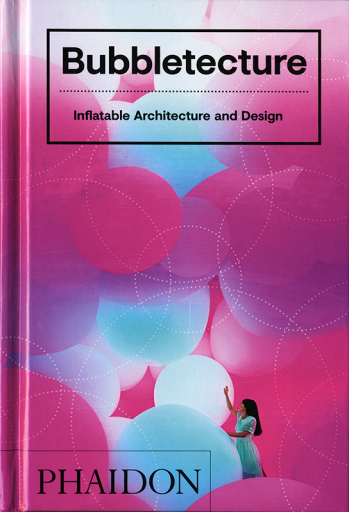


Bubbletecture



Inflatable Architecture and Design

PHAIDON

Bubbletecture

Inflatable Architecture and Design

Sharon Francis



Introduction

Innovative, revolutionary and often avant-garde, inflatable objects and structures are imbued with political, cultural or social significance. By their very nature, they are an expression of advancement; a reimagining of traditional forms. Influential in aviation for more than two centuries, this deceptively simple technology has in recent decades been at the forefront of architectural movements, enabled cutting-edge artistic practice and has been symbolic of technological utopianism.

Bubbletecture is a select compendium of inflatables now. Showcasing more than two hundred works, this book features projects that span the realms of architecture, art, design and fashion from the 1960s through to the present day. In this introduction the back-catalogue of pneumatics is delved into — a potted history of sorts — illuminating the appeal, potential and wide application of inflatable technology, giving context to the surprising array of materials, forms, colours, sizes and locations of pneumatics today. While bouncy castles and pool floats might be the populist face of blow-up objects, this book vividly demonstrates that the world of inflatables is far richer.

The First Inflatables

The invention of the first inflatable — the hot-air balloon — came about in the mid-eighteenth century in France. At this time, Paris was the cultural junction of the intellectual and philosophical movement known as The Enlightenment,

which took place from 1715 to 1789, the latter being the year of the French Revolution. Philosophical and scientific enquiry abounded, led by prolific writer and poet Voltaire and later influenced by the ruminations of René Descartes. These philosophers argued for a society based upon natural law and scientific reasoning. The Enlightenment succeeded in bringing about a paradigm shift in French culture, felt across Europe, which moved thought towards science and reductionism, and away from religious dogma.

It was in this climate in 1782 that the French brothers Joseph-Michel and Jacques-Étienne Montgolfier created the first hot-air balloon by burning straw and wool to heat air under a large, lightweight paper and fabric bag. A year later, the first manned, untethered flight took place with passengers Jean-François Pilâtre de Rozier and Marquis François Laurent d'Arlandes flying over Paris for about fifteen minutes.

In 1784 Jean Baptiste Meusnier, recognized as the father of modern dirigibles, or airships, was the first to propose the familiar cigar-shaped crafts still used today. It was not until Count Ferdinand von Zeppelin, a German nobleman and army general, devoted himself to their development that airships became successful. Working with a team of engineers, he created the Luftschiff Zeppelin 1 — commonly referred to as LZ1 — in 1893. At 128 m (420 ft) long, it was the largest object ever built to fly. The internal aluminium frame allowed the airships to be larger, more weather-resistant and travel faster.

The LZ1 was launched in front of a crowd of 12,000 in 1900 and, despite some technical hitches, this flight heralded the so-called 'golden age' of air transport.

Zeppelins continued to be developed and manufactured and were used extensively by the Germans during World War I in bombing raids over cities, including in London and Paris. The Zeppelins went from strength to strength in the post-war period until the infamous Hindenburg disaster of 1937. The largest airship ever built, the Hindenburg's tail burst into flames while landing in the US after a transatlantic flight — a disaster that all but brought about the demise of the dirigible industry.

Twentieth-Century Ballooning

In 1932 Auguste Piccard, a Swiss scientist, undertook the first manned flight into near-space in a helium balloon, reaching a record-breaking 16 km (9.94 mi) high. Over the next few years records continued to be set and broken. In 1935 Explorer II, a helium balloon with a sealed cabin, manned by US Army Captains Albert Stevens and Orvil Anderson, reached an altitude of 22 km (13.6 mi). This highly publicized flight became a milestone in aviation history, establishing that human survival within a pressurized chamber was possible, and paving the way for future space travel.

