The Rebirth of a Semi-Disintegrated Enterprise: Towards the Future of Composites in Pre-Synthesized Domestic Dwellings; and the Societal Acceptance of the Anti-In Situ Architectural Movement

Timothy James Keepers

University of South Florida

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The Rebirth of a Semi-Disintegrated Enterprise: Towards the Future of Composites in Pre-Synthesized Domestic Dwellings; and the Societal Acceptance of the Anti-In Situ Architectural Movement

by

Timothy James Keepers

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Architecture
School of Architecture and Community Design
College of The Arts
University of South Florida

Major Professor: Mark Weston, M. Arch.
Rick Rados, B. Arch.
Alex Bothos, M. Arch.

Date of Approval:
March, 25 2010

Keywords: Prefabricated, Prefab, Pre-synthesized, Technology, Modular, Panelized, System, Housing, Residential, Dwelling, Anti-in Situ, Architecture

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Dedications

To the people who have, and will always be there for me.
Rita and Jim Keepers
Catherine Schultz
Acknowledgments

To every professor, I couldn’t have asked for a better school experience. I am greatly honored to have had the opportunity to study and learn underneath such a wide variety of talented individuals. I owe any success to all of the faculty and adjuncts who have influenced me in some way throughout the years, especially:

Mark Weston, Bob MacLeod, Rick Rados, Steve Cook, Mike Calvino, Jin Baek, Alex Bothos, Dan Powers, Stanley Russel and Vikas Metha

To all of my fellow students and design Ta’s throughout the years who have made my studio experience academically advantageous. All of my skills are the result of observing and learning from others. For this I would like to thank:

John Stinson, Daryl Croi, Josue Robles Caraballo, Keuibler Perry, Sobec Sobleslaw, Thao Nguyen, Jason Abrams and Matt Gaboury

R.G Keller, your home in Waukesha was the spark that got me interested in architecture in the first place. Thank you for your house.

To my parents and family; thank you for always being there for me throughout my entire school experience.

Last, to Catherine Schultz: 444 days from when this document is handed in we will be married, and all the editing you did for this paper will seem like it never happened. If not for you, this document would have been a mess.
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The Rebirth of a Semi-Disintegrated Enterprise:

Towards the Future of Composites in Pre-Synthesized Dwellings; and the Societal Acceptance of the Anti-In Situ Architectural Movement

Timothy James Keepers

ABSTRACT

The prefabricated home has been said to be the site of innovation, exploration and sometimes spectacular failure since the mid 20th-century (Home Delivery, 8). Despite years of research and advancements in technology, pre-synthesis in the domestic realm has typically remained loyal to past construction methods/materials and banal aesthetic ripostes. As a result, the modern pre-synthesized home suffers in terms of programmatic diversity, spatial feedback, supertemporal expansion (in reference to the supertemporal art movement) and societal acceptance.

Materials and technologies are constantly upgrading in our increasingly technetronic society. Re-marketing the prefabricated home will require a similar modus operandi. Investigating the successes and failures of other prefabricated products and systems will lead to a better understanding of what the next generation of pre-synthesized housing systems will require. These requirements are then to be cultivated and supported by a theoretical entity, deployableHOMES, which represents an architectural process in a product oriented civilization.

Motivated by the performance capabilities of underutilized materials such as FRP pultrusion and concrete polymer technology, this thesis proposes the formulation of a pre-synthesized component housing system which offers the maximum plasticity of design by allowing for distinctive environmental, spatial and programmatic responses. The system will be used to articulate a series of prototypes to be deployed in different topographical conditions.

The future of prefabrication lies not in a series of ephemeral structures, which adopt non inclusive proprietary construction systems, but with fully integrated systems of interactive components. Components which allow for the reflection of changes in societies perspectives of understood programmatic space and aesthetics of domestic tectonic pragmatism. These changes attempt to inaugurate an anti-in situ architectural movement which no longer imitates individuality or spatially responsive interactive design.
**Etymology of an architectural process**

**deployableHOMES**: The representation of a mock company which encompasses all systems, logos and built intentions.

**dH_Systems**: Refers to all construction systems, components, panels and profiles within the deployableHOMES catalogue. This catalogue is appended throughout the thesis, becoming larger and more complete while periodically eliminating outdated pieces as needed.

**Spēk’tre Series**: Represents a specific series of component systems within deployableHOMES. These systems are conceptualized throughout the thesis, a new one emerging when a specific change, adaptation or ‘a ha’ moment requires one.

