

Loop House



Loop House – Design in Motion

The proposed design of the 'Plan-less' House, the Loop House, is a building founded through a dynamic relationship with its surrounding environment. The Loop House is situated in the Badlands of Alberta, in western Canada; an area of continuous transformation where patterns of motion are found in the immense fields of farmlands, or in the hoodoos — sculptural rock landforms, carved through time by erosion.

The North American west epitomizes the frontier. It presents an expanded, dynamic sense of boundary in the curving and undulating Badlands themselves, and it gives a view of the infinite, in the endless flat plane of the prairies, leading one's eye to the horizon that meets with the immense sky above.

It is with this landscape that the Loop House seeks a connection. A linear wetland is carved in the ground, acting as a natural system for water collection, waste treatment and irrigation, while setting up the principal east-west axis upon which the house is aligned. The building itself picks up on the dynamic fabric of this landscape, as a ribbon of structure loops and envelops the building, giving the house form and stability. This dynamic structural ribbon weaves the building into the landscape by drawing a continuous, living terrain around and through the living spaces themselves.

Within the house a constant connection to the environment is made, as the building relies on the sky for heat, water, and energy, the structure's form emulates and envelops the terrain, and all of the interior spaces remain open to the panoramic, infinite vista beyond.

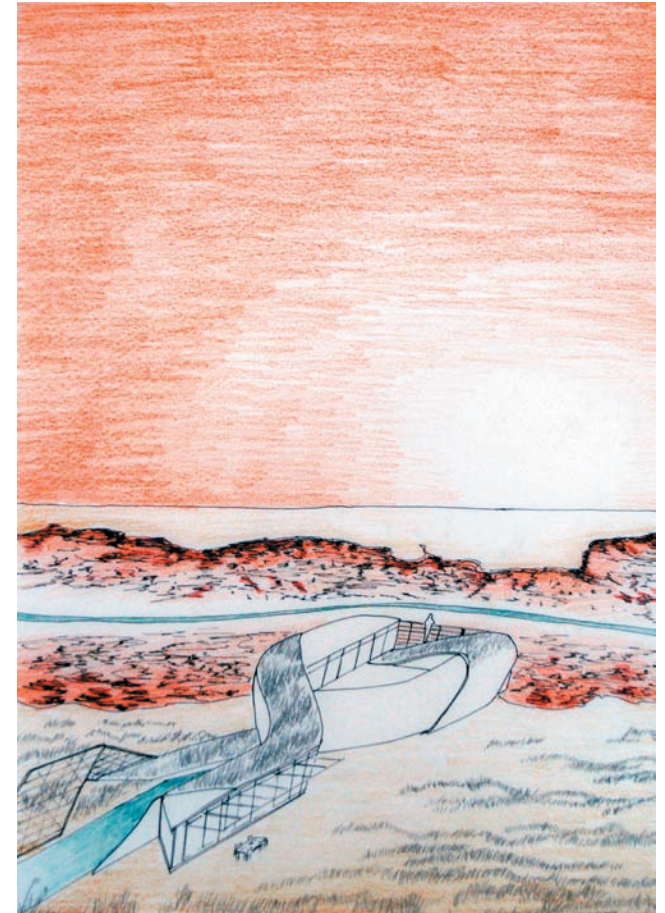
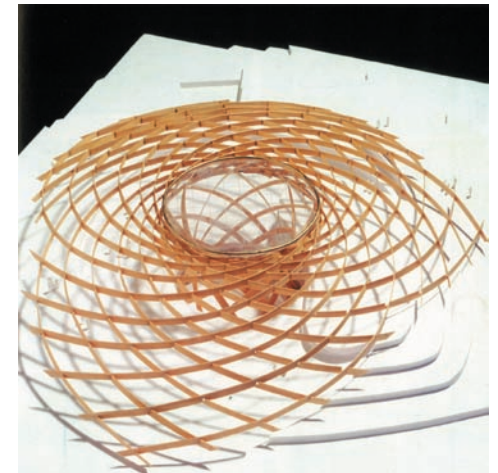


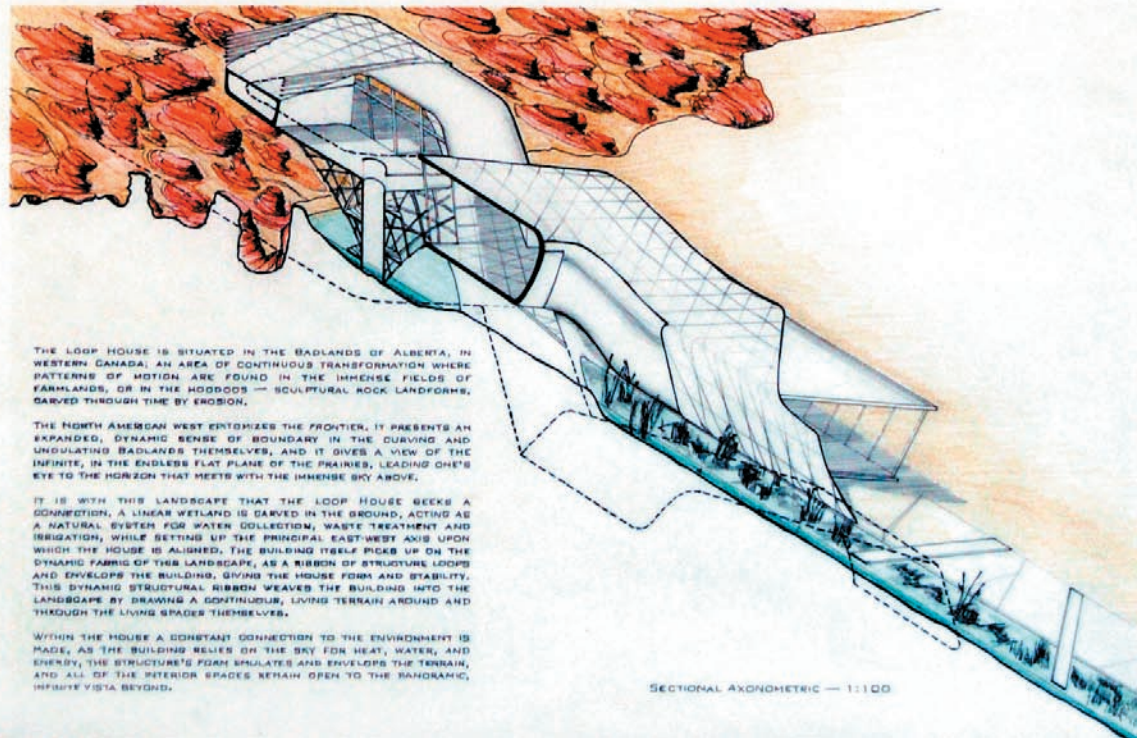
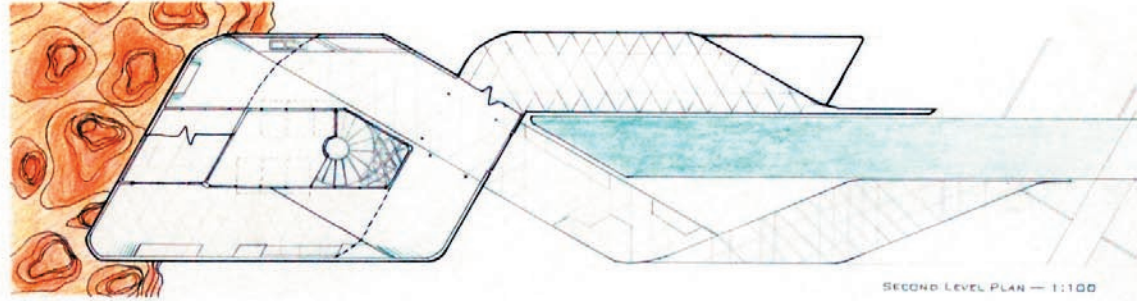
Table of Contents

4	Competition Panels
6	Introduction
7	Natural Precedents
8	Site Context
10	Traditional Structures and Crafts
12	Industrial Revolutions
13	The Rise of Modernity
19	Integrated Structures
22	Fabricating Complex Form
28	Activating Architecture
31	Bibliography



The Eden Education Resource
Centre, Grimshaw Architects
(Metamorph, 2004, 191)

LOOP HOUSE



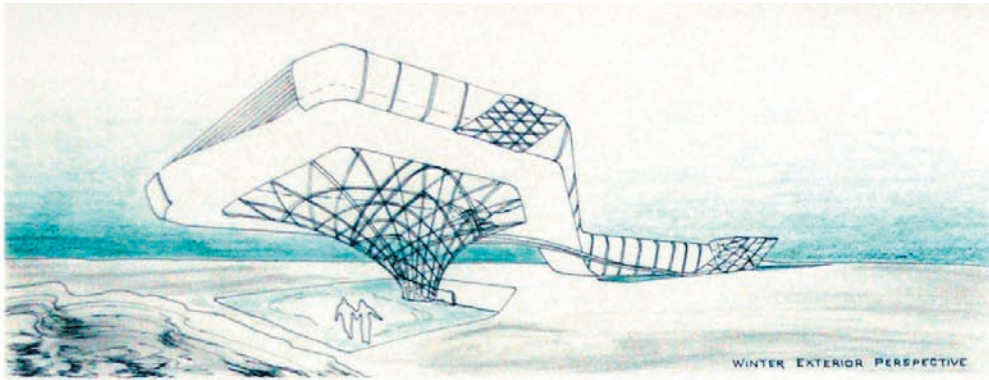
THE LOOP HOUSE IS SITUATED IN THE BADLANDS OF ALBERTA, IN WESTERN CANADA, AN AREA OF CONTINUOUS TRANSFORMATION WHERE PATTERNS OF MOTION ARE FOUND IN THE IMMENSE FIELDS OF FARMLANDS, OR IN THE HODDODS — SCULPTURAL ROCK LANDFORMS, CARVED THROUGH TIME BY EROSION.

THE NORTH AMERICAN WEST ENTRENCHES THE FRONTIER, IT PRESENTS AN EXPANDED, DYNAMIC SENSE OF BOUNDARY IN THE CURVED AND UNGLAZING BADLANDS THEMSELVES, AND IT GIVES A VIEW OF THE INFINITE, IN THE ENDLESS FLAT PLANE OF THE PRAIRIES, LEADING ONE'S EYE TO THE HORIZON THAT MEETS WITH THE IMMENSE SKY ABOVE.

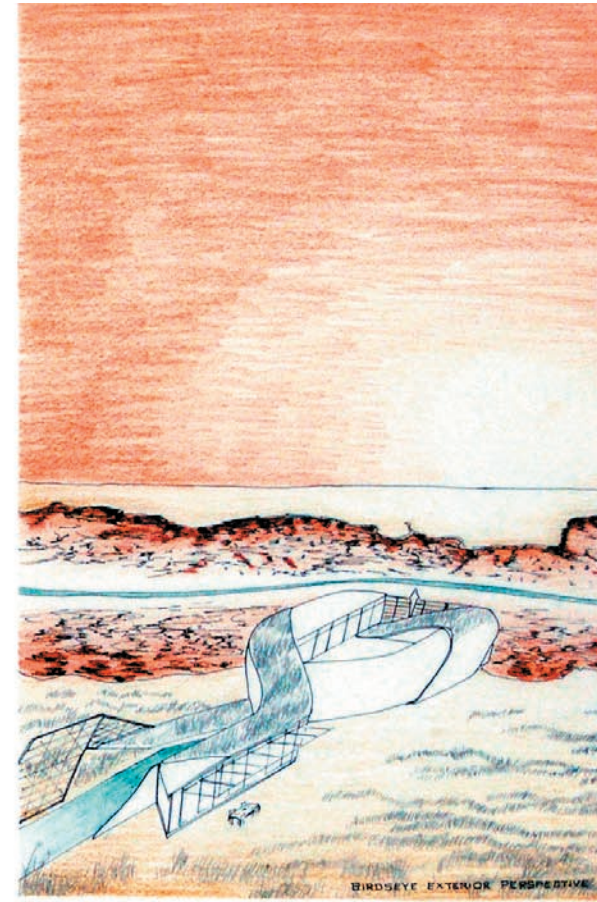
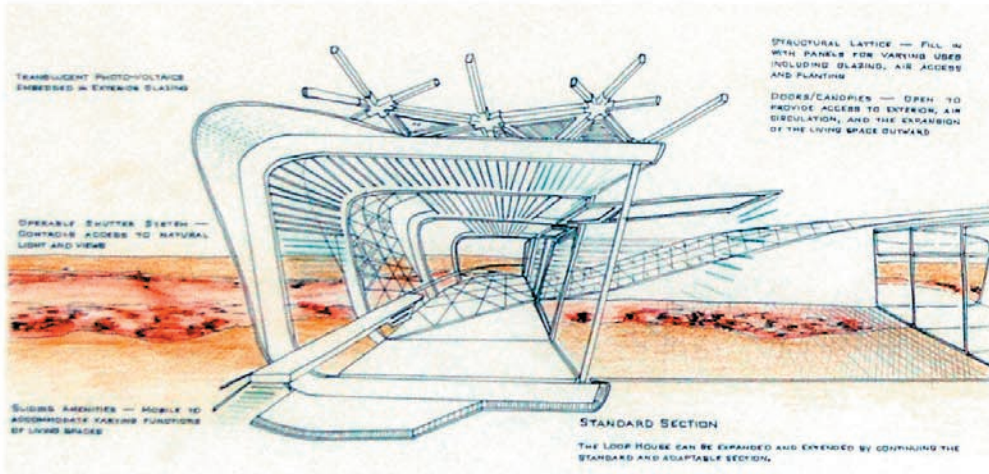
IT IS WITH THIS LANDSCAPE THAT THE LOOP HOUSE SEEKS A CONNECTION, A LINEAR WETLAND IS CARVED IN THE GROUND, ACTING AS A NATURAL SYSTEM FOR WATER COLLECTION, WASTE TREATMENT AND IRRIGATION, WHILE SETTING UP THE PRINCIPAL EAST-WEST AXIS UPON WHICH THE HOUSE IS ALIGNED, THE BUILDING ITSELF PICKS UP ON THE DYNAMIC FABRIC OF THE LANDSCAPE, AS A RIBBON OF STRUCTURE LOOPS AND ENVELOPS THE BUILDING, GIVING THE HOUSE FORM AND STABILITY, THIS DYNAMIC STRUCTURAL RIBBON WEAVES THE BUILDING INTO THE LANDSCAPE BY DRAWING A SERRATED, LIVING TERRAIN AROUND AND THROUGH THE LIVING SPACES THEMSELVES.

