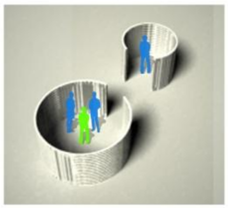
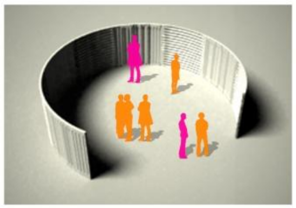

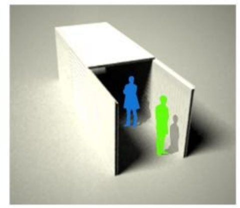

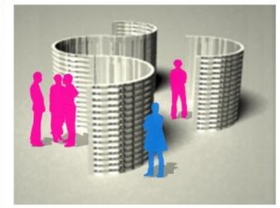

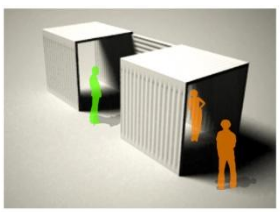
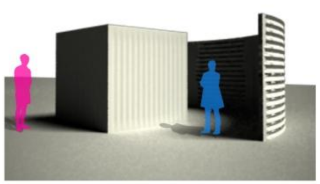
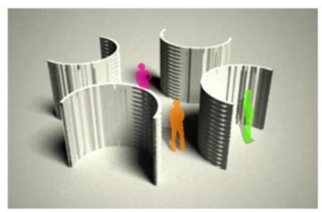

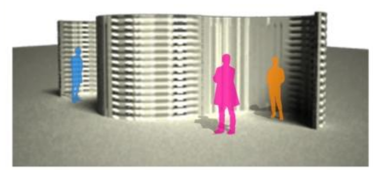


pfff Inflatable Pavilion Competition

Arch 684
Sue Tang
February 2012

0.0 Competition Overview

PFFF inflatable pavilion competition focuses on the design and realization of an inflatable mobile pavilion that can promote contemporary art and culture around the world. City Vision and FARM; the competition sponsors; aim to garner awareness and support for creativity by displaying works and installations of national and international artistic youth in a mobile inflatable pavilion. Lectures and presentations will take place within the pavilion, while exhibiting artistic work. Potential sites for the pavilion are piazzas, public squares, parks, meeting places, and FARM Cultural Camp tour's stops in diverse cities.

The pavilion is designed within several parameters. Parameters include a maximum dimension of 50 square meters, an occupant load of 30 people, singularly coloured waterproof PVC material, and a pneumatic structure. An investigation of various materialities, atmospheric conditions, methods of inflation and deflation, and anchoring systems, will establish the success and safety of the project. Variables for the pavilion include; an open or closed space; therefore with or without a roof; seam jointing techniques of welding or sewing; and anchoring to the ground with bolts or concrete blocks. Other factors that influence the design include ease of transportability, assembly and installation. The pavilion should also account for internal security and durability. A successful pavilion will take into account the parameters while embodying the spirit of the FARM Cultural Camp project. [1]

The winning pavilion design, by Sitbon Architects, in relation to my proposal will be analyzed through the understanding of the history, ideology, and technical information presented. With a thorough investigation of inflatable architecture, a sensitive and appropriate design response for the PFFF inflatable pavilion competition will emerge.

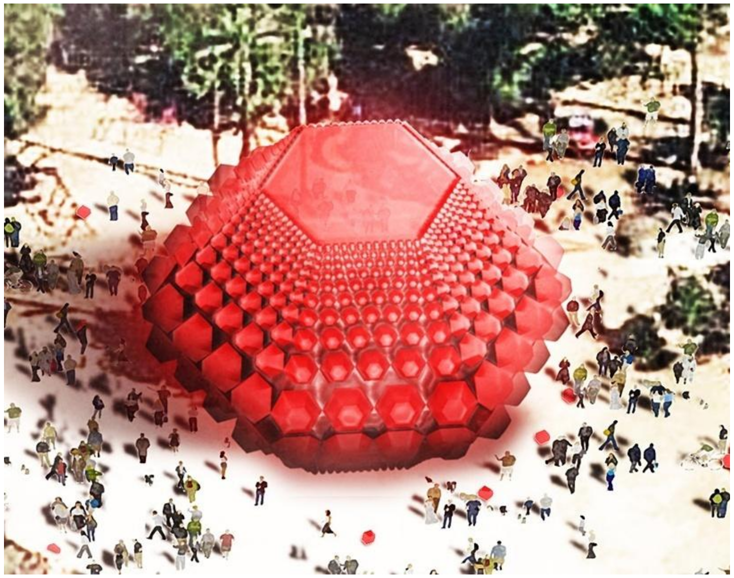

Figure 1: Winning Proposal by Sitbon Architects, 2012

Figure 2: Proposed Pavilion, 2012

[1] http://www.cityvision-competition.com/pfff/brief/

1.0 The Beginning of Inflatables

The history of inflatables begins the invention of hot-air and hydrogen balloons in 1780's France. The first balloon, created by French brothers Montgolfier, was composed of linen and paper in 1783.[2] France was on the cusp of revolution. An anxious society was looking to the sky for refuge. Airborne inflatable devices were portrayed as a means of protection and escape. The fascination and development of pneumatic airborne transportation continued into World War I with gas-filled airship flotillas. During that time, experiments with inflatable architecture also took place. In 1917, F.W. Lanchester of Britain received the original patent for a "tent or roof structure supported by internal air pressure".[3] During World War II, investigations into inflatable technology broadened. Decoy bridges, tanks, and airplanes were several of the inflatable devices used to distract opposing forces.

