SOFTSKIN
ANTICIPATING CHANGE FOR THE FUTURE ARCHITECTURAL ENVELOPE

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ABSTRACT

The architectural proposition in this thesis aims to study the symbolic, physiological and emotional implications of the spatial and experiential qualities of architectural space, through an exploration of future possibilities for the envelope. The Architectural envelope defines a relationship between inside and outside, marking a threshold between two different environments. It is therefore of a dual nature, a two-sided surface. The outside is the expressive face of architecture, a communicative surface; the inside is an expression of our own intimate worlds, which we decorate with desires and memories. Thus the envelope is determined by our timeless desires for both protection from and connection to the outside world. Yet the future of the architectural envelope is uncertain. Entering this space of uncertainty, the objective of this thesis is to question the possibility of imagining the envelope as a more complex skin, a soft skin, one that is a multi-layered system, following the model of the living skin.

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SOFTSKIN

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1

THE ARCHITECTURAL ENVELOPE

1.1 THE ARCHITECTURAL ENVELOPE : INTRODUCTION

The Architectural envelope has been a site of intensive experimentation and re-examination over the course of the twentieth century, and it continues to be a crucial territory for exploration and innovation today. With the unprecedented advances in material science, technologies and fabrication techniques, many ideas formerly destined to remain as concepts or drawings can now be realized. This research seeks to anticipate the driving forces and trends that will shape the future of the envelope. As such, it proceeds in the following manner: In the present chapter I begin by offering definitional exploration of the key concepts of the envelope, and the meaning of these terms in the context of this research. Following this, I present an overview of the most influential and revolutionary theories that have influenced the development of the modern architectural envelope up until today, focusing, in particular, on the genesis from shelter to free façade, and the significance of natural metaphors for the architectural envelope. There are two primary modes of conceiving of shelter: cave and hut, the tension between these modes and within them, in the symbolic, cultural and emotional associations they hold are themes that this thesis explores in both research and design. Therefore a number of philosophical and theoretical key concepts are traced to establish the factors that influence changes in the development of the envelope and how it has been conceived.

1.2 DEFINING THE ENVELOPE

The fundamental utilitarian function of the envelope has been to contain, protect, and separate the interior from the exterior. However, this role extends beyond functionality - a building's envelope is its interface between the outer world and the building's inner space: "it demarcates ownership and limits, and determines form and image"¹. The envelope of a building therefore represents and symbolizes the state of architectural thinking of the time in which it was produced. Moreover, it is sometimes also a broader expression of changes within the culture and society of which it is a part.

In addition to "envelope", there are a number of other terms that describe this zone between the exterior and the interior. The most traditional term is "wall", which can be used to describe any vertical built structure. Historically, walls have been understood as boundaries: of social and political space, as well as dividers of functional and psychological domains. As such they also function as symbols of power and isolation. For Marcos Cruz, walls "shelter from natural threats as well as [help] to preserve the physical and moral integrity of the body, they are able to repel the "ugly" and any 'polluting matter'... they can create security while safeguarding physically and aesthetically our inner world by protecting it from the unwanted and the other"².

Le Corbusier paid special attention to walls and was known for his personal love of walls. This attachment is evident in one of his texts quoted by Marcos Cruz when he characterizes the potential beauty of a wall in terms of the emotions and impressions that it can stir: "A wall is beautiful, not only because of its plastic form, but because of the impressions it may evoke. It speaks of comfort, it speaks of refinement, it speaks of power and of brutality, it is forbidding or it is hospitable, it is mysterious. A wall calls forth emotions."³

1 Beesley, Philip, Hayley Isaacs, Pernilla Ohrstedt, and Rob Gorbet. *Hylozoic Ground: Liminal Responsive Architecture*: Philip Beesley. [Cambridge, Ont.]: Riverside Architectural Press, 2010.

2 Cruz, Marcos. *The Inhabitable Flesh of Architecture*. 2013.p.71.

3 *ibid*.p.73

In the twentieth century, the functional and practical role of the wall was affected by a number of advances in building technologies and materials, most importantly the invention of reinforcing bars for concrete construction; advances in iron alloys for steel manufacture; and new manufacturing techniques for glass production. Developments such as the skeletal frame structure and the possibility to use large surfaces of glass shifted the role of walls dramatically. The introduction of the term curtain wall appeared in the architectural lexicon to distinguish the non-load-bearing exterior wall from a building's structure. Accordingly, the conceptual and psychological role of walls shifted as well from being a necessary structural component attached to a structural system (usually masonry) to being an independent expressive architectural element.

As exterior walls were liberated from the need to simultaneously be load bearing walls the term Envelope appears as a generic term that describes the total enclosure of a building. The term "skin" was initially coined as a differentiator between cladding and the structural "bones" of a building. More recently, the term skin has been associated with conceiving of the envelope as an intelligent environmental system. In this way the term skin has come to replace "facade" in some instances, since the term facade still retains an association with the wall as the site of urban composition. In other words, the architectural facade is the public face of architecture that communicates a certain message while "skin" is more of whole enclosing system as an integral part of a building or a space.¹

On the significance of the envelope as an architectural feature, Alejandro Zaera Polo, in his recent essay 'The Politics of the Envelope: A Political Critique of Materialism' notes that the envelope is possibly the oldest architectural concept that "materializes the separation of the inside and the outside, natural and artificial and it demarcates private property and land ownership". Zaera Polo further notes that, as the envelope becomes a facade, it "operates also as a representational device, in addition to its crucial environmental and territorial roles."²

1 Moloney, J. Designing kinetics for architectural facades: State change. Abingdon, Oxon [England: Routledge, 2011. p.8.

2 Zaera Polo, Alejandro. "The Politics of the Envelope: A Political Critique of Materialism." Volume magazine #17, March 2008.p.193- 207.

Other, similar terms that are present in the current architectural discourse are boundary, interface, and surface. The definition of "surface" in twenty first century architectural discussions has been broadened to include skin, threshold, edge, boundary, and – sometimes – an interior space¹. While there is a widespread association between the term interface and the digital screen, an interface can be more than a screen. It can also be any place where "different conditions can meet and exert an influence on each other... interfaces are spaces where boundary negotiations take place"².

1 Chatterjee, Anuradha. Surface and Deep Histories: Critiques and Practices in Art, Architecture and Design. Newcastle upon Tyne: Cambridge Scholars Publishing, 2014. p.1.

2 Cruz, Marcos. The Inhabitable Flesh of Architecture. 2013.p.69.

*" The primary objective of architecture has traditionally been thought to be the provision of shelter."*¹

-Peter Eisenman

1 Eisenman, Peter. Eisenman Inside Out: Selected Writings, 1963-1988. New Haven, CT: Yale University Press, 2004. p. 209.

1.3 BRIEF HISTORY

Fig. 1
The Primitive Hut
Marc-Antoine Laugier
1755

1.3.1 SHELTER: AN IDEA IN THE MIND

In the beginning of his seminal text *An Essay on Architecture*, Marc-Antoine Laugier imagines and narrates a poetic description of humankind's first conception of an architectural idea: a shelter. "Man", Laugier says, was "in need for an abiding place" where he could enjoy in peace nature's gifts, but which would also protect from the heat of the sun and the frightening rain. At this time, Laugier writes, shelter was sought in a cave: "a cave presents itself to his view, he slides into it, and finding himself dry applauds his discovery. But new defects make him dislike his adobe, he sees himself in darkness, he breathes an unhealthful air... the man is willing to make himself an adobe which covers but not buries him"¹ Thus shelter is not a mere physical barrier and container. It also affects our psychological state, and is an expression of our needs and aspirations. This idea was more fully realized thousands of years ago when humans left the cave in search for a shelter that appealed to their minds. We re-enact this moment still today with every new design idea.

Laugier further describes the search for materials that seem to be proper to a given design idea and its implementation: "some branches broken down in the forest are the proper materials for his design". The "rustic cabin" or what is called the primitive-hut – illustrated on the cover of Laugier's book (Fig. 1) is the result of this design process. It is a simple symbolic frame that imitates classical architectural structures and utilizes natural materials.

Peter Eisenman categorizes two architectural modes, the physical and the metaphysical. Eisenman describes the cave as a physical shelter that pre-existed humans, enclosing them. It provided protection and structure as well as access. The cave countered natural forces without having any intrinsic cultural or emotional meaning. However, Eisenman states that shelter also exists in the mind as an idea, which he recognizes as the metaphysic of architecture. The realization of this aspect occurred when the caveman abandoned the cave and started looking for materials with which to build his own shelter.²

¹ Marc-Antoine Laugier, *An Essay on Architecture* (1753), trans. Wolfgang and Anni Hermann (Los Angeles: Hennessey & Ingalls, 1977), 12. Also, see Christian Norberg-Schulz, *Intentions In Architecture* (Cambridge: MIT Press, 1997 & 1965). p. 109-111.

² Eisenman, Peter. *Eisenman Inside Out: Selected Writings, 1963-1988*. New Haven, CT: Yale University Press, 2004. p. 209.

In his text *Magic Architecture*, Friedrich Kiesler analyzes modes of building shelter and compares materials and methods of construction to shelters constructed by insects and mammals. He concludes that "the frame house of our time is erected in the same way as an orangutan erects his"¹. Further, Kiesler describes another mode of shelter-making that follows the cave model: "piling stones upon each other... guided by our collective memory of sheltering caves, which, in truth, were nothing else but a continuous arch of stones above us"². We build shelters, Kiesler argues, when nature fails to provide us with ones where food is readily available. We therefore make our own versions of caves and thick foliage. The "Architecture of man, small and great alike, receives and depends on nature's inspiration, her designs, construction principles, forms and materials"³ (Fig. 2). Even today, the architectural envelope follows one or a combination of these two essential modes of providing shelter – the physical and the metaphysical – to achieve climatic, functional, and practical appropriateness as well as an expression of an aesthetic intent.

In the cave model of shelter we see a subtractive approach, wherein shelter is found in a natural or human constructed cavity. Here, enclosure is defined by a space carved out of a solid, or an imitation of this condition. A second, additive approach, follows the model of Laugier's rustic cabin or what is called the primitive-hut model. The primitive-hut model is basically an assembly of a frame structure with covering elements to provide a protected interior, possibly reminiscent of the natural condition of a tree or a forest canopy. The former mode is solid, heavy, protective and isolating, a very strong divider between the different conditions of inside and outside. The latter by contrast, is of a lighter weight, and is more open and accessible. Consequently, there is greater connection between inside and out, and this shelter is more like a two-sided membrane.

