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Competitions Elective
Metal Construction Association Competition –
Nature Campus

Seeking Inspiration in Nature

"The works of the past always influence us, whether or not we care to admit it, or to structure an understanding of how that influence occurs. The past is not just that which we know, it is that which we use, in a variety of ways, in the making of new work…. The typology argument today asserts that despite the diversity of our culture there are still roots of this kind, which allow us to speak of the idea of a library, a museum, a city hall or a house. The continuity of these ideas of type, such as they are, and the esteemed examples which have established their identity and assured their continued cultural resonance, constitute an established line of inquiry in which new work may be effectively grounded."

The Harvard Architectural Review. Volume 5. Precedent and Invention. Between History and Tradition: Notes Toward a Theory of Precedent. John E. Hancock.

The subject of invention has always been questionable in realm of architecture. A seemingly unexplored idea by one architect is most often influenced by a similar idea of another. In fact from its very roots as the primitive hut, architecture could potentially be perceived as a single cohesive exploration of ideas. This unified investigation is what contributes to the success of architecture as a creative, generative process. Now, in the wake of new technological advances in the practice of architecture designers have begun look to another generative process for inspiration. New projects are beginning to explore nature as a source of precedence. So, when it came to designing a nature centre for Chicago's Northerly Island, aside from finding inspiration in a number of architectural projects, we also sought inspiration in nature itself.

After reading various articles on the way nature has served as precedence for architectural inspiration we came upon some extremely interesting ideas. Louis Sullivan the successful American architect who practiced in Chicago often found inspiration in nature and applied an abstracted geometrical translation of these natural forms in the ornamentation of his buildings. Frank Lloyd Wright, who apprenticed under Sullivan, was also very interested in conventionalizing geometry, which he found in nature. Fig. 1 is a floor plan drawn by Wright. The plan is

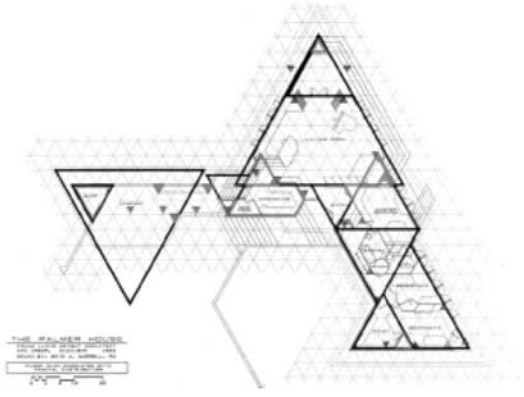

Fig. 1 Fractal Floor Plan designed by Frank Lloyd Wright

composed of a number of different sized equilateral triangles that are arranged on a grid of smaller but identical triangles. Wright was able to generate a form by simply manipulating the scale of a single shape. This is known as fractal geometry and its origins are evident in the analysis of plant formations. Fig. 2 is an image of a particular species of cauliflower. As you can see, the geometry of each cauliflower pod is composed of a combination of smaller pods of an identical geometry. Thus in our proposal for the nature centre we used this concept of fractals to generate a design. But, to begin the design process we would have to find a naturally occurring geometry that could relate to the requirements stated in the design brief.

Fig. 2 Fractal Cauliflower Pods

The competition brief challenged competitors to incorporate metal materials into their design in a creative and innovative manner. After researching a number of cutting edge metal materials we decided upon one we would use for our design proposal. The material is aluminum foam. Used in modern aircraft construction this lightweight, high strength, corrosion resistant material would be an ideal construction material for buildings. As illustrated in Fig. 3, aluminum foam essentially applies the structure of foam to aluminum ultimately creating a lighter less dense aluminum product without compromising the material's inherent strength. After learning more about the foam structure we found that it too is composed of a fractal geometry that is applied in three dimensions and it is this geometry which gives foam its rigidity. The answer to the design concept was clear. We would derive the geometry of our design from the geometry of aluminum foam. Fig. 4 is a diagram illustrating the concept of fractals and how it is applied in our design.