The Radome, designed by Walter W. Bird's and constructed in 1948, was the first pneumatic building to be realized. The 16.5m in diameter building, commissioned by the US Air Force, was a prototype radar dome. The building needed to withstand extreme weather conditions, and possess a membrane with appropriate strength to protect the antenna, while adequately thin as not to interfere with radar signals. With the Cornell Aeronautical Laboratory, Birdair's material studies, analysis and wind tunnel test proved the feasibility of pneumatic structures. Development of suitable fabrics and coatings emerged from the initial material explorations. Birdair became a pioneer and advocate for inflatable architecture due to the advantages of pneumatic technology. With inflatable structures, minimal material is required material for large spans and potential exist for an ease and efficiency of construction and assembly. Although Birdair endorsed the potential of inflatable buildings, he recalls that,

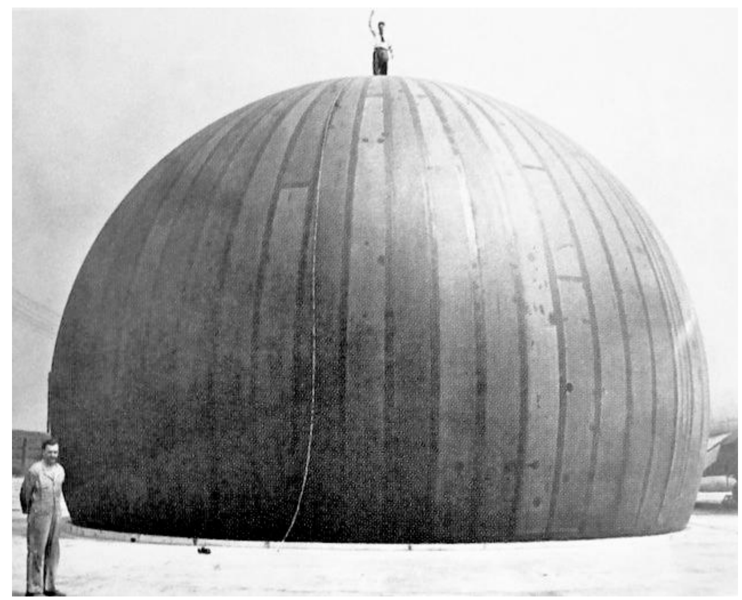

Figure 3: Walter Birdair's *Radome*, 1948

[2] Beukers, Hinte, & Staal, 154.
[3] Topham, 43.

"Architects do not regard fabric as a viable material for building construction."[4] Birdair's swim shelter in 1957 was one of the first domestic applications for an inflatable building.

The Dymaxion ideal derived by Buckminster Fuller in 1958 resonates with the structural and ideological traits of pneumatics. Dynamic and maximum efficiency in construction became the precursor to the interest in lightweight architecture. Buckminster's geodesic Sun Dome, displayed the ingenuity of a tensegrity structural system.[5]

Figure 4: Buckminster Fuller's *Sundome*, 1960

Frei Otto, a German architect and engineer, paved the way for a new construction territory of lightweight, mobile and tensile architecture. His work, Tensile Structures, published in 1962, contains a chapter of the physical principles found in pneumatic structures. Otto's soap bubble experiments illustrated the 'ideal' pneumatic form. The most efficient shape was achieved with minimal surface area. Thin soapy films stretched over rods, rings, and strings demonstrated the ideal distribution of tension in a technical membrane. Extracting the knowledge his experiments and drawing from the characteristics of nature, Otto established the best forms for pneumatic and tensile lightweight structures. His research on pneumatic structures would provide the technical basis for the inflatable movement in the late 1960's. The 1960's and 1970's marked the height of development and interest in pneumatic technology.

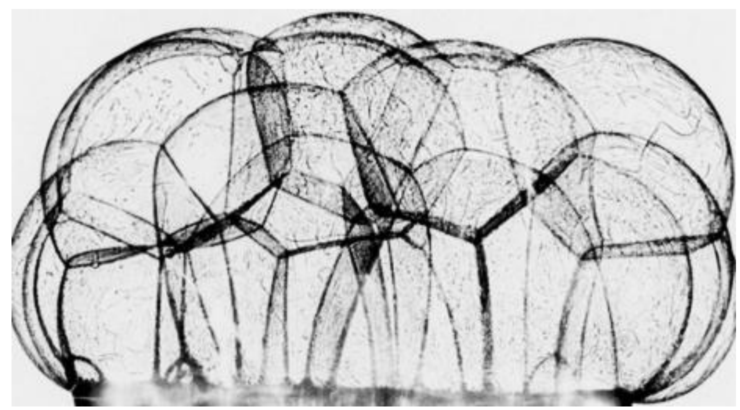

Figure 5: Frei Otto's soap bubble experiment, 1987

2.1 1960's & 1970's Inflatable Ideology

In 1968, at the legendary Structures Gonflable exhibition in the Musee d'Art Moderne in Paris, over a hundred pneumatics objects on displayed expressed the spirit of innovation and new utopias. This novel future was thought to be plastic, technological, nomadic, informal and

[4] Topham, 45.
[5] Herwig, 38.

personal. In architecture, inflatables and public action went hand in hand.[6] By disrupting the rigidity of form, the nature of pneumatic architecture facilitated the heightened awareness of social and commercial context. During the late 1960's and early 1970's, Co-op Himmelb(l)au, Archigram, AntFarm and Haus-Rucker-Co were several firms that established their ideology through pneumatic proposals. The principles of lightweight, mobile architecture that developed from Frei Otto, Buckminster Fuller and Walter Birdair continued to define the pneumatic investigations that followed.