**System 1, 2 & 3**: These are the systems acting under the Spēk’tre Series. They are essentially shifts or crescendos through the process of the thesis providing for major improvements in the construction system as a result of a social, programmatic, aesthetic or production change. They are represented by a series of domestic prototypes and are sometimes also referred to as the dH_Systems.
Since the time of antiquity, the act of architecture as a means of exploring and synthesizing both meaningful spatial characteristics and pragmatic construction methods has been recorded as an instrument for reproduction. The first discovery of this type was found on a shipwreck in the Bay of Tunes which was filled with plans for the structural and sculptural components for the construction of classical temples in Rome’s North African colonies (Home Delivery, 10). This became the first step of many throughout the course of architectural history that would attempt to expedite the construction process while maintaining aesthetic concepts within. Early on, both the construction and architectural industries realized the potential advantages such an efficient system would have on the economy. These ideas eventually branched off into a section of construction and design often referred to as prefab, prefabrication, pre-synthesization or pre construction. This type of construction comes in many forms, from military to domestic. Although, to what extent of pre-synthesizing must take place in any particular structure for it to be considered relevant to this topic is and always will be debatable, but one thing is certain - prefabrication has changed the building industry in the past and will continue to do so today.

Prefab, or the characteristics of such, vary depending on their level of dependence on it and how the prefabrication process takes place. The repeated use of prefab can be found as early as the 12th century. Pre construction of wooden elements for temples was a common construction practice in Japan at this time. By the 18th century, homes in Scandinavia, Japan and Russia were utilizing the economics of rapid home construction by prefabricating portions of the home, but, it wasn’t until the late 19th and early 20th century that deliberate attempts were made to commandeer prefabrication as a means of expediting the construction of multiple structures and even creating an aesthetic message through the exploration of architecture as an art form.

Fig: 1. Patent images for a pre-fabricated summer home
In 1833, H. Manning designed and sold the Manning Portable Colonial Cottage. This was in response to the British emigration to Australia in the 1830’s and was by all modern accounts, the first publicized prefabricated house. Although it has been shown that some pre-assembly of structural components had taken place earlier, this was the first home that incorporated ease of transportation and construction by laypersons. The home was delivered as a series of pre-constructed pieces which could be easily connected with bolts. Manning affirmed that his system took into consideration ease of passage saying, “None of the pieces are heavier than a man or boy could easily carried for several miles, it might be taken even to a distance without the aid of any beast of burthen” (Home Delivery, 40). This singular trait was paramount to the success of this system as transportation of materials in Australia was limited to either horse or manual conveyance. By 1858, France began looking to modern materials as a means of repairing the cities old infrastructure as it was going through a restoration process of its Gothic structures. Eugene Viollet-Le-Duc, a French Gothic Revival theorist, suggested the use of cast iron, a relatively new material at that time. He wanted to create a tectonic marriage between new technologies and the old by applying prefabricated structural iron elements into the unsound parts of the buildings. Much like a precursor to the High Tech architectural movement, his drawings recall an outward expression of the beauty of high performance materials through meaningful connections. His spaces attained an unusual lightness
for that time resulting from the structural performance of the iron opposite the Gothic construction methods which used massively thick walls as the load bearing structural elements.

By the turn of the 20th century, architects, theorists and inventors had established different systems for the production of homes using a variety of materials such as timber, concrete, sheet metal and cast iron. All of these systems were intended to be produced and sold, and some were even subject to patent (Home Delivery, 15). This proved that the pre construction of homes through a systematic process of erection could be profitable and was socially acceptable. Architects and engineers, in the early 19th century, began showing an interest in concrete construction but were mostly limited to large structures and not the home. By 1906, Thomas Edison played architect and inventor with his Single Pour Concrete System. The single pour system not only proved that homes could be made of concrete, but could be done so in a single pour. Columns, cornices, lentil details, bathtubs and even an optional piano could be included in the single pour which used patented form work and concrete dispersion methods. However, the successful system was not without problems. As with many architects today, Edison struggled to fully understand all of the processes need for such a system to work. A major unforeseen failure of his system was the premature cracking throughout the building as it settled, due to the impossible task of creating such a large homogeneous mixture of concrete at once. Despite some frustrations the success
of the system came not just from its efficiency of production, or even strength against the elements, but its ability to resemble typical wooden homes of that same style and time period.

In 1908, a new company entered the marketplace and used prefabrication as a means of mass producing homes at a far greater rate and scale than ever before. From 1908 to 1940, Sears & Roebuck, of Chicago, sold their famous Mail-Order Kit Houses all over the U.S. Throughout the years; they sold and constructed 100,000 homes with 447 different styles for customers to choose from (Home Delivery). Although the company’s designs were not particularly innovative or original, they were the first to produce a series of easily reproducible factory made parts, trusses, posts, beams and offer multiple floor plans to the consumer. One major advantage of Sears & Roebuck was their ability to offer home buyers a wide variety of exterior trims, upgradable appliances, countertops, cabinet finishes and even drawer handles. This was very convenient during a time when the car was still quite expensive and America’s infrastructure was still growing. It was difficult for the average consumer to go to the store to choose interior options and transport their purchases home, so Sears brought it to them. It wasn’t until the white flight post WWII that malls and big box retail stores popularized the DIY mentality of the home owner. Today, the average home buyer enjoys choosing from a multitude of design options and upgrades to purchase for their home. Although the Sears & Roebucks’ style of semi-limited purchasing power was effective at the time, it proved to
be fatal for them in the late 1940’s.