Gottfried Semper and Adolf Loos correlate the architectural idea of a shelter and enclosure to clothing, covering and textiles. In his text *The Principle of Cladding*, Loos talks about this idea saying that "in the beginning we sought to clad ourselves, to protect ourselves from the elements, to keep ourselves safe and warm while sleeping. We sought to cover ourselves. Originally consisting of animal fur or textiles, this coverage is the earliest architectural feature."⁴

1 Friedrich Kiesler-Zentrum Wien, Museum für Moderne Kunst (Frankfurt am Main, and Germany). Friedrich Kiesler: *endless house*. Ostfildern-Ruit, Deutschland: Hatje Cantz, 2003. p. 20.

2 *ibid.* p. 20.

3 *ibid.* p. 21.

4 Loos, Adolf. "The Principle of Cladding" in *On Architecture*. California: Ariadne Press, 2002.

Semper discusses the symbolic meaning of an enclosure relative to our need for protection: “the need for protection, cover and spatial enclosure supplied some of the earliest inspiration for industrial interventions. The use of these covers is thus older than language. As such, they form perhaps the most important element in the symbolism of architecture.”¹

Ryner Banham in his seminal text *A Home Is Not A House* describes two types of shelters², the tent and the campfire. The tent, similar to Laugier’s primitive hut, is a structure based on enclosure, with a defined boundary, structural components and a protective membrane. By contrast, the campfire is not defined by its structural presence like the previously described modes of sheltering. Rather it is centralized around a source of energy. The campfire defines a space where temperature is regulated and creates a shelter with boundaries that are undefined, blurred and gradual. The campfire model is a dynamic flexible model that is maintained by the user’s interaction with it. (Fig. 3,4)

The cave, the primitive hut, the tent and the campfire are all shelters that provide a certain degree of protection and maintain a certain level of comfort. However one model – the campfire – is more dependent on spatial, climatic and complex social factors than the others. This makes it a more dynamic system as apposed to a fixed object. The campfire is thus a primary example of a soft system, the subject of further exploration in chapter two.

The tension between these modes and within them, in the symbolic, cultural and emotional associations they hold are themes that this thesis explores in both research and design. Therefore a number of philosophical and theoretical key concepts are traced in the next section to establish the factors that influence the development of the envelope and how it has been conceived.

1 Semper, Gottfried. *Style In The Technical and Techtonic Arts; or, Practical Aesthetics*. 1860.p. 123.

2 Banham, R. *The architecture of the well-tempered environment*. Chicago: University of Chicago, 1969.

Fig. 2
 Reyner Banham's tent diagram
 represents the environmental
 behavior of a tent
 1- tent membrane deflects wind and
 excludes rain
 2- reflects most radiation, retaining
 internal heat, excluding solar heat,
 maintaining privacy

Fig. 3
 Reyner Banham's camp fire diagram
 represents the environmental
 conditions around a camp fire
 1- zone of radiant heat and light
 2- downwind trail of warmed air and
 smoke

1.3.2 SURFACE OF REPRESENTATION

The role of the architectural envelope has evolved throughout the twentieth century as it has progressed from being a structural element that is a part of a complete structural system, to become a completely independent element that holds cultural and representational associations.

The idea of the facade as a distinct representational face of the building has existed since the late medieval and early Renaissance periods. In their book *Surface Architecture* (2002), Leatherbarrow and Mostafavi highlight the fact that there was a time separation between the completion of the construction of the main building and the completion of the construction of the facade of many Renaissance churches. This delay led to a distinction between the building's walls and its facade (or face), the latter being its most expressive part¹. They also mention that this tradition that began during the early Renaissance has continued up until today. Therefore, the facade - since the Renaissance - has been considered a vertical plane of composition and the public surface of architecture². In the 18th century - by the times of Boullee and Ledoux, the architectural character had become more than a representational expression of a genre. Instead, the building's whole volume assumed the role of character formation. For Boullee, the building had to consist of a flat surface and be absolutely stripped of detail, its decoration consisting of a play of shadows, "outlined by still deeper shadows"³. The whole volume assumed the role of expression, and the outer surface of the building now conveyed its functions more literally, making the wholeness of its surfaces and profiles a complete site of representation. Robert Venturi's model of the architectural envelope suggests that the envelope is an agent which represents and transmits messages. The envelope according to Venturi communicates ideas and conveys narratives and messages by means of materials and tectonic making.

1 Leatherbarrow, D., and M. Mostafavi. *Surface architecture*. Cambridge, MA: MIT Press, 2002. p.9.

2 Moloney, J. *Designing kinetics for architectural facades: State change*. Abingdon, Oxon [England: Routledge, 2011.p.8.

3 "Etienne-Louis Boullee, *Architecture :Essay on Art*, in Helen Rosenau, *Boullee and Visionary Architecture* .London, 1976 . p. 106.

Fig. 4
Robert Venturi
Vanna Venturi House, 1964.

1.3.3 FREE FACADE : THE DISAPPEARANCE OF THE EXTERIOR WALL

The development of the skeletal frame structure, defined as an assembly of vertical and horizontal components constructed to support floors, walls and roofs of a building, marked a major transformation in the history of modern architectural design and construction. Coming at the end of the Nineteenth Century, the skeletal frame structure shifted the concepts of building structure and skin radically, leading to the emergence of the curtain wall as an architectural concept and a system. The use of curtain walls remains dominant today.

The invention of the skeletal frame structure also meant that exterior walls were no longer relied upon for structural support, freeing the building envelope to become a blank canvas for architects to try new ideas and materials. It therefore became possible to think of the envelope as an independent architectural element free from the requirements and the formal consequences of a load-bearing structure. This shift brought with it new architectural expressions, and altered the relationships between exterior and interior, architecture and nature, and foreground and background in architectural design and construction.

By the turn of the Twentieth Century, the frame structure itself became part of the exterior architectural expression, in-filled with large surfaces of glass. This had fundamental implications for both interior space and exterior expression. It became possible to open up the facade completely, by installing large windows and thick glass surfaces as expressive architectural elements. The Bauhaus Building, designed by Gropius and Meyer in 1926, is a great example of the articulation of the curtain wall as the main exterior expression. Banham described the building as the masterpiece of modern architecture, for its architectural innovation¹ (Fig. 5). Le Corbusier noted that the history of architecture was the same as the history of the window: whereas the traditional concern was with the area between the windows, the window became an element in itself, rather than an expression of a construction approach. In the early decades of the twentieth century the introduction of the horizontal, continuous window came as a reflection of this notion.²

1 Banham, Reyner. *Age of the Masters: A Personal View of Modern Architecture*. New York: Harper & Row, 1975.p.157

2 Le Corbusier, *Precisions* (Cambridge, Mass., 1991). p. 51.

The Dom-ino House was Le Corbusier's revolutionary concept that made pristine continuous exterior walls possible. Dom-ino House is a structural system composed of thin, reinforced concrete slabs supported by narrow columns that are pushed to the inside, cantilevering the floor slabs at the exterior wall. This meant that there was no need for exterior walls for support, and all the mechanical systems could be hidden inside (Fig. 6). The re-definition of the facade as an independent surface, along with the introduction of the horizontal continuous window or "window wall" was a fascinating idea for architects at the time. Thus conceived, the envelope became a kind of covering: a form of clothing or continuous wrapping. As Leatherbarrow and Mostafavi observe: "Once the skin of the building became independent of its structure, it could just as well hang like a curtain or clothing"¹

Following this, notions of transparency as both a visual effect and a metaphor, became the profession's new fascination. As the outside skin of buildings became a thin transparent layer of glass, exposing interiors completely, the design emphasis shifted from solids to voids. Architects explored the range of visual expressive effects made possible through the use of glass. Transparency, reflectivity, and opacity were the poetic effects that resulted from the technological advances of that era. For example, Mies's theoretical and built projects explored these effects in a poetic and symbolic manner. In the buildings and texts of the mid 20th century, the modernist ideal of transparency was evident both metaphorically and literally. The glass envelope maintained its traditional function as barrier that sealed interior space. But it also gained a new function as a connective device because of the new type of optics that the glass facade made possible. There was a general fascination in maximizing transparency and minimizing the physical presence of the exterior walls.

Paradoxically, as the exterior surface became an autonomous entity with the emergence of the free facade, its very necessity came into question. In fact, Banham questioned the very presence of the envelope, arguing that with the widespread domestication of air conditioning after the 1930s the envelope had been freed from its traditional role as an environmental mediator. According to Banham, this meant that – if the envelope were present at all – it would be rendered as the thinnest possible membrane, a simple separator preventing leakage between two adjacent atmospheres.

1 Leatherbarrow, D, and M. Mostafavi. Surface architecture. Cambridge, MA: MIT Press, 2002.p. 42.

Fig. 5
Bauhaus Building, Dessau, 1925-1926

Figure. 6
Le Corbusier, Dom-ino System, 1915

" The contribution of the present age is that it is now possible to have an independent wall of glass, a skin of glass around the building; no longer a solid wall with windows. even though the window might be the dominant part- this window is the wall itself, or in other words, this wall is itself the window. And with this we have come to a turning point..it is the disappearance of the outside wall." ¹

- Arthur Korn

1 Korn, Arthur. Glass in Modern Architecture of the Bauhaus Period. New York: G. Braziller, 1968. p 6.

1.3.4 NATURAL METAPHOR

A number of architectural theories and built projects in the 1960s and 70s suggested radical ideas and design approaches in reaction to the modernists' model of the envelope as a minimal wrapping or covering, that is, stripped of all ornaments, representational and symbolic details. Archigram was one of the most influential architectural movements of the twentieth century. Its members produced a remarkable amount of theories and projects that influenced the architectural thinking at the time and paid great attention to architectural interfaces, envelopes, and enclosures. Archigram's members questioned fundamental architectural concepts, and explored these concepts with new materials and technologies. Some of these materials were not, at the time, considered possible building materials.

Archigram's production took place mainly on paper. Often described as visionary, optimistic and fantastical, the architectural images produced by its members are the most memorable from the 1960s and among the most influential ever made. Their ideas about the architectural envelope specifically were generally a result of their frustration with the ubiquity and superficiality of the glass curtain walls that had begun to seal cities' streets. Intimacy with the body and its senses was a primary concern and many projects attempted to explore this notion in depth. For these reasons, natural and biological metaphors and analogies defined the underlying conceptual framework and the aesthetics of Archigram's body of work. Concepts such as growth, reproduction, sensitivity to the body, compositional formlessness, exposed and visible circulation, and complex relationships, are few of the many metaphors they drew on. In Archigram, the critique of the superficiality and rigidity of curtain walls was expressed through a desire to design an interface that is similar to the biological substance, skin; something that would be able to function like an active organ. Thus, analogies between the architectural envelope and the living skin, on both metaphorical and physical levels were visible in almost all of the projects and images they produced.