WITHIN THE HOUSE A CONSTANT CONNECTION TO THE ENVIRONMENT IS MADE, AS THE BUILDING RELIES ON THE SKY FOR HEAT, WATER, AND ENERGY, THE STRUCTURE'S FORM ENLARGES AND ENVELOPS THE TERRAIN, AND ALL OF THE PTERIOR SPACES REMAIN OPEN TO THE BARRIADIC, INFINITE VISTA BEYOND.

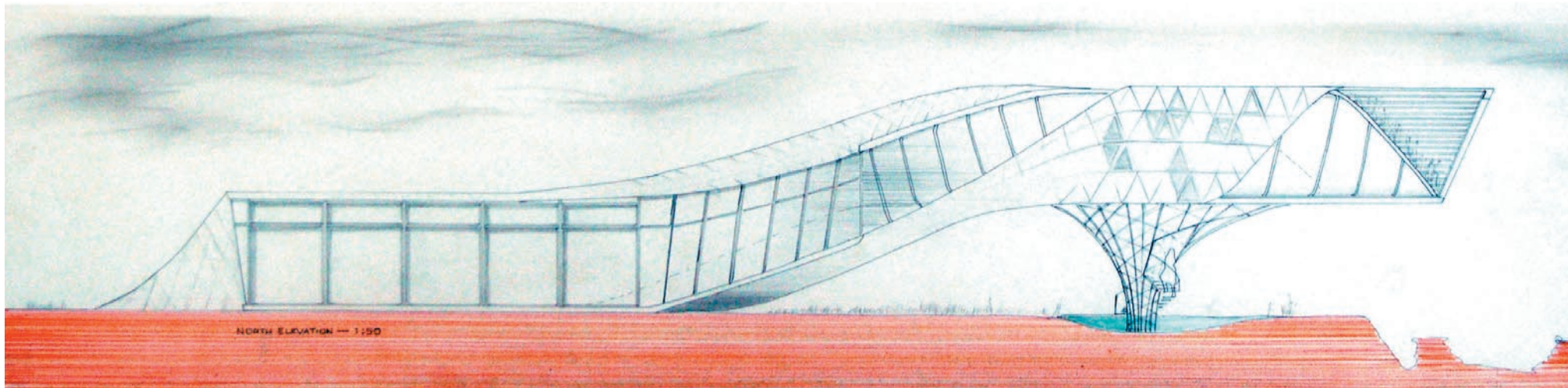
LOOP HOUSE



WINTER EXTERIOR PERSPECTIVE



BIRDSEYE EXTERIOR PERSPECTIVE



The Plan-less House – Questioning Boundaries

The notion of a “Plan-less” house is one founded in challenging boundaries. The very idea of defining space in a permanent, definitive fashion is a human endeavor we can trace back through the entire history of architecture. But this method of defining space has become curious in recent times, with our capacities to communicate and travel to nearly anywhere around the earth in short or near instant time, making our environment a truly connective field. What role, then, should architecture play in such an interconnected sphere, if its primary function is the very definition of space?

The two primary means of developing the design to question boundary, both relate to the building’s connectivity and affectation with its surrounding landscape and environment. The first approach relates to the building’s form, being one of fluid motion, wherein the inhabitants and landscape flow from interior to exterior and back continuously, such that the divide between inside and outside itself comes into question. The second means is in the house’s structure itself and the way in which this form is subdivided and constructed, primarily based in roots of patterning or tiling; crafts that themselves evoke an infinite connectivity in their own capacity to be extended infinitely. Tiling, however, is further used as a means of embedding an adaptive quality in the design, where again the relationship between spaces can be negotiated constantly through manipulation, or transformation of the tiled pattern. Future development of this design looks to incorporate a responsive patterned skin, reacting to the inhabitants and surrounding environment, enveloping the entire growing and moving form, making the structure a living space.

The works of the past always influence us, whether or not we care to admit it, or to structure an understanding of how that influence occurs. The past is not just that which we know, it is that which we use, in a variety of ways, in the making of new work...

The typology argument today asserts that despite the diversity of our culture there are still roots of this kind which allow us to speak of the idea of a library, a museum, a city hall or a house. The continuity of these ideas of type, such as they are, and the esteemed examples which have established their identity and assured their continued cultural resonance, constitute an established line of inquiry in which new work may be effectively grounded.

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

The precedents for this project span a large history, from the natural history of the earth, and the specific site of the project — the landscape of the Badlands of Alberta, to traditional architectures and crafts that express a notion of connectivity found in various forms of desert living. Further precedents are found in contemporary buildings that attempt to bridge these areas in new forms evocating motion, with patterned or tiled structures that themselves adapt and transform, changing the boundary between spaces to an interface of greater connectivity with the environment. Though this paper is presented in a linear historical fashion, it is clear that there are connections between the processes, forms and ideas that cross back and forth between the differing eras.



Water/Glass House by Kengo Kuma
(Bognar, 2005, 52-53)

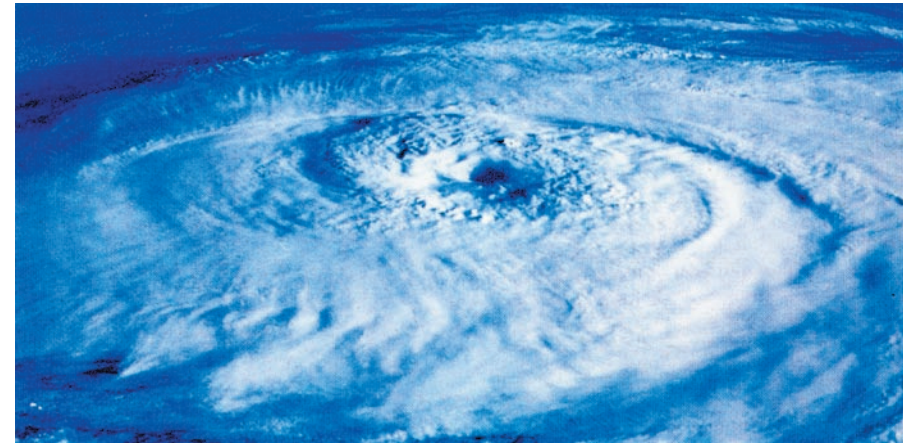


Horai Onsen Bath House by Kengo Kuma
(Bognar, 2005, 174-175)

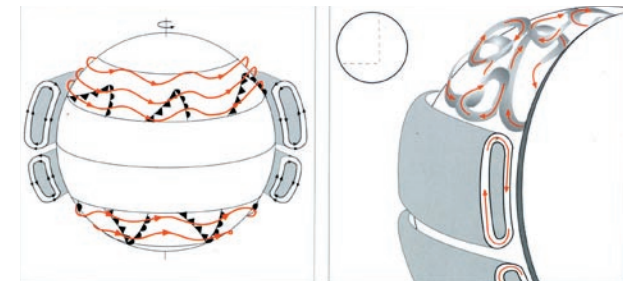
Natural Precedents

Nature expresses the ultimate form of the responsive, dynamic reality in which we live. With constant interchanges of energy, the earth's natural processes give rise to the forms of dynamism expressive of the fluid motion through which the earth operates. These are especially visible in the dramatic vortex forms of air movement in large storms, hurricanes and the earth's wind patterns, as with the jet stream that surrounds the earth, all of which are fuelled by the constant energy of the sun and the rotation of the earth, in which the wind movements attempt to create balance in a dynamic equilibrium. It is this primary essence of fluid motion giving form that informs the shape of the Loop House and the elements of the landscape that surrounds the structure.

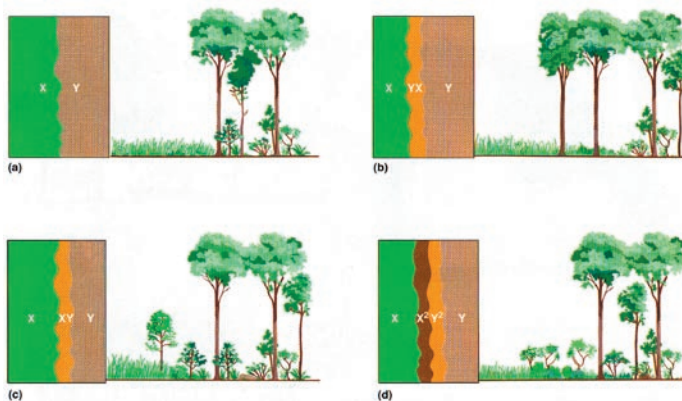
It is natural to follow that the earth's biotic elements then also exhibit reflexive or responsive capacities, in an effort to contend with the dynamism that surrounds them. Plants too respond to the sun's light, in their conversion of sunlight into organic matter while also converting carbon dioxide into oxygen through photosynthesis. In this respect, plant cells act as solar cladding systems, that operate with their selective permeability. Further, cellular structures demonstrate the natural process of tiled elements to give form to larger organisms, in much the same way as the Loop House is fundamentally a large single form, composed of like patterned components.



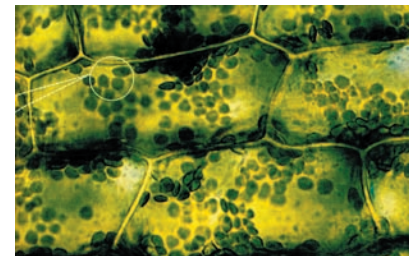
Chaotic energy movements fuelled by the sun's energy (Behling, 1996, 29)



The Earth's fluid wind patterns (Behling, 1996, 29)



An ecotone demonstrates the way in which two ecological communities can create a boundary between them, which in some cases, can generate an entirely new form of community (Smith, 2000, 283)



Phototropism, or growth of plants toward light, arises with unequal distribution of auxin, wherein cells on the darkened side elongate (Behling, 1996, 31)

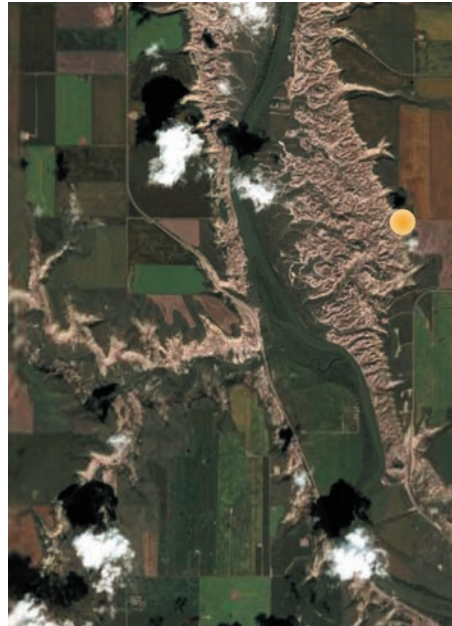
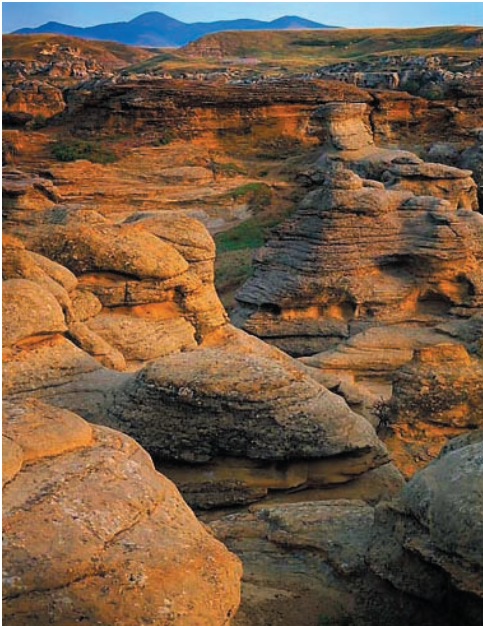


Solar tracking found in the leaves of *Robina pseudoacacia* (Behling, 1996, 31)

Site Context

The site of the Loop House is located in the Badlands of Alberta, near Writing-on-Stone national park – a dramatic landscape of water and wind-carved sculptural rock formations, surrounded by farmland. The farm fields themselves evoke both a cellular quality, in the parcelling of the land, as well as demonstrate the tracing of movement in the fields themselves from the paths of motion of harvesting machinery, when viewed from above. The hoodoos, also demonstrate their sinuous form from the fluid motion that shaped them. These two immediate formations from movement, along with the patterning of the fields themselves, then become direct inspiration for the project, as they relate to the Loop House's own form and tiled structure.

The building itself is directed toward the west, as though it is itself travelling to the boundary of the frontier, expressed in the great dynamic rift that has been carved through the land. With it's largest exposure facing south, the Loop House makes optimal use of the sun's light for energy and daylighting purposes. As the house sweeps across the edge of the cliff the structure approaches, it provides a panoramic view of the epic landscape surrounding the building.