Co-op Himmelb(l)au, founded in 1968 by Wolf Prix, Helmut Swiczinsky and Michael Holzer, proposed an "architecture has no physical ground plan, but a psychic one. Walls no longer exist. Our spaces are pulsating balloon. Our heartbeat becomes space; our face is the facade."[7] Their projects, Villa Rosa, The Cloud and AstroBalloon captured with union of body, architecture and technology. Villa Rosa, conceived in 1968, exhibits a pneumatic dwelling unit that permits volumetric changes in the spatial experience due to manipulation of air flow. The pneumatic prototype of a supply structure depicts variability of a cloud. Three spaces are transformable with the eight inflatable balloons. The inflatable components of Villa Rosa augment the size of the living unit. Air and dynamics become the building materials for these transformable spaces.

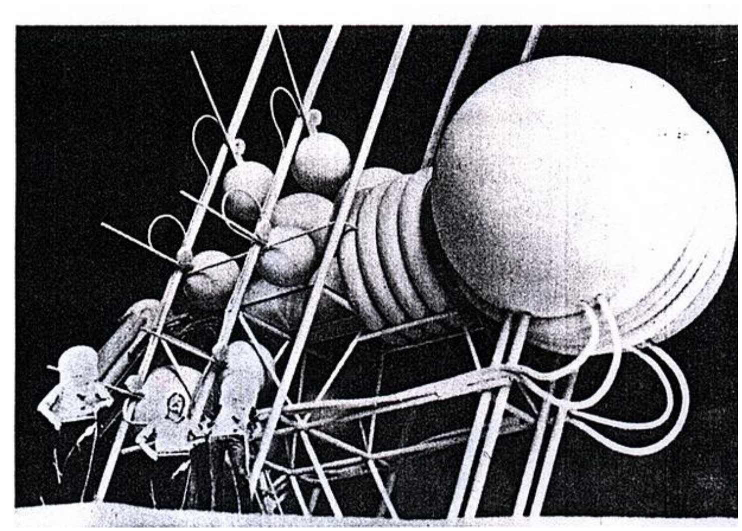

Figure 6: Coop Himmelb(l)au's *Villa Rosa*, 1968

AntFarm, a collective of architects formed in 1968, initially set out to create an alternative architecture that suited a nomadic lifestyle. These 'environmental nomads' explored the transformative potential of pneumatic structures.[8] The group, composed of Chip Lord, Doug Michels, Hudson Marquez and Curtis Schreier, felt that "pneumatic structures connoted the provisional, the ephemeral, the flexible, the transparent, and the

[6] Noever, Kipnis, & Lavin, 38.
[7] Noever, Kipnis, & Lavin, 57.
[8] Lewallen & Seid, 15.

emancipatory."[9] Formless and fluctuating characteristics of inflatable space were designed to fabricate a fantasy environment. The fluid geometry could promote radically different behaviour and alter states of consciousness. Large scale polyethylene inflatables, also known as pillows, provided the ideological environment needed for social and economic transformation. Beginning on October 11, 1969, during Liferaft Earthweek, an inflated 100-by-100-foot pillow became the site in which participants would fast in protest of the exploitation of natural resources and the threat of population growth. Pillows were portrayed as 'counter architecture', therefore characterized as amorphous environments, curved non-rectilinear patterns, and sensory overload potential of light, sound, movement, water and temperature.

Antfarm's *Inflatocookbook*, published on December 1970, exemplifies the potential to radically change the relationship between people and their built environment. The book provided a set of instructions and technical information that outlines 'quick, cheap, lightweight construction, and easy to use, polyethylene construction... (that) involves the user in all phases of the production, making it a medium for learning about whole design processes.'"[10] The notion that individuals had the power to change their immediate environment and social structures was prevalent in the work of AntFarm. AntFarm used inflatables to facilitate participatory engagement of social and environment causes. Their vision of a mobile, media, technological, nomadic, and environmentally conscious future coincided with the space inflatables created.

"In case you hadn't figured out a reason or excuse, why to build inflatables becomes obvious as soon as you get people inside. The freedom and instability of an environment where the walls are constantly becoming the ceiling and the ceiling the floor and the door is rolling around the ceiling somewhere releases a lot of energy that is usually confined by the

Figure 7: AntFarm's *Inflatocookbook*, 1973

[9] Lewallen & Seid, 15.
[10] Scott, 62.

xyz planes of the normal box-room. The new-dimensional space becomes more or less whatever people decide it is -a temple, a funhouse, a suffocation torture device, a pleasure dome."[11]

Haus-Rucker-Co, created in 1967 by Laurids Ortner, Günther Zamp Kelp, Klaus Pinter, and Manfred Ortner, employed pneumatic devices to critique social and economic conditions. With their projects Balloon für Zwei, Gelbes Herz, Connexion Skin, Oasis 7 and Grüne lunge, they conceptualized inflatable architecture as an extension of the body and as a protective enclosure. The series of projects, presented under the title, Mind Expanding Programme, attempted to address the relationship between technological and human evolution. "Mind Expanding programme aims to explore the inner-space, the space inside man, and to discover and develop psy-phy forces. Mind Expanding Programme creates an alphabet of aggressive molding. Shaped develop aggressive energies that have a psychological and physical impact on man."[12] Balloon für Zwei (Balloon for Two), created in 1967, intensifies the experience of two people seated next to each other in an inflated bubble suspended several meters above the street. The decorated transparent PVC envelope acted as the medium in which the senses of the inhabitants and the exterior world could be filtered. Balloon für Zwei's goal was to achieve feelings of calmness, relaxation and love between the participants.