Shortly before Sears & Roebuck began marketing their first home Henry Ford revealed his first assembly line. As a result, prefabrication began to turn away from creating doppelganger dwellings and began pushing for the integration of industry and artistic expression through architectural space. In 1909, Walter Gropius began researching the opportunities of industrialized housing for both single and multiple families. This quickly resulted in an alliance between himself and the German General Electrical Company to create the General House Building Corporation. The underlying goal was to create a system, or series of systems, that would finally create a bond between art and industry, architecture and machine. This became the basis of Gropius’ exploration for years to come, as well as the founding principles of the Bauhaus. Five years later, Le Corbusier continued the same exploration into what would ultimately become the Modernist architectural movement and introduced his Maison Dom-ino. This was a basic building type developed for mass production and was the keystone of his five points of architecture. Le Corbusier created a company which explored this idea of structure, but by 1920, his Societe d’entreprises industrielles et d’etudes (SEIE), had gone bankrupt. Through the writings and theories of Le Corbusier the early 1900’s would be a dramatic turning point for the pre-synthesis of dwellings. The idea of melding architecture as a high art dealing with space, function, environmental perception and ultimately industry would bring about the modernist ideas taught and performed at the Bauhaus. Two years after the beginning of WWII, the Bauhaus or Staatliches Bauhaus (building school) opened its doors.

The Bauhaus was a German avant-garde school of the arts lead by Walter Gropius. The school raised the question, “If a factory product has made such a revolution both in the production of once hand crafted objects…as well as in modern mobility….then why is the culture of building so resistant to transformation?” (Home Delivery, 13). At this time Gropius grounded his ideology for a better world through the continuation of his exploration for a combined, factory produced, clean and systematic building and design system.

“Human housing is a matter of mass demand. Just as it no longer occurs to 90 percent of the population to have shoes made to measure but rather buy ready-made prod-
ucts that satisfy most individual requirements thanks to refined manufacturing methods, in the future the individual will be able to order from the warehouse the housing that is right for him. It is possible that present-day technology would already be capable of this, but the present-day building industry is still almost completely dependent on traditional crafts and construction methods” (Walter Gropius, “Wohnhaus-Industrie,”).

Le Corbusier further joined Gropius’ quest for modernism in two of his papers. One example appears in his 1923, paper, “Toward an Architecture,” where he rationalizes the design process with techniques of customized assembly. By relating the assembly line to the production of homes, he believed that they could successfully respond to the housing crises. In 1927, he wrote a pamphlet called “Pour batir: standardiser et tayloriser” which “articulated the tension between freedom and order, which he thought could be mediated by architecture as an art and as a system of industrialized building” (Page 17, Home Delivery). Also shown was an example of his factory produced housing system.

In 1941, the American government began recognizing the benefits of industrialized construction and requested a series of prototypes for defense housing. The George A. Fuller Company won the contract with the Quonset hut. Born of necessity during WWII, the Quonset hut was a strictly performance-based design with re-
quirements of rapid assembly, ease of deployment and low cost. George Fuller realized that prefabrication was the best solution for the requirements and modeled the aesthetic from the WWI British Niissen hut. Constructed of conventional materials like corrugated steel sheet and preassemble plywood faces, the Quonset hut became a visual icon through its shape and successful use of materials and prefabrication during the war effort.

In 1942, Walter Gropius joined Konrad Wachsmann to make their modernist philosophies come to fruition with the Packaged House for the General Panel Corporation. This was yet another opportunity to explore the realm of industry and design for Gropius, but this time with the intention of rapid deployment and production in response to the U.S housing shortage. The design utilized a panelized housing system that focused on adaptability of program and design. The system found efficiency of construction and design through a single connection. The Packaged House was one of the first to use a completely panelized structural system and still allow freedom of design to a certain extent. Although praised among the architectural community, like the panelized Lustron home of 1947, certain oversimplifications would lead to the financial failure of the General Panel Corporation 10 years later. As Lustron Homes simplified by utilizing only one singular building material, the Packaged House found problems with the use of a singular X-wedge connection used for the whole system. This eventually proved problematic to the soundness of the structure and ultimately became too limiting.
From 1941 to 1967, Buckminster Fuller’s designs took their place in architectural history. From his Dymaxion car to his geodesic dome at Toronto’s Expo 67, Fuller had a niche for designing with the latest materials and techniques. 1941 to 45 was the height of production and design for his Dymaxion systems. The Dymaxion Deployment Unit (competition with the Quonset Hut) and the Dymaxion Aribarric were prototypes for the U.S. Military, but his most famous was the Dymaxion Dwelling machine better known as the Wichita house. Buckminster Fuller saw the future of the American home in prefabrication and eventually became a pioneer in the industry. He had a passion for creating a completely prefabricated house out of the most technologically advanced materials at that time (Neder). He was also very interested in reinterpreting how the middle class family lived. Obsessed with technology and the invention of the new modern man and home, he believed that his designs could become a utopian solution for the modern family. In 1945, he began a partnership with California-based Beech Aircraft Co. to mass-produce his Dymaxion home as a product (Neder). The Dymaxion design, although quite interesting, was not well accepted by the public. In the beginning, 50,000 homes were ready to be ordered, but eventually a lack of funding, bad advertisement and Fuller’s growing interest in other projects lead to only three homes ever being constructed.