In the realm of materials production, the 1960s was an era of nylon, foam and plastics. Fascination with these materials inspired architectural ideas such as enclosures and building skins that are soft membranes, similar to second skins that can be pushed away and pulled in to adjust its relation to the body. The architectural skin would therefore be proximate to the body's skin. In Michael Webb's Cushicle/Suitaloon project (1966) the membrane that defines the space is pushed out by its occupant (Fig. 8). In this line of architectural thinking, the skin of a space could be supported by a "system of vertebrae that respond very directly to the nervous system of the person within"¹

Lightweight enclosures, motifs of anti-monumental skin and guts, and geodesic skins appeared repeatedly in Archigram work. For example in David Greene and Michael Webb's "Story of The Thing" image, they design a placeless triangulated space frame, a layer of skin that floats above the city, formless and placeless: "a thing, a floating plasma with an unstated purpose"²(Fig. 9). The introduction of stretched plastics and pneumatics enabled architecture in general to become more fleshy and flexible, able to move and transform. Archigram wanted to push these new possibilities to their limits. Another few examples that used geodesic skins on a large scale are Michael Webb's Sin Centre (1959 - 1963) and Peter Cook's Montreal Tower (1963).³ The direct analogy with the living skin can be clearly observed in the U.S. Pavilion at the Montreal Expo in 1967. This pavilion was designed by Buckminster Fuller to represent a living, breathing skin. Fuller describes the work in the following manor:

"Anyone looking at the geodesic dome in Montreal saw a very beautiful piece of mechanics. It did all kinds of things to your intuition. You saw there were curtains that could articulate by photosynthesis [light sensors] and so forth, could let light in and out. It is possible, as in our human skin, all of our pores, all of the cells organize, so that some are photosensitive and some are sound-sensitive, and they are heat-sensitive, and it would be perfectly possible to create a geodesic of a very high frequency where each of these pores could be circular tangency's of the same size. One could be a screen, other breathing air, others letting light in, and the whole thing could articulate just as sensitively as a human being's skin."⁴

1 Sadler, Simon. Archigram: Architecture Without Architecture. Cambridge, Mass: MIT Press, 2005. p.129.

2 ibid. p. 89.

3 ibid. p. 113.

4 Bonnemaison, S., and P. Beesley. On growth and form: Organic architecture and beyond. Halifax: TUNS Press, 2008.p. 68.

Similarly, the dome in Peter Cook's Montreal Tower (1963) was a metaphor of a living skin in the sense that it was dynamic, its openings were broken down into repetitive components similar to the pores of the skin with automated shutters that open and close to modulate the sun's rays. And, since the shutters open and close individually, they create infinite variations of patterns.¹

Archigram strove constantly toward further dematerialization, toward "the notion of an ultimate in skins: a membrane which is not there. The skin which can be seen through; the skin which can be parent to all within; the skin which can be regularized, the skin which can be treated as an environmental totality"². This notion was explored in Michael Webb's Magic Carpet and Brunhilda's Magic Ring of Fire (1968) where pressurized air is the only medium of the envelope (Fig. 10). Webb's Magic Carpet was the most immaterial solution for the problem of enclosing the body in an ultimate state of comfort. The space was filled with tubes that blow air at varying pressure, pivot and eject gases to maintain the body's position in the space and adapt to changing conditions.³

These biological analogies of the architectural skin are re-emerging today as the technologies required for the physical realization of these concepts become available. Moreover, current concerns about the environmental crisis create a new impetus toward more responsive and performative envelopes. The living skin has become a recurring trope in architectural theory in the Twenty First Century. Architects today are designing architectural envelopes that are self-regulating intelligent systems and the notion of layered skin and other skin metaphors such as pores, bumps, wrinkles, are ubiquitous in contemporary architectural theory. For example, in the project Kunsthaus Graz (2000), designed by Peter Cook and Colin Fournier, the idea of the continuous skin is explored to its extreme. The skin wraps around the whole building as a continuous membrane, and the swellings of the skin define a varied and rich experience, organizing the whole program. Here the skin is not a separate element. It is an integral part of the architecture in that it holds the building together, and defines the character and the spatial experience of the architecture.

1 Bonnemaison, S., and P. Beesley. On growth and form: Organic architecture and beyond. Halifax: TUNS Press, 2008.p. 67-68.

2 Cook, Peter. Experimental Architecture. London: Studio Vista, 1970. p.5.

3 Sadler, Simon. Archigram: Architecture Without Architecture. Cambridge, Mass: MIT Press, 2005. p. 116.

Fig. 7
Coop Himmelb(l)au
The Restless Sphere, 1971.

Fig. 8
Michael Webb, Suitaloon, 1967.
The suitaloon blurred the boundaries between different kinds of bodily enclosures, of buildings and clothes, of inside and outside.

Fig. 9
Michael Webb
Magic Carpet and Brunhilda's
Magic Ring of Fire, 1968.

Fig. 10
David Greene and Michael Webb,
Story of the thing, 1963.
A placeless, formless triangulated
space frame that floats above the
city.

Fig. 11
Archigram's work expressed a
desire to design an interface
that is similar to the biological
substance skin.

1.3.5 THE BIOLOGICAL MODEL

Amanda Reeser Lawrence and Ashley Schafer, describe the contemporary architectural surface as a site of performance and effect similar to the biological skin, as well as a territory of architectural invention. They further note that the architectural surface is transforming from a two-dimensional plane into a three-dimensional interface¹.

The current instantiation of the corporal desire to connect and collapse boundaries between the body and architecture is described further in Ellen Lupton's *Skin: Surface, Substance and Design*. Lupton describes industrially-produced 'skins' as envelopes and surfaces that complete and "supplement the inadequacies of the body's natural envelope"² (our actual skin). *Algae-Cellunoi* is another rather extreme exploration of the architectural skin as a hybrid between the man-made and the natural. The installation designed by marcosandmarjan, Guan Lee and Richard Beckettis in 2013 is an ornamental, external wall structure composed of numerous cellular components that work as a scaffold for algae to grow in. The patterns have multiple gaps that aim for a gradual involvement of nature in the installation's three-dimensional surface. Each cellular component is also designed to host a variety of flasks in which liquid algae can grow and create a varied ecology of natural elements on the wall.(Fig. 12)

These recent design theories and explorations are defining a new typology of the architectural envelope as an active, performative, and adaptive entity. Moreover in this new typology aesthetics are directly related to its performance. As such, this new territory of exploration that extends beyond the visual and the representational nature of architecture into a hybrid of science, biology, and architecture, which will require a new type of knowledge. There is no doubt that the role of the architectural envelope is extending far beyond its traditional role as a barrier and a container, and its formal expression is profoundly changing and evolving. The question is whether - by understanding how the envelope has evolved historically and what forces have driven these changes - we are able to project and imagine the future envelope, a more complex one that is more similar to the living skin than ever before.

1 Lawrence, Amanda Reeser, and Ashley Schafer. *Expanding Surface*. Columbus, OH: Praxis, Inc, 2007.

2 Lupton, E., and J. Tobias. *Skin: Surface, substance + design*. New York: Princeton Architectural Press, 2002

Fig. 12
marcosandmarjan with Guan Lee and Richard Beckett, Algae-Cellunoi, 2013.

Fig. 13
STUDIO ROOSEGAARDE,
Flow, 2013

Fig. 14
STUDIO ROOSEGAARDE,
Lotus Dome, 2011

Fig. 15
Philip Beesley,
Hylozoic Ground: Venice Biennale -
Venice, Italy - 2010

2

SOFT

2.1 SOFT: METAPHOR

Soft as a term is wide-ranging in its meaning. It describes material qualities, textures, implies character qualities, and defines strategies and new approaches to design. The most common associations with the term have been material characteristics that imply the ability of a material to transform itself in response to pressures without losing its integrity. It also refers to the flexibility of a system.¹

Soft architecture emerged in the 1960s and 70s as a counterpoint to permanent, static and hard systems in architecture. Thus, soft architecture marked an era of radical change in architectural visions. Archigram's investigations, Buckminster Fuller's research into lightness, and large urban visions, such as Plug-in City and Walking City, were all part of the soft campaign. This was further characterized by a promotion of individualism, responsiveness and nomadism as apposed to the more conventional values of permanence and hardness in both materials and systems. For proponents of soft architecture, these latter values were viewed as no longer suitable to address the emerging urban complexities of the time. Plug-in City (Fig. 16) and Walking City (Fig. 17) are probably the best-known images to come out of Archigram. They are both exemplary of the notion of soft systems. Peter Cook's iconic scheme for Plug-in city indicates the scale of Archigram's ambition at the time: it was a mega structure, devoted to continued circulation. The structure's functions were scrambled and its boundaries blurred. Here, the clean, zoned, hierarchal separation of space that characterized orthodox urban planning gave way to flexible, interchangeable, dynamic, undefined characters, and suggested experiences that were less determinate, on both mental and physical planes. The fixed and the ideal were replaced by the adaptive and the transient; defined boundaries were replaced with blurry gradual transitions.

These projects and theories, and many others at the time, promoted architecture as an event, that could only be realized by the active involvement of its inhabitants. This was a vision of an architecture that could be enlarged and changed, anticipating architecture of endless possibilities. What unites these projects was their attempt to develop design strategies that shifted emphasis from the malleability of material to the flexibility of system.

