Pneumatic Decoys: Blowing Up Architecture

Architectural inflatables have historically performed as countercultural decoys. Despite attracting attention through their peculiar effects, these air-filled membranes—also known as pneumatics, blow-ups, airdomes, airhouses, or windbags—typically elude critical consideration.[1] Masquerading as playful, immaterial, and impermanent, inflatable architectures are more likely to be viewed as utopian derives, rather than covert disciplinary strategies.

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Routinely reduced to simple geometries with minimal tectonic complexity, inflatables employ transparency and the otherwise invisible medium of air to generate a barely-there form of architecture. Yet, not unlike a decoy—a thing used to mislead or lure into a trap—the architectural inflatable operates like a wolf in sheep's clothing. In other words, the inflatable is not nearly as innocent as it seems.

Through their participatory and do-it-yourself nature, inflatables offer an alternative to traditional modes of generating architectural form and space. Blurring the line between air and building, or building and installation, they demonstrate that architecture can be soft and temporary, and even as immaterial as air. Significantly, the instantaneity and ephemerality of pneumatics subverts the conventional Design-Build relationship characterized by careful planning and durable detailing. Because inflatables are mobile, instant, and scale-able, they serve as performative decoys to lure new processes, technologies, and sensibilities to the discipline of architecture. In addition, their ability to perform—both technically and culturally—affords the inflatable unique versatility as a disciplinary model for architectural experimentation.

This paper is organized into three parts: I) Defining Pneumatics, II) Pneumatic Pedagogy, and III) Beyond Pneumatics. Defining Pneumatics examines the technical and cultural significance of the architectural inflatable, arguing that through soft tectonics, the inflatable offers a potentially sophisticated model for contemporary architectural experimentation. Pneumatic Pedagogy illustrates how inflatables can inform Design-Build strategies in the architectural studio, inspiring material, structural, and formal innovation. Beyond Pneumatics poses the question: To what degree does the inflatable serve as a literal (vs. conceptual) model for rethinking how we design and build architecture today?

I. DEFINING PNEUMATICS

It could be said that inflatables are classified by their ability to perform, both technically and culturally.[2] This pneumatic ambidexterity results in a form of soft tectonics, where the architectural inflatable occupies the territory between two radically different, yet converging disciplinary agendas: one being material and structural innovation, and the other being social and cultural engagement. It is precisely this sweet spot—the capacity for pneumatics to inform not only how we design and construct, but also how we inhabit space— that necessitates further inquiry into this type as a model for Design-Build.

Technically, the inflatable embodies innovation. By employing air as a medium to inflate various types of plastic or synthetic membranes, pneumatics push the architectural envelope, both literally and figuratively. In the early 1970s, Arthur Quarmby, one of the pioneers in plastics and architecture, referred to pneumatics as "the most important discovery ever made in architecture … [because] they can free the living environment from the constraints which have bound it since history began".[3] A few years later Roger Dent reaffirmed the potential of inflatables to innovate, claiming, "pneumatic construction points the way to an architectural revolution".[4]

During the sixties and early seventies, pneumatics began blowing up in avant-garde architectural circles. Inflatables offered not only an alternative to the formal and material constraints of the modernist box, but a new way of envisioning architecture's relationship to both technology and culture. Reyner Banham explains that the "apparent do-it-yourself potentials of low-pressure inflatable technology" ushered in a new way of thinking about architecture in an expanded field. Rather than relegating design and construction to professional experts, the simplicity, affordability, and accessibility of low-pressure pneumatics allowed anyone to participate in the creation of form and space.[5]

When Banham spent an entire day inside of a pneumatic dome to tape a TV spot in 1967, he was delighted by its "tendency to behave like a living organism," adding that "the beauty of that simple wind-bag was the directness and continuity of its response" [6]. As the television crew repeatedly entered and exited the inflatable with equipment, Banham noticed how the space expanded and contracted. If anything, a constant air flow necessitated that the inflatable be monitored by its user: air needed to be let out, otherwise it would "carry on like a neurotic bullfrog puffing itself up, straining, creaking, wrinkling along the seams, trying to lift itself off the floor".[7] What he identified was the inflatable's capacity to engage the body and environment in a symbiotic relationship that was radically different from typical buildings.