As WWII ended, the “growing demand for single-family homes and the widespread ownership of cars led many Americans
to migrate from central cities to suburbs" (Using Internet & Query Approach of customizing Prefabricated Houses, 11). It was at this time that Levitt and Sons In. began servicing the growing need for single family homes with both their New York and Pittsburg Levittowns. By the end of 1948, they were completing 150 homes per week. As the demand for homes grew so did the number of housing systems that tried to cash in. In 1946, Carl G. Strandlund founded the Lustron Corporation Inc. It quickly became the poster child for prefabrication failure. Lustron was a response to both the current success of Pennsylvania and New York’s Levittown and the capitalistic opportunities of the current subsidized government housing program. Having sealed a 40 million dollar grant from the government Lustron Homes attempted to duplicate the design and spatial conditions that were characteristic of every post WWII dwelling as a way to ensure that they too would find the same financial success as others had. A number of things eventually went wrong, starting with Strandlund’s inability to synthesize ideas, production capabilities, material cost, aesthetic and environmental responses and the eventual societal acceptance of such a product. The homes were designed with considerable interior and exterior limitations. First, the walls incorporated all the shelving which suggested that Lustron had already taken the first step deciding how one decorated their interior. The exterior came with the same proprietary enamel coated steel giving it the public reputation of being of a “bathtub” or a “hotdog stand” house. Eventually the public showed that no one
Fig: 17. Lustron home, Westchester two bedroom

Fig: 18. Pieces to a Lustron Westchester laid out

Fig: 19. Panel machine at Lustron Inc.
wanted a house which offered a total of three similar floor plans made completely of steel. The industrialization and production methods of such a house were also a fault in question. Until the production of the first prototype, it wasn’t realized how elaborate and expensive the machinery had to be, as well as the knowledge it took to rapidly erect a homemade of some 3,000 pieces. Lustron declared bankruptcy in 1950 after making only 2,500 of the 25,000 that were slated for construction. The blame was placed on the increasing cost of producing each house as a result of the problems that were arising on the production side.

1949 saw yet another advancement in prefabrication, but this time pertaining to design. The Case Study House No.8, or Eames house, is located in a semi-wooded area of the Pacific Palisades in Los Angeles California. The Eames house proved to be a beacon of success to both architectural designers and the prefab movement alike. This was achieved by its ability be structurally manipulated, while retaining its visually contemporary aesthetic that the final product echoed. The house became a critical step for prefabrication, as it further pushed the boundaries of domestic industrial design to become an individual piece of architecture, free from factory made constraints of homogeneous design, and at the same time utilized the allure of pre-sized components to efficiently create structural beauty. The house was one of 25 case study homes built between 1945 and 1966 as part of an exploration of American residential architecture for the Arts and Architecture magazine. They homes were
a direct response to the mass of developer produced homes during the post-WWII government subsidized housing scramble. Aside from its De-stijl like pallet of colors, interesting exterior aesthetic and interior spatial qualities, the Eames house is best known for its use of all off the shelf parts obtained from a standard steel manufactures catalogue. Prior to construction the design, done in part with Eero Saarinen, (creator of the TWA terminal in Los Angeles), was to project off a small ledge in the back of the site and cantilever forward. Once the pieces were delivered, Eames and his wife decided to turn the structure 90-degrees and nestle it next to the ledge. This required the complete redesign of the home using the same parts. The design seen today is a testament to the flexibility of a housing system that uses purely industrial components, and still has the ability to become both a beautiful and individual piece of architecture.