Images of the hoodoos of Writing-on-Stone National Park, AB (Berdan, 2006), (Europa Technologies, 2006)

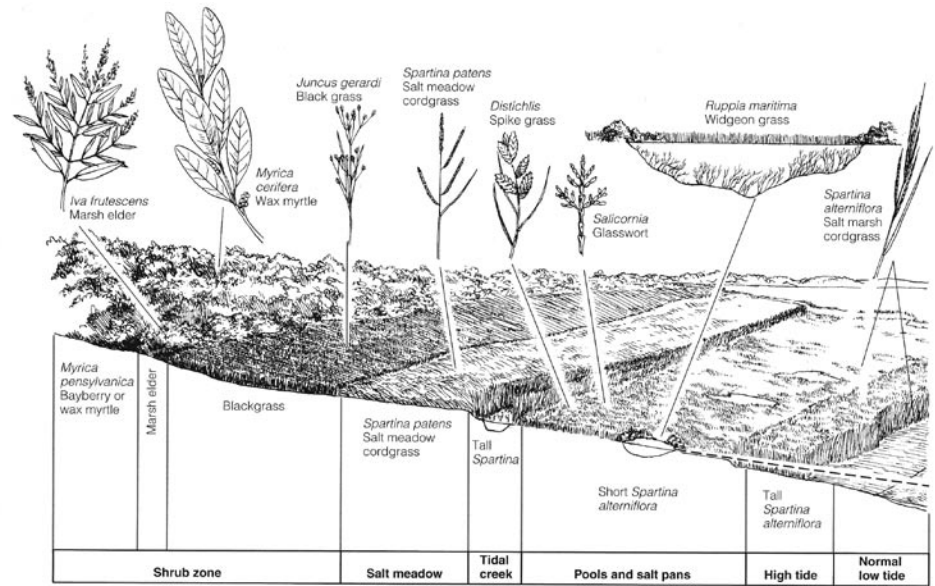


The surrounding site context of the Loop House

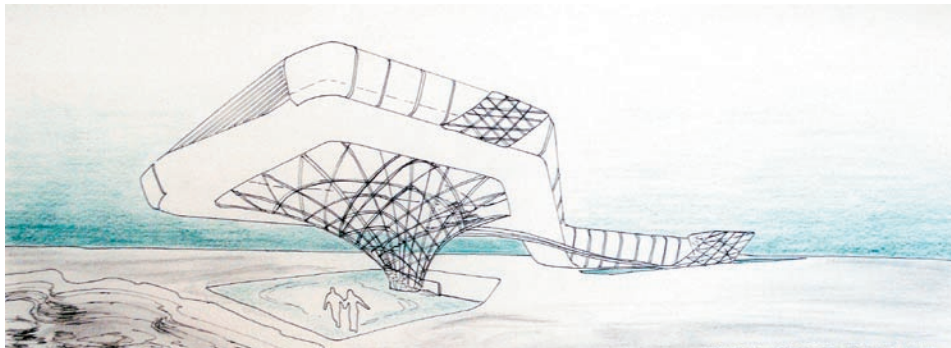
A primary relationship with the landscape is expressed in the project through the linear wetland that is carved into the landscape, reaching to the east from the west edge of the cliff on which the house is perched, overlooking the hoodoos. This wetland system is firstly used to collect rainwater, but further acts as the primary means of waste treatment, and water purification.

Ecological zonation through marshlands, being a demonstration of ecological growth is also, in itself, expressive of the expansion of the boundary condition. Zonation demonstrates the natural gradient of life forms that exist in such ecological communities, and thereby defines a boundary condition gradually. It is with this understanding that the Loop House has been developed, applying the idea of a multi-layered, dynamic boundary, as a means of developing the house's own envelope, as will be explored in further sections.

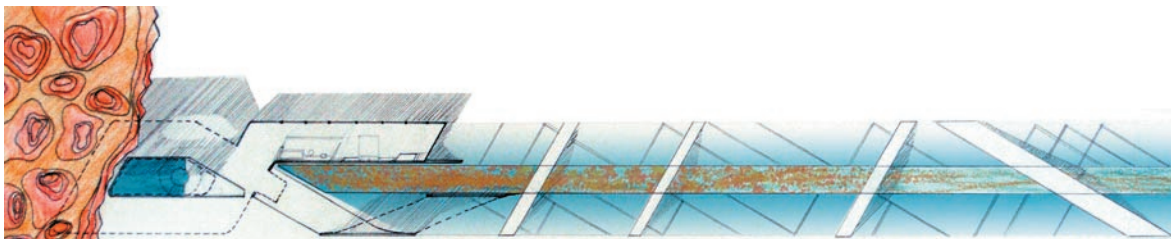
The forward most part of the wetland system has been developed with the idea that it may hold the purest water to provide passive cooling in the summer as a reflecting pool by providing moisture to the dry air, but would also be active in the winter when the water freezes to form an ice rink, where the movement of skaters is etched about the structure's base.



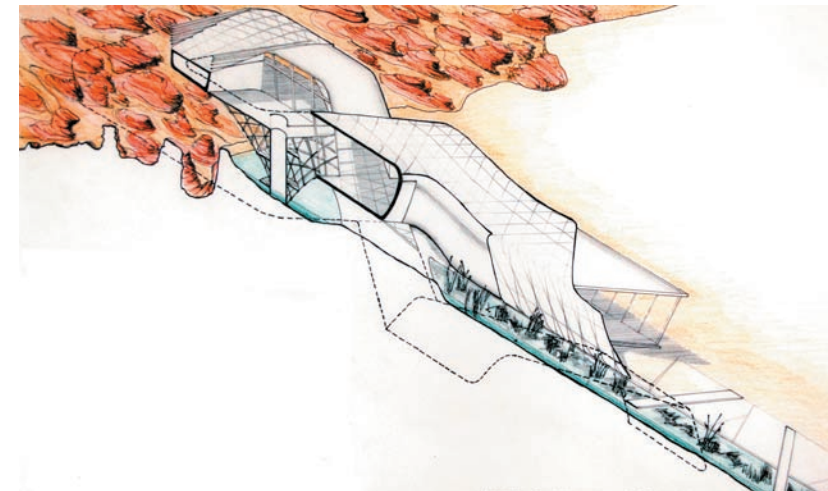
Patterns of zonation in a New England salt marsh (Smith, 2000, 282)



Loop House perspective in winter



Loop House ground level plan

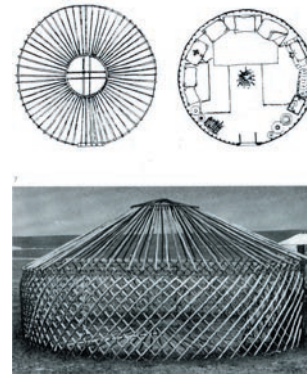


Loop House sectional axonometric

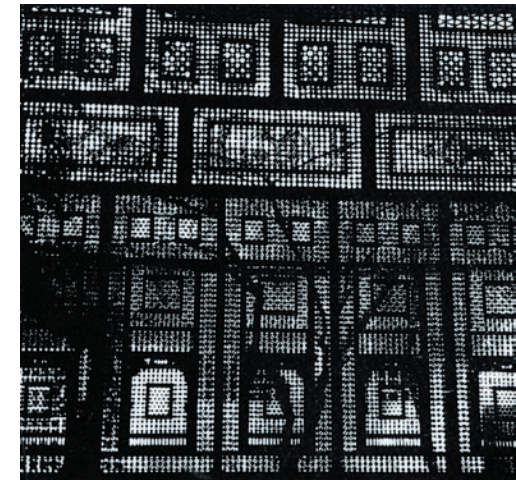
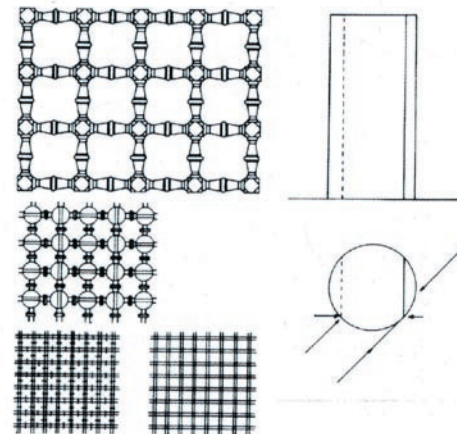
Traditional Structures and Crafts

The traditional crafts of making textiles, tiling and general patterns can be traced through many civilizations around the globe. These crafts naturally find their way into architectural design, as means of subdividing structure, creating ornament, and developing complex relationships with the surrounding environment. Weaving, knitting, braiding and embroidery – the primary means of creating textiles, then figures naturally into the making of architecture. The yurt, an example of nomadic building applicable to arctic climates, illustrates this transfer of craft directly, and further gives an initial inspiration for the Loop House's own dynamic, patterned skin, as the yurt's lattice structure can be collapsed, and moved quite literally to a new location.

It is fitting that other architectures of hot, and dry climates would also be of interest in the generation of the Loop House's design, as the weather around the Badlands shifts drastically from cold and dry in the winter, to hot and dry in the summer months. Typical screening devices in Arab and Indian architectures alike, create dramatic and complex relationships with the exterior, through their capacity to shade, allow the passage of air, and inspire with intricate patterns. These patterns themselves suggest an expansion to the infinite, through their own capacity to be carried out indefinitely, reflecting the Loop House's own aspiration of expansion, in its lattice structure that envelops the building and engages the surrounding terrain.



The yurt, a lightweight, lattice-structured structure that can be contracted for transportation, found in varying regions, but typically in arctic climates (Behling, 1996, 49)



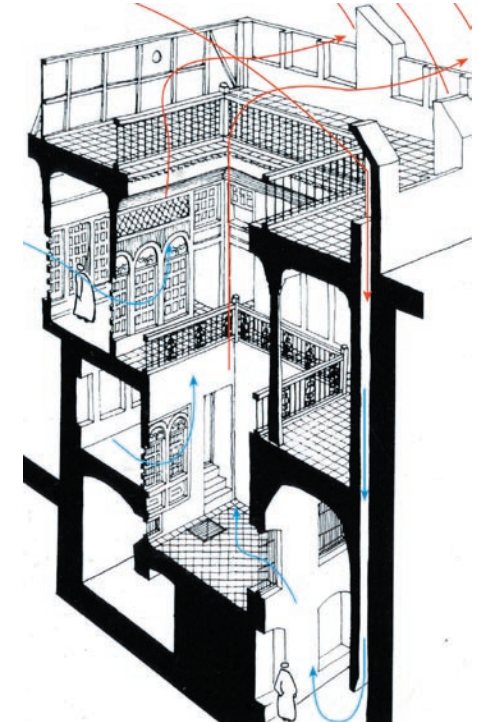
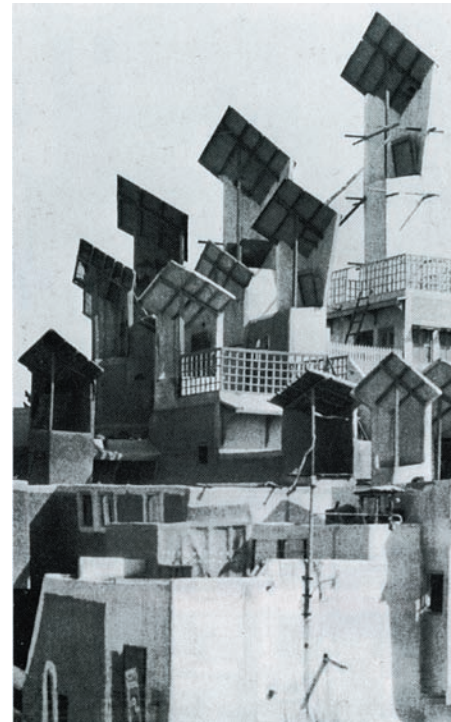
Screens designed by Hassan Fathy, based on traditional Arab structures (Behling, 1996, 185)



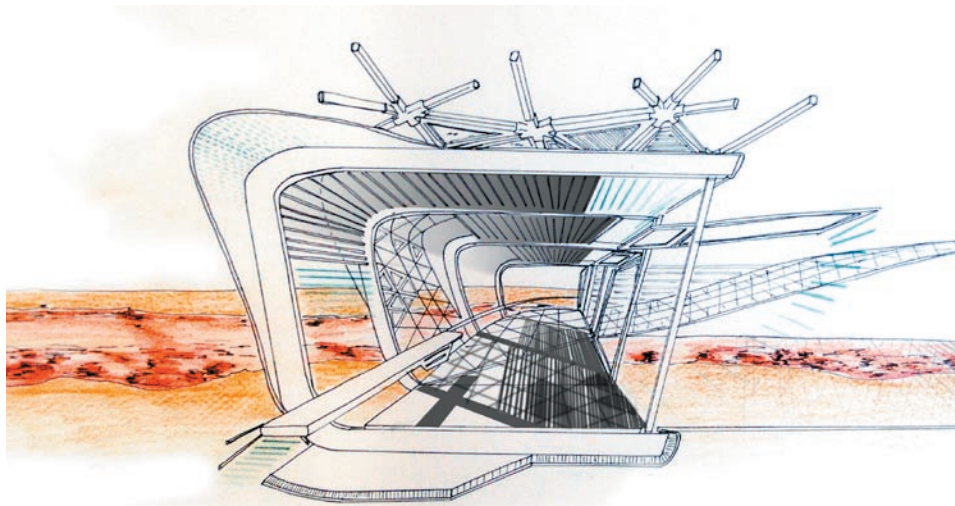
Mogul screens act as sophisticated shading devices in Indian structures, creating dramatic plays of light within spaces (Behling, 1996, 117)

In looking further at examples of vernacular Arab structures, and other buildings of the steppes, we find integrated means of shading and cooling through air movement. In principle, such structures utilize courtyard spaces and wind towers in combination with open screens to promote air circulation from a combination of natural wind patterns and stack effect. A similar arrangement is created in the Loop House, where in the upper level, a central courtyard-like space is also open at the bottom through a grated floor. This allows air to pass up and through the structure. This is combined with operable doors that have the option to hinge horizontally such as to provide additional shading and encourage air circulation inside.