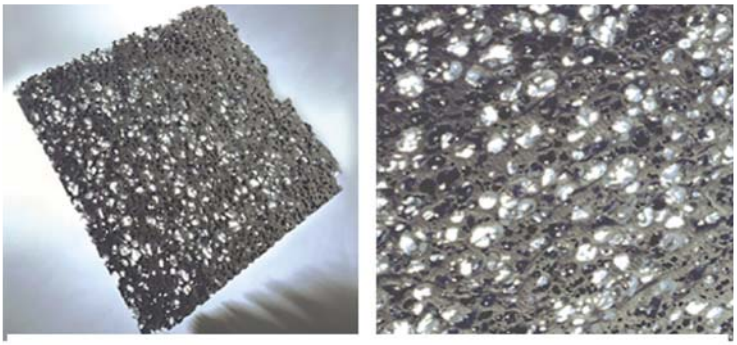

Fig. 3 Aluminum Foam

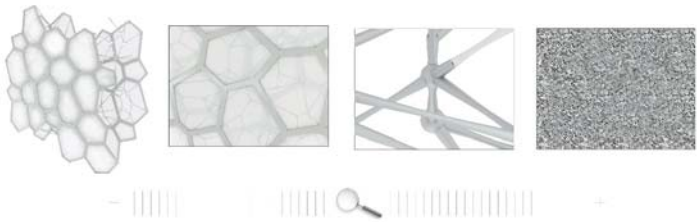

Fig. 4 Fractal Diagram of relationship between material and structure

Another important aspect to the competition's brief was the development of the landscape. As the city of Chicago increases its density, allocating large areas of land for green space becomes a challenge. Thus the city's need for green space must be facilitated through the development of Northerly Island into usable public park space. The landscape design in our proposal was most significantly influenced by Daniel Burnham's plan for the Chicago lakefront. Burnham's plan imagined Northerly Island to be a kind of hybrid urban, Wildlife Park where the flora and fauna native to Illinois could flourish in the setting of the city. The islands geometry was defined by a series of lagoons, which were connected by a waterway that divided the island from the mainland. These shallow waters would provide an excellent ecosystem for native fish and waterfowl. Pavilions would be constructed throughout the landscape to accommodate those visiting the Island. Our scheme employs similar tactics. We proposed the removal of all boats and docks from the lagoons such that they can be turned into marshes to satisfy the competition requirement of a natural habitat for native water species. Next we decided to break up the required program of the nature center into four different pavilions, which would encourage pedestrian circulation throughout the entire site. In an attempt to give our landscape design a contextual relationship to the parks surrounding the island we looked to Burnham's plans of Grant Park for inspiration. Fig. 6 is a plan of a park proposed for Chicago designed by Burnham. Buildings and fountains are placed a primary axis that run north to south, and east to west. These primary circulation routes are bisected by diagonal paths, which terminate at a central focal point. We proposed a similar scheme. Our buildings were located at four sides of the island along an interesting north south, east west axis where they surround a central focal point – the outdoor amphitheatre. Next we overlaid our fractal pattern over the landscape and connected the buildings by a path system derived from the intersections of this geometry. The large intermediate hexagonal shapes are designated as gardens and would be planted with native plant species.

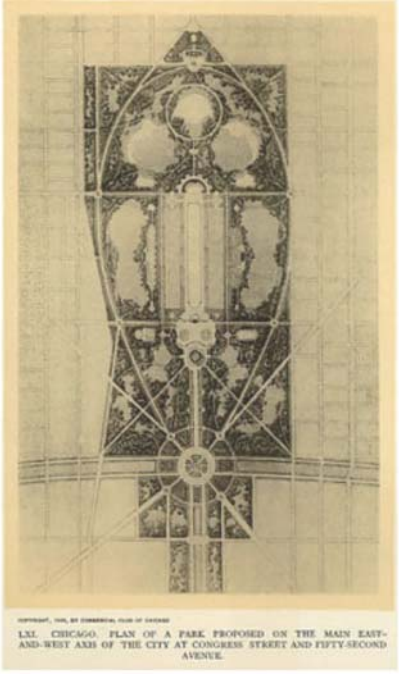

Fig. 6 Chicago Park Plan drawn by Daniel Burnham

When it came to the design of the four buildings there were specific stipulations by which we designed such that the buildings function and form was to our liking. First we looked at buildings that facilitate program similar to that required in the competition brief. Projects that influenced us most include the Great Glass House by Norman Foster, and The Eden Project by Nicholas Grimshaw. Both buildings are large free span domes that are

Fig. 8 The Eden Project by Grimsawe Architects

sunken into the earth. The use of a large dome-like roof structure would allow us to achieve large open spaces within the buildings to accommodate large exhibitions. Sinking our buildings into the earth decreases the visible height of the buildings and thus responds to Island's flat typography. Both buildings employ the use of grass berms to blend the domed roof structure into the immediate landscape. We did the same. This design decision would also allow us the freedom of locating program such as washrooms and offices below the earth such that the central domed portion of the buildings is free of program and open to circulation. The use of a light-emitting roof structure allows us to create a controlled interior environment, which can sustain plant life – essential to the design of our aviary. However, to seek inspiration, which would inform the design of the pavilions beyond their general form and typology we would once again look to nature and the idea of fractal geometry.