Culturally, pneumatics became the go-to device for artists and architects looking to push the boundaries of form and space. Ant Farm's *Inflatocookbook* (1971), a do-it-yourself (DIY) manual for pneumatic construction, claimed that designing and building an inflatable could be as easy as following a recipe. By offering an alternative to the xyz plane routine, pneumatics could be experienced in ways previously unknown to architecture. According to Ant Farm, it was not merely what one could easily create with plastic and air, but also how these new architectures challenged *a priori* spatial and social conditions. They write,

> … why to build inflatables becomes obvious as soon as you get people inside. The freedom and instability of the environment where the walls are constantly becoming the ceilings 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 xyz planes of the normal box-room.[8]

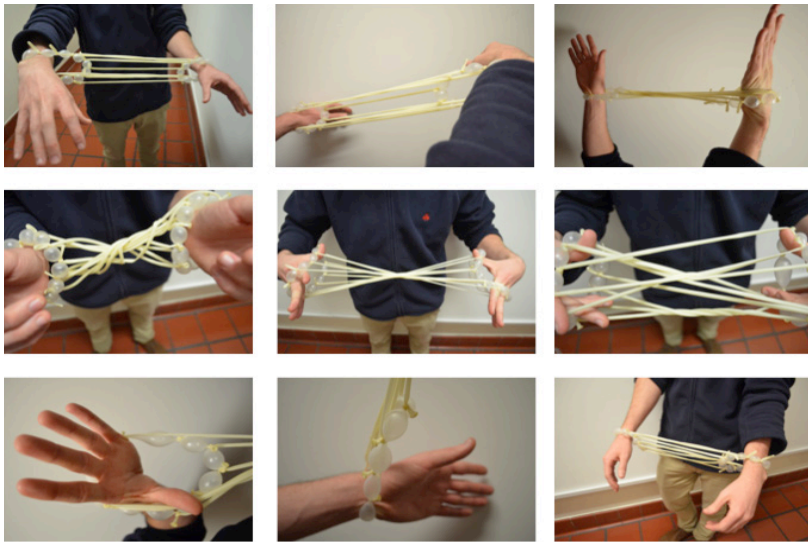
Here, the constantly shifting form and space of the pneumatic membrane dislodged architecture from social, disciplinary, and environmental norms. In effect, architecture was redefined through the malleability of these new-dimensional spaces.

As suggested through the DIY leanings of Ant Farm's *Inflatocookbook,* inflatables allowed just about anyone to generate their own pneumatic anywhere, anytime. Specifically, it was the mobility, instantaneity, and scale-ability afforded by inflatables that inspired an escapist and anti-monumental approach to design during the 1960s and 70s. Mobility, or the capacity to be temporary and/or move from one location to the next, allows architects to conceive of form and space as not bound to any one site, location, or even any given form. Rather than tethering itself to a foundation, a pneumatic temporarily appropriates space by inflating.[10] This use of air to inflate a membrane —be it a fan, blower, air vent, etc.— offers an instantaneity not afforded by conventional modes of construction (i.e. wood, steel or masonry construction). Likewise, the mobility and instantaneity afforded by pneumatics also suggests an elasticity of scale and form. Whether conceived of as small or large, singular or multiple, most inflatables are intrinsically modular, and have the capacity to adapt to a variety of scalar conditions.[9]

Historical precedents demonstrate the mobile, instant, and scale-able qualities of inflatables. Reyner Banham and Francis Dallegret's *Environmental Bubble* (1965) proposed a domesticated utopia equipped with modern amenities, freed from the fixity and permanence of the traditional home. As illustrated by Dallegret's rendering, a transparent plastic dome was inflated by air-conditioning output, and could be sited anywhere, even on a rock. The portability of Michael Webb's *Cushicle* (1964), an inflatable envelope containing appliances and personalized apparatuses, and *Suitaloon* (1967), a garment that inflated into a nomadic living envelope, took the notion of mobility even further. Webb's architectural apparatuses were conceived as prosthetic spatial extensions of the human body, mirroring the perpetual dynamism of its wearer/occupant. In addition, Webb was interested in prefabrication and modularity: his pneumatic suits included plugs to connect multiple units, suggesting a part to whole relationship with infinite scale-ability.