1 Bhatia, N., L. Sheppard, and Archinect.com (Firm), InfraNet Lab (Firm). Goes soft. Barcelona: Actar, 2012

Fig. 16
Peter Cook, Plug-In city, 1964*

Fig. 17
Archigram, *Walking City*, 1964

*In his book *Archigram: Architecture without Architecture*, Simon Sadler suggests that "The aesthetic of incompleteness, apparent throughout the Plug-In scheme and more marked than in megastructural precedents, may have derived from the construction sites of the building boom that followed the economic reconstruction of Europe."¹

1 Sadler, Simon. *Archigram Architecture Without Architecture*. Cambridge, Mass: MIT Press, 2005.

The concept of soft systems emerged during the 1960s and 70s across a variety of domains¹. Soft systems are nonlinear systems, which are known primarily for their capacity to change over time, and which continually manifest new properties, forms and patterns. In this way, they are similar to all biological systems. In conjunction with other projects and theories in the 1960s which hinted that buildings could be enlarged and changed, soft architecture anticipated an architecture of endless becoming, similar to biological systems. For Sanford Kwinter "A system is soft when it is flexible, adaptable, and evolving. When it is complex and maintained by a dense network of active information." Moreover, "the stability of the system is rooted in its dynamics, in its capacity to handle and process movement, change, difference - in a word, information- transforming all irregular ripples and disturbances in the universe into engines of creation by absorbing these into its own already existing and deeply intertwined, internal movements"². However, as Kwinter further notes in *Soft System*, this notion lacked a clear direction until the occurrence of two major events that changed everything. These "Copernican" events, as Kwinter described them, encapsulated the new architectural ideals in a striking way. The first event was the hypothesis of continental drift, and the second was the advent of the first images of the earth taken from outer space transmitted by the Apollo Astronauts. What emerged with these events was a new "terrifying" concept of energy and movement. In concert with the theory of Continental Drift, the Apollo photographs showed the earth for the first time in an uncanny perspective. More than simply an inert system of thermal and energy flows, it appeared like a living body, and the kinetic and fragile nature of it was striking. The images further showcased the complexity of its movement, the continuous shifting of its colours, hues and textures. The earth seemed, newly, to be in a position between stability and instability, in continuous movement yet in a beautiful balance. It appeared as a system that is driven by its very softness.

1 Bhatia, N., Sheppard, L., & Archinect.com (Firm), InfraNet Lab (Firm). (2012). *Goes soft*. Barcelona: Actar.

2 Kwinter, Sanford. *Soft Systems in Culture Lab*, ed. Brian Boigon, Princeton Architecture Press, 1993. p. 211.

Dynamic Stability
Soft Systems

"The Stability of a system is rooted in its very dynamism, and its capacity to handle and process movement, change, difference (in a word information)." ¹

- Sanford Kwinter

¹ Kwinter, Sanford. *Soft Systems in Culture Lab*, ed. Brian Boigon, Princeton Architecture Press, 1993. p. 211.

2.2 SOFT: BOUNDARIES

The boundary in architecture is a threshold that is commonly represented by the facade, the wall, the window and the door. This section studies the extended meaning of “boundary” in the architectural context by looking at a number of theories and projects that attempted to define the boundary as a surface where intense interactions take place, and as a surface that contributes to the architectural experience rather than being an inert barrier. Reyner Banham, Michelle Addington, Frederick Kiesler, to name a few, provided definitions, and asked crucial questions about the meaning of an architectural boundary, challenging conventional thinking.

In her text ‘Contingent Behaviors’ Addington criticizes the modernist’s idea of the interior as contained within a sealed envelope. She questions the relationship between interior and exterior conditions, and between the body and its surroundings. With the aid of HVAC systems, the boundary in the early twentieth century has transformed from being a boundary of exchange to a boundary of discontinuity. Addington notes “the envelope has morphed from its role as a mediator of surrounding conditions to the determinist of those conditions”¹. Addington describes the thermal exchanges that take place between the body’s skin and its surroundings as transient and variable. This contrasts with the common approach of conceiving of the envelope as a static container:

“even though developments in analyzing and stimulating the interior environment have revealed the remarkable variety and transiency of that environment, we stubbornly cling to the belief that the envelope supersedes all - acting as a barrier to the exterior, container of the interior and determinant of all extant physical phenomena. Essentially we privilege that which we see, that which matches our image of a permanent and static architecture”².

Similarly, the work of Inside Outside Studio³ explores conditions of architectural boundaries that engage the invisible and address the senses, by using soft materials like textiles, light, sound and plantings. The boundary in their work is dependent on natural phenomena, its conditions placed beyond human control and the influence of designers, being instead continually influenced by environmental conditions . Their work introduces the invisible, the subconscious, the phenomena of action/reaction and the “biology of things” as the materials of architectural boundaries.

1 Addington, Michelle. “Contingent Behaviours.” *Energies: New Material Boundaries: Architectural Design*, May 18, 2009.

2 *ibid*

3 Blaisse, Petra. “The Instinctive Sense of Space and Boundary.” *Energies: New Material Boundaries: Architectural Design*, May 18, 2009.

The free plan is an architectural concept that emerged with the development of structural systems that eliminated the need for load bearing walls. The free plan is a continuous space with no divisions, and no conventional walls or rooms. Some projects in the mid twentieth century took this notion to extremes and proposed spaces without boundaries, or suggested new types of boundaries. An early visionary example is the House of The Future, by Alison and Peter Smithson. This concept was developed in 1956 for the Daily Mail Ideal Home Exhibition in London¹. House of The Future suggested new ways of designing and occupying a space, and presented a vision of a space without walls and rooms in the conventional sense. An open plan with thick, deep outer walls that enclosed spaces within them, these spaces were described by the architects as fitted enclosures. The floor plan radically eliminated the idea of walls as dividers and the permanency of space and function. Instead, it presented a fluid continuous space that responded – metaphorically – to inhabitants' desires and needs. (Fig. 18)

Like many architects in the mid Twentieth Century Frederick Kiesler was interested in architectural concepts that resonated with the human body. One of these concepts was the boundary between body and architecture. Kiesler considered the two as one entity, and described architecture as a living organism and an extension of the human body. Kiesler's work therefore proposed a biomorphic, self-bearing architecture that is in continuous dialog with the human body. Architecture in Kiesler's view was ecological and social. These ideas were revolutionary at the time, and presented an attack on the rectangular, international construction of the twentieth century.

Kiesler presented an architectural model of his theoretical project the Endless House in the Visionary Architecture Exhibition at the Museum of Modern Art (MOMA) in 1960. The project was a result of fifteen years of research and design explorations that concerned humans, nature, and technology. Kiesler's clay model and drawings of the Endless House show his intent of making architecture as a living organism, a house that is a an "artificial cell"²; a system that is incorporated into nature that can just as well be on the ground, floating on water or on sand.

1 Cruz, Marcos. *The Inhabitable Flesh of Architecture*. 2013.p. 103.

2 Friedrich Kiesler-Zentrum Wien, Museum für Moderne Kunst (Frankfurt am Main, and Germany). Friedrich Kiesler: endless house. Ostfildern-Ruit, Deutschland: Hatje Cantz, 2003.p. 12.

Kiesler argued that a house – as with all other forms of architecture – should not be conceived as walls and roof with mechanical systems, but as a “living organism, with the reactivity of a full blooded creature”¹. He explained his proposal by noting that the user can adapt to any given physical conditions of a space, but would not be able to settle in a space with unfavorable psychic conditions, “they will ultimately leave the finest window frame (admitting no draft), the best laid highly polished floors and withdraw to a cave in order to be free and happy.”² Thus, “The Endless House is not amorphous, not a free-for-all form, its shape and form are determined by inherent life forces, not by building code standards.”³ Kiesler also labeled the spaces according to the physical qualities of a space, and the amount of daylight they receive. The formal composition of the Endless House was derived from the social dynamics of the inhabitants, and the distribution of natural daylight beams in the space. Moreover, there is a continuity of the entire space as the curved surfaces:

“Sweep on past the boundaries of the room and of the house itself... instead of being stopped abruptly, as in boxed spaces, the enclosure seems to sweep on past the boundaries of the room and of the house itself, encompassing far reaches beyond, and yet they return to shelter him and integrate him within space”⁴.

Kiesler’s attack on two-dimensional architecture thinking and an argument for a notion of space as the sum of every possible movement the human body can make within it is probably best expressed in the poem When I Conduct:

*“ When/ I conduct/ the orchestra of space/ by grace/ of the unknown/ the endless house/ has ins and/ out/ without a door/ or wall/ they change at will/ from void to fill/ yet standing still/ they cannot/ budge/ or billow-bulge/ until I/ split/ with light/ reality-illusion/ it’s simply done/ by magic fusion/ of what is not/ what can/ [but] does not want to be/ yet must obey/ oh! Stay/ succumb/ don’t play/ me/ dumb/ my/ scribble/ nibbles/ crumbs of mine/ and God’s and Devils/ fall/ in line ”*⁵

1 Friedrich Kiesler-Zentrum Wien, Museum für Moderne Kunst (Frankfurt am Main, and Germany). Friedrich Kiesler: endless house. Ostfildern-Ruit, Deutschland: Hatje Cantz, 2003.p. 32

2 ibid

3 Frederick Kiesler, “Notes On Architecture as Sculpture” in Art in America, May-June 1966

4 Friedrich Kiesler: endless house.p. 55

5 ibid. p 58-59

Fig. 18
House of The Future by Alison and
Peter Smithson, 1956

Fig. 19, 20, 21
Endless House by Frederick Kiesler, 1958

MAISON DE VERRE, 1928
PIERRE CHAREAU

ENDLESS HOUSE, 1950
FRIEDRICK KIESLER

RONCHAMP CHAPEL, 1951
LE CORBUSIER

HOUSE OF THE FUTURE, 1956
ALISON AND PETER SMITHSON,

SUITALOON, 1968
MICHAEL WEBB [ARCHIGRAM]

CENTRE GEORGES POMPIDOU, 1977
RENZO PIANO, RICHARD ROGERS & GIANFRANCO FRANCHINI

WALL HOUSE 2, 1973
JOHN HEJDUK

THE HOUSE WITHOUT ROOMS, 1974
RAIMUND ABRAHAM

EYEBEAM MUSEUM/ATELIER COMPETITION, 2001
GREG LYNN

SUN TOWER, 2008
MORPHOSIS

Fig. 22

An illustration of the architectural precedents that informed the design project. The projects shown in the above drawing push the boundaries of the normative conception of the architectural envelope, the notion of boundaries, and the role of the walls in making the architectural space .

Fig. 23
Study for Endless House by Frederick Kiesler, 1958

Fig. 24
Endless House by Frederick Kiesler, 1958

2.3 SOFT: RESPONSIVE

This section provides a brief overview of the implications of movement and transformation in the context of architectural skins, and is concluded by a design experiment involving two-dimensional geometrical forms that are transformed into three dimensional objects when specific forces, or stimuli, are applied to them. The geometrical patterns are inspired by Ron Resh's research in folding geometries. One of these two dimensional patterns was selected and digitally modeled to create a mesh or a screen that is able to transform and move in response to certain parameters such as daylight, heat or visual effects. Such a screen is intended as part of the final design proposal, and it creates one of the skin layers that are proposed.