The second project of the Mind Expanding Programme, Gelbes Herz, further developed the intention of Balloon für Zwei in a concentrated spatial experience. The double layered, inflated pulsing bubble provided an interior chamber where two people could comfortable escape from reality. The inflatable explored the idea of architecture and mechanics in the body by the sequence of air flow. By manipulating air, a rhythmic pattern of inflation and deflation into the chambers occurred. As Haus-Ricker-Co stated, "Gelbes Herz

Figure 8: Haus-Rucker-Co's *Gelbes Herz*, 1968

Figure 9: Haus-Rucker-Co's *Oasis #7*, 1972

[11] Scott, 84.
[12] Topham, 74.

offers the possibility to leave the real world environment for a certain period of time, to enter a spice that acts a strong contrast to the natural environment. Time develops its own rhythm while one is inside Gelbes Herz and one has to adapt to it." Connexion Skin, Oasis 7 and Grüne lunge further developed the relationship between architecture and body, achieving higher states of consciousness, and environments which presents an urban refuge for relaxation and play.

Archigram, a 1960's avant-garde collective of architects based in London, proposed new architectural realities based on technology to replace conventional building forms. Although most of Archigram's projects were theoretical, several of them alluded to the use of inflatables. Projects such as Air-house project, Blow-out village, Cushicle and Suitaloon, Leisure study, Free-time inflatable dwelling and Air-hab re-envisioned the ideal city on the basis of flexibility, free and choice through pneumatic technology.

The Blow-out Village is a speculative proposal for a mobile community that utilizes hovercraft, hydraulic and inflatable technology. The typology of the 'village' is transformed to combine the three aspects of technology. The mobile village contracts, expands and moved as needed. Hydraulics raise the main mast where a weatherproof transparent plastic cover over the whole village.[13] The concept of the 'bubble' and the ideology it infers additionally evolves in the Cushicle and Suitaloon project.

The Cushicle and Suitaloon, was presented as being free from the hierarchies that buildings have traditionally continued. The minimal structure of a building was reduced to clothing, therefore augmenting the idea and relationship between architecture, context and stability. The self-sufficient bubble would allow the participant to move freely in a nomadic lifestyle. Similar to AntFarm's *Inflatocookbook*, the Suitaloon was conceived as a participatory

Figure 10: Archigram, *BlowOut Village*, 1966

[13] http://archigram.westminster.ac.uk/project.php?id=89

activity in which the participant could alter their environment at their will. The personal enclosure offered by the Cushicle would further develop into larger, more comprehensive technological urban environments by Archigram. The amalgamation of personal enclosure, which could be achieved by inflatables, allowed a total environment and the domestication of the natural environment through technology. "It begins to appear when there is no longer a capsule, but the hybrid referred to above; part event, part space, part skin, past sense. The 'bubble' is about expansion into the environment, about domestication of the environment, and in its ultimate form, dissolving into the technological mediascape."[14]

Figure 11: Archigram's *Cushicle*, 1967

AntFarm, Archigram, Co-op Himmelb(l)au, and Haus-Rucker-Co were several of the prominent groups that emerged in the 1960's that urged the re-evaluation of the role of traditional architecture through pneumatic architecture. "To fold, inflate and see each other in a black white red purple cloud balloon can help to break down people's category walls about each other and their own abilities and can be a hint at the idea that maybe anybody can/should/must/take space-making beautifying into her, his own hands."[15] With the affordability of PVC and inflatable materials and the introduction of high frequency PVC welding, architectural collectives and individuals were able to realize full-scale prototypes. The constructed events that inflatables assisted in propagating became the voice of a new generation. Inflatables de-materialized architecture through its minimalist materiality and offered a radically different environment. In the late 1960's and early 1970's, inflatables participated not only in an architectural or urban scale, but also in a social and geopolitical one.[16]

As the social, cultural and economic climate changed in the mid-1970's, popularity of

[14] Schrijver, 117.
[15] Lewallen & Seid, 17.
[16] Scott, 80.

inflatables waned. The oil crisis in the 1970's resulted in price increase of PVC to approximately 400 percent. Pneumatic structures could not satisfy the emerging urge for material stability, durability and cost efficiency.

2.2 Beyond the Inflatable Moment

Although pneumatic architectural proposals fell out of favour in the 1980's, several artists such as Maurice Agis, Yayoi Kusama, and Hans Hemmert, continued with an inflatable infatuation. The interiors Colourspace, Dreamspace and Luminario created by installation artist, Maurice Agis, employed the plasticity of PVC to create ephemeral spatial colour fields. From 1970's Colourspace to 2001's Dreamspace; Agis continually evolves the design of his immersive environments. Modular components of his installations allow the manipulation of the form and simplified manufacturing, transportation and assembly process. [17]

In architecture, plastic materials and recycling methods have fostered a current emergence of pneumatic building proposals. Several recent projects that employ pneumatic architecture include Nicholas Grimshaw and Partner's Eden Project, Kengo Kuma's Teahouse, and Diller Scofidio + Renfro's Hirshhorn bubble. The development of new inflatable synthetic materials can inform contemporary architecture design. The invention of ETFE (ethyl tetrafluoroethylene), provides architects with an alternative building material. ETFE, which is a lightweight, transparent foil, is stronger than glass, is non-stick, self-cleaning, recyclable, long-lasting, provides insulations, and is not degraded by sunlight.

Nicolas Grimshaw and Partners' Leicester Space Centre and The Eden Project, constructed in 2001 utilize ETFE panels. The air-filled ETFE pillows of the Eden project are

Figure 12: Maurice Agis' *Dreamspace*, 2001

Figure 13 : Nicholas Grimshaw and Partner's *Eden Project*, 2001

[17] Topham, 91.

energy efficient, modular, lightweight, strong and adaptable. The panel consists of three heat welded layers of ETFE foil and is inflated to a two meter depth. Advancement in computer technology allows ease of design, fabrication and installation of the inflatable panels to complex geometries. The Eden Project, housing the world's largest greenhouse, is a contemporary example of inflatables facilitating an eco-conscious mandate.