As the housing boom slowed around 1956 prefabrication shifted slowly from solutions for quickly made, cheap homes for housing shortages, to high design solutions for the masses. Experiments in new technologies and the utilization of current ones through new means became the focus of prefabrication from the mid to late 20th century. A pioneering example is the Monsanto House of the Future, erected at Disneyland in 1957. This was the first time that plastics, a newly developed material, were utilized as a modern construction material which exhibited its ability to express new characteristics through its molding capabilities. This home, and others of the same material that followed, utilized the composite plastics abil-
ity to create a single-shell, or monocoque, structural outer skin. This was previously unattainable in the building industry as there was no singular material that could successfully serve as the roof, wall and floor all in one fluid piece. The plastic structure was shown flexing its arm of strength in the dismantling process, “The house was so indestructible that the crew gave up and left some of the support pilings in place, they can still be seen in Neptune’s Grotto between the Tomorrowland entrance and Fantasyland” (Icon: Disney’s Monsanto House of the Future). Supposedly, the planned one-day demolition ended up taking two weeks as the wrecking ball just bounced off the exterior. Workers cut the house into pieces with hacksaws” (Icon: Disney’s Monsanto House of the Future).

The Futuro Home by Matti Surronen, built later in 1965, like its predecessor, came to fruition by utilizing similar structural materials. The vacation home was constructed with a series of singular panels made of a composite plastic to be connected in a factory or on site. The client wanted the home to be strong and easily transported. The strength to weight ratio of such a material made it perfect for this task. As the name would have it, the home resembled more of a Buckminster Fuller Wichita home from space, if that is possible, with an entry that is reminiscent of the space ship from the movie Flight of the Navigator. The design proved to be popular enough that it eventually became an art icon. Surronen later produced a number of domestic variations utilizing the same technology, such as the Venturo home of 1971, which was visually a little softer on the eyes.
By the mid 20th century, prefabrication was being utilized all over the world and was slowly becoming more popular with larger scale projects and facilities. In 1959, a group of Japanese architects, called Team X, brought prefabrication to large scale housing design through their Metabolist movement. These architects concerned themselves with the use of plug-in spaces that were wholly contained. In this sense, prefabrication became a tool to create a series of contained structures which could be exchanged for another of its equal. The movement began as a technocratic response to the cultural resurgence and population growth that followed WWII in Japan. It was believed that perceptions of home, and the tall structures that were containing them, must be challenged so as to allow for complete adaptability, or metabolic growth. The movement gained praise for their Takara Beautilion at the Osaka World Expo’70, which was comprised of a prefabricated tubular steel framework. Once connected the room blocks could be plugged in and added to as need be. The whole structure, windows and all only took six days to complete. Today, the most famous and remaining works are the Japanese Nakagin Capsule Tower by Kisho Kurokawa, which is able to last 200 years if the capsules are replaced every 25 years, and Moshe Safdie’s Habitat 67 residential complex built for Montreal’s Expo’ 67’s. Although only a hand full Metabolist works still stand, their design philosophies and aesthetic qualities are still used and explored today. One prime example is Horden Cherry Lee Architects Micro Compact Home tree village. Although the idea of
Fig: 27. Nakagin Tower and elevations

Fig: 28. Nakagin Tower plan

Fig: 29. Micro Compact Home tree village

Fig: 30. Micro Compact Home unit in transit
a structure that has the ability to shed, add new or combine units sounds successful, many times the units were very sterile or ridged. Their program must typically conform to a simple and programmatically unfruitful floor plan to keep unit homogeneity. This is the case for the Nagakin Tower, as it’s 142 owners have slated it for demolition soon.

The late 20th century saw the new face of modernism with a group of British architects fronting the 1970’s High Tech architectural movement. Deeply interested in the factory-produced, modernist pedagogy of the Bauhaus, the High Tech Movement focused on simplistic, uncomplicated Mesien like plans which tirelessly combined factory produced standardized, interchangeable parts with a proclivity to expose or glorify the systems on the exterior. In this case, aesthetics came from the tectonic expression of the structural pieces through a series of primarily exposed bolted, welded or hooked moment connections. The focus of the buildings was the structure itself as the interior typically disregarded any type of specific program in order to keep an open plan which was considered far superior in its ability to adapt. A common interest among the leaders of this movement, (Richard Rogers, Renzo Piano, Norman Foster and Michael Hopkins) was the design and technological philosophies of Bukminster Fullers Dymaxion principles and the 1960’s “space-age” architectural think tank Archigram. High Tech architects were interested in a plug-n-play type of pseudo mass kinetic architecture and the interchangeability of the Metabolist
movement. Common themes often reappear in the few examples of High Tech structures such as the exposure of massive heating and cooling ducts, somewhat reminiscent of Frank Lloyd Wright's Larkin Company Administration Building, freestanding towers or space frames acting as structural exoskeletons and cables in high tension all leading to multiple predetermined positions precisely and pragmatically calculated to carry the desired load. All of these, literally, outward expressions of structural systems emanated from the grander concept, the efficiency of structure and construction through prefabricated components. Nearly all of the supporting projects, with the exception of the steel gerberettes on Richard Rogers Centre Pompidou, utilize either off the shelf type connections or factory produced hybrids to create an aesthetic expression of construction that, ideally, would be interchangeable. A project, built years earlier, portrayed beginning theories of the High Tech movement but in dwelling form. The Keck crystal house was built for the 1933 Century of Progress exposition at Chicago’s Fair. Keck speaks of the importance of the open plan as well as prefabrication through standardized parts made of enduring material as the future, and savior, of the modern mass produced home.