Softness also implies responsiveness and thus movement and change – elemental qualities of living things. Architecture is described as dynamic, living, and responsive when it incorporates actual physical movement or transformation within its structure. This architectural design therefore utilizes time as a compositional element, similar to colour, texture and pattern. The sense of motion provoked by the design becomes a visual design element. Cedric Price's Fun Palace (1964) is one of the most influential examples of interactive, dynamic architecture. Price considered architecture to consist in events rather than objects: an event "not as static snapshots but as a continuous evolution of phenomena unfolding in time". Kinetic architectural components, such as kinetic architectural skins, according to Moloney, provide a similar context in which phenomena unfold in time, "a facade which operates as a continuous multiplicity would be capable of potentially infinite variations."¹

¹ Moloney, J. Designing kinetics for architectural facades: State change. Abingdon, Oxon [England: Routledge, 2011.p. 36.

2.3.1 TIME: ARCHITECTURE OF CHANGE

In their book, *Kinetic Architecture*, William Zuk and Roger H. Clark stated that for architecture to be part of life, it should accept and reflect change: "our present task is to unfreeze architecture, to make it a fluid, vibrating, changeable backdrop for the varied and constantly changing modes of life. An expanding, contracting, pulsating, changing architecture would reflect life as it is today and therefore be part of it."¹ Zuk and Clark offered a rich and comprehensive study of an architecture of change, drawing inspiration from biological systems. The emphasis in their research is on kinetic structural systems. However they also offer a study of the aesthetic of motion and the incorporation of time as a design element: "since time is the basic measure of motion, it becomes an important factor in design."²

Movement:

Another key advocate of the architecture of transformation is Chuck Hoberman, who believes that transformation is a major new frontier of design. Hoberman defines transformation as the ability of an object or a structure to transform itself by itself, "one that has an innate property of controlled change"³. Hoberman believes that such capabilities lead to functional benefits and intelligent responsiveness within the built environment. A transforming object may be foldable, retractable or shape shifting. Hoberman argues that the creation of transforming objects and systems requires a new design approach. This approach draws on mathematics, mechanics and structural engineering such that a designed object can transform similar to the way a natural organism does.: "an approach that is inspired by nature, not from a visual standpoint, but rather from a functional one"⁴. To achieve this level of similarity to a natural transformation, according to Hoberman, the design of such object should be based on key principles: it is made of many smaller parts that act as an "integral whole"; it should be a hybrid between a structure and a mechanism (i.e. a structure that sustains load and a mechanism capable of converting applied force into movement); is made up of kinetic blocks; and has a behavior based on its underlying geometry. Moreover the transforming object will acquire its unique qualities through adherence to three additional critical design criteria. The design should be (1) complete and fully three-dimensional; (2) smooth and continuous; and (3) reversible and repeatable. Here the emphasis is on the object's behavior and functional benefits rather than its appearance or its material qualities.

1 Zuk, W, and R. H. Clark. *Kinetic architecture*. New York: Van Nostrand Reinhold, 1970.p. 154.

2 *ibid.*

3 Hoberman, Chuck, *Transformation in Architecture and Design* in Kronenburg, R, and F. Klassen. *Transportable environments 3*. London: Taylor & Francis, 2006. 70.

4 *ibid.*

Transformation in nature embodies these key qualities. These transformations in size and shape reveal natural processes. Transformation in nature is based on the fact that forms found in nature metamorphose into new forms. Natural transformation occurs continuously and is not broken into discrete steps; it is fully three-dimensional; it moves between completely different sizes and shapes. Reversibility is, however, not found in nature since natural transformation never repeats mechanically and is not strictly reversible.

Aesthetics of movement: The temporal and the ephemeral:

Zuk and Clark introduced the issue of kinetic aesthetics, which can be considered the first direct discussion of kinetics in architecture that goes beyond function or technology. Their emphasis is on developing a temporal understanding of aesthetics, and this idea occurs throughout their examples, as designers conceive kinetics in terms of multiple overlapping rates of change, from daily to yearly temporal scales. Zuk and Clark identified the potential for a new aesthetic based on kinetics and suggested ways in which this might be studied, such as through time-lapse. Since time is the basic measure for motion, it becomes an important factor in design. This suggests that kinetic architecture must be considered as a continuum. The movement unfolds, but what the form has just been or what it will be are matters for memory or speculation respectively. This architecture can never be confronted in its entirety, as a complete whole. In this understanding, the sense of motion itself can be a visual aesthetic much as has traditionally been the case with basic elements like color, texture, and pattern. Thus, a definition of form that is time-dependent must be recognized. In his book *Flying Dutchmen: Motion in Architecture*, Kari Jormakka considers actual movement as apposed to the representation of dynamic lines of force, referring to architectural projects within a historical framework.

Like all things, moving things are characterized by specific forms. But the definition of form in the case of transformable objects is more complex than for static objects, since form necessarily changes with movement. Thus movement conveys a complex and unfathomable perception of forms. This is often described as the “poetry of movement” because when compared with a static object, a transformable/ responsive object has an ephemeral quality and aesthetic. A famous example is the wonderful sphere designed by Chuck Hoberman, which enters into a different relationship between form and movement, where the form is conditioned by its movement. For example, when Hoberman’s object is moved by throwing it into the air, the colors change. Although the form and the movement are in themselves simple, they appear complex and are beyond the human capacity for full exploration or understanding. Therein lies the poetry of the transformable object.

1964

Fig. 25

Fun Palace
Cedric Price

1970

Fig. 26

Kinetic Architecture
Zuk and Clark

1987

Fig. 27

Arab World Institute
Jean Nouvel

1992

Fig. 28

Kinetic Light Sculpture
Christian Moller

2001

Fig. 29

Aegis HYPO-SURFACE
Mark Goulthroe

2003

Fig. 30

Bix electronic skin
Peter Cook, Colin Fournier

*" For me, buildings are the ultimate interactive experience. We are immersed in them, moving through spaces with new vistas and perspectives constantly opening before us. My vision of transforming architecture extends and inverts this process: instead of moving through a building, the viewer may be stationary and it is the building itself that changes. Walls disappear and reappear. A roof spirals open. The inside becomes outside. An object expands and envelopes one ."*¹

-Chuck Hoberman

Fig. 31 Ron Resch

Fig. 32 Chuck Hoberman

Fig. 33 A recent design project by Hoberman

¹ Chuck Hoberman, Transformation in Architecture and Design in Kronenburg, R, and F. Klassen. Transportable environments 3. London: Taylor & Francis, 2006. p. 70-71.

Fig. 34 , 35
2D Geometrical Patterns that transform into three dimensional objects when folded.

2.3.2

MOVEMENT STUDIES

Fig. 36
Movement study

Type 1

Unit tessellation

Type 2

Digital Simulation of the movement

Type 3

Fig. 37
Movement study

Digital Simulation of the movement

Fig. 38
Movement study

Fig. 39-A
Study of an architectural surface

Fig. 39-B
Study of an architectural surface

3

SKIN

Fig. 40
Human Skin Layers

SKIN

*"The skin is the oldest and the most sensitive of our organs, our first medium of communication, and our most efficient protector... Even the transparent corner of the eye is overlain by a layer of modified skin."*¹ - Ashley Montagu

*"The body is, in effect, nothing but a strata of skin in which interiority and exteriority are thoroughly convoluted"*² - Mark C. Taylor

*"The skin is the deepest"*³ - Paul Valery

1 Montagu, Ashley. *Touching: The Human Significance of the Skin*. New York: Columbia University Press, 1971. p. 3

2 Mark C. Taylor, *Hiding*, 1997) Taylor, Mark C. *Hiding*. Chicago: University of Chicago Press, 1997.

3 Valery, Paul. "Idee Fixe: A Duologue by the sea" (translated by David Paul), in P. Valery. *Collected Works of Paul Valery*, Vol. 5, New York: Bollingen Foundation. 1965, p. 31.

3.1 SKIN: METAPHOR

The term skin in the architectural context was originally coined to draw a distinction between the building's structural components – the bones – and its envelope. Recently it has been used to describe intelligent environmental systems that draw analogies with the composition and function of the living skin.

Skin metaphors have become ubiquitous in art and architectural theory in the last decade. The source of the skin metaphor, the human skin, is a protective organ that guards against the action of physical, chemical and bacterial threats to the internal organs. Based on this, metaphors of skin have been increasingly applied to architectural works, referencing, for instance, the skins ability to self regulate, and to adapt to changing environments, as well as its permeable surface and varying textures. Such analogies have been used in an effort to improve the performance of the architectural envelope, or in some cases, to resemble the organic nature of the living skin. The ever growing fascination with natural forms and biological metaphors is being realized through materials that are able to change form and appearance, as well as digital modeling tools that are able to model complex curves and forms, and building technologies that are able to make these ideas possible.

In *Skin: Surface, Substance and Design*, Ellen Lupton looks at the notion of skin as both substance and metaphor in recent design practices. Lupton discusses the relationship between the emerging interest in skin among artists, designers and architects and the technological and digital advances in the last decade. The technologies available today enable designers and architects to make objects and buildings that resemble biological and natural forms and systems, and biological skin is one such system. Lupton argues therefore, that "The primacy of the skeleton has given way to the primacy of skin"¹. Skin is our surface of interaction with the exterior world, through its intelligent mechanisms we adapt and accommodate climatic changes and respond to pleasure and pain. Like the living skin, intelligent exterior and interior surfaces are being theorized and designed to control climatic changes, and to regulate and circulate air and light. An Intelligent building skin is a responsive and an active controller of the interchanges occurring between the external and internal environments, and has the ability to provide optimum comfort to inhabitants by responding to stimuli and adjusting itself automatically.

1 Lupton, E., and J. Tobias. *Skin: Surface, substance + design*. New York: Princeton Architectural Press, 2002.p. 31

3.2 LIVING SKIN: COMPOSITION

One of the most distinguishing characteristics of living skin is its multi-layered composition, each layer being in a constant state of transformation. Layers of skin form complex systems and thereby an organ of the body is generated. Internal organs, bones, connective tissue, muscles are all composed of differentiated layers of skin¹.