Kengo Kuma's Teahouse constructed in 2007 uses a new inflatable material called Tenara. Due to the material properties of Tenara, the highly transparent membrane is lightweight, and tactile. The double membrane system expands and contracts as though it breathes. To maintain its form, polyester string is used to connect the two membranes together. The joints of the membrane and the strings are placed approximately in a 600mm pitch. The joints, seen as dots on the membrane, provide articulation of the surface. The soft textural membrane provides a sense of intermediacy between reality and the imaginary world. Kuma's desire to foster an interactive communication between the environments is portrayed with the materiality and pneumatic structure of the Teahouse. As Kuma states, "at times the architecture becomes small as it holds its breath, and at other times it breathes in deeply to become grander. A new dynamic style for the architecture was devised."[18]

Diller Scofidio + Renfro's Hirshhorn bubble, to be completed in 2012, is proposed as an inflatable event space that will alter the 1974 Hirshhorn museum. The pneumatic structure playfully blurs interior and exterior space of the museum with a thin translucent membrane. Cable rings and exiting structure will provide the membrane with support and form.[19] The project, currently in development, will launch an increased contemporary interest in the possibilities of pneumatic architecture. From the hot-air balloons of the 1780's to current pneumatic architectural proposals, the advancement in materiality, computer-generated

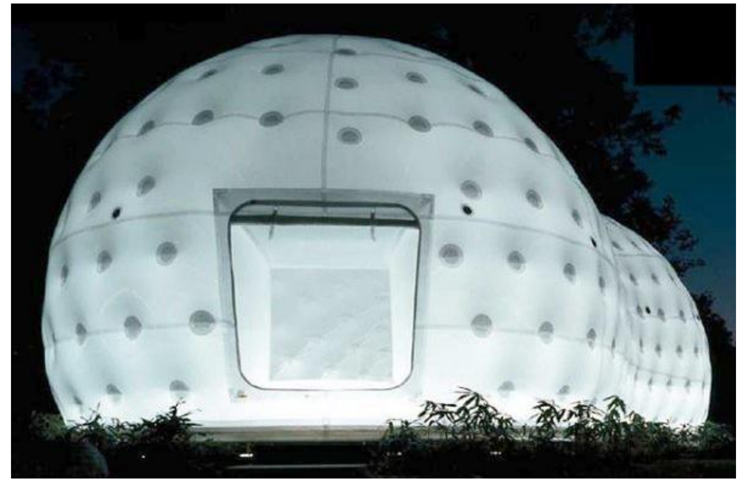

Figure 14: Kengo Kuma's *Teahouse*, 2007

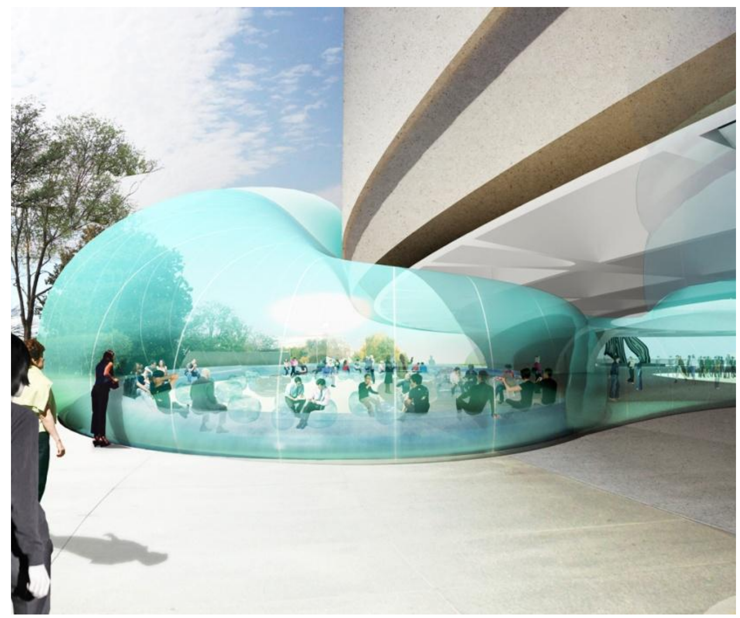

Figure 15: Diller Scofidio + Renfro's *Hirshhorn bubble*, 2012

[18] http://kkaa.co.jp/works/tee-haus/
[19] http://www.dsrny.com/

geometries, and construction technology provide today's society with the tools to realize the vision of the future presented during the Inflatable Movement.

2.3 Technical Details of Pneumatic Structures

Thomas Herzog, in *Pneumatic Structures: A Handbook for the Architect and Enginee*r draws on Frei Otto's principles of pneumatics. Understanding the technical details of an inflatable will ensure the safety and success of proposed projects. Several factors such as materiality, jointing techniques and anchoring are briefly covered to provide a general understanding of inflatable structures. A membrane which uses a gas (usually air) to maintain its shape is the governing principle and definition of pneumatics. The membrane is in constant tension; therefore minimal material can be used for its structure.

Suitable materials for inflatables depend on its tensile strength, flexibility and durability. Materials such as plastic films, fabrics, rubber membranes, and metal foils can be used. Synthetic films are ideal for pneumatic structures due to their high gas diffusion resistance, flexibility, workability and high light transmission. Plastic films are primarily produced from PVC, polyethylene, polyester, polyamide, polypropythene, polyvinylflouride, polyterephthalate and synthetic rubbers. The limit of synthetic films is determined by the low tear resistance, tensile strength, and low weather resistance. [20]

The development of the membrane relies on its structural design, cutting pattern and jointing techniques. The structural stability of a single or double membrane relies on the relationship of the internal and external air pressure. With a double membrane structure, either the internal air pressure equals the exterior or interior space receives a higher or lower atmospheric pressure than the exterior. Cutting patterns are informed by the geometry of

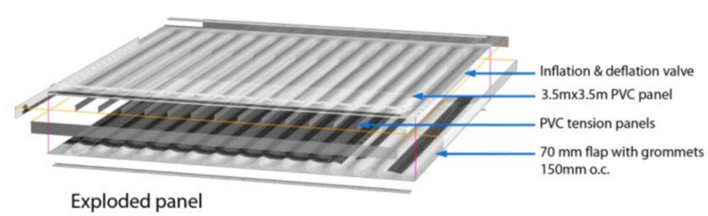

Figure 16: Proposed construction of the panel

[20] Herzog, 140.

membrane and the construction of the seams. Generally, commercial semi-finished materials for membranes, such as foils and coated fabrics are supplied in widths of 150cm. The joints of an inflatable should have the strength equal to the main material, flexibility, low relief and density that prevents air leakage.