Building upon these notions of transience and adaptability, Hans Hollein's *Mobile Office* (1969) suggested that one could work anywhere, anytime. Extending the inflatable beyond the realm of domesticity, Hollein demonstrated how the production of the architect could be as flexible and mobile as the air-filled structures he/she creates. In effect, the formal, material, and spatial innovation enabled by pneumatics can, in turn, directly impact how we live, work, and play, challenging the distinction between private and public space. Similarly, in their performance *Basel Event: The Restless Sphere* (1971), Wolf Prix and Helmut Swiczinsky of Coop Himmelb(l)au used human bodies to propel a 13-foot inflatable sphere down the street, rendering the pneumatic membrane as a barely-there form of architectural enclosure. Although the bubble was simple in form and materiality, its size and transparency also directed attention to the malleable definitions of private and public space, and the impact inflatables can have as a counterpoint to existing architecture.

Haus-Rucker-Co's *Yellow Heart* (1968), a pneumatic space capsule, was designed as a private retreat. Suspended inside an interior sphere comprised of soft, pulsating air-filled chambers, its two inhabitants would experience an altered state of consciousness in response to the physical and visual patterning of the structure's swelling skin. *Villa Rosa* (1968), another pneumatic project by Coop Himmelb(l)au, demonstrated both technical and cultural prowess. Privileging spatial experience over specified form, this structure vibrated, inflated, and emitted colors, sounds,



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and smells in order to affect the perception of its inhabitants. Designed with the objective to dematerialize space, like *Yellow Heart, Villa Rosa* rendered itself a living organism, in a state of flux.

But, pneumatics weren't simply about employing aesthetic allure and sensorial seduction to subvert preconceived notions of what constituted architectural form, space, and experience. They also had the ability to operate as mechanisms for launching social, political, and environmental critique. For example, Ant Farm's *Clean Air Pod* (1970) performance at UC Berkeley employed a 50-by-50-foot inflatable to call attention to poor environmental air quality and pollution. According to Felicity Scott, it was through these types of pneumatic performances that Ant Farm "suggest that what is at stake for disciplines like architecture is the ability to forge an ongoing political (and aesthetic) practice, a contestatory practice that appropriates tools at the limits of social and technological developments but deploys them to strategic ends".[10] By staging a hypothetical situation where the atmosphere was poisoned and only clean air could be found inside the pneumatic pod, Ant Farm deployed the inflatable as a performative decoy. In effect, the immateriality of air had become the new medium for radical thinking and making.

II. PNEUMATIC PEDAGOGY

In 2012, in the architecture department at the University of San Diego (USD), the author taught a materials research and fabrication studio on the topic of pneumatics, in collaboration with Los Angeles-based architect Peter Tolkin. The following two summers the author also taught an inflatables workshop in the Ticino region of Switzerland to architecture students from Cal Poly, San Luis Obispo. Both provided an opportunity to explore Design-Build pedagogy through hands-on experimentation with air-filled structures, and solidified an appreciation for the mobile, instant, and scale-able qualities of inflatables.

Pneumatic Studio

At USD, Pneumatic Studio was treated as a design laboratory, encouraging collaboration and invention. Through materials research and hands-on experimentation, this course emphasized process. Ant Farm's *Inflatocookbook* was employed as a template to experiment with inflatable structures and space. Because it is still used today as the go-to how-to for pneumatics, we asked: How can this manual, and likewise inflatable architecture, be reimagined in the 21st century?

Figure 1: Kyle Ober explores the malleable properties of latex balloons with respect to the body.

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Pneumatic Studio encouraged students to continually interrogate the potential of inflatables and their relationship to art, architecture, performance, and the human body. The semester was divided into four distinct phases: 1) Inflated Bodies, 2) Deflated Bodies, 3) Housing Bodies, and 4) Performing Bodies. Each phase was comprised of a series of projects exploring pneumatic design and construction at a variety of scales. The course began with individually led projects, gradually incorporating one or more partners. Students eventually formed into groups, working collaboratively to design a series of pneumatic constructions. Student work was reviewed at the end of each phase, where pneumatic research and experimentation coalesced into a series of inflatable constructions, as well as documentation of this process.

Here, the ability to identify design problems and challenges was as important as presenting solutions. Due to the performative and ephemeral nature of inflatables, students were also asked to document their design process through a variety of mediums, ranging from photography to stop motion animation. As a materials research studio, students were encouraged to share their findings—successes, failures, and new discoveries—as a means to contribute to a greater collective understanding of pneumatic design and construction.