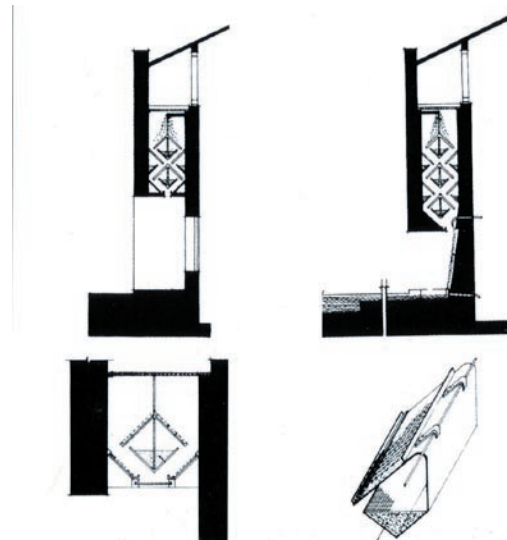
Hassan Fathy has taken the cooling method in traditional Arab structures further, by incorporating passive cooling systems into the walls themselves. These expanded wall sections allow wind to pass through, and carry moisture inside that has been collected from the water running within the wall. This very idea of expanding the section, to become a fluid, and dynamic system is integral to the Loop House's own design. Mobile shading systems, and a reconfigurable lattice skin allow variations on shading, energy collection, and daylighting, as will be explored further through the development of the dynamic building envelope.



Ventilation and screening systems found in vernacular buildings of the steppe (Behling, 1996, 64)



The Loop House's standard section involves layered elements for energy collection, heating, cooling and shading

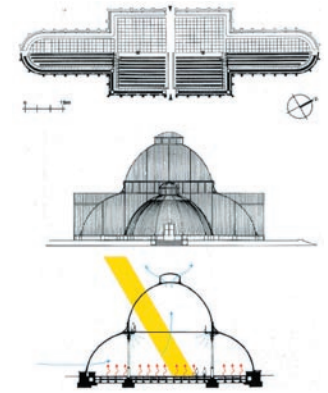
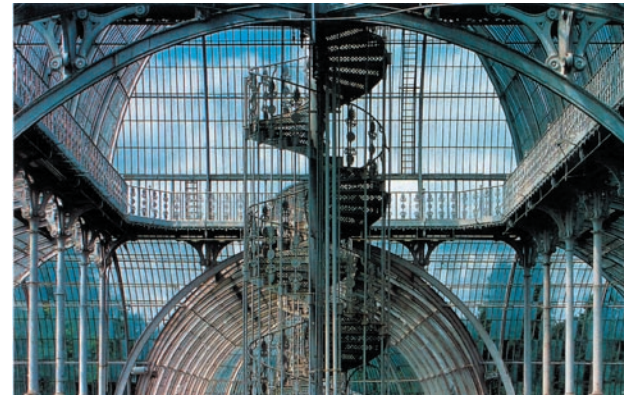


In expanding the building section to contain a special means of diffusing water for natural cooling, Hassan Fathy has created a system for cooling air in new buildings based on Egyptian vernacular construction (Behling, 1996, 185)

Industrial Revolutions

The industrial revolution brought about many changes to construction and our relation to the environment. Iron, and later steel made it possible to build immense structures with relatively thin members, allowing greater visual connectivity to the exterior world through the parallel development of glass production. It is not surprising that this same connectivity was being established spatially as well, as world travel was becoming more prevalent with new modes of transportation being developed, and the capacity to transport goods globally at greater speeds with much larger quantities was taking hold of developing countries. It is within this world development that Joseph Paxton's Crystal Palace and the idea of the green house was made, where the plant species of the globe have been brought into a single structure. This new level of connection to landscape, through the very permeation of the natural world inside, suggests the new level of interconnectivity that arose in this period. This linking to landscape is most commonly seen in similar structures of curving filigrees of steel, inspiring the Loop House's own ambition for connection to it's local environs through its ribbon of framework.

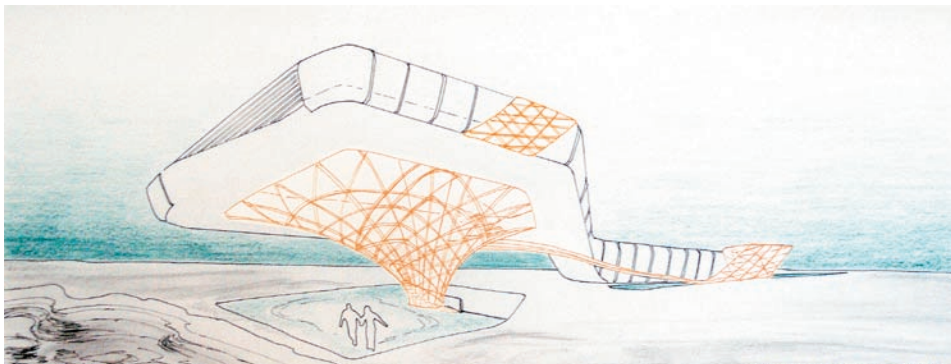
As mentioned, it is at this same time that new or improved modes of transportation were becoming ever more available, again utilizing similar means of developing structure, as exemplified in railway stations and the Zeppelin air-ship. Again, this focus on movement as a means of establishing connection is the fundamental gesture of the proposed design.



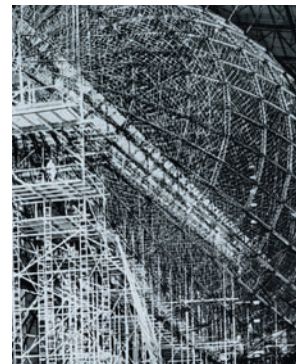
The Great Palm House at Kew Gardens, London, made of cast and wrought iron (Behling, 1996, 139)



A comparison of a greenhouse and railway station, both informed by the architectural developments brought by the Crystal Palace (Minter, 1990, 13), (Behling, 1996, 141)



The structural frame wrapping around the Loop House



Frame and skin of the Zeppelin airship (Behling, 1996, 154)

The Rise of Modernity

Philip Johnson – The Glass House

The glass house has become an icon of the modern movement in architecture, having been approached by several architects of the era, not least of whom is Philip Johnson. His design, at New Canaan, Connecticut, is a clear development from Mies van der Rohe's glass houses, such as the Resor House, or the Farnsworth House of 1947. Common to all designs is a clear intention to achieve minimalism in structure, and a maximal relationship with the context of the local environment through immense, panoramic glazing and the absolute minimum of interior partitions, to create complete visual continuity between inside and out.

It is interesting that the glass house, as an architectural work, somehow takes on greater significance through its very minimalism and transparency, such that what remains opaque becomes absolutely essential. In much the same way, the Loop House attempts a visual and spatial merging with the landscape, through its form, and the panoramic view through the building achieved by its open plan, and translucent envelope.



Exterior and interior views of Philip Johnson's Glass House (Whitney, 1993, 33, 37)



Plan of the Glass House (Whitney, 1993, 43)



Rendering of the Resor House by Mies van der Rohe (Whitney, 1993, 97)

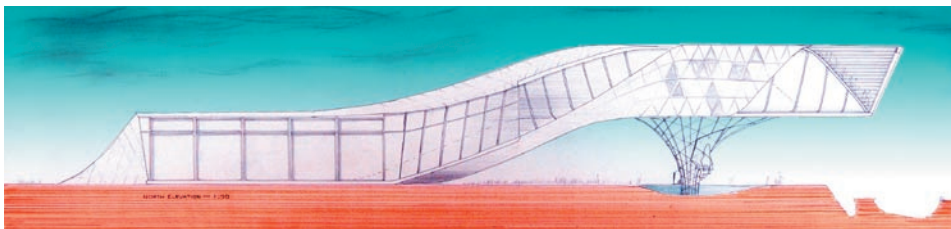
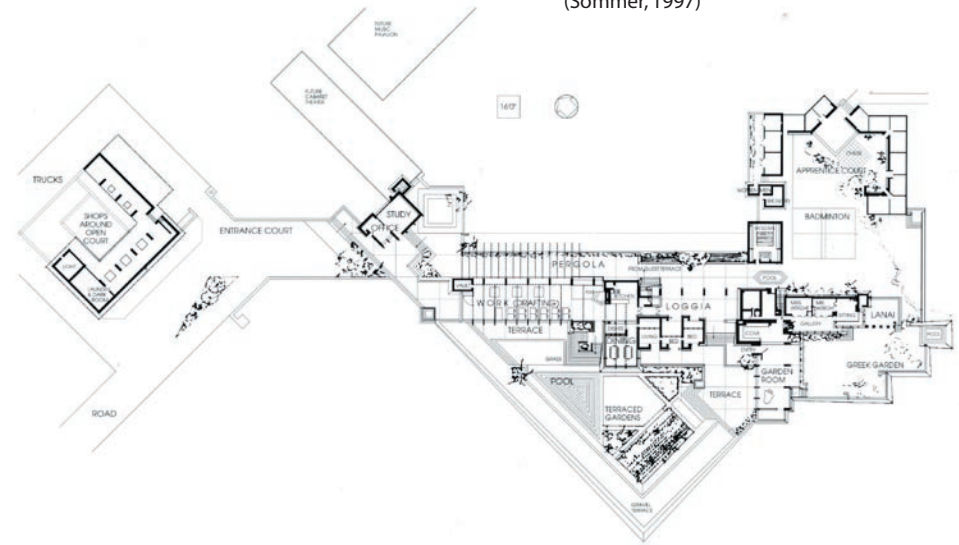
Frank Lloyd Wright – Taliesin West

The ideological approach to architecture as a means of creating an absolute connectivity with the landscape is exemplified in the desert retreat of Taliesin West, in Scottsdale, Arizona. Like Johnson, Wright sought a merging with the panoramic, rural landscape, but his approach was much more spatial, in that the structures of Taliesin West sprawl across the land, while emphasizing the horizontality of the plane of the desert terrain. A similar landscape is found surrounding the Loop House, and like Wright's design, it expands across the ground, but in a much more linear fashion, and further attempts an emulation of the form of the fluid landscape below.

Wright's mastery of abstract, though naturally inspired geometries, is reflected in the large spatial configurations of his work, but also in the details, the ornamentation and the accompanying furniture of his designs. Though of an American genre, his pattern work also seeks a stretching and continuation into the horizon much like the Arab pattern work mentioned earlier. It is this same type of patterning that finds its way into the proposed scheme of the 'Plan-less' house that allows both a subdivision of larger elements, and an implication of the infinite.



Frank Lloyd Wright's Taliesin West (Sommer, 1997)



The Loop House's form, emulating the movement of the landscape below and the sky above

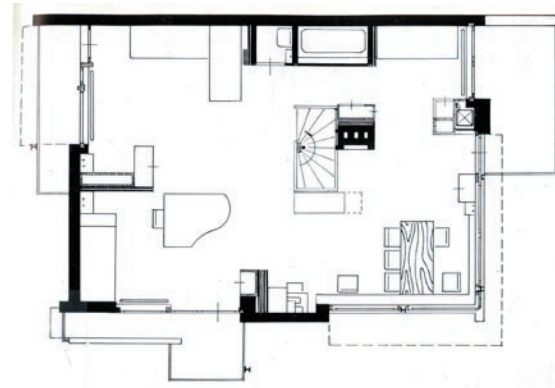


Gerrit Rietveld – Schröder House

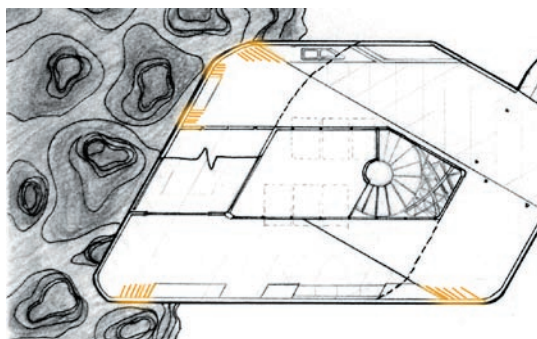
Gerrit Thomas Rietveld was commissioned by Truus Schröder-Schräder to build her home in 1924, and together they worked out a design inspired by a new way of living that would promote the owners freedom and independence. The design then called for a high level of flexibility with respect to the use of space within the house, and its varying relationship with the neighbourhood.

From the outside, we can see the complex interplay of planes and lines that slip past one another to create multiple layers of the exterior facades, allowing for an expanded sectional relationship with the local environment. This layering is used conceptually in the same way in the Loop House, but the elements in the proposed design share this sliding relationship in literally a dynamic mode, as the various layers of shading, glazing and structural elements can be interchanged, or are in some cases, entirely mobile.

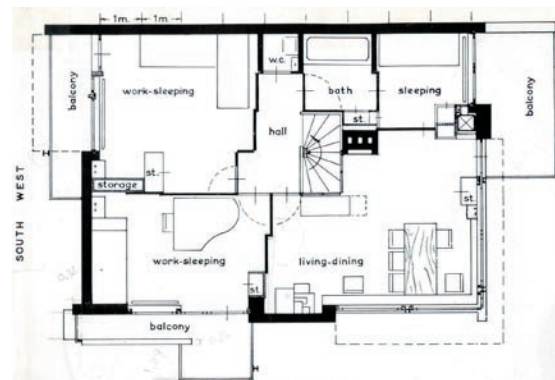
Rietveld himself incorporated mobile, collapsible and foldable elements in the Schröder House, as viewed in the various spatial arrangements possible on the upper floor by opening and closing mobile partitions. The same mobility is visible in the Loop House, but instead of dividing space, the various amenities can be relocated to different areas of the building, as they slide on rails on the perimeter of the design.