Several jointing technique include sewing, cementing, vulcanising, welding, riveting, and clamping. Seams created by sewing can include double, multiple sewn and double overlap. The strength of the seam depends on the strength of the seam thread and number of stitches. Excessive stitches tear the membrane while weak sewing thread tear the seam. Although cementing displays high strength, it is expensive and complicated in comparison to other jointing techniques. Cementing would be recommended for high grade materials, repairs, and complex forms. Welding, which can be used on all thermoplastic synthetics is cost and time effective. With PVC coated fabrics, the adhesive strength of the bonding is adequate to the material strength. Hot key, hot air and high frequency are three of the welding processes employed. 20mm seam widths are adequate. Depending on the membrane design, separable joints might be necessary. Zip fasteners, press fasteners, lacings, peg joints connecting strips and clamps are methods in which sections of the membrane can be connected. Simple tent lacings, called "Dutch lacings" consist of hooks running along one surface while cable hooks are located on the other.

The anchoring of pneumatic structures must resolve the vertical and horizontal forces carried by the membrane. The anchoring must resolve the tangential force applied by the membrane. Ballast and ground load anchors are the primary anchoring systems utilized. Ballast pockets or ballast containers are filled with bulk material or water. The size of the ballast is dependent on the ground surface friction and condition of the subsoil. Ground load anchors are typically made of steel or reinforced concrete. Screw, hinged, injection, driven-in,

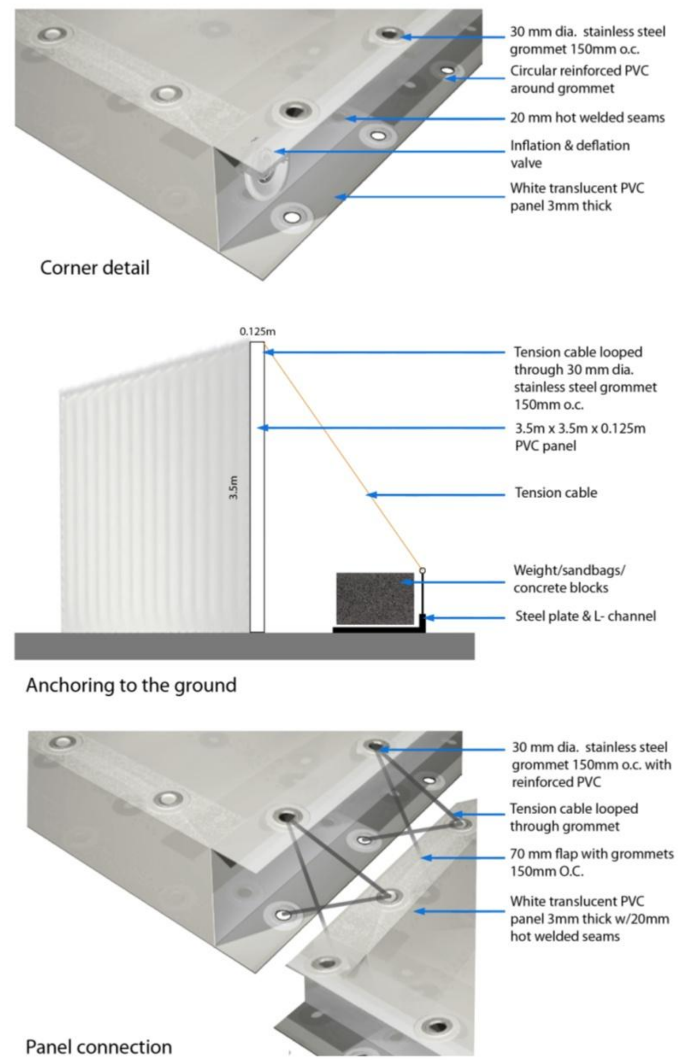

Figure 17: Seams, jointing technique and ground anchors

and socket are various types of ground load anchors.[21] Various other structural and physical factors include thermal, humidity, and acoustical control.

3.0 Design Proposal

The proposed pfff inflatable pavilion is designed with the intention of maximum flexibility, portability, ease of construction, assembly, and while encapsulating the FARM mandate. With eight modular inflatable square panels, the form of the pavilion can transform to promote contemporary art and culture anywhere. Factors such as site, weather, artwork, and occupant capacity are accommodated in the variations the pavilion. The modularity of the panels enables a cost effective solution and a consistent geometry as the background to the artwork.

Figure 18: Gerwald Rockenschaub's *Inflatable wall*, 1997

The design of the modular panels draw on the ideas presented by Austrian artist, Gerwald Rockenschaub, in his 1997 installation piece titled Two Inflatable Walls. The inflatable panels suggest a space where multiple events can be interpreted. His work calls into question the context of the architectural installation through the contrast in its materiality and form.[22] Drawing from Rockenscahub's installations, my proposals aim to explore geometry that can negotiate space with its participant, artwork and surroundings.