Human skin consists of two distinct layers: the Epidermis forms an outer layer and the Dermis, the inner layer. The Epidermis is mainly composed of dead cells, contains pigments, pores, and ducts, and is only a few cells thick. It consists in a stratum of cells that migrate toward the surface, where they compact into a layer of dead material. The palms and soles build up a thick layer of these dead cells to provide the strength and hardness required against pressure, while other area of skin are highly sensitive and packed with nerve cells. By contrast, the inner layer, the Dermis, consists of a living network of protein collagen, blood vessels, nerve endings, fat tissues, and the basis of hair follicles and sweat glands. The cells of the Dermis are continually multiplying to replace those cells that are shed from the outer surface. The skin is a self-repairing system whose exterior is "senseless and inert while its inner layers are flush with nerves, glands and capillaries"². Skin is thus both dead and alive. This fascinating system is a result of our bodies' need to be resilient and adapt to varying exterior conditions. (Fig. 45- 46)

Lupton describes skin as a "multilayered, multipurpose organ that shifts from thick to thin, tight to loose, wet to dry, across the landscape of the body". Skin lacks definitive boundaries, it flows continuously from the exposed surfaces of the body to its internal cavities. It represents an ambiguous transition between our outsides and insides. It is a continuous membrane that surrounds every curve, corner and crack in our bodies and it varies in thickness, texture, color and sensitivity across the body. For instance, the thickness of the skin varies from 0.5 mm on the eyelids, up to 4mm on the palms of the hand and soles of the feet, in order to respond effectively to different types of pressure and accommodate different functions.

1 Lupton, E., and J. Tobias. Skin: Surface, substance + design. New York: Princeton Architectural Press, 2002.p. 44
2 ibid. p. 27

Fig. 41, 42, 43, 44
Human Skin

Fig. 45
Human skin layers

Fig. 46
Skin Layers

Architectural skins are our detached skins. Therefore, they can be conceived as second, or third, skins, following the model of the living skin. A number of projects in the last few decades are borrowing ideas and concepts from living skin, building skins that are composed of series of layers and masks that can be peeled away or thickened. This multi-layering approach creates a gradual transition between the outside and the inside, therefore replacing the sharp definition of exterior and interior with a blurred boundary and a deep skin.

The double facade system is considered one of the earliest examples of the concept of layering the envelope to achieve more sensitivity to the exterior conditions and consequently more comfort and control. Depth was created despite the use of thin glass, allowing natural ventilation and control over daylight. Lord's On Sunset, a project by Greg Lynn, utilizes folds and curved surfaces to create an exterior skin that penetrates the building and creates spaces within the folds. The interior too is composed of layers of folded surfaces that connect interior spaces vertically and horizontally (Fig. 47). Para Cube, a project by Marcos Novak, follows a similar approach. The building is composed of a rectilinear frame structure interlaced with a membrane layer that deforms and folds back on itself. The membrane layer pushes the frame structure as it changes its form and thus creates spaces that are temporary. (Fig. 48)

Skin also communicates emotional and physical states. It can blush, blanch, get goose pimples and sweat, or go blue with cold. This is drawing on some projects that have employed digital media screens as their expressive exterior envelope, communicating certain messages to the public and in many cases interacting with the user or responding to certain conditions.

Fig. 47
Greg Lynn, Lord's Clothing store on Sunset Boulevard in Hollywood, 2001.

Fig. 48
Marcos Novak, Para Cube, 1998

3.3 SKIN: SURFACE AND DEPTH

This section looks at a number of projects where the exterior envelope is conceived as a surface that has depth and in some projects this depth is translated into an inhabitable space. Although the modernists had a fascination with transparency and an inclination towards extreme thinness of walls, a few projects suggest the opposite: extreme depth. The general approach to the notions of surface and space during the Twentieth Century, was of complete separation, contrast and tension. The modernists' focus was on conveying the tension between the exterior surface and the interior space. Thus the exterior surfaces of buildings have been conceived as two dimensional planes, as transparent glass exterior walls were "hanging" outside the structural system and completely sealing the interior. The only connection to the outside world was a visual connection. However in the last few decades, the exterior envelope has been more integrated into the spatial experience of the interior. In his book *The Inhabitable Flesh of Architecture* Marcus Cruz argues that "the symbolic meaning of shells and solid walls as prime protective layer is an outdated concept that does not fit with the trends in which intimacy and privacy of homes has become infinitely permeable to the outside world.¹" Instead Cruz considers the architectural skin as the new flesh of architecture, and that walls are more than mere dividers of space and barriers, but instead have their own spatial identity and are part of the spatial and emotional experience which they enclose. The exterior envelope or even the interior walls could become inhabitable interfaces where a relationship between body and architecture, body and nature, exterior and interior, can be established.

A similar criticism of the two-dimensionality of walls and enclosures is found in Donlyn Lyndon and Charles W. Moore's *Chambers for A Memory palace*:

"[...] too many architects have presumed that the abstractions of the elevation are the real thing, and have produced buildings whose walls have no thickness, no overlapping is possible, and there is simply one plane of transition between inside and outside. By eliminating the nuances that make it fun to move from one place to another within a set of spaces, such buildings severely diminish the pleasure of choosing your own positions within the structure."²

1 Cruz, Marcos. *The Inhabitable Flesh of Architecture*. 2013.p. 98

2 Lyndon, Donlyn, and Charles Willard Moore. *Chambers for a Memory Palace*. Cambridge, Mass: MIT Press, 1994. p 91.

The chapel of Notre Dame du Haut in Ronchamp (Fig. 49), designed by Le Corbusier and completed in 1955, is an example of celebrating the exterior walls. The spiritual walls of the chapel present an interpretation of walls as inhabitable interfaces, where a constant dialog takes place between the visitors and the architecture of its thickened walls. The chapel's inhabitable walls create the whole spatial experience of the structure. Further, a variety of programs are embedded in the walls of the chapel. Each of the four sides of the chapel has a different character, a functional northern wall, a spiritual southern wall, a ritualistic eastern wall and a private western wall. The depths of the walls define the experience of each side of the chapel's interior¹. The interaction with the chapel walls creates a duality and a fusion between the space and the boundary, the interior and the exterior. Furthermore, Le Corbusier decided to embed the confessionals in the mass of the western facade, where it pushes the wall to the outside and creates a bulge visible on the outside. He paid special attention to the confessionals, the most intimate spaces in the chapel, and created detailed sketches and drawings of these spaces. To enter the confessionals one has to be literally inside the wall. Cruz notes that this specific wall is "not a normal wall"², in that it is a continuation of the earth, a poetic wall that compels the visitor to look into the wall and into earth. The wall wraps up the human body in its rough textured surfaces and creates a spatial intimacy with the body like a womb or a shell. (Fig. 50, 51)

In Christopher Alexander's *Hand-carvable-spaceframe* (1967), the materiality of the walls was designed to be extremely malleable, and reconfigurable according to the individual needs of the user. This project and other projects from that era such as Michael Webb's *Suitaloon* (1967) (Fig. 8) looked at the architectural surface as a zone and a depth rather than a thin boundary. A more recent research project is marcosandmarjan's *Lofting House* (2005). *Lofting House* is composed of a series of inhabitable walls that define a sequence of private volumes, where the arrangement and the use of the spaces are flexible and open. The boundary between interior and exterior space is blurred. In this project, the walls are used as interfaces with niches, nooks and built-ins, transforming the traditional room-space into the wall-interfaces and provoking an interpretation of space with rather unidentified boundaries. (Fig. 52, 53)

1 Cruz, Marcos. *The Inhabitable Flesh of Architecture*. 2013.p.121

2 *ibid*.p.126

Fig. 49
Le Corbusier, Notre Dame du Haut, Ronchamp France,
1950-54. Plan view.

Fig. 50, 51
Walls of Notre Dame du Haut, Ronchamp.

*"The whole spatial and physical experience of the building [the chapel of Notre Dame du Haut] works in relation to the depth of its inhabitable walls"*¹

- Marcos Cruz

¹ Cruz, Marcos. The Inhabitable Flesh of Architecture. 2013.p.121

Lupton writes about the metaphorical representation of the skin in the contemporary architectural discourse as surface and depth¹. The skin as Lupton describes is a surface of maximum interface and intensity. An application of this concept is evident in Greg Lynn's entry of the Museum of Art and Technology (2001). The project introduces "pockets of space" that are formed when the exterior skin intersects itself. These pockets make the exterior wall become an integral part of the interior space and trigger a continuous negotiation between two environments and an intense spatial experience along the architectural envelope. (Fig. 54)

Kunsthaus Graz, designed by Peter Cook and Colin Fournier (2000) pushed the idea of a continuous deep skin to the extreme at the time. The building is lifted up off the ground and almost every function, apart from the hollow exhibition spaces within, is literally embedded into the facade that wraps around the whole building. The architectural skin, in this project, defines the spatial experience and organizes the program. (Fig. 55)

Erik L'Heureux in his book *Deep Veils*² showcases a number of his projects that respond to questions on envelope, surface, skin, form, atmosphere and perception. L'Heureux defines a deep veil as a thickened spatial envelope and enclosure that merges social, sensorial and atmospheric qualities, as a counterpoint to transparent glass facades of orthodox modern architecture³. His projects explore the spatial and physical qualities produced by opaque screens, or veils, that are layered, woven, perforated and stacked to create new types of enclosures. Such enclosures are an integration of open and closed, walls and windows, surfaces and depth. *Deep Veils* in the context of L'Heureux's book refer to the concept of modulating climate, view, structure and experience through spatial and material configurations of layered and thickened surfaces.

In one example, L'Heureux's notes that the verandah – an open space similar to a patio that extends outside of a building and is usually roofed or partly enclosed – is an example of a thickened envelope, "a doubling or thickening of the envelope as a volumetric shading device that enclosed the interior private space." The verandah and other similar types of spaces mediate between two different environments, the inside and the outside, becoming a third space, a volumetric envelope that extends the boundary of a space into a spatial gradient: "neither inside or outside, the verandah operates as an in-between, neither entirely public nor entirely private"⁴.