1) Inflated Bodies

The first phase explored inflatables at the scale of the human body. Imagining inflatables as prosthetics, or bodily extensions, these projects worked with conventional inflatable readymades, ranging from balloons to toys. What, we asked, are the possibilities and constraints of these materials, and how do they relate to air? The first project asked students to take a readymade—in this case numerous clear latex balloons—to construct a wearable pneumatic construction. Armed with hand pumps and some elementary knowledge about balloon tying methods, students immersed themselves in the playful and exploratory process of transforming balloons into prosthetic extensions of the human body. Students were encouraged to test the limits of the material. In many ways, the latex balloon performed as an architectural unit. Not unlike a brick, it necessitated logic of pattern and connection. Because these constructions were mono-material—meaning that only balloons and air were allowed—the beauty of working with latex was its flexibility: it served as architectural unit, structure, and connection.

Figure 2: Jacob Bruce and Monika Marambio designed a series of pneumatic arches that could be moved around to generate different spatial conditions. They also incorporated lighting and confetti to test out atmospheric effects.

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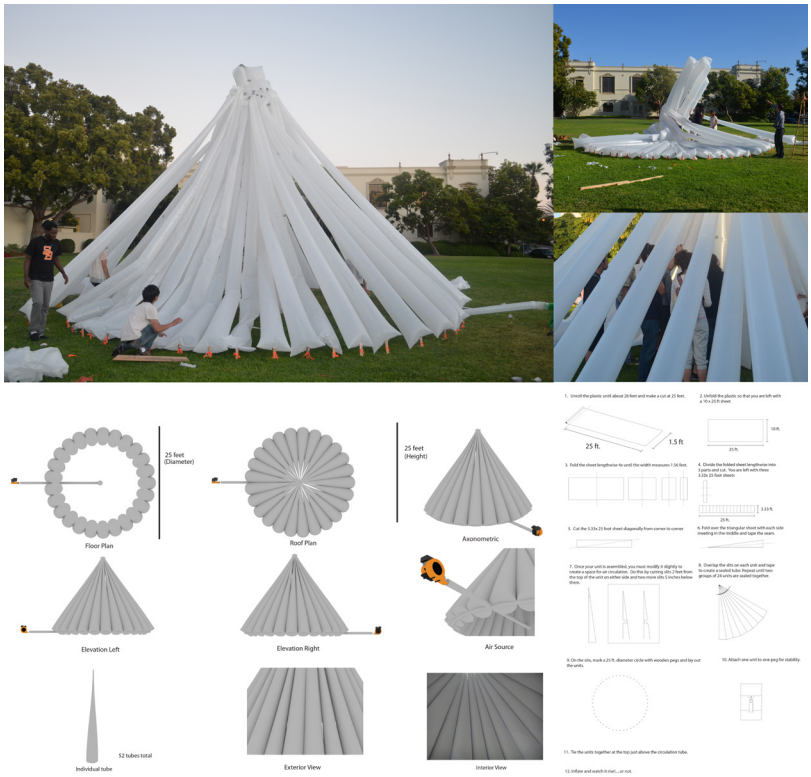
2) Deflated Bodies

For the next project, students selected an inflatable toy or object to analyze. This necessitated that they disassemble an inflatable readymade to understand its form, material(s), color/patterns, structure, and seams/plugs. The dissected inflatable subsequently operated as a kit of parts, capable of being reimagined as an altered readymade or hybrid construction. The resultant altered readymade not only needed to hold air, but also had to take on a different identity and/or function from that of its original legibility as an object. This was achieved by exploring a variety of materials, as well as transformations of the original object. Through hybridization—fusing one readymade with one or more other readymades—students were encouraged to explore multiple recombinations. Through this analysis and transformation of a pneumatic type, students familiarized themselves with the techniques of pattern making, seaming techniques, material exploration, and working with air. Taking this newly acquired knowledge, they were then asked to fabricate a small space for two people.