Paul Rudolf's creation of the, 1971 Oriental Masonic Gardens in New haven Connecticut became yet another artistic solution for creating an architecturally unique structure. Utilizing a 1950’s American Icon, made famous years earlier by Wally Bram’s 1935 aluminum shell Airstream Clipper trailer, Rudolf said the mobile
home was the “brick of the twentieth century” (Home Delivery, 154). The mobile, or trailer home, has always been an itch on the back of the preverbal architectural community. Previously, the mobile home had proven to be a success as it was easily produced in a factory, made to fit directly on a truck and once delivered could be inhabited in a matter of days. It was based purely on efficiency of production and fully utilized the industrial side of construction, but, completely neglected any formalistic qualities of design or program. In this case Rudolf embraced the iconic structures, almost in a sort of satirical pop art fashion, and designed a volumetric high density community by literally stacking and assembling individual trailer homes side by side. Heralding things to come, like the prominent use of shipping containers in modern day dwellings, I.E Adam Kalkins 12 container house, the Oriental Masonic Gardens proved that certain pre-synthesized housing types themselves could become components, in their own right, and become a piece of a large infrastructure. Using each unit as a building block, a pinwheel formation was conceived allowing for individual entry into each unit and semi private back/
court yards between. The connection method of each unit allowed the whole community to be able to be disassemble and move to another site if need be.

As the 20th century drew to a close and the new century loomed on the horizon, new technologies for the production and manipulation of existing materials allowed designers to go directly from the drawing board, to reality with great precision. Inventions such as the CNC (computer numerical controlled) routers, plasma cutters, water jets and laser cutters began to revolutionize the design industry. Although some of these machines, such as the CNC router, have been available since 1910, it wasn’t until the late 20th and early 21st centuries that a major resurgence in the incorporation of these machines with both the production of large and small structures alike began again (The Father of the Second Industrial Revolution). In a way, these machines sparked a second industrial revolution. The long awaited synthesization of computer and machine, man and precision, and most importantly, design and intention is slowly become a reality and will lend itself quite nicely to the production of the product home.
Case Studies

Matti Surronen: Futuro home

Resembling something out of a 1940 "Space Invaders" film, the Futuro home has gone from a recreational ski cabin to a world renowned art icon. The Futuro home was built as a commission for Dr. Jaakko Hliienkai in 1965, and was intended to be a vacation home which needed to be “quick to heat and easy to construct in rough terrain.”(Futuro House-Home of he future). After some deliberation, the architect, Matti Suuronen, realized that traditional methods and materials would not be able to stand up to the rigors of the environment that were implicated in this particular project. As a result, this cabin became a prime example of the structural longevity and spatial manipulation of a composite home. The ship could accommodate eight people comfortably, and like Buckminster Fuller’s Wichita home, it showed a considerable amount of effort went into making the most of the internal space.

Almost everything came designed into the home itself,
making it one of the few successful pre-fab homes that reinterpreted the traditional floor plan for an un-traditionally designed home. The final materials consisted of a series of prefabricated panels made of fiberglass reinforced polyester plastic that were then bolted together. The structure takes the shape of an ellipsoid, which was intended to give a 360 degree display of the exterior environment, stressing the importance of the horizon as major design element. Through the unconventional use of a common material in other industries, the Futuro home proved to be a light weight, easily transportable, structurally efficient programmaticaly inventive dwelling.

About 96 Futuro homes were built worldwide. Although the number is not known as to how many of these homes have survived, at least 50 are known to still be in use. As a result of the fully composite construction, the 35-year old homes have proven to gracefully withstand the test of time. As one could predict, the failure of the home was in part due to its cosmetic aesthetic. Although people had difficulty accepting the idea of living in a “space age” home, the Futuro proved to be an ingenious combination of architectural iconography, structural research and programmatic creativity.

