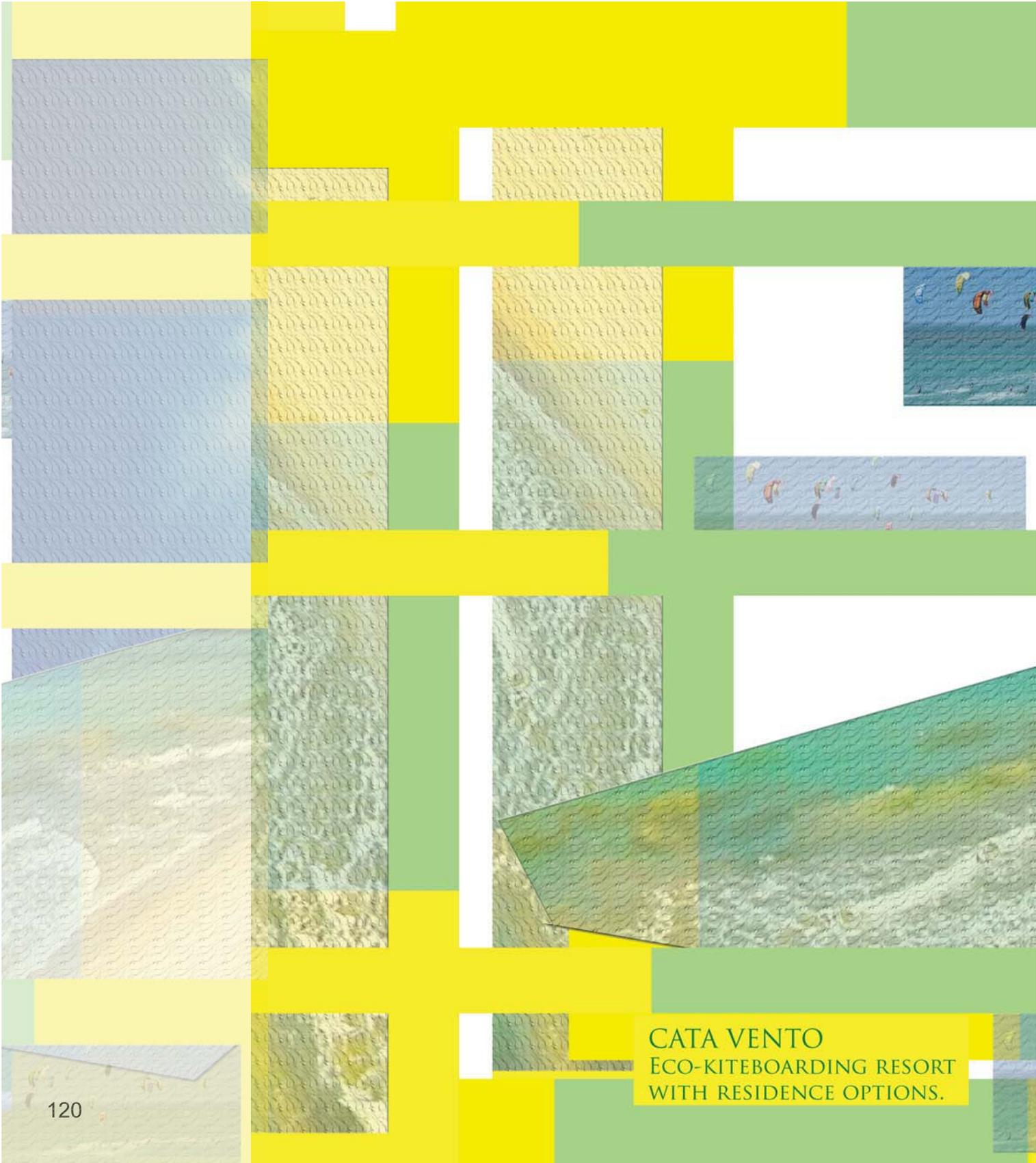
ECO RESORT BECAUSE ALL ELECTRICITY IS PRODUCED ON SITE WITH SELF LAUNCHING AND SELF FLYING KITE WIND TURBINES.



KITE WIND TURBINE FLIES TETHERED AND IN A CIRCLE.

CONTACT: rjess@hotmail.com FOR MORE INFORMATION
INVESTMENT OPPORTUNITIES AVAILABLE.





CATA VENTO
ECO-KITEBOARDING RESORT
WITH RESIDENCE OPTIONS.



CATA VENTO
ECO-KITEBOARDING RESORT
WITH RESIDENCE OPTIONS.

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