Rietveld's Schröder House, demonstrating its flexible and dynamic plan on the upper floor in both open and closed configurations (Brown, 1958, 35, 46, 47)



Some of the mobile amenities in the upper level of the Loop House

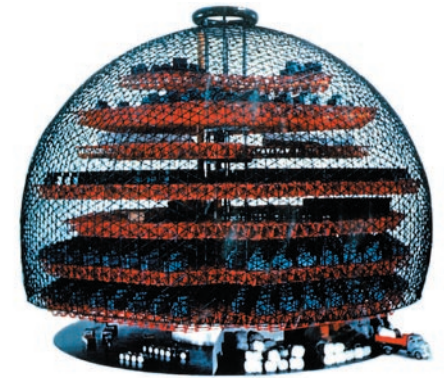
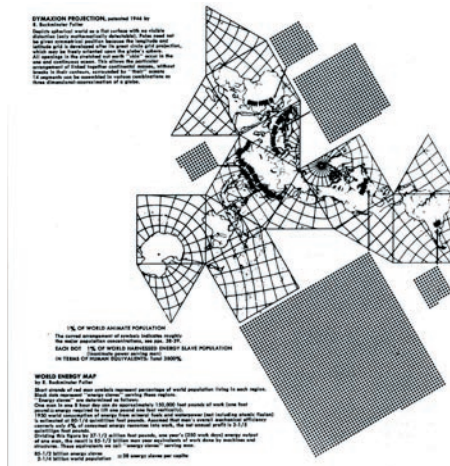


Buckminster Fuller – Mapping and Mobility

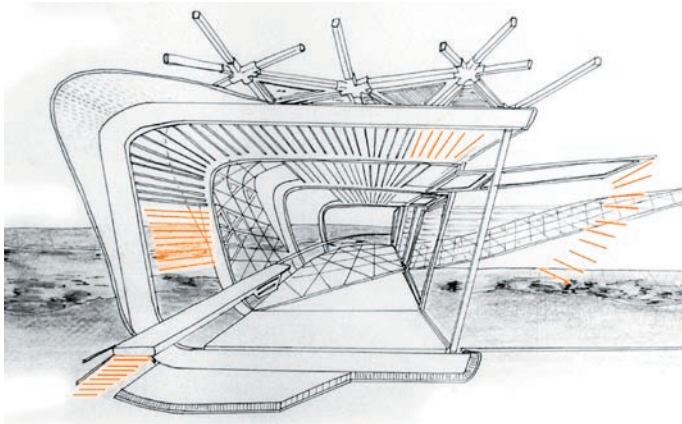
Much of the design work by Buckminster Fuller can be traced back to an aspiration to further understand our own relationship with the earth. Early work in mapping was pursued to better represent the surface of the earth as a whole in a two-dimensional representation, with minimal distortion in the drawing. The development of the Dymaxion Air-Ocean map became the geometric starting point for his design of the geodesic dome – a structure subdivided by triangular arrangements of members, that in turn frame larger pentagonal and hexagonal arrangements. Through this structure, Fuller was trying to make new connections to the entire planet, both in it's form, a derivative of the sphere of the earth, but also by virtue of the continuous, immersive view the geodesic dome gives from within.

Fuller's making of the dymaxion house, like other structures, sought a minimal impact on the earth, but strangely, a high degree of connection, through, like other aforementioned structures, a panoramic visual connection, and an efficiency of form and structure to be found in natural structures themselves.

Because of the efficiency of such light structures, Fuller envisioned the possibility of air-lifting these buildings to other locations, allowing them to be of a truly globally-connected nature. This emphasis on mobility comes back down into the human-scaled amenities, as with his 'O-volving' shelves. Again, similar efforts for mobility and amenity can be seen in the proposed design scheme of the Plan-less house.



Buckminster Fuller's Dymaxion air-ocean map, and his subsequent development of the geodesic dome (Behling, 1996, 17), (Gorman, 2005,123)



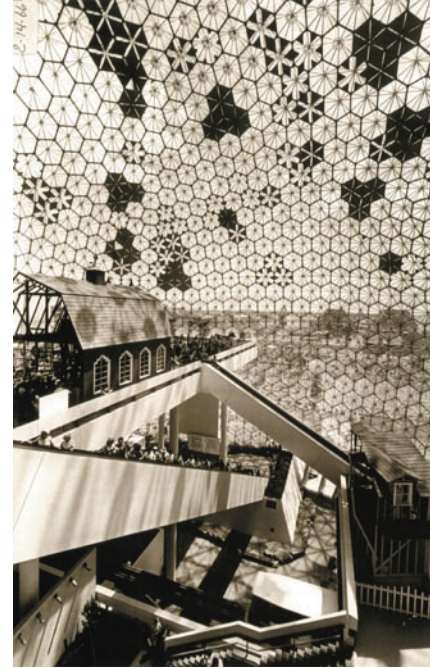
Fuller's 'O-volving' shelves, giving mobility to amenities, as with the mobile systems in the Loop House (Gorman, 2005,80)



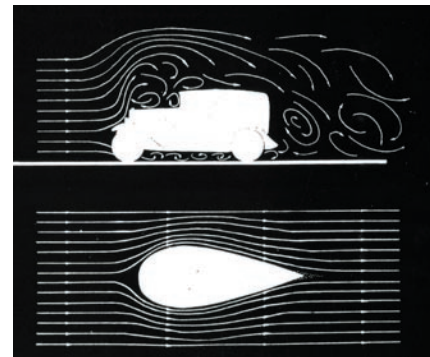
Exterior and interior views of Fuller's Wichita house, reminiscent of his dymaxion house design (Gorman, 2005, 80)

One of the best examples of a constructed geodesic dome is Fuller's U.S. Pavilion of the 1967 World Expo in Montreal. Originally, this was to be lined inside with a map of the entire earth, along with representations of economic and natural flows around the globe, such that it would become a form of command centre for global operations. This vision was never realized, however, an active system of shutters was installed instead, meant to vary the amount of light entering the structure, to control daylighting and heating, thereby creating a more direct relationship with the local environment.

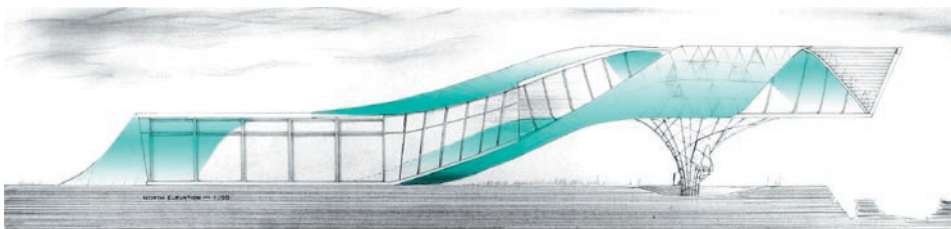
Fluid movements, and mobility are explicitly part of Fuller's idea of connectivity, as with his design for the Dymaxion car, wherein he establishes a form to improve aerodynamics based on ideas of fluid dynamics. In much the same way, Fuller developed his 'Rowing Needles', achieving a personal sense of linking to the environment through its engagement. It is this essence of connectivity in motion that the Loop House seeks.



Interior view of Fuller's geodesic dome built for the U.S. Pavillion in Expo '67 in Montreal (Gorman, 2005, 11)



Airflow around a Ford sedan and an ideal streamline form (Gorman, 2005, 57)



The fluid form of the Loop House shown from the North Elevation



Fuller's Rowing Needles (Gorman, 2005, 17)

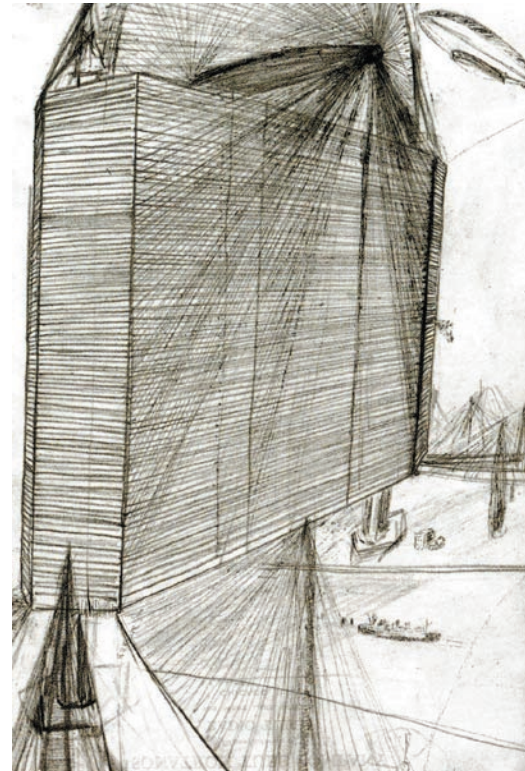
The City Connected

Since the beginning of the 20th Century, connectivity has been felt to rise globally, as cities become ever more linked by transit systems, developing modes of transportation, and the rapid acceleration of communication technologies. It is understandable that this interconnection would be expressed further in the visions of cities themselves. Harvey Wiley Corbett's 1913 visionary drawing of a future city clearly demonstrates new levels of connection through the Piranesi-like rendition of a network of bridges spanning between large buildings. This vision then not only makes the structure of the city significant, but the circulation through it becomes fundamental to its development.

In much the same way, Buckminster Fuller, already deeply involved in projects of a truly global nature, envisioned a combined suspension bridge, and office building. The structure itself, suggesting a required interconnection for structural support, further alludes to the nature of the bridge as a fundamental element of city infrastructure, paramount to the connection between regions of a city, and further, a connection to the land on which it is built.



A view of an interconnected city of the future, envisioned by Harvey Wiley Corbett, in 1913, *Scientific American Magazine* (McQuaid, 2005, 104)

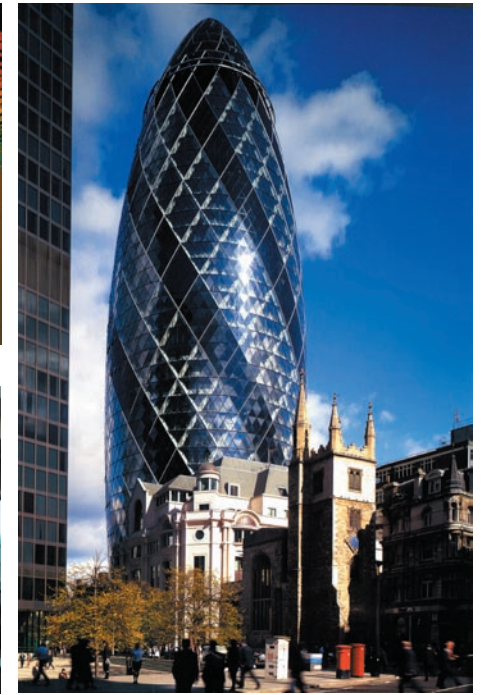
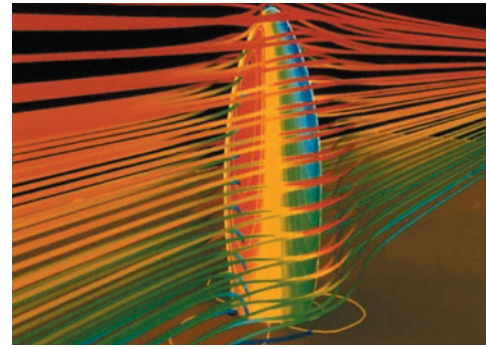


Sketch by Buckminster Fuller of a combined suspension bridge and office building, incorporating further elements of the structure of the Brooklyn Bridge, and a Ferris Wheel (McQuaid, 2005, 104)

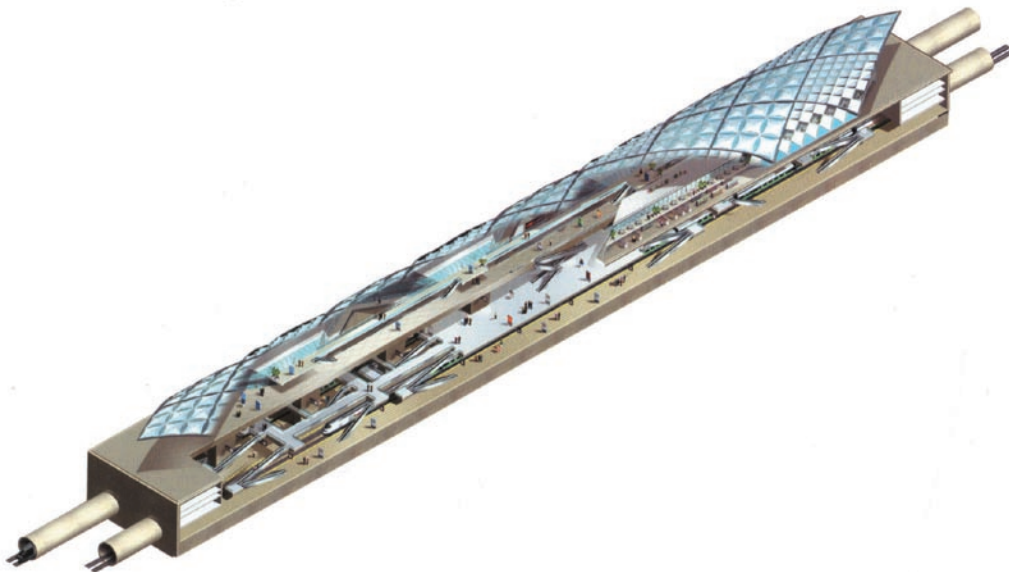
Integrated Structures

Norman Foster and Partners – Detailed Connections

The contemporary work of Norman Foster and Partners can be seen in direct lineage following the developments by Buckminster Fuller and like minded designers, seeking geometric and structural efficiency in the form-making of significant architectural works. It is easy to see the similarity of pattern making found in Foster's works in the structural and cladding systems as are found in some of the earlier or traditional structures that have been mentioned before, even though these are now applied to more intricate or complicated forms. The design of the Swiss Re Headquarters building in London demonstrates the elegant application of the helical pattern of glazing and cladding systems, in alignment with the triangulated frame, supporting the building. The form of the building itself is derived through an optimization from wind-load modelling, while also being a form that gives a continuous view of the city that surrounds the edifice. We see then the forming of the tower by extending the geodesic dome vertically, standing as an icon of modernity, having undergone the transformation into our contemporary era. It is not surprising that many of the same ideas of iconic form, and patterned division appear in structures explicitly designed for modern connectivity, as with the Florence High-Speed Railway Station.