In 1978 and 1981, respectively, the first Atlantic and Pacific crossings in a helium balloon were made, setting new duration and distance records each time. Balloon flight came full circle, with a return to hot-air ballooning when UK

businessman and adventurer Richard Branson and Swedish aeronautical engineer Per Lindstrand crossed the Atlantic in 1987 in the largest balloon ever flown. The duo followed this with a Pacific crossing in 1991, reaching record-breaking speeds of up to 395 km (245 mi) per hour.

In February 1995 American aviator and adventurer Steve Fossett made the first solo transatlantic flight, travelling from Korea to Canada. Eventually succeeding on his sixth attempt, in 2002, he was the first person to fly an uninterrupted, unrefuelled, solo circumnavigation of the globe in any form of aircraft.

Warfare

From 1794 to 1945 balloons were predominantly used in warfare. In the US Civil War and through World Wars I and II, balloons were tools for surveillance, transportation, communication and weaponry.

During 1944 and 1945 1,100 men of the 23rd Headquarters Special Troops, known as the Ghost Army, an elite unit whose speciality was tactical deception, staged more than twenty battlefield deceptions using inflatable tanks. Their role was to create the impression that the allied forces were bigger and more powerful than they actually were. Inflatable tanks, together with rubber airplanes and elaborate costumes, were deployed in combination with a soundtrack of armoured and infantry units broadcast via powerful amplifiers. It is now estimated that the Ghost Army saved tens of thousands of lives and

was instrumental in a number of Allied victories in Europe.

Inflatable Structures

Initially created for the US military, the first basic inflatable structure was designed by engineer Walter Bird in the Cornell Aeronautical Lab. His radomes — a structural, weatherproof enclosure — were used to protect radar antennae. Hundreds were utilized during the late 1940s and 1950s. Bird set up Birdair Structures Inc. in Buffalo, New York in 1956, developing inflatables that included storage sheds, greenhouses and pool enclosures. These products raised the profile and potential of inflatables, and caught the attention of architects, leading Bird on to numerous collaborations.

In the late 1950s — the same period as the design and construction of the Guggenheim in New York City — Frank Lloyd Wright took an experimental deviation to explore a prototype for an inflatable village. In an attempt to create a model of affordable housing — a concern he revisited from time to time — the Fiberthin Air Houses were conceived. The hemispheres were constructed from vinyl-coated nylon fabric and supported by low-pressure air that was provided by a fan-driven heating and cooling system.

The 1960s

Not since the post-war Modernist social utopias imagined in Europe in the 1920s had there been such a spirit of change to emerge as in the 1960s. It was in this

anti-establishment environment that a second wave of utopian architecture took off across Europe and the US. Cheap, mass-produced plastic had become widely available, making exploration of the potential of inflatables an appealing possibility. Young, radical architecture groups embraced the creative potential of inflatable technology, whether as a vehicle for dissent against the conventions of traditional architectural education, or in reaction to the pervading Brutalist movement of the time.

This experimental vision was fuelled by the counter-culture movement and happened within the context of the first space explorations. Architects and artists at the forefront of this movement include collaboratives such as Austrian firms Coop Himmelb(l)au and Haus-Rucker-Co (page 181), Ant Farm in the US (page 223) and Archigram in the UK (page 194).

With their dwelling prototype Villa Rosa, 1968, Coop Himmelb(l)au used the potential of pneumatic structures to explore habitation and modes of existence within the city. Restless Sphere, 1971, was an interactive transparent orb, 4 m (13 ft) in diameter, which served as a performance piece within the city streets of Basel, Switzerland — set into action by a person walking inside. Around the same time, Spatial Effects were experimenting with their Waterwalk series (page 162) that performed similarly on water.

Haus-Rucker-Co's parasitic bubble Oase No. 7, which was installed, sucker-like, on the side the Museum of Art and Trade in Kassel, Germany in 1972, explored the creation of utopian environments through

On a different scale, Ark Nova (page 88), a collaboration between architect Arata Isozaki and artist Anish Kapoor, provided a mobile performance and exhibition space to unite communities still rebuilding after the devastation caused when a major earthquake and tsunami hit Japan in 2011.