3) Housing Bodies

The third phase of the course explored how pneumatics offer a virtually instant means of exploring space in three dimensions and at 1:1 scale. The objective was to design and build a pneumatic pod, informed by their altered readymade, that could be inhabited by at least two people. By constructing their designs at full-scale, students were able to quickly understand the technical and cultural possibilities of pneumatics. By moving beyond architectural representation (drawings and models), they were able to address both the pragmatic challenges posed by inflatables (craft, seaming techniques, air handling, structure, etc.), as well as the spatial and atmospheric potential of their designs (materiality, scale, lighting, etc.) Challenged by the task of translating their ideas from concept to construction, students quickly embraced the challenges and opportunities posed by Design-Build.

Figure 3: Alana Barber and Rachel Smith constructed an inflatable out of 100 IKEA shopping bags and duct tape.



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4) Performing Bodies

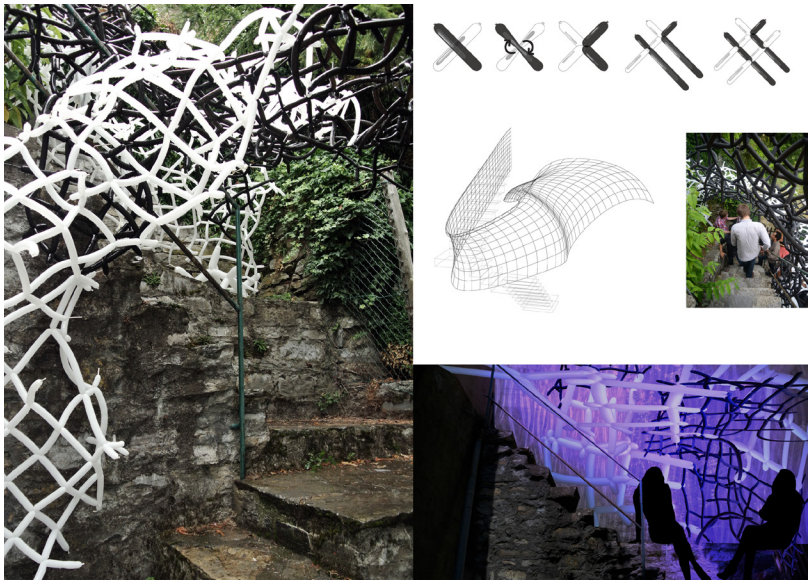
The final phase of the course explored inflatables at the scale of performing bodies. Rather than being imagined as an enclosure for two people, these pneumatic constructions were designed to house collective bodies. The research asked the students to design a three-ring circus, exploring the notion of three distinct yet simultaneous spaces for housing events. Two students questioned whether inflatables should be limited to plastic sheathing. In the spirit of Marcel Duchamp, they discovered a readymade—the ubiquitous blue IKEA shopping bag – and transformed it into a building material. A group of four students devised a simple pneumatic unit that, when repeated radially, generated a spectacular and monumental gathering space. They also learned that what appeared to be a very simple design—as their step-by-step instructions for assembly communicate—was in fact much more complicated to construct.

Inflatable Workshop

Building upon this studio, the following two summers the author traveled to Switzerland to conduct a workshop with architecture and art students from Cal Poly, San Luis Obispo to create a series of site-specific inflatable installations. These workshops began with a lecture and discussion about the history of inflatables and their relationship to art and architecture. Subsequently, students were asked, over the course of three days, to design and construct a full-scale pneumatic construction.

Whereas latex balloons had previously been used to create body constructions, here they were more overtly exploited for their mobile, instant, and scale-able properties. First of all, the materials (thousands of balloons and a dozen hand pumps) had to fit into a suitcase. Secondly, access to blowers or air compressors was limited, and possibly non-existent. Because the workshop was only a few days, as opposed to a semester, the viability of designing and building something at full-scale had to be

Figure 4: Karen Gonzalez, Chen Lee, Leighton Steele, and Kyle Ober designed a tent-like structure out of inflatable tubes, using only plastic sheeting, clear packing tape, wooden stakes, and one fan.



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addressed. These constraints made latex balloons all the more appealing as an alternative to the traditional pneumatic toolkit of plastic sheathing, duct tape, and fan.