Fig. 9 Foster + Partner's Great Glass House

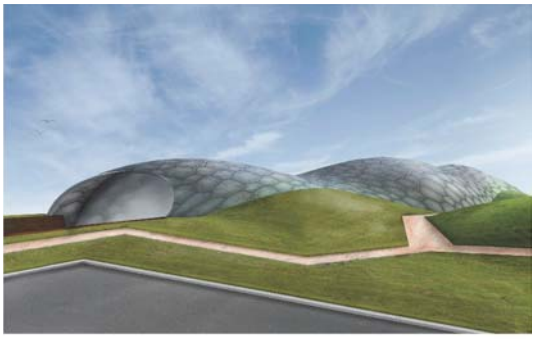

Fig. 10 Exterior rendering of our competition proposal

The final challenge that remained was the design of a roof structure that would function well in a dome configuration and achieve a clear span. We were determined to use the same geometry, as the foam structure which when translated in a structural system would afford us added rigidity without added weight. We happened upon two projects that explore similar structural systems. The first, depicted in Fig. 11 is a tower deigned by Michael Rojkind for Mississauga's Absolute International Design Competition. The tower exploits the use of the structural system by utilizing the concept of a double skinned façade. Two facades composed of the foam geometry are constructed parallel to one another and are connected by a similar foam structure in the perpendicular direction – as illustrated in Fig. 12. The arrangement of the foam structure in all directions is what gives foam its rigidity and Rojkind's tower applies this very concept in a structural space-frame system. Another building that employs this kind of structure is the "Water Cube" building designed by PTW Architects for the 2008

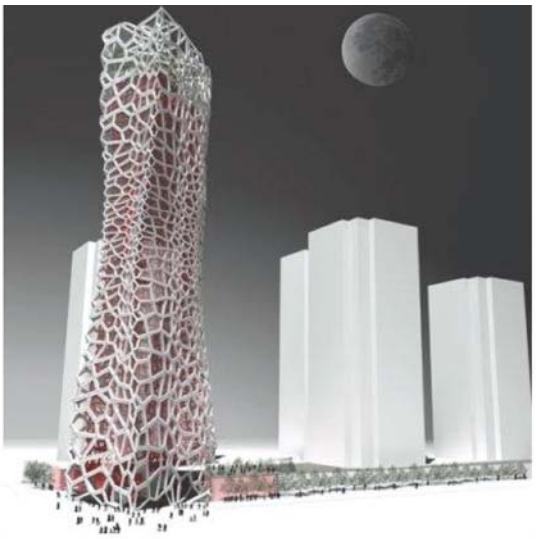

Fig. 11 Tower designed by Rojkind Architeqtos

Beijing Olympics. The building's footprint is 7.8 acres, all of which is spanned without the use of any intermediate columns. The building also addresses another problem inherent with its structural system. As shown in Fig. 12, the intermediate voids between the structural members are filled with semi-transparent films. There are interior and exterior films; the films are inflated to achieve their bubble like appearance. The air space within the films provides a layer of insulation, ideal four our building's location in Chicago. The danger in using a light emitting roof structure is the building's potential to act like a giant green house and trap in all of the heat from the sun creating an extremely uncomfortable interior environment. The semi-transparent films on the "Water Cube" building prevent heat gain by only emitting diffused natural light. In addition like Rojkind's tower it also employs the use of double skin façade to better control the interior's temperature. Fig. 14 is a diagram illustrating how our roof structure acts as a double skin façade and reduces heat gain.

Fig. 12 Steel Foam Structure used in the "Water Cube" building

Fig. 13 "Water Cube" building under construction with inflated films

The design of the project was finally complete. After seeking inspiration in both nature and contemporary architectural projects we submitted a cohesive design, which assimilated both architecture and nature into a single scheme, which met all of the specific design requirements for the competition. As demonstrated through the drawings of Frank Lloyd Wright the assimilation of nature and architecture as been and idea that architects have toiled with for generations. And it is this exploration of a single idea that, "constitutes an established line of inquiry in which new work may be effectively grounded" (John E. Hancock).

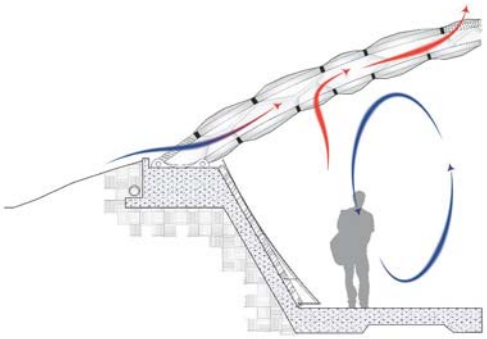

Fig. 14 Detailed wall section of our design proposal

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