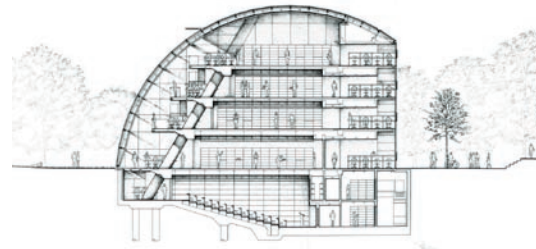


Sir Norman Foster's Swiss Re Headquarters in London, England, shown in an illustration of wind loads on the tower, and in photographs showing the relationship to the cityscape beyond (McQuaid, 2005, 108) , (Foster, 2005, 273, 275)

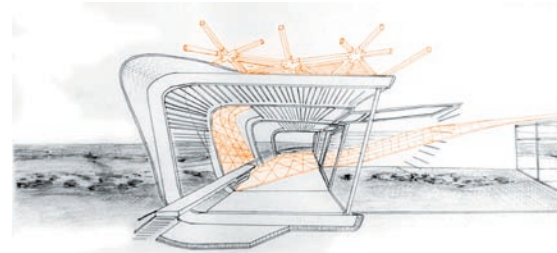


Foster and Partners' design of the Florence High-Speed Railway Station (Foster, 2005, 52, 53)

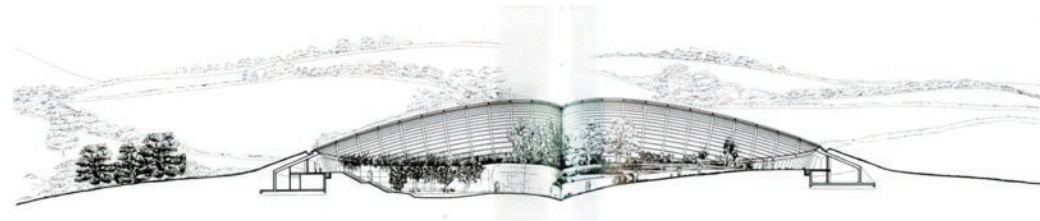
The alignment of structure and envelope is clearly defined in Foster's University of Cambridge, Faculty of Law building, in the curved, triangulated facade, giving optimal access to view and light. This same approach is then found in the Loop House, as its layered structure creates a pattern in which varying panels for environmental control (through access to light, air and the collection of solar energy) can be inserted into the structural grid. Much of the same environmental control systems can be found in the Great Glasshouse of the National Botanic Garden of Wales, allowing control of the environment within through opening and closing panels of the exterior building skin, to moderate air flow in and out of the building. Further, this structure merges with its surrounding landscape, effectively becoming a hill of glass, offering a complete openness to the sky above.



Foster's building for The University of Cambridge, Faculty of Law (Foster, 2005, 113)



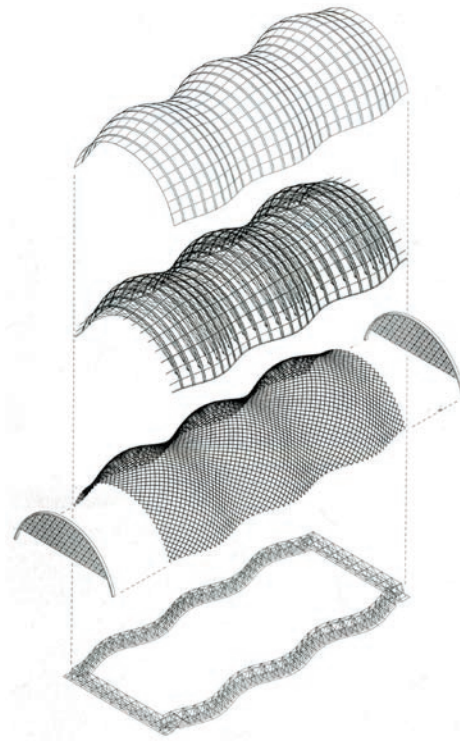
The Loop House's structure wrapping around the building like a ribbon



Great Glasshouse, National Botanic Garden of Wales (Foster, 2005, 160-162)

Shigeru Ban – Crafting Form from Nature

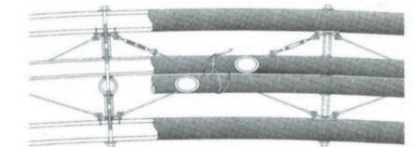
Using paper as his chief structural material, Shigeru Ban explores, like other previous architects, elegant, light-weight structures using spaceframe systems to support continuously open spaces, much like his more high-tech counterparts, but in this case relying on natural, organically derived materials. The Japan Pavilion for the 2000 Hanover Expo and the Paper Arch featured at the MoMA in New York both demonstrate this style of building, where an openness is achieved through a continuous lattice structure, providing an uninterrupted space, while remaining transparent to its urban context. It is this principle of openness that has been explored throughout the architecture described here that culminates in Shigeru Ban's Curtain Wall House. This building, borrowing elements from traditional Japanese buildings, and utilizing contemporary materials, achieves a special level of connection to the exterior, as the flowing curtain that 'separates' the interior from the exterior is further affected by the fluid motions of the wind. The building then becomes a highly poetic play between natural forces and built form, where the two intertwine to give the house a life of its own.



The Japan Pavillion for the 2000 Hanover Expo (Ban, 2005, 134, 137)



Curtain Wall House, Itabashi-Ku, Tokyo (Ban, 2005, 50)



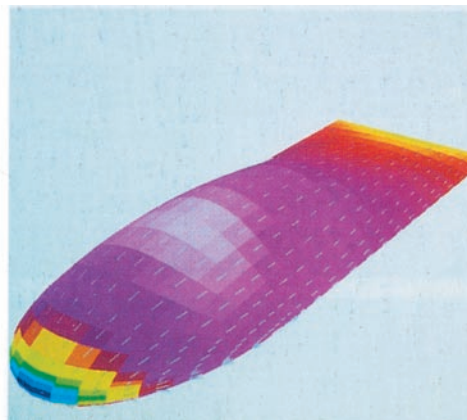
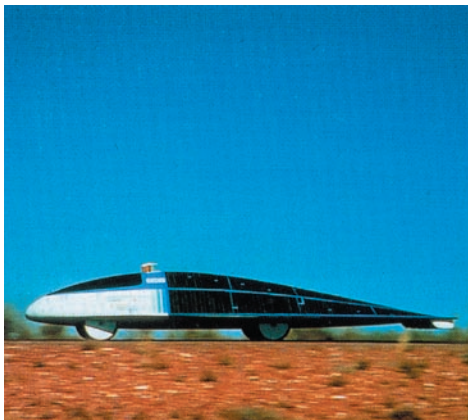
The Paper Arch, New York (Ban, 2005, 128, 129)

Modern Textiles – The Technology of Motion

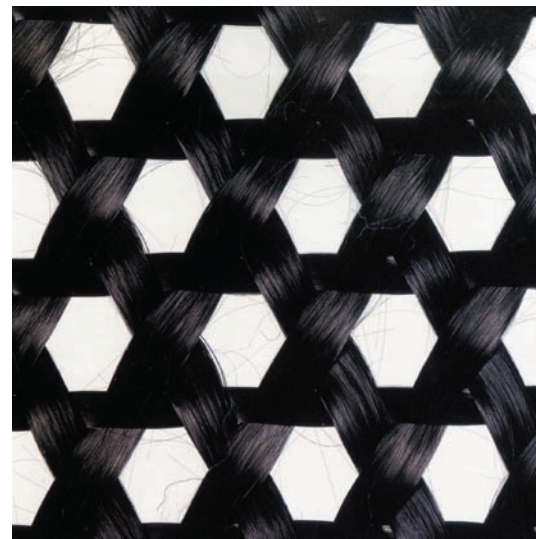
We have been looking at a history of design and construction rooted in traditions of pattern making and textiles, and forms founded in movement – both of these areas relate to achieving connection with landscape and the environment. Contemporary hi-tech textiles certainly continue these traditions, and can be found in specialized, high performance systems of movement and modes of transportation. Carbon fibre is a principle example of such modern fabrics, used for its incredible strength and light weight. This newer material is naturally applied to complex forms, as with those requiring multiple curvatures to achieve greater aerodynamics. It is these forms, derived from newer understandings of fluid dynamics, form optimization, and contemporary materials that inspire new forms of architecture.



Total Eclipse bicycle frame designed by Stefan Behrens, made of woven carbon-fibre composite; rotor blisk developed by Foster-Miller Inc., utilizing triaxially braided carbon fibre; WilliamsF1 BMW FW26, the chassis, composed of carbon aramid epoxy composite (McQuaid, 2005, 43, 44, 17, 45)



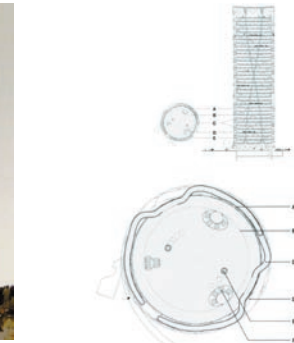
The Solar Racer, designed by Paul MacCready, created for the optimization of shape and performance (Behling, 1996, 222)



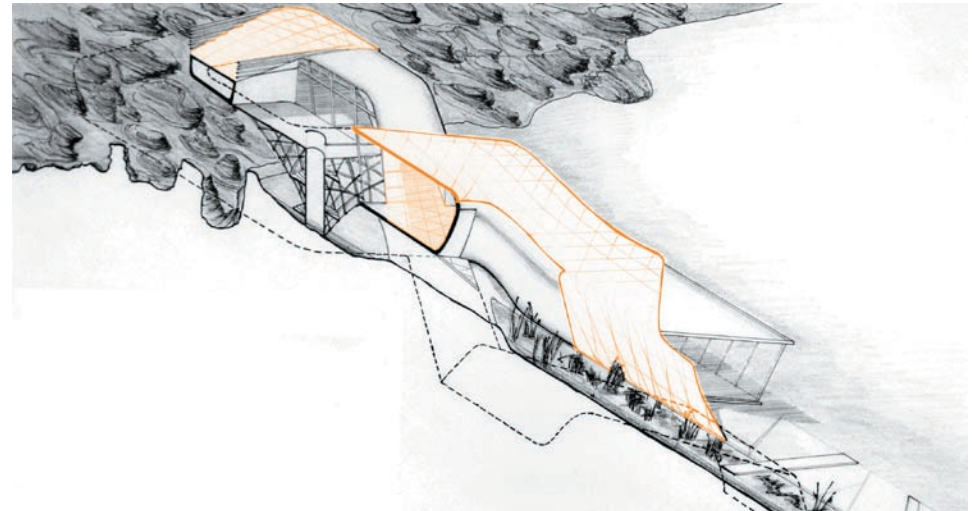
Triaxially woven carbon fiber designed and manufactured by Sakase Adtech Co. Ltd. (McQuaid, 2005, 45)

It is in Peter Testa's Carbon Tower, that we find this direct translation of modern, high performance materials into a continuum of an architectural language of a fused pattern and form making. In this structure, Testa Architecture and Design utilizes a double-helix woven structure of twenty-four twisted strands of pultruded and braided carbon fibre. The structure is then stabilized by continuous braided tendons within the floor plates, such as to create a completely integrated, three dimensional textile structure. Such buildings are fundamentally different from typical trabeated or arcuated construction, in that the structural integrity of the textile-based building incorporates an inherent flexibility, as the entire system is tied together, giving it much greater strength and resistance to forces placed upon the building. The Loop House, though not using as advanced materials as the Carbon Tower, utilizes a similar principle of meshing and interconnecting structural elements to give the building a continuous, looping structure that strengthens the building as a whole.

It is natural to follow that such methods of woven structural fabrics figure not only ideologically into our perception of landscapes, but further, can be used to form or reinforce designed or existing terrains, extending the connectivity of textile architectures around the earth.



Peter Testa's Carbon Tower
(McQuaid, 2005, 112, 114)



Axonometric of the Loop House's
textile-inspired structure



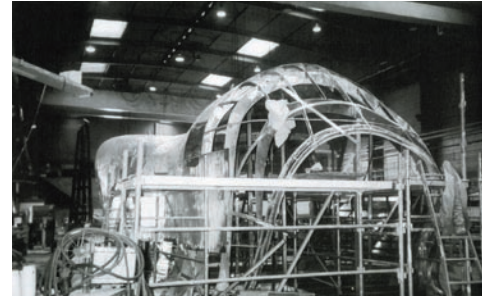
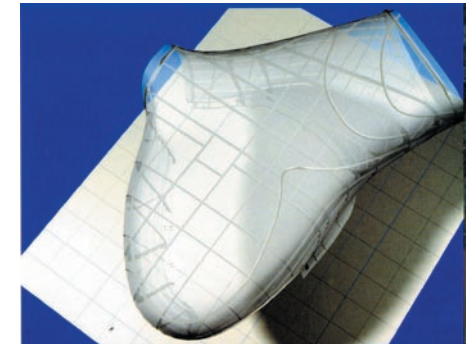
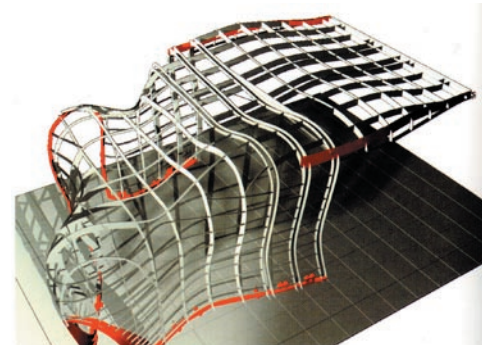
Lightweight collapsible carbon/
epoxy boom structures
(McQuaid, 2005, 120)



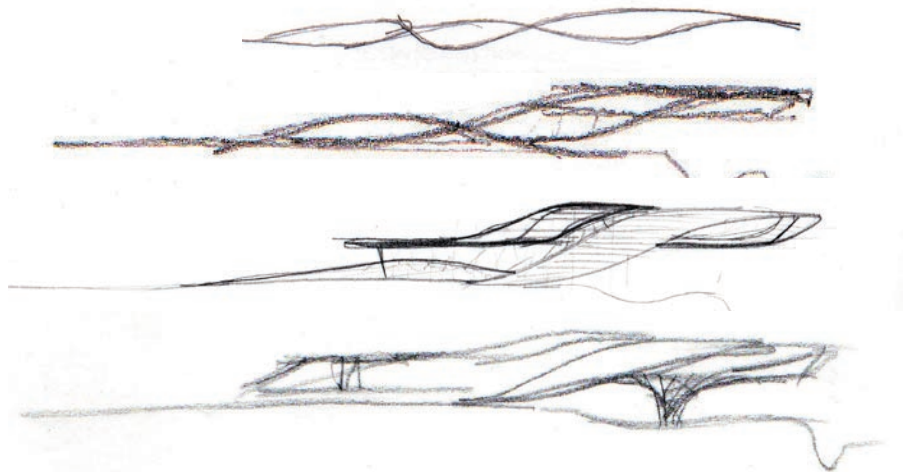
Wire gabions and Pyramat® turf
reinforcement
(McQuaid, 2005, 122, 123)

Exotic Form

With the form-making possibilities brought to us by computer-aided design, fabrication and exotic woven structural materials, coupled with a more contemporary understanding of the world in the sense of fluid movements and transfers, we can now develop much more complex iterations of dynamically inspired architectures. It is in pushing fabrication methods utilizing greater possibilities of customization of structural elements that these more complex three dimensional forms can be framed. Though the possibilities exist for such exotic, irregular frames, the Loop House translates it's own dynamic form, developed initially from sketches emblematic of such flowing forms, into a standardized section that allows for regularity of structure and a dynamism in shape.