After a discussion about the evolution of pneumatics on the first day, workshop participants began by familiarizing themselves with latex balloons and hand pumps. Working with white, black, and/or clear balloons, students explored a variety of inflating, tying, and assembly techniques. On the second day, each group designed a proposal for their site-specific inflatable installation, as well as a few material mockups, exploring the structural, formal, and atmospheric potential of working with balloons. On the third and final day, working exclusively with balloons and hand pumps, students created a variety of large-scale intricate inflatable structures that responded to the unique historical, cultural, and environmental context of a remote Swiss-Italian hill town. Significantly, the workshop not only challenged *a priori* definitions of what constitutes an architectural inflatable, but also reaffirmed the potential of the inflatable as a model for rethinking Design-Build pedagogy.

III. BEYOND PNEUMATICS

In 1968, at the peak of pneumatic play, Banham pointed out that the inflatable was not a novel invention. He writes, "You name it, someone is blowing it up right now, but it isn't quite as new as is sometimes made out".[11] What Banham stressed was how technological advancements in plastics, paired with shifting cultural sensibilities, facilitated a new era for architectural experimentation. Whereas the modernist box had exhausted its potential, inflatables were happening.

In 1972, Dent addressed the rising popularity of pneumatics in schools of architecture, albeit with reserve. He writes,

> The dynamism of pneumatics coupled with their do-it-yourself experimental potential has fostered a blow-up craze in the field of architectural education which has extended not only into architectural magazines but also into the daily national press. Although this publicity has extended the familiarity of pneumatics, it has in some cases been detrimental to further development, for such attempts to attract publicity very rarely consider the detailed practicalities of pneumatic use. It is therefore not surprising that public opinion has been rather skeptical about pneumatics. However, it appears that this voguish way of looking at the subject is one the wane and with it will go many of the frivolous proposals that have been made for pneumatic application.[12]

Although Dent acknowledged the viability of the pneumatic as a pedagogical and professional model, he was, above all, an advocate for "a throw-away architecture"

NOTES

1. For the purposes of this paper, I typically refer to air filled architectural membranes as either inflatables or pneumatics. Although Reyner Banham also refers to them as "wind bags," Roger Dent clarifies the specific terminology and definition of pneumatic architecture. He writes, "The words 'pneumatics', 'blow-ups', 'inflatables', 'airdomes', 'airhouses', and many others are tossed around rather nonchalantly to describe in one case the whole field of this technology and in another just one particular aspect. To define it accurately, however, it should be known collectively as pressurized construction, a term which implies the control and stabilisation of all kinds of structures by means of pressure differentials achieved by the uniform loading actions of air, gases, liquids, or even granular solids." Roger N. Dent, *Principles of Pneumatic Architecture* (New York: Halsted/ Wiley, 1972) 15.

2. For a comprehensive mapping of both the technical and cultural dimensions of architecture inflatables circa the 1970s, see: Thomas Herzog, *Pneumatic Structures: A Handbook of Inflatable Architecture* (New York: Oxford University Press, 1976); Roger N. Dent, *Principles of Pneumatic Architecture* (New York: Halsted/ Wiley, 1972); Arthur Quarmby, *Plastics and Architecture (New York: Praeger, 1974);* and Reyner Banham, "Monumental Wind Bags" in *New Society* (18 April 1968, vol. 11, no. 290: 569-570, Arts in Society). Essay reprinted in Marc Dessauce (ed.), *The Inflatable Moment: pneumatics and protest in '68* (New York: Princeton Architectural Press and The Architectural League of New York, 1999).

3. "I believe that pneumatics are the most important discovery ever made in architecture; that they can free the living environment from the constraints which have bound it since history began and that they can in consequence play an immeasurable part in the development of our society."Quarmby, *Plastics and Architecture*, 114.

4. Dent, *Principles of Pneumatic Architecture,* 13.

5. "The taste that has been turned off by the regular rectangular format of official modern architecture and Bauhaus-revival modern-antique furniture, is turned right on by the apparent do-it-yourself potentialities of low-pressure inflatable technology." Banham, "Monumental Wind Bags."

6. "For the human occupant it was a kind of partnership relation with the enclosing membrane, each going independently but sympathetically about its business. Quite unlike the relationship with the static shell of traditional building where you can beat your fists on the walls and scream and get no more than an echo for response: here a blow directed at the enclosing skin would produce a flurry of reproachful quivering and creaking, quickly dying away as the even tenor of its normal breathing ways was resumed. I like that." Banham, "Monumental Wind Bags."