This domestic creation resembles the effective use of high performance products in architecture and the construction industry. The success of the home was in part due to its ability to be created cheaply, easily and precisely. Although the components that make

Fig: 40. Futuro home, trailer transportation: http://www.eichlernetwork.com/images/front/futuro_3.jpg

Fig: 41. Futuro home model presenting the floor plan: http://www.futurohouse.com/369.jpg
the Futuro can only create this one single design, it none the less exemplifies the importance that all aspects of an architectural product be accounted for. Although lacking in its ability to create multiple shapes responsive to both site and consumer, the Futuro home properly combines industry and design into one entity.
Peter Eisneman: House VI

House VI is perhaps one of the better examples of how architecture, at its core, should be the fundamental synthesis of artistic expression, structural competence and client comprehension. House VI is an example of a residence that ultimately ignores two of these aspects but fully succeeds at the other. Peter Eisenman completed House VI in 1975. This home, built for Richard and Suzanne Frank, in Cornwall Connecticut, became a source of both pride and frustration for the couple. The extremes of both lead Suzanne Frank, to write “House VI, The Clients Response,” a catalogue of memories recalling the home as formalistically beautiful yet distressing to reside in.” (Clients Response,10). For Peter Eisenman, this was one of his earliest built works, and as a result, the major structural and attributing building failures were tied directly to his incomplete and incorrect specifications. Strangely enough, Eisenman eventually admitted that his process of designing...
this home required him to ignore construction materials, techniques and program. For Eisenman, House VI became an “aesthetic and theoretical manifestation of his post-factualism ideology.” (Client's Response, 15) The home was a direct expression of Eisenman's design process; the structure and program were simply an afterthought to the systematic manipulation of his grid (Clients Response, 30). Ultimately, the home itself was no more than a jewel of high architectural design nestled in its wooded site with the intention of being marveled at, not lived in.

Among many unfortunate program faux pas, the home boasted windows that looked out to blank walls, columns that didn’t touch the ground, columns placed in the middle of the dining room and a master bed room with a glass strip that permitted the use of anything larger than two twin beds. The clients recalled that in the beginning of the design process, they even had to fight for bathrooms (Clients Response 16). The lack of structural integrity would become apparent only 12 years after the home was constructed. In
order to keep every room in the home from leaking, and ultimately collapsing, the Franks embarked on a massive refurbishing project which proved to be nothing more than a financial disaster.

This particular structure was chosen as a case study for its opposite attributes to those of the Futuro home. These case studies were both chosen for their two different extremes on the spectrum of prefabrication and design. While the Futuro home is easily prefabricated it is extremely unforgiving to the option of design change, while House VI is the manifestation of a completely original structure which in no way could be mass produced. The idea was that studying the design and construction ideologies, as well as the haptic and phenomenological aspects of both, would lead to an understanding of a middle option. Both have great positives and great negatives which make them what they are. As a thesis that is concerned with both the manipulation of design ideologies as well as ease of construction both case studies shed light on what direction prefabrication in domestic architecture needs to go.
Fig: 50. House VI design process and architectural graphics
Empiricism & Speculation: Determining the need to change

**In-Situ: The inadequacy of current construction**

The need for a factory-controlled system that portrays the functional integration of material production and design is obvious, and has been throughout the history of domestic construction. Tragically, today’s homes are typically constructed in-situ (on site), and utilize exhausted methods and materials of construction. The lack of material economy in site-built homes can be seen as far back as the 1600’s, when settlers constructed wood structures out of the once common Heart Pine wood. These trees, stronger and harder than today’s common pines, were completely exhausted by the early 1900’s, and still today have not recovered to numbers that allow them to be used again (Wood Web).

Currently, the in-situ home typically takes 6-12 months to construct, and results in a considerable amount of material waste and major site clean up post completion. The traditional home is constructed in a stick and batt form consisting of wood 2x4’s and fiberglass batt insulation. This type of construction has been the result of billions of dollars a year spent on the unnecessarily early renovation of homes (Characteristics of New Housing). Contractors often use this method of construction as it is quick, least expensive and offers the maximum financial return. With all of the new technology available, from construction systems to material production, it’s hard to understand why most of the 1.5 million homes built each year are designed in the traditional stick a batt form (Characteristics of New Housing).

A home constructed entirely of wood is extremely susceptible to mold and other early environmental and structural problems, due to its completely organic nature. Likewise, typical fiberglass batting gathers mold easily under any damp condition. Mold from both wood and insulation poses a very serious health risk, and “it is estimated that over 500,000 people die yearly as a result of mold related illnesses” (AIAH). There are more than four man in types of mold that can occur on any surface, such as a window header or sill, wooden 2x4’s, the backside of drywall and batt insulation. Mold can cause any one of 25 known toxins that are destructive to a person’s health (Biosign).