Design and construction of a form for the Restaurant Le Georges, Centre Georges Pompidou, Paris, by Jakob+MacFarlane sarl d'architecture (Schmal, 2001, 132-135)



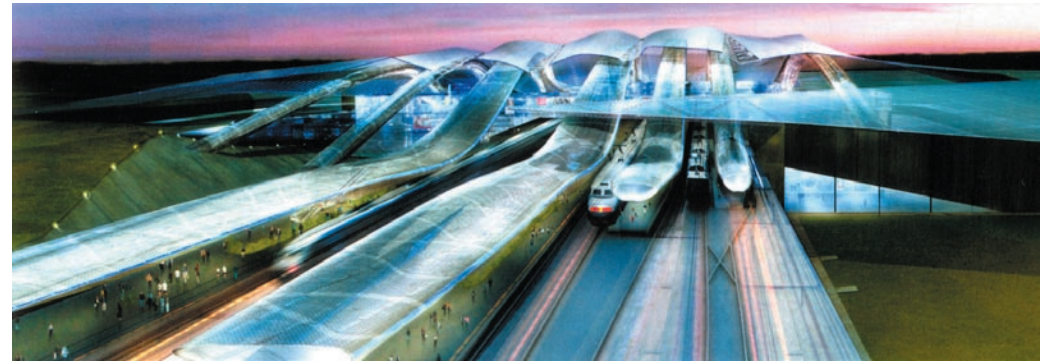
Developmental sketches of the Loop House



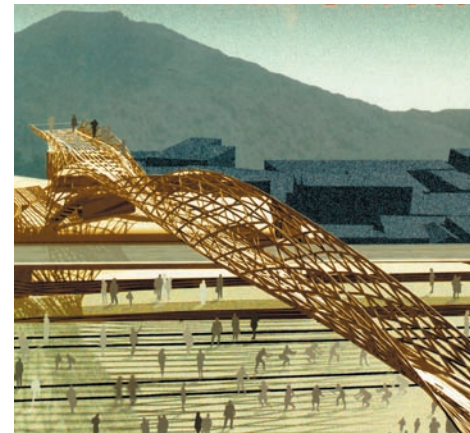
Design iterations of the form of Steven Holl Architects' Kiasma Museum of Contemporary Art, Helsinki, Finland (Metamorph, 2004, 129)

Infrastructural Design

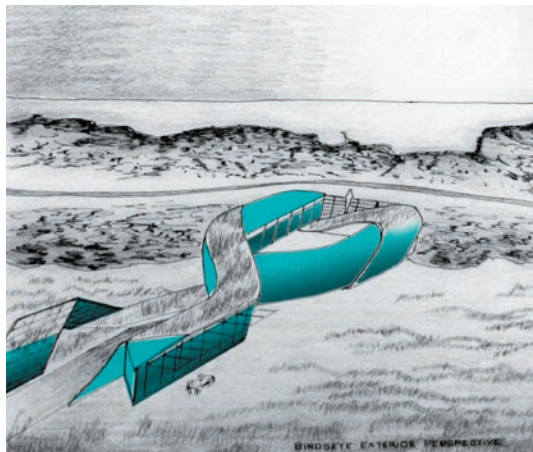
When the possibilities for fluid form are applied to structures inherently functioning and supporting movement, we can find a special balance of purpose and poetics. The bridging/observing work, by RUR Architecture PC for Alishan Infrastructure in Taiwan, aligns itself with the former Alishan railroad right-of-way, relating to the infrastructural heritage of the area, in proposing a dramatic, artificially formed, but naturally inspired open-air sculptural piece, meant to be engaged as much by tourists, as the work engages the landscape itself. Asymptote's BMW Event and Delivery Centre, plays on the technology developed by BMW of both its heritage as an airplane component manufacturer and high-performance automobile designer. Inside, circulation for both pedestrians and automobiles interweave through the structure, separated by transparent divisions that create an immersive environment of movement. A similar inspiration of movement is found in the Loop House scheme. The Napoli Tav Station competition entry submitted by Eisenman Architects, continues this focus on the shape of the actions within, and further fuses the undulating, active curves of the train station, with the surrounding landscape – a sensibility, and sensuousness of form merging with terrain that will be explored further.



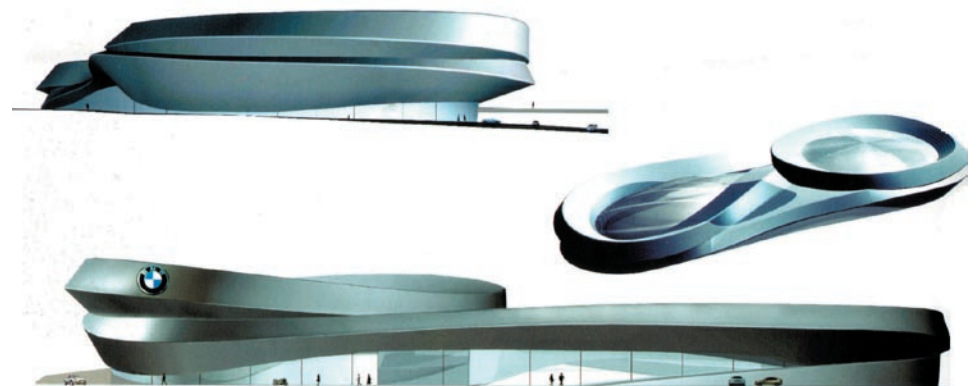
Eisenman Architects' competition entry for the Napoli Tav Station, Naples, Italy (Metamorph, 2004, 241)



RUR Architecture PC's design for Alishan Infrastructure, Taiwan, Republic of China (Metamorph, 2004, 203)



Bird's eye view of the Loop House, demonstrating its contoured, flowing form



Asymptote's BMW Event and Delivery Centre, Munich, Germany (Metamorph, 2004, 266)

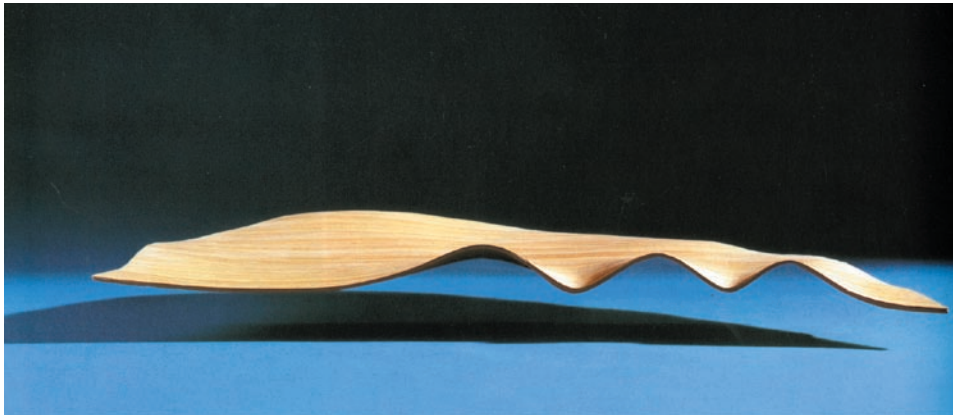
Landscapes – Land Shapes

The Santa Caterina Market, built over the ruins of a convent in Barcelona, Spain, clearly demonstrates the application of traditional tiling, in a twenty-first-century structure, that approaches a mix of landscape form and the colouring and sense of the textures of the goods within the market. This project provides a new terrain in its roof structure, visible from the surrounding apartments, emblematic of the fluid, if not turbulent motion that goes on within the building.

Renzo Piano's Zentrum Paul Klee, in Bern, Switzerland, further integrates its sinuous form into the landscape. The conceptual model demonstrates the formal composition as one originating in both the rolling hills next to the Alps, beside which the building stands, and the sculptural work of Paul Klee himself. Even before completion, the framing of the structure appears to dip into the land, and gently rise out again, demonstrating the continuation of the idea behind project from its formal inception into its supporting structure.



EMBT's Restoration of Santa Caterina Market, Barcelona, Spain (Metamorph, 2004, 189)



Renzo Piano's Zentrum Paul Klee, Bern, Switzerland, concept and construction (Metamorph, 2004, 186)

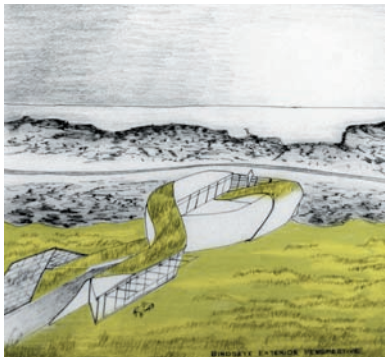
The Canadian psyche, and indeed identity, is arguably intertwined with the varying and powerful landscapes that constitute the country itself. Raymond Moriyama's New Canadian War Museum in Ottawa recognizes this, as the building itself echoes the natural geological forms of the region. Rising gently from the Ottawa River, the building remains as subtle as a grassy pastoral landscape, while its plan directs view to Parliament in the distance.

In continuing the linkages between fabrics and landscape, the pleated roof structure of the Liaunig Collection Museum unites with the park in which it is situated in Austria. This project challenges preconceptions of what is natural and artificial, through its blurred boundary of building and landscape, as the view from inside diverges across the valley, village and castle in the distance.

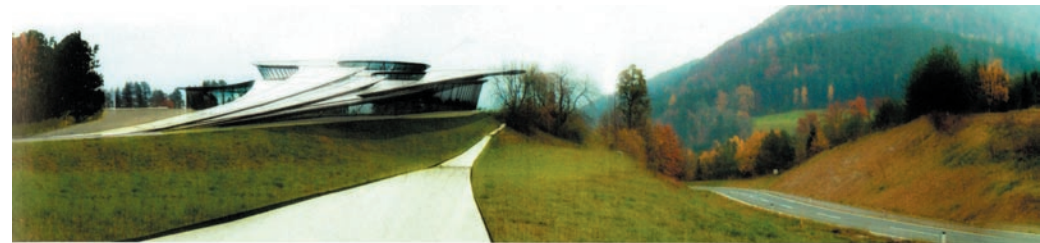
By acknowledging local topography of southern Alberta, the Loop House pulls the prairie landscape up, around and through the building, along the path of the structural ribbon, in which panels for planting can be placed on the more horizontal surfaces.



Rendering of Raymond Moriyama's New Canadian War Museum, Ottawa (Moriyama, 2006, 47)



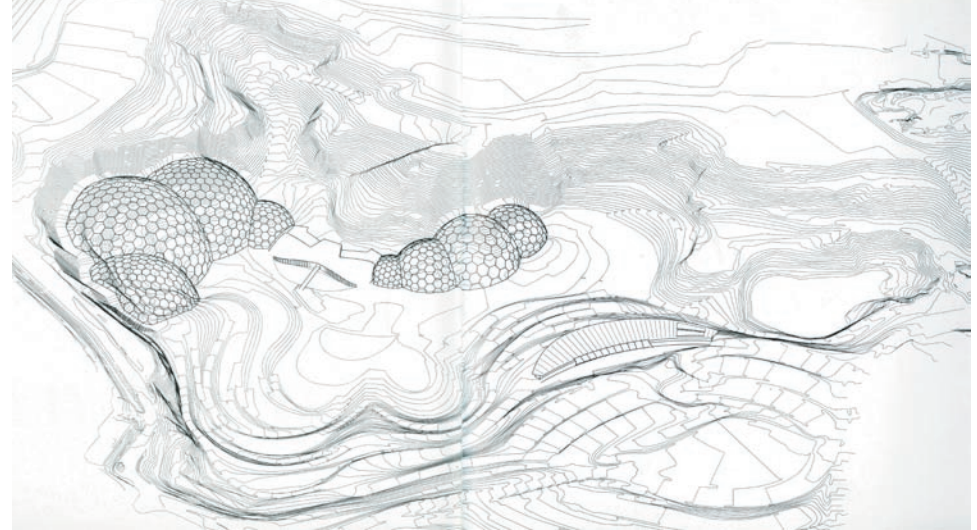
The landscape folding over, and travelling through the Loop House