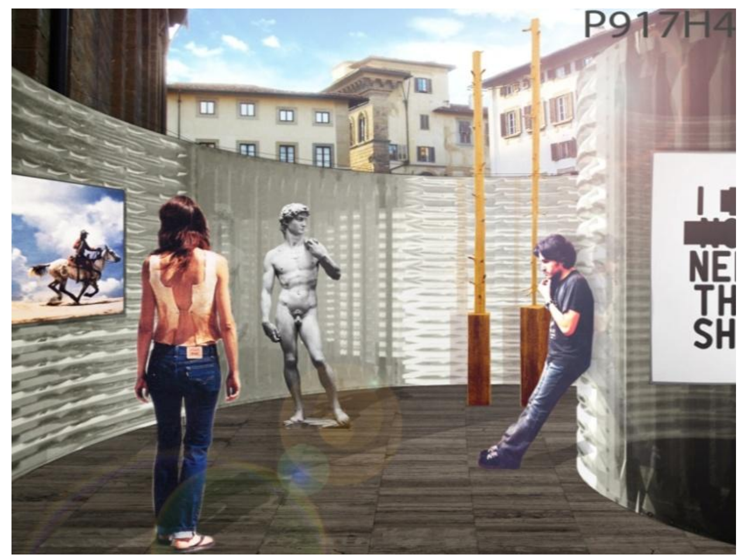

Figure 19: Proposed interior view

The pavilion is constructed out of translucent PVC tarpaulin material, which is waterproof, UV resistant, and durable. With cable tension members, the rectilinear panel can become curvilinear. The panels become the roof and/or wall. The tension members also enable structural stability to resist again wind, rain, and snow loads. The stainless steel grommets allow the panels to affix together and provide the connection to the tension members. Grommets were chosen as the connection method as a result of its ease of use and

[21] Herzog, 145.
[22] Topham, 109.

existing PVC fabricating methods. The jointing method of lacing creates a transparency in the assembly of the panels. Emphasizing the separable joints with grommets provide a potential connection to hang artwork.

The white translucent PVC allows exterior visual access to the pavilion, natural light into the pavilion, and provides a neutral backdrop for the artwork. The pavilion not only becomes a facilitator of contemporary art and culture, but it can be a social hub. As a result of the pavilion's ability to integrate within fluctuating circumstances, sites, and environments, it is possible to have the cultural art park to suit all needs.

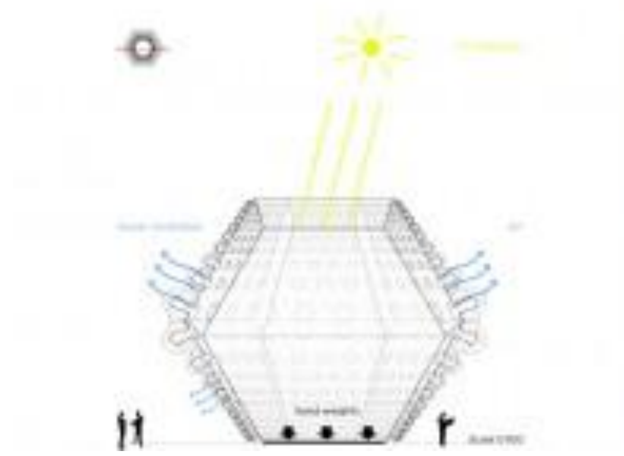

Figure 20: Sitbon Architects pavilion section

3.1 Winning Proposal

On February 2012, pfff announced the winning proposal by Sitbon Architects. The project, titled 'Grenade' aims to create a new way to spread art and culture in an original way. The pavilion is composed of red coloured modules that allow the light and air to filter into the interior. The form and design of the module is derived from the aerodynamic forces acting on the inflatable structure. The internal space is conceived as a different environment than the exterior. Modules scattered on the ground can lead the participants to the pavilion.

Figure 21: Sitbon Architects pavilion interior view

Due to the height, the pavilion can be easily located in the city. The modularity of the pavilion permits rapid assembly and disassembly. The mounting of the modules can be completed with minimal difficulty. Grenade restores the active role of architecture in the individual by engaging the environment. A dialogue and relationship between the existing context and inhabitant strengthens due to the passage of air, light and a specified view through the membrane of the modules. The Grenade harnesses energy to create an original approach to the inflatable pavilion. Through exceeding the conventional notions of inflatable pavilions, Grenade promotes and cultivates the FARM mandate. [23]The Grenade achieves an innovative quality that challenges the perception of the city and architecture through its colour, height, geometry and design of the modules.

3.2 Material and Construction Investigation

After the submittal of my proposal into the pfff competition, in an attempt to understand the construction, materiality and method of pneumatic architecture, a small scale inflatable was constructed. Through the process of making, I became aware of the factors that influence the success of a pneumatic installation. Initially, the inflatable was designed to be a 6 meter long circular tube with a 2.5 meter diameter. As per the initial material investigation in Figure 22, the envisioned participants would be able to crawl through the space. The initial inflatable investigation was a single membrane yellow PVC sheet double sewn together. Interior air pressure and membrane form was maintained by a fan.