Aside from its susceptibility to mold, typical fiberglass batting is also quite misleading as to how it achieves its R Value. Performance testing for this type of material is done in an enclosed box heated to 70°F, with no air movement (R-19 fiberglass). This environment is unrealistic and often produces R values higher than how they actually perform in a home. At the Oak Ridge National Laboratory, in Oak Ridge, Tenn., R-19 fiberglass batting tested at a true R-10.3 in a test home over the course of a month (R-19 fiberglass).
Low performance materials and construction techniques typically result in the renovation of homes at an expedited rate. This is problematic to the majority of Americans who fall into the low to middle income range, as for these individuals home renovation is not always an option due to the expense of such a project. A variety of the problems that these homes face is highlighted in a study conducted by The University of Central Florida in October 2003 (Tracy, 2003). Of 406 homes studied, 386 of the homes sustained serious defects, including faulty foundations, dangerous moisture intrusion and inadequate framing (Tracy, 2003). These findings also portray the absence of quality control and overall lack of attentive craftsmen in the construction industry. People have the right to purchase a structure that will last more than 15 years without major maintenance, let alone be environmentally and aesthetically pleasing. Homes today should be able to reflect the owner’s culture and needs while sustaining spatial, tectonic and site responsive explorations of the designer.

The housing industry as we know it is being annexed by the many speculative land developers who apparently want nothing more than to construct the cheapest homes possible. As a result, the vast majority of homes built today greatly resemble each other. Additionally, prospective home buyers are offered a very limited number of floor plans, which are in no way responsive to the site and environmental or visual landscape. The transition the controlled prefabrication of modern dwellings has the ability to reverse the current deficiencies of the housing industry leaving room for inventive...
Prefab: The material and aesthetic reoccurrence

Paul Rudolph once said, “The manufactured house is the brick of the twenty-first century” (Massive change 2004, 33). Today, this brick is anything but an efficiently produced spatially and aesthetically redundant manifestation, which utilizes all too common materials and systems of construction. It seems that promises of a modern product home have become evident only in singular exhibitions of what we know as the concept home. Much like the concept cars shown yearly at auto shows by Cadillac, Mercedes, Ford, Lexus and others, these one of a kind homes never make it past the showroom or the first owner. As many of today’s modern prefabricated companies have the good intention of producing on a large scale, their homes for the most part are usually constructed only once. Typically, constructed for wealthy clients or architectural exhibits, the structures and pragmatic systems that produced them find their end prematurely.
Although there are many types and forms of pre-construction, or pre-modification in today's product-oriented industries, pre-fabricated housing, or prefab, specifically refers to "any construction method where a significant part of the construction takes place off-site in a factory" (Swierk 2005,5). Currently, prefab can be broken down into three main categories: fully modular, sectional, and component. The Metabolist architectural movement popularized the fully modular typology with Habitat 67 and the Nakagin Capsule Tower. This type of prefab system constructs the home, or space, as a series of fully pre-constructed pods, which are then shipped to the site and connected through a common means. The result of this type of design typically makes the individualized spaces small and confined to a limited number of programmatic options.

Sectional prefab refers to dwellings such as Ray Kapps' Living Home and the designs by M.a Architectures Hive Modular series. This requires sections, or large chunks of the home to be completed in a factory and then shipped to the site and connected. A drawback would be an unforeseen connection or site issue that would discourage the sections from coming together properly. It's usually too expensive to ship an entire section back to the factory and therefore expensive on-site fixes can accrue. The fixes can in turn jeopardize the efficiency of the system as a whole, as this efficiency was previously acquired from controlled conditions at the factory. Likewise, this type of system, on average, has utilized traditional construction methods and materials but uses them in a factory.
type production process.

Lastly, a component structure typically refers to any home that is constructed of multiple pieces and connected on-site like Legos. Anything made predominately of a panelized system is a good example of this type of system. Two modern examples are the BlueSky Mod by Richard Stark, and the Loblolly House by Kieran Timberlake. This method also has some positives and negatives. On one hand, this is the only system that can fix an incorrectly sized component of the system quickly as it only requires the re-cutting and shipping of that particular component or panel. Additionally, this system has the ability to be utilized in a multiplicity of ways by any designer. A component system also has the ability to completely resize certain portions of the structure by purchasing larger panels. This notion is unattainable by sectional and fully modular, as these types of decisions would have been previously made and constructed in the factory. Also, the previous two types of construction typically use proprietary connection methods and frameworks, and therefore are both useless and typically unavailable for purchase by other designers and architects. On the other hand, a panelized system, sometimes referred to as “flatpak” (made famous by IKEA), requires on-site assembly, and therefore may take five to thirty days to construct, instead of the typical 15 hours to seven day assembly, as with the fully modular and sectional.

Although each has their own unique economies of production and promises of design flexibility, each type of prefabrication
typically uses the same common materials as any other dwelling. A great majority of prefabrication today must conform to the typically orthogonal ideologies of the grid as a result of the machines that produce them. An effect of this is prefabrication looking somewhat common, with the exception of exterior cladding.

One of the most recent examples of this is the Loblolly House by Kieran and James Timberlake. The system does an exceptional job at producing each piece beforehand. From the floor cassettes to the Bosh