The Future

New materials and systems are always under development, creating myriad possibilities for inflatables in the future.

The Diodon Project (page 215), for example, created by French student collective Dynamorphe, prototyped a new construction system combining an inflatable with an auxetic material that has the capacity to shrink, expand and multiply via real-time digital control. The inflatables of Chico MacMurtrie, recognized for his large-scale kinetic installations such as *Chrysalis* (page 248), integrate amorphous robotic systems that are interactive on multiple levels, simulating the architecture of the human body.

New 'Balloons'

Among a number of near-space and stratospheric projects underway is Google's Loon (page 169), a network of polyethylene balloons carrying remote-controlled solar-powered electronics systems that beam down high-speed Internet coverage to remote areas.

Since 2011 the American aerospace and defence company Lockheed Martin

has continued to develop and test its High Altitude Airship (HAA) — unmanned, helium-filled vehicles that operate above the jet-stream in a geostationary position for telecommunications, surveillance and weather monitoring.

Elsewhere, Barcelona-based Zero2Infinity are simplifying space access with the Bloostar, a prototype rocket that launches from a balloon which has ascended to 25 km (15.5 mi). Satellites at these altitudes facilitate transmission and collection of information as well as scientific research and testing. The possibilities for stratospheric balloons include power generation, communications, data collection, security, weather forecasting and Earth observations. Zero2Infinity's Bloon stratospheric balloon is also in development, working towards offering commercial trips for six people — two pilots and four passengers — up to an altitude of 36 km (22 mi) from bases in Spain.

Technologies in Development

In 2017 MIT Media Lab's Tangible Group developed a system, called AeroMorph, which, with minimal human interaction, folds paper, plastic and fabric into various origami shapes when inflated. The methodology has a range of potential applications in wearables, toys, automated packaging and even building systems.

Intelligent pneumatic systems have the potential to respond to environmental conditions in real-time. A research team at the Institute for Advanced Architecture in Catalonia, Spain, has developed a construction 'skin' that does just this, to allow active adjustment

to fluctuations in the environment. Various materials, including silicon and fabric, have been tested for suitability, allowing dozens of cells to inflate or deflate, reducing wind vibrations and drag and controlling light infiltration.

The Next Frontier

In a competition backed by NASA, architectural firm Foster and Partners created a conceptual, modular habitat for Mars. The proposed dwelling is constructed robotically prior to the arrival of the astronauts; semi-autonomous robots then select the site and dig a crater, allowing inflatable modules to sit within it, forming the core of the dwelling. The inflatables are rapidly deployed and provide stability despite uneven ground conditions. 3D-printed components, made from the excavated soil and rocks, complete the construction.

NASA scientists working in collaboration with researchers from the agriculture department of the University of Arizona in Tucson, USA have developed an inflatable Lunar/Martian greenhouse prototype that allows vegetables to be grown in deep space. Carbon dioxide exhaled by astronauts is used by the plants for photosynthesis in what is called a 'bioregenerative life support system'. The system is also designed to be used for air revitalization, and water and waste recycling.

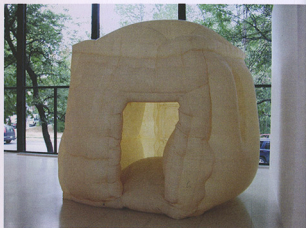
The possibilities for future development and use, in and beyond the digital age, have the potential to expand as new frontiers, materials and processes seek

to exploit the versatile, lightweight and sustainable nature of inflatable products. Having established itself within the domain of exploration and experimentation — from the very first steps of aviation to cutting-edge fashion — the blow up serves to blow out traditional forms and perceptions. 'Bubblectecture' is thought-provoking and constantly evolving; this book is a visual ode to its tremendous variety and a celebration of the curiosity it inspires.

Notes

Bubblectecture includes a number of special features, as follows: at the top of each project is the name of the design, followed by the name of the architect, artist or designer who created it. Next to this is a balloon icon that identifies the scale of the project, from small to large. At the back of the book is a Directory of Architects, Artists and Designers.