7. "This tendency to behave like a living organism when roused is what I find missing in most accounts of the inflatable experience. Unlike conventional architecture which stands rigidly to attention and deteriorates (like a guardsman with moths in the busby) inflatables (and tents, to a lesser extent) move and are so nearly

Figure 5: Nick Batie, Alex Buckthal, Catie Halliday, and Brian Hohl designed a site-specific pneumatic installation using only latex balloons along an existing stair in Scudellate, Switzerland.

that could change and adapt to contemporary cultural desires of mobility and "continuous change".[13] What Dent suggested was not a fixation on the inflatable as type, but rather a rethinking of architecture all together.

In 1974, Quarmby questioned why the pneumatic "has so far failed to revolutionize architecture," urging architects and engineers to commit themselves to exploring the infinite possibilities of air filled structures.[14] He writes, "Despite these difficulties and shortcomings in the present situation we can still use plastics materials and processes to turn building on its head, to rethink architecture and to question the whole basis of function and construction."[15] A year earlier, Cedric Price acknowledged that inflatables were falling short of their potential to revolutionize architectural thinking. Price states, "Pessimistically, I consider that the application—in the field of structures—of pneumatic techniques is too involved with solving normal structural and shelter problems".[16] What Quarmby and Price identified was the potential of pneumatics to transform how we design and build; yet both believed that its capacity for innovation had been overlooked.

Now, some fifty years later, architecture must beg the question: Is the inflatable still a viable model for disciplinary invention? Meaning, to what degree does the inflatable serve as a literal (vs. conceptual) model for rethinking how we design and build architecture today? The common misnomer is that inflatables are too instant, impermanent, and playful to be taken seriously. Yet, due to their tendency to lure new processes, technologies, and sensibilities into the discipline, it can be argued that pneumatics operate as performative decoys to blow up architecture. In addition to their capacity to innovate technically and culturally, the mobile, instant, and scale-able qualities of pneumatics can undoubtedly inform contemporary strategies of Design-Build in post-secondary education today.

living and breathing that it is no surprise that they have to be fed (with amps, if not oats)… The beauty of that simple wind-bag was the directness and continuity of its response. Every slight change of state inside or out—even a heated conversation—brought compensating movement in the skin, not through the expensive intervention of a computer, but by direct variation of curvature under balance of pressures." Banham, "Monumental Wind Bags."

8. "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 the environment where the walls are constantly becoming the ceilings 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 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. A conference, party, wedding, meeting, regular Saturday afternoon becomes a festival." Ant Farm, *Inflatocookbook*, 1971/1973.

9. Pneumatic structures can achieve maximum effects with minimal means. Similar to Buckminster Fuller's geodesic domes, inflatables are affordable, lightweight, and can be deployed just about anywhere. They also suggest, like Fuller's domes, a range of material applications, meaning they are not limited to being executed in only one material. For further reading on Fuller, and his influence on Design-Build pedagogy, see Daniel Lopez-Perez (ed.), *R. Buckminster Fuller: World Man* (The Kassler Lectures) (New York: Princeton Architectural Press, 2013).

10 Felicity Scott, *Architecture or Techno-Utopia: Politics After Modernism*. (Cambridge, MA: MIT Press, 2007), 245.

11. Banham, "Monumental Wind Bags."

12. Dent, *Principles of Pneumatic Architecture,* 225-226.

13. "There is a distinct desire for continuous change, a desire to keep altering one's surroundings… These trends imply either a mobile architecture or an architecture with a much shorter lifespan than at present, perhaps even a throw-away architecture planned for obsolescence after a specific time." Dent, 226.

14. "It is often claimed that there is no theoretical limit to the space which a low-pressure pneumatic form can enclose, and in certain circumstances this claim can be substantiated. Certainly it is now (and has been for several years) a practical proposition to enclose areas many square miles in extent by using a technique which is unique in that its cost rate falls as the span increases. How is it that this matchless technique has so far failed to revolutionize architecture." Quarmby, *Plastics and Architecture*, 98.

15. Quarmby, 8.

16. Cedric Price, "Pneumatics: A Key to Variable Hybrid Structuring," a paper given at 1st International Colloquium on Pneumatic Structures in Stuttgart, Germany. Published in Ant Farm, *Inflatocookbook* (1973).