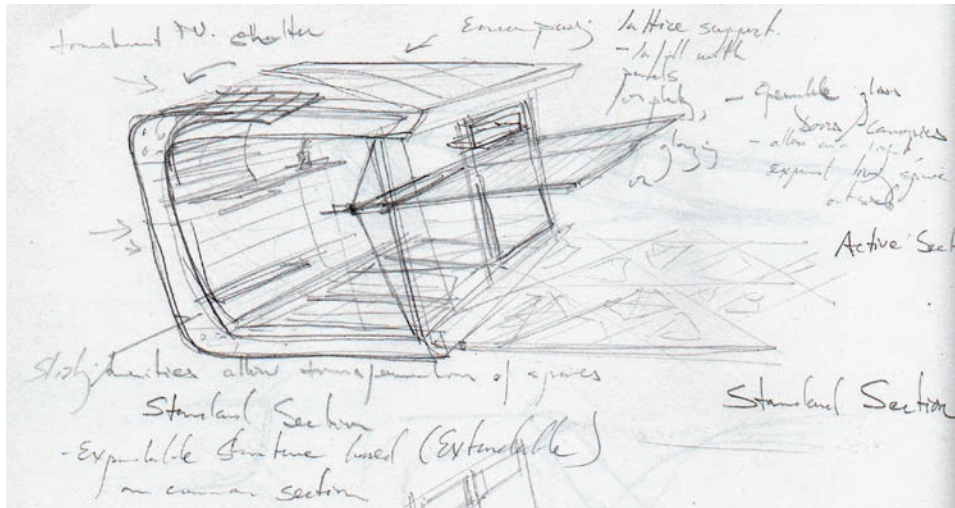
Benoît Cornette Architectes' Liaunig Collection Museum, Neuhaus, Austria (Metamorph, 2004, 183)

Nicholas Grimshaw and Partners – The Greenhouse Re-imagined

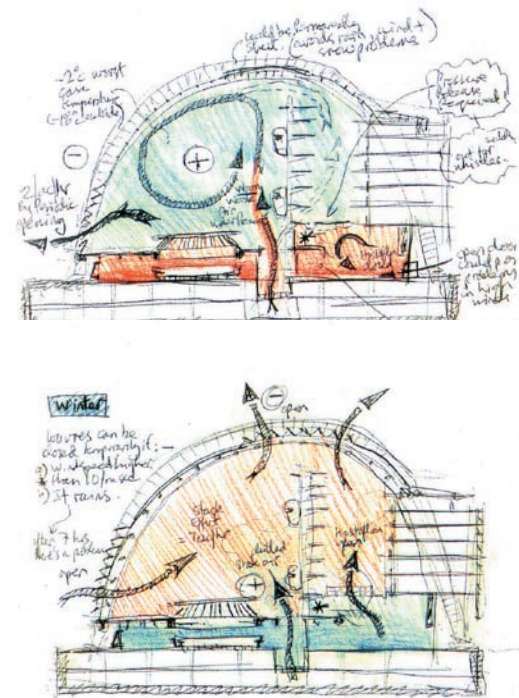
The Eden Project is effectively a continuation of the development of our relationship with nature and the environment through architectural design as it began with early greenhouse designs, and the associated progress in construction techniques and materials initiated during the industrial revolution. This particular project, designed to be the largest plant enclosure in the world, needed to be constructed by the lightest, most ecological means possible. The natural solution was to turn to the efficiency of the geodesic structure. The logic of this construction method, following its patterning of hexagonal space-frames, allows integrity within the structure, even when pieces are removed from the ideal spherical form, to accommodate the topography of the area. Fittingly, other projects by Grimshaw look to means of controlling the environment within buildings through natural means, and relationships with the exterior environment. The Ludwig Erhard Haus, for example, incorporates many systems into the buildings envelope to control air circulation within the structure, through temperature and pressure differentials between the interior and exterior, such that the boundary of the building envelope is much more like that of a cell, allowing fluid transfers to occur in a dynamic equilibrium.



Bird's eye view of the Eden Project, Cornwall (Pearman, 2000, 128-129)



Sketch of standard section of the Loop House



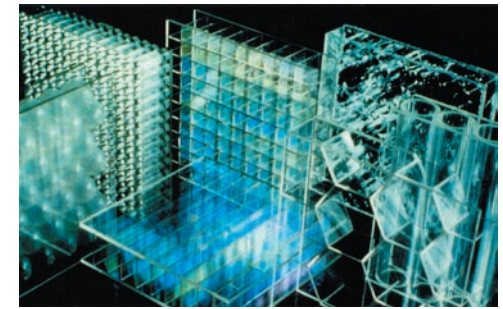
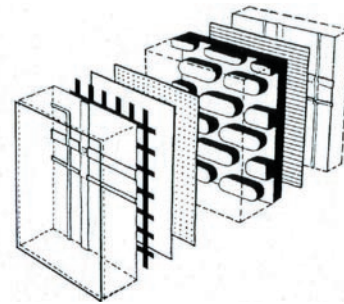
Sketches by Neven Sidor, and photograph of the atrium of the Ludwig Erhard Haus, Berlin (Pearman, 2000, 63)

Dynamic Patterns - Active Envelopes

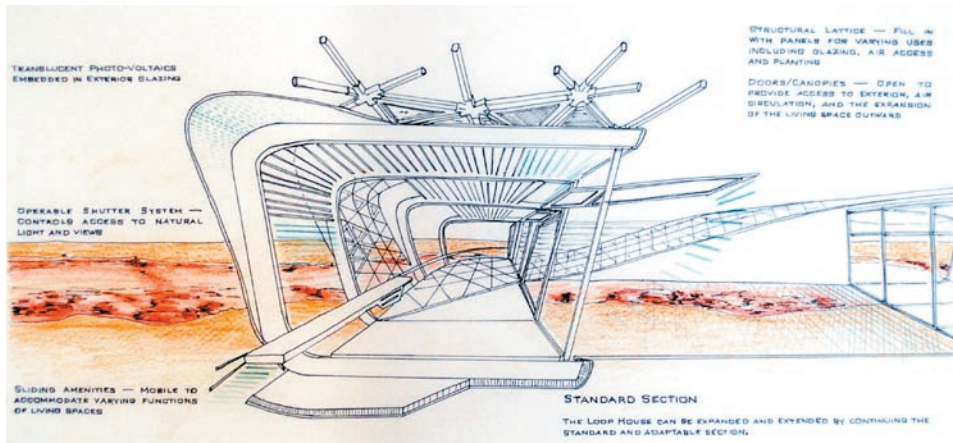
Reaching back to the initial inspirations or derivations from natural, cellular structures, similar ideas of active response found within these biological precedents are now transferred to artificial, architectural systems. Toyo Ito's Tower of the Winds was one of the earlier projects incorporating responsive technologies into the building fabric. Wind patterns were recorded by computer, and replayed through interpretive lighting visible through the perforated aluminum skin surrounding the tower. This play with light through dynamic building envelopes is seen in contemporary hi-tech glazing systems developed at Mike Davies of the Richard Rogers Partnership, such as the concept of the multi-layered fully dynamic wall, composed of varying layers that can respond in a chameleon-like fashion to the environment. A most notable example of a built, active wall system meant for controlling light is found in Jean Nouvel's building for the Institute of the Arab World, incorporating thousands of dynamic sensory shutters that are computer controlled, and arranged in a complex organization that recalls its roots in traditional abstract Arab patterning.



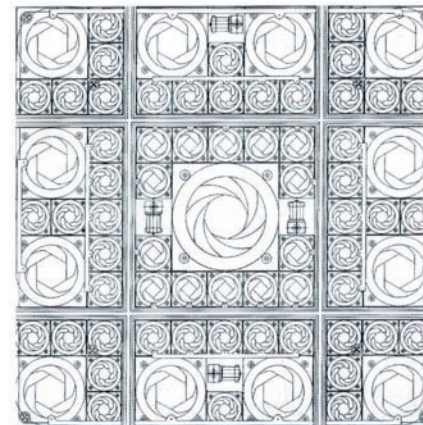
Toyo Ito's Tower of the Winds (Metamorph, 2004, 109)



Various glazing systems to alter light's passage through a building (Behling, 1996, 214-215)



Developed standard section of the Loop House, demonstrating the multiple active layers in its construction



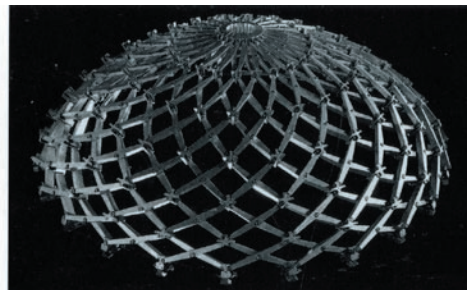
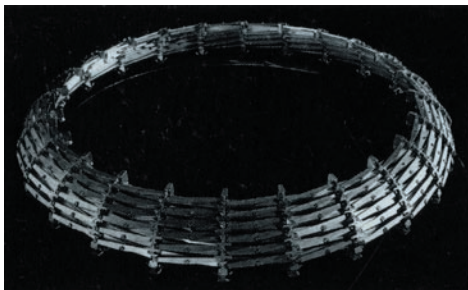
The shutter system of Jean Nouvel's Institut du Monde Arab (Behling, 1996, 217)

Living Buildings

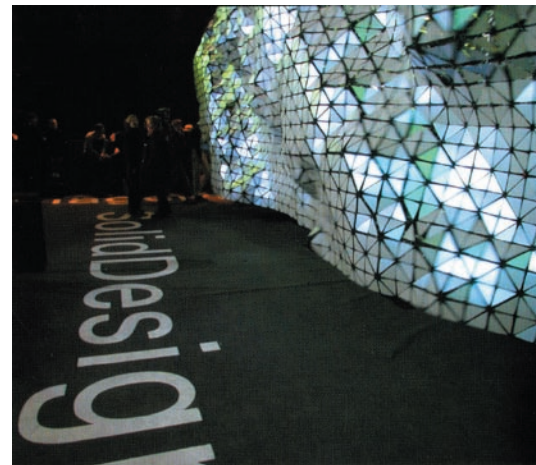
The next step in responsiveness, to which the Loop House alludes through its dynamic form, is the actual transformation of the building's structure and form, by utilizing systems of sensing and actuating that are integrated into the building fabric. Further development or iterations of the Loop House concept could incorporate the expressive qualities of such moving forms and active patterns of structure and cladding, thereby bringing spatial and temporal movement into the functioning and poetry of the building's inhabitation. Though such buildings and structures are based in technology and design of a complex and exotic genre, they seem to return to their primary roots of inspiration in natural systems, as they begin to exhibit the characteristics of living organisms.



ONL's WEB of North Holland
(Metamorph, 2004, 303)



Charles Hoberman's Iris Dome Retractable Roof (Behling, 1996, 226)



Hyposurface, by dECOi
(Oosterhuis, 2003, 84)

Bibliography

- Responsive Architectures: Subtle Technologies 2006. Edited by Philip Beesley, Sachiko Hirose and Jim Ruxton et al., . Cambridge, Ont.: Riverside Architectural Press, 2006.
- Metamorph: 9. International Architecture Exhibition Trajectories. Venice, Italy ed. New York, N.Y.: Rizzoli, 2004.
- Minimalist Spaces. Edited by Aurora Cuito. Translated by Harry Paul. Spain: Pco Asensio, 2001.
- Ban, Shigeru. Shigeru Ban. New York, N.Y.: Princeton Architectural Press, 2001.
- Bech-Danielsen, Claus. Ecological Reflections in Architecture: Architectural Design of the Place, the Space and the Interface. Copenhagen: Danish Architectural Press, 2005.
- Behling, Sophia, Stefan Behling, and Bruno Schindler. Sol Power: The Evolution of Solar Architecture. Munich ; New York: Prestel, 1996.
- Bognar, Botond. Kengo Kuma: Selected Works. New York: Princeton Architectural, 2005.
- Bourgeois, Jean-Louis, and Carolee Pelos. Spectacular Vernacular: A New Appreciation of Traditional Desert Architecture. Salt Lake City: Peregrine Smith Books, 1983.
- Brown, Theodore M. The Work of G. Rietveld, Architect. Utrecht: A.W. Bruna, 1958.
- Cachola Schmal, Peter. Digitalreal: Blobmeister, Erste Gebaute Projekte. Basel; Boston: Birkhäuser Verlag, 2001.
- Europa Technologies, TerraMetrics, and NASA. Google Earth. 2006.
- Glancey, Jonathan. Nigel Coates: Body Buildings and City Scapes. London: Thames and Hudson, 1999.
- Gorman, Michael John. Buckminster Fuller: Designing for Mobility. 1st ed. Milano: Skira, 2005.
- McQuaid, Matilda. Extreme Textiles: Designing for High Performance. 1st ed. New York: Princeton Architectural Press, 2005.
- Minter, Sue, Chris Jones, P. E. Morris, Peter Riddington, and 20 Royal Botanic Gardens, Kew. The Greatest Glass House: The Rainforests Recreated. London: Hms0, 1990.
- Moriyama, Raymond. In Search of a Soul: Designing and Realizing the New Canadian War Museum. Vancouver: Douglas & McIntyre, 2006.
- Oosterhuis, Kas. Hyperbodies: Toward an E-Motive Architecture. Basel; Boston: Birkhauser, 2003.
- Pearman, Hugh, and Nicholas Grimshaw. Equilibrium: The Work of Nicholas Grimshaw & Partners. London: Phaidon Press, 2000.
- Prestinzenza Puglisi, Luigi. Hyper Architecture: Spaces in the Electronic Age. Translated by Lucinda Byatt. Basel; Boston: Birkhauser, 1999.
- R. Berdan. "Science & Art: Writing-on-Stone Provincial Park." [cited September 25, 2006]. Available from [www.scienceandart.org/ images45/photo12.jpg](http://www.scienceandart.org/images45/photo12.jpg).
- Sir Norman Foster and Partners. Catalogue: Foster and Partners. Munich; London: Prestel, 2005.
- Smith, Robert Leo, and T. M. Smith. Elements of Ecology. 4th ed. San Francisco: Benjamin Cummings, 2000.
- Sommer, Robin Langley, and Balthazar Korab. Frank Lloyd Wright: A Gatefold Portfolio. New York: Barnes & Noble Books, 1997.
- Such, Robert. Landscape Architecture. Toronto: Azure Publishing Inc., 2005.
- Whitney, David, and Jeffrey Kipnis. Philip Johnson: The Glass House. 1st ed. New York: Pantheon Books, 1993.
- Wigginton, Michael, and Jude Harris. Intelligent Skins. Oxford: Architectural Press, 2002.