1 Lupton, E., and J. Tobias. *Skin: Surface, substance + design*. New York: Princeton Architectural Press, 2002.

2 L'Heureux, Erik G, Nasrine Seraji-Bozorgzad, and Erwin Viray. *Deep Veils*. 2014

3 *ibid*

4 *ibid*

Fig. 52
Marcos Cruz
Lofting House, 2005

Fig. 53
Marcos Cruz
Cyborgian Interfaces, 2007

Fig. 54
Greg Lynn
Competition Entry, 2001

Fig. 55
Peter Cook
Kunsthau Graz, 2003

3.4 POETICS OF THE SKIN: TRANSPARENCY AND TRANSLUCENCY

"I was never really interested in just transparency. In fact, I was always suspicious of it. The zone I feel comfortable in is the distance between the translucent and the opaque." - Steven Holl

Translucent materials transmit light and obstruct the view. Their effect is therefore a hybrid between transparency and opacity. Architectural skins that utilize translucent materials evoke a sense of mystery and ambiguity, as well as a serene atmosphere¹. Translucent materials further add a sense of depth to architecture, as they absorb, disperse and amplify light. This complex interaction with light influences experiential and spatial effects of the envelope and, consequently, the space within. According to Scott Murray, depending on the material and light conditions, "Translucency is rarely a fixed state and maybe perceived as nearly transparent, nearly opaque, or an apparently equal blurring of the two."² Translucency is therefore a more complex visual and experiential effect than transparency. Yet, few architects in the mid twentieth century looked at alternative architectural effects to transparency, as the dominant idea of twentieth century modern architecture. Nevertheless, translucency as an architectural effect has begun to play an important role in the development of architectural skins of the twenty first century, and it is a desired effect among many contemporary architects and designers.

The stained glass walls of Gothic cathedrals are early examples employing translucent surfaces' effects to suggest mysterious and poetic atmospheres and evoke certain feelings of serenity and vagueness. The interaction of these stained glass surfaces with light during different times of the day and the play of contrasting effects of transmitting light and obscuring the views to the outside, were certainly a significant part of experiencing the space emotionally, (Fig. 58). Steven Holl, a central figure in the discourse of translucency in the twenty first century, pays great attention to the poetic effects of translucent materials on spaces. Holl notes that "an attention to phenomenal properties of the transmission of light through material can present poetic tools for making spaces of exhilarating perceptions." Similarly, Murray, notes that two modes of material performance are responsible for creating architectural effects: the physical properties of materials and their related phenomenal effects. These two modes, according to Holl and Murray, should be equally considered and engaged in the design process.

¹ Murray, Scott. Translucent Building Skins: Material Innovations in Modern and Contemporary Architecture. London: Routledge, 2013.

² ibid. p. 1

Fig. 56 - 57
Philip Johnson
Glass House ,1949

Fig. 58
The stained glass walls of Gothic
cathedrals

Fig. 59
Pierre Chareau
Maison De Verre, 1932

Fig. 60
Steven Holl Architects
Higgins Hall insertion, 2005

The effect of time on the appearance and perception of a translucent material plays a key role in creating a varying and continuously changing character of an envelope and consequently the space within. One of the early Twentieth Century examples that employ translucent surfaces as architectural skin is the Maison De Verre, designed by Pierre Chareau in 1932. The design utilizes translucent glass lenses as a skin of the house, and the material's interaction with light is its main architectural expression. The house is almost fully clad in translucent glass blocks. The exterior envelope is supported by a steel frame structure. The steel frame is exposed to the interior and the floor slabs are cantilevered beyond the columns, following the Dom-ino frame structure model. The structural system enables the exterior envelope to be a continuous wrap around the house, interrupted only by mullions, which makes the house look like a translucent glass box. The architect's vision was that the only way to get maximum daylight into the space while maintaining privacy is by building an entirely translucent envelope¹. Maison De Verre presented a unique enclosure system and an innovation in the use of a material to achieve practical and poetic outcomes. A more contemporary example of this is the Higgins Hall insertion by Steven Holl Architects in Brooklyn, New York. The project was completed in 2005. The new addition designed by Holl is entirely clad in translucent glass surfaces, with very small areas of clear glass for views. The translucent envelope focuses the experience inwardly, obscuring the outside. However the interior space is filled with natural daylight, shifting in intensity during the day and suggesting a sense of ephemerality and vagueness. At night the building glows and illuminates the spaces outside and reveals movement and activity happening inside through the play of shadows.

¹ Murray, Scott. *Translucent Building Skins: Material Innovations in Modern and Contemporary Architecture*. London: Routledge, 2013.p. 577

3.5 SKIN: MEDIATOR

This section provides a brief overview of a few architectural concepts that look at the architectural skin as a filtering system and a mediator between the indoor and the outdoor. The architectural skin's performance has been one of the main concepts that are continuously studied and improved in the last few decades by architects, engineers and material scientists to address the environmental issues that are pressing today. Living skin functions as an active controller of the interchanges happening between the external and the internal environments of biological beings. Skin functions as a weather-protecting membrane that keeps water out, allows water and light in, and modulates the flow of energy. The thermal actions of human skin are an example of skin's mechanisms to control the body's temperature. When the external environment is warm the sweat glands secrete moisture, which evaporates and cools the body's surface. Conversely, when it is cold, the blood vessels in the dermis contract to reduce blood flow and reduce heat loss through the skin, thereby keeping the body warm (Fig. 41 - 44). Skin thus provides the optimum comfort by continuously adjusting itself and is the threshold between outside and inside.

On a performative level, human skin has been perceived as a model for the architectural skin in the way it controls and responds to external environmental conditions. On a basic level, architectural skin controls thermal comfort, ventilation and light conditions. A building's skin can therefore provide a comfortable indoor climate through adjustment of its characteristics, in response to stimuli. For example, when it's overheated it will provide means to shed excess heat; in case of cold, it will increase thermal insulation. A building's skin can be used to fine-tune the local microclimate, as a support to other climate control systems. Perhaps the most important factor here is lighting. Outdoor lighting conditions, especially direct sunlight, affect not only indoor lighting conditions, but also the indoor thermal climate. The human skin, when exposed to direct sunlight darkens to protect the outer layer and the inner tissue from the radiation. This is a slow process and is not reversible in a short period of time. Nevertheless, the general concept is applicable to the skin of a building, where certain elements can adjust and respond to changing lighting conditions. Variability of skin is another concept that can be adopted into the architectural skin. Skin varies in thickness, texture and composition in different parts of the body; and there is also an internal skin and an external one. An architectural skin can also vary in scale, type, materiality, and other characteristics to act as a filtering system. Three examples are particularly instructive here: [1] the James Fitch Model; [2] the Mike Davies Model; and [3] Scott Murray Model.

3.5.1 [1] James Fitch Model

In his diagram of the architectural envelope, published in 1948 in *American Buildings: The Environmental Forces That Shape It*, James Fitch depicted the wall as a selective two-way filter. He envisioned the building envelope as analogous to the skin of the human body in the way it responds to external environmental factors. Fitch described the envelope as a meso-environment, which is an interface between the microenvironment of the body and the microenvironment of the outside world. Because of the continuous fluctuation of all environmental factors across time, the building wall must be visualized not as a simple barrier but rather as a selective, permeable membrane with the capacity to admit, reject and/or filter any of these environmental factors. All building walls have always acted in this fashion, of course. Modern scientific knowledge and technical competence merely make possible much higher, more elegant and precise levels of performance than previously. According to Scott Murray, Fitch's depiction of the building wall as a selective two-way filter remains as a useful analogy, particularly given today's growing concerns about energy efficiency and sustainability.¹

Fig. 61
James Marston Fitch's diagram depicting the building envelope as the primary determinant of human well-being.

1 Murray, Scott. *Contemporary Curtain Wall Architecture*. New York: Princeton Architectural Press, 2009. p. 75

3.5.2 [2] Mike Davies Model

A second pivotal project that uses the concept of layering as a strategy for filtering variant environmental factors in the design of the architectural envelope was conceived in 1981 by Mike Davies. Davis formulated the idea of a Polyvalent Wall, which became the first example of a façade made up of one layer that was able to cater to different functional attributes within a glass element. The polyvalent wall provided sun and heat protection, and regulated the functions of the wall automatically according to current conditions. The wall itself was to generate the necessary energy. Herein lies the origin of the term 'Intelligent wall', which was first applied to Davies' concept of a polyvalent wall. His idea, not yet realized, still acts as a driving force for new façade technologies, and many researchers have been engaged in this topic over the last two decades. As Davies notes what is needed is an environmental diode, a progressive thermal and spectral switching device, a dynamic interactive multi-capability processor acting as a building skin.

"The diode is logically based on the remarkable physical properties of glass, but will have to incorporate a greater range of thermal and visual adaptive performance capabilities in one polyvalent product. This environmental diode, a polyvalent wall as the envelope of a building, will remove the distinction between solid and transparent".¹

Fig. 62
Mike Davies, the concept of
polyvalent wall as drawn in 1981.

¹ Mike Davies, A Wall for All Seasons, 1981

3.5.3 [3] Scott Murray Model

In his book *Contemporary Curtain Wall Architecture* Scott Murray notes that Fitch's concept of the architectural envelope as a filter and thus a "third element" – after our skin and the clothing we wear – is still valuable today. Murray offers an adaptation of Fitch's diagram and analysis through a detailed examination of the environmental factors that affect the envelope. He further suggests ways to respond to these factors. Murray categorizes environmental factors as Atmospheric, Luminous, Sonic and Biological and argues that some of these factors are welcomed into the interior space such as summer breeze and daylight while others should be protected against such as summer humidity and precipitation. In Murray's view the curtain wall should therefore act as a selective filter "purposefully controlling the flow of heat, light, air, water and sound, as well as the subsequent impact that these elements exert on the interior space". Murray further argues that because the architectural envelope is the primary interface between the exterior and the interior, there is an increasing expectation that architecture should respond to climatic conditions and it is therefore expected to achieve a higher level of performance¹.

Fig. 63
Scott Murray's adaptation of
James Fitch's model of the
architectural envelope

¹ Murray, Scott. *Contemporary Curtain Wall Architecture*. New York: Princeton Architectural Press, 2009. p. 78

3.5.4 SKIN AS A MULTILAYERED FILTER

Fig. 64
The architectural envelope is a surface of a dual nature. It belongs to both the inside and the outside: a surface that defines a boundary while at the same time joins the interior and the exterior.

Fig. 65
An adaptation of James Marston Fitch's diagram (1948) and Scott Murray's diagram (1984).

Fig. 66
The architectural skin as a selective filter.

Fig. 67
The architectural envelope: a gradient threshold.

" Most of the identity of a dwelling lies in or near its surfaces- in the three or four feet near the walls, floors and ceilings. This is where people keep most of their belongings, this is where special lighting fixtures are, this is where special built-in furniture is placed, this is where the special cozy nooks and corners are that individual family members make their own.."