Project name: Inside Out
Artist: Ana Rewakowicz
Location: Montréal, Canada Date: 2001



Using a room in her apartment in Montréal, Canada, as a mould, artist Ana Rewakowicz covered all surfaces with multiple coats of rubber liquid latex until a significant thickness built up. After peeling away the imprint, Rewakowicz was left with a transportable skin, complete with architectural details and other remains, such as dirt and hair. This 'skin' was then connected to an external second layer for support, allowing the room to be inflated. Recreated in galleries as a 'room within a room', Inside Out is an installation that, when separated from origination, is both disconcerting and playful.

Project name: Snowballing Doorway
Artist: Alex Schweder
Location: Syracuse, New York, USA Date: 2009



For this interactive installation, artist Alex Schweder inserted an over-inflated archway into the existing structural portal of a gallery space. The arch provided a tight, yet accessible, passage until it deflated and was replaced by the inverted, mirror-version archway above. The two identical archways passed air back and forth between each other continuously, one deflating as the other expanded with the shared air. Examining the constraints of architectural space, the passageway became a volatile place of engagement, alternately accessible then non-existent. It is now part of San Francisco Museum of Modern Art's (SFMOMA) permanent collection.

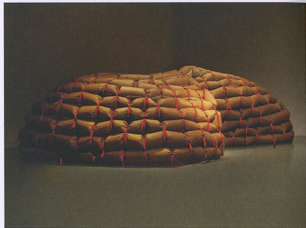
Project name: **Sleeping Bag Dress**
Artist: **Ana Rewakowicz**
Location: **Mexico City, Mexico** Date: **2004**



Wearable as a kimono-style dress, this multipurpose garment converted into a sleeping bubble that could fit up to two people. Inspired by the early pneumatic work of Archigram, Ana Rewakowicz was concerned with the rise of materialism and waste. The dress provoked a conversation about lightness; how to live and travel with less. Inflated by a fan powered by batteries charged from a built-in solar panel, the wearer became self-sustainable in their clothing-cum-portable shelter. It was road-tested in 2005 during her walking performances in Mexico City, Mexico entitled *A Modern Day Nomad Who Moves As She Pleases*.

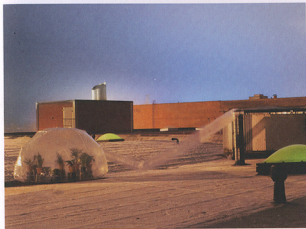


Project name: **Cosy Shelter**
Artist/Designer: **Lambert Kamps**
Location: **Helsinki, Finland** Date: **2012**



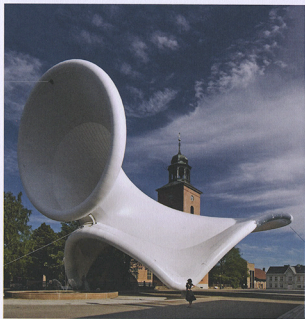
Despite its military-like appearance of a sandbag fortress, this igloo-shaped hideout is actually made of pillow-shaped inflatables, covered on the outside in brown vinyl and secured together with red strapping. The utilitarian exterior belies the cosy interior, which, in contrast, is clad in an assortment of colourful woolen blankets in banded layers. The shelter has a large opening in the top, not visible from outside, that allows light in. Installed inside the Design Museum in Helsinki, Finland, artist and designer Lambert Kamps' installation provided a play space for adults and children alike.

Project name: **Air Cleanser**
Artist: **Ana Rewakowicz**
Location: **Pori, Finland** Date: **2008**



Situated in the seaside town of Pori, Finland, this installation consisted of a clear plastic geodesic dome that was inflated over the roof ventilator of a factory. A selection of potted plants were placed within the dome, investigating the capacity for plant life to absorb pollutants from the air; the air emitted from the vent was warm, creating a suitable environment for the plants, but it was also toxic. When NASA tested the air after a twenty-four hour period, it was confirmed that the plants were absorbing factory pollutants and adding a small amount of fresher air into the atmosphere.