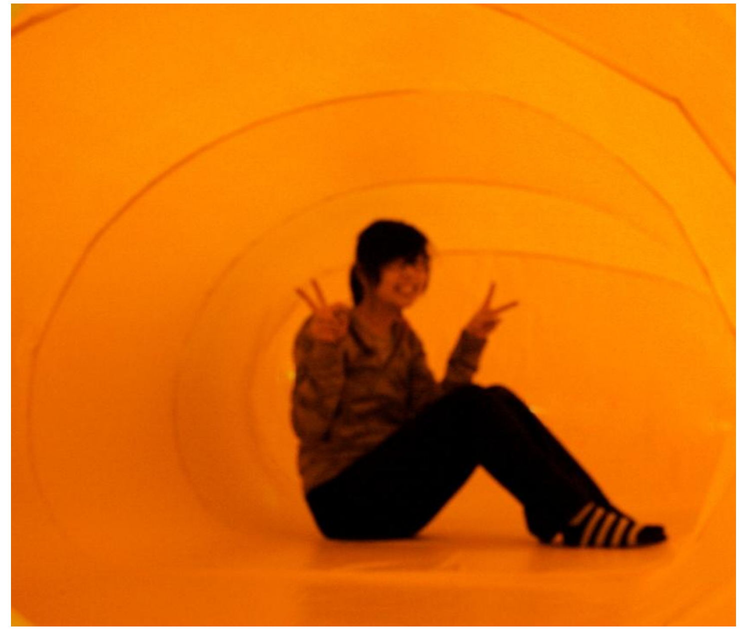

Figure 22: Desired interior

The second investigation aimed to create an airtight double membrane inflatable. The outer membrane comprised of reflective Mylar while the inner membrane was yellow PVC sheets. Although Mylar strips were sown in between the membranes to support the inner membrane, the infrequent spacing distorted the desired form. Maintaining air pressure with air-tight seams became the main issue that arose. Both materials were double sewn with a minimum of 20cm seams, but tears in the material and gaps in the sewing allowed air to escape. Welding or covering with seams should have been employed to minimize and prevent air leakage.

Figure 23: Inflatable

The weight and durability of the material became evident during the assembly of the project. The Mylar was significantly lighter than the PVC, therefore its material self-weight did

[23] http://www.cityvision-competition.com/pfff/results/

not heavily influence its deflation through the seams. The PVC did not sew as well as anticipated and had low tear resistance with minimal point pressure. The reflective Mylar was durable, but did not have the translucent quality desired. As a result of air leakage, the inflatable was cut into a smaller portion to become manageable. Even with the smaller scale, making the inflatable air tight was a challenge. The valve was constructed out of an existing valve found from a beach ball. Affixing the valve became an obstacle due to the difficulty and constraints of the sewing machine.

Through the process, I have understood that material choices, geometry and jointing techniques are crucial to the success of an inflatable. My initial conception of the inflatable did not come to fruition. As a result of the initial material exploration, the conclusions will inform the analysis of the proposed pavilion and launch future investigations.

4.0 Conclusion

With the research of precedents, inflatable ideology and construction methodology, I believe I would have developed a different strategy towards the competition. Instead of a rigid rectilinear geometry, the design should allow for a flexible and forgiving form. By developing a fluid geometry for the pavilion, it would better capture the ideology an innovative, plastic, technological, nomadic, informal and personal architecture of the late 1960's and 1970's. Although the competition specifies PVC as the inflatable material to be used, the advancement in recycling technology and the invention of newer, safer and more durable plastics can breed a new wave of pneumatic architecture. New materials, such as Tenera, used in Kengo Kuma's Teahouse, can be ecologically responsible.

The important of inflatables lies on their influence as social catalysts. The persuasion of pneumatic architecture is evident in the works of Co-op Himmelb(l)au, Archigram, AntFarm and Haus-Rucker-Co. Pfff Inflatable Competition attempts to harness the ideology and power of inflatables to promote contemporary artwork. Although my proposal for the competition was not successful, analyzing the winning design and launching a material and construction investigation supplies me with the knowledge to tackle prospective pneumatic ideas. Social, economical and cultural progress can be possible with inflatables. Arthur Quarmby, in *The Plastics Architect,* states the "pneumatics are the most important discovery ever made in architecture; that they free the living environment from the constraints that have bound it since history began and that they can in consequence play an immeasurable part in the development of our society".[24] The fascination for pneumatic architecture will continue to grow and develop.

[24] Topham, 150.

Appendix A: References

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Appendix B: Image References

Figure 1 - Sitbon Architects, http://www.bustler.net/images/news2/grenade_pfff_inflatable_architecture_02.jpg

Figure 2 - By author

Figure 3 - Walter Birdair, Topham, 41 .

Figure 4 - Buckminster Fuller, http://www.moma.org/interactives/exhibitions/2011/AccesstoTools/

Figure 5 - Frei Otto, http://rodrigo.fablabbcn.org/wp-content/uploads/2012/02/frei-otto-lightness_max-466x254.jpg

Figure 6 - Co-op Himmelb(l)au, Noever, Peter, Jeffrey Kipnis, and Sylvia Lavin, 55.

Figure 7 - AntFarm, 8.

Figure 8 - Haus-Rucker-Co, Topham, 75.

Figure 9 - Haus-Rucker-Co, Topham, 76

Figure 10 -Archigram, http://archigram.westminster.ac.uk/project.php?id=89

Figure 11 - Archigram, Sadler, 184.

Figure 12 - Maurice Agis, Topham, 90.

Figure 13 - Nicolas Grimshaw & Partners, http://0095b6.com/lostritto/arch470fa08/wp-content/uploads/2008/10/eden-project-2.jpg

Figure 14 - Kengo Kuma, http://amazingdata.com/mediadata6/Image/amazing_fun_featured_2065611210104178106S600x600Q85_200907232022019023.jpg

Figure 15 - Diller Scofidio + Renfro, http://static.worldarchitecturenews.com/news_images/13080_1_WAN%20Hirshorn%20Diller%20Scofidio%20Alt.jpg

Figure 16 - By author

Figure 17 - By author

Figure 18 - Gerwald Rockenschaub, http://peterheimer.com/main/content.php?nav=2-0

Figure 19 - By author

Figure 20 - Sitbon Architects, http://www.cityvision-competition.com/pfff/results/

Figure 21 - Sitbon Architects, http://www.cityvision-competition.com/pfff/results/

Figure 22 - By author

Figure 23 - By author