- Christopher Alexander¹

"A wall is beautiful, not only because of its plastic form, but because of the impressions it may evoke. It speaks of comfort, it speaks of refinement, it speaks of power and of brutality, it is forbidding or it is hospitable, it is mysterious. A wall calls forth emotions."¹

- Le Corbusier

Fig.69
The architectural Envelope as a selective filter

4

ARCHITECTURAL PROPOSAL : AN INHABITABLE SKIN

ARCHITECTURAL PROPOSAL

*"Man is a nucleus of natural forces, living in emotions and dreams, through the medium of physique. Every millimeter of his physical environment is inspiration, not merely mechanical contact."*¹

- Friederik Kiesler

Can the architectural skin become the architectural body itself?

The architectural proposition in this thesis suggests an inhabitable architectural skin. By thickening and layering the architectural skin, the design aims to explore and produce a number of spatial and experiential effects. The design vehicle for this concept follows the program of a dwelling that is situated in the climate zone of the city of Toronto. However, the project does not follow the normative description of a dwelling as consisting in spaces that are permanent and predefined. Rather, this design creates zones of different spatial characteristics, which allow for a certain degree of softness and flexibility in using and experiencing the space. This architectural proposal therefore explores the possibility of a unification of space and skin, surface and structure, by upsetting normative categories and blurring the boundaries between different architectural elements. The architectural space imagined here is contained within layers of enclosures, with no definitive division of space or clear separation. The skin functions as a selective filter and creates zones of varying conditions for the dweller. Thus, typically distinct architectural elements such as facade, roof, wall and interior space are merged into one continuous deep skin, a continuous wrapping from "outside" to "inside".

This interface between the exterior skin and the interior space creates a new type of space that combines structure and architecture into one entity, thereby producing a graduated spatial experience. Through analogy to the complex structure of living skin, composed of multiple, integrated dermal layers with specialized functions, this project suggests an external protective layer and internal layers that are more "capable of responding to internal and external stimuli.

¹ Friedrich Kiesler-Zentrum Wien, Museum für Moderne Kunst (Frankfurt am Main, and Germany). Friedrich Kiesler: endless house. Ostfildern-Ruit, Deutschland: Hatje Cantz, 2003.p. 30.

Can we become connected to the architectural body that surrounds us?
Can we blur the boundaries between the inside and the outside, the skin and the body?

This design proposal is not derived from floor plans, and does not rely on walls to divide the space. Instead, it is based on sectional studies of space and redefines the “walls” as continuous surfaces that flow from one space to another and imply different physiological effects. The stone walls suggest an extension of the earth below, and create a cave-like enclosure. Taking inspiration from Kiesler’s studies of the Endless House and Raymond Abraham’s House Without Rooms, the essential functions of the space are not the traditional room-space that are typically predefined and fixed. Rather, the space is adaptable to different uses depending on the conditions desired by the inhabitant. Another type of enclosure is a thin membrane that is translucent, lightweight and almost floating in the center of the house, allowing daylight while obscuring view. This aims to suggest feelings of intimacy, ambiguity and lightness.

The boundaries imagined in this design are vague and the gradual transition from inside to outside and back again, represents an attempt to heighten the tension between the interior and the exterior, surface and space, skin and body. The outer skin is composed of operable components that both hide and reveal what lies behind. It takes the form of a continuous wrapping that merges the walls, floors, roof, and structure into a continuous body.

Fig. 70
Friedrick Kiesler
The Endless House
1950

Fig. 71
Raimund Abraham
The House Without Rooms,
1974

Fig. 72
Marcos Cruz
Lofting House
2005

Fig. 73
Greg Lynn
Lord's Retail Store
2001

Fig. 74
An early study for the project

Can the architectural skin become the architectural body itself?

Fig.75, 76, 77, 78
Sketch model: Architectural skin layers

Fig. 79, 80, 81, 82
Sketch model: Architectural skin layers

*"Thanks to the house, a great many of our memories are housed, and if the house is a bit elaborate, if it has a cellar and a garret, nooks and corridors, our memories have refuges that are all the more clearly delineated."*¹

- Gaston Bachelard

Habitation: Thick Skin

This project follows the general description of a house, but it does not follow the normative definitions of rooms, nor does it impose functions. Instead, it presents spaces to the user, for her to decide on the activity that will take place therein. This project's defining characteristic is its exaggerated, thick envelope; like the layers of skin it constitutes, and holds together, it is the body of the house.

The house is designed as an enclosure made up of smaller enclosures that are connected in space in uninterrupted continuity; a journey in this house is a "sequence of fixations in space"². This is a project about "walls" as dividers of space and as enclosures; yet, this project has no walls, in the conventional sense. There are no doors to mark points of entry and exit; all boundaries are blurred, all thresholds, gradual. Here, a wall may be a rock, or a series of light rays, or a silence that creates in our imagination a feeling of a separation between one space and another, thus allowing a transfer in our minds from one place to another.

1 Bachelard, Gaston, M. Jolas, and John R. Stilgoe. The Poetics of Space. (1994) p. 8

2 ibid.

Fig. 83
Sectional model: Skin layers

Inside Out: The outer skin

"The enclosure seems to sweep on past the boundaries of the room and of the house itself, encompassing vast reaches beyond"¹

-Friedrich Kiesler

The outer skin is composed of two systems, one is a system of ribs, an exoskeleton, that both protects and supports. It is two sided, and is experienced differently from inside and outside. As a boundary condition, it is unclear: an interface of interaction. The ribs are covered by a series of kinetic shell-like parts. Like the living skin, this outer skin is firm in appearance and therefore evokes a sense of protection.

¹ Friedrich Kiesler-Zentrum Wien, Museum für Moderne Kunst (Frankfurt am Main, and Germany). Friedrich Kiesler: endless house. Ostfildern-Ruit, Deutschland: Hatje Cantz, 2003. p.55.

Fig. 84, 85
Architectural model

A narrow space passes alongside the outer skin. Part of it is inside, protected by the outer skin from the rain, the sun and the snow but welcomes sunlight and breeze. And part of it is outside, floating in the air. It is a space and a threshold. It is a space of movement, and pause. The outer skin veils and reveals the movement beyond it; as bodies move, it reveals the play of shadows, light, and wind created by this movement.

Fig. 86
Inside out: The outer skin

Entrance and passage

" Our contact with the world takes place at the boundary line of self through specialized parts of our enveloping membrane"¹

-Juhani Pallasmaa

The first direct encounter with a space happens upon entry. In this house, there are two entrances, one from the East and one from the West. Similar in their material characteristics, the two are nevertheless distinguished by their very different interactions with daylight. Upon arrival one is welcomed by a delicate enclosure, made up of an array of geometrically shaped components, that function as a whole, like the cells that make up an organ. The surface filters daylight, through the movement of cells which move very slowly; their movement is unnoticeable, yet the light changes.

The effect is that of a friendly creature that is breathing slowly, breathing daylight. The infinite variability of natural light patterns are exaggerated in this space, creating a dappled experience like passing under an arch of thick foliage. This is not an entrance that one can hurry through. As a visitor, you pause for a moment delighted by the flickers of light and the subtle, almost invisible movement that surrounds you, mingling with the sound of the wind. The enclosure and the space within become an extension of your mind and body. You stay.

Fig. 87, 88
Entrance and passage
Architectural model

Of Stone and Air: Verticality, Tension, Transition

"The most essential auditory experience created by architecture is tranquility."¹

-Juhani Pallasmaa

This project is composed of three levels that are essential to achieve verticality and tension in the simplest way. The verticality creates a welcomed tension between the underground and the uppermost space. In order to create memorable experiences of transition the vertical spaces of the house are connected by staircases, each of which has a different character. The staircase at the eastern side of the house is supported by a heavy mass of stone, which connects the entry space to the underground space. There are two other staircases at the far west end of the house. One, leading to the underground space, is carved directly into the earth on which the house is built, an artery between surface and depth. It is squeezed between two heavy walls, narrow and dark.

The third staircase moves upwards from the ground level. It touches a mass of stone on one side and is suspended in the air from the other side. Traveling up the steps, one is tempted to caress the stone; it is cold, rough, and dark. But then, at the top of the staircase the inhabitant loses herself in the shock light suddenly showering down. The uppermost space is bright, calm, and warm. It faces west; a place to watch the sun set. Here, the space is wrapped in a thin, transparent skin, revealing the shadows of another enclosure that lies just beyond.

Fig. 89
Stone and air

Fig. 90
Detail
Architectural model

Fig. 91, 92
Verticality, Tension, Transition
Architectural model

The staircase and the underground space

" an illusion of protection – or just the contrary – [you] tremble behind thick walls"¹

- Gaston Bachelard

A staircase adds a sense of verticality and extension, it creates movement and connection in the spaces of the mind. The first staircase is near the entry space, narrow and steep, yet inviting. It takes you underground, from light to dark, from weightlessness to heaviness. Surrounded by thick walls, cold stone, it leads you underground, where the stone is cold, and the silence is deep. You feel sheltered for a moment. But the silence is intense: "maybe it's not a shelter", you think, and you look for a way out. So you take a few steps in the other direction, and once again are confronted with light: you are outside, and nothing is separating you from the natural world. You are now surrounded by nothing but air...

Fig. 93, 94, 95
Details
Architectural model

Spaces of intimacy : a space for one person

"Heightened experiences of intimacy, home and protection are sensations of the naked skin"¹

- Juhani Pallasmaa

The center of the house is its warmest, the most intimate. The centre is defined by two different types of enclosures. One is raised a few steps above the main level, the second, at ground level, is enclosed by a very thin translucent membrane. The membrane connects and encloses these two spaces vertically, a space on the main level and a space that is carved in the earth below. There is a stark contrast between the roughness, the coldness of the earth and the light translucency of the membrane. An intense and contemplative space, not one to be taken for granted. Here you rest, and meditate.

Fig. 96, 97
Spaces of intimacy
a space for one person
Details: architectural model

DRAWINGS AND MODELS

Fig. 98
Lower level plan

Fig. 99, 100, 101
Skin layers
Sectional Model

Fig. 102
Main level plan

Fig. 103
Upper level plan

Fig. 104
Axonometric sectional studies

Fig. 105
Experiential section
1:100

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EARLY DRAWINGS AND MODELS

Fig. 106
The architectural skin as a multi-layered system

Fig. 107
The architectural skin as a multi-layered system

Fig. 108, 109
Skin layers

Fig. 110
Skin layers as an architectural space

Fig. 111-115
Skin layers as an architectural space

Fig. 116
Skin layers as an architectural space

Fig. 117
Skin layers as an architectural space

Fig. 118, 119
Sectional studies

Fig. 120-122
Floor plan studies

Fig. 123-124
Floor plan studies

Fig. 125-128
Skin layers as an architectural space

Fig. 129-134
Sketch models

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