Project name: Tuballoon
Architect: Snøhetta
Location: Kongsberg, Norway Date: 2006



The main stage for Norway's annual Kongsberg Jazz Festival, Snøhetta's membrane structure, Tuballoon, measures 20 m (65½ ft) in height and 40 m (130 ft) in length. A hybrid structure, it combines 1 m (3¼ ft) diameter inflatable perimeter tubes with an hourglass-shaped tension membrane, made from galvanized steel. Erected each year for the three-week festival, the structure is a dynamic and tuneable acoustic environment; its shapely form provides a classic clamshell-like shading over the audience to keep quiet performances intimate, while the PVC fabric construction is nearly transparent to sound during amplified performances.

Project name: Living in a Bubble
Artist: Ana Rawakowicz
Location: Québec, Canada Date: 2003



This surreal space, an installation at a gallery in Rouyn-Noranda, Canada, is the interior of a golden-hued meteorological balloon, which was set within an enclosed, semi-airtight cube measuring 2½ m (8 ft) in each dimension. Usually the balloon rested deflated, the air removed by a blower. When a viewer approached artist Ana Rawakowicz's work, a motion detector triggered the blower that was sucking the air out. A negative pressure inside caused the balloon to inflate and fill the space, bulging at the portholes, and allowed a person to climb inside the opening to the sphere within.

Project name: Uniblow Outfits
Artist: Ana Rewakowicz
Location: Montréal, Canada Date: 2001



Artist Ana Rewakowicz's Uniblow Outfits piece consisted of two inflatable suits, each constructed from a double layer of rubber latex with a cavity. The wearers donned the suits in their uninflated state, then walked around to activate the built-in foot pumps, which filled the cavity with air. With each step, the suits inflated further and, as they reached capacity, it became increasingly difficult for the wearers to continue moving. The suits were displayed in a shop front in Montréal, Canada; the work investigated issues surrounding strategies of fashion advertising and how they influence our understanding of the body.

Project name: Galeroom
Designer: Studio GGSV
Location: Paris, France Date: 2017



As part of its fortieth anniversary celebrations, the Centre Pompidou in Paris staged an interactive exhibition that introduced children to four decades of art and design. Within the Galerie des Enfants, Studio GGSV created an installation in three parts, including playful sculptures, a performance by Chinese artist Liu Bolin, and this brightly coloured inflatable structure, Galeroom. Referencing works in the Centre Pompidou by artists such as René Magritte, Sol LeWitt, Karel Appel and Salvador Dalí, it sprang from the house's chimney to form a dome, which was illuminated by a marbled 'skylight'.

Project name: Conversation Bubble

Artist: Ana Rewakowicz

Location: Ghent, New York, USA (or elsewhere) Date: 2006



This structure, made of clear vinyl, required the participation of five people in order to be inflated, each plugging a hole in the ellipsoid space. Cocooned within the base, the bodies of the participants were immobilized between layers of vinyl; their heads were unrestricted, but contained within the sphere, which became a literal speech bubble. The five people were free to chat for as long as the group agreed to continue, but the restrictions of this collaborative, interactive piece required a unanimous decision to keep going or end: no one person could leave of their own accord. The work was first exhibited at Art Omi gallery in Ghent, New York, USA.

Project name: Timeline

Artist: Victorine Müller

Location: Lucerne, Switzerland Date: 2005



Swiss artist Victorine Müller's *Timeline* work took the form of a monolithic, transparent, inflatable elephant. Part-installation, part-performance art, part-sound work, the pneumatic piece was performed in Lucerne, Switzerland. Positioned within the belly of the beast, the artist sat cross-legged inside the form, which was lit from below, heightening a sense of intimacy. Later in the performance, the elephant was laid on its side, motionless and disempowered, as if sleeping or even dying. Müller described the PVC structure as: 'an elephant in a quiet, dark space, awe inspiring yet also arousing our sympathy.'

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Bubbletecture celebrates the surprising, entertaining and often innovative world of inflatable architecture and design. Including cutting-edge buildings, provocative art installations and sublime fashion, as well as ingenious — and practical — chairs, lights and accessories, Bubbletecture demonstrates that all things inflatable are simply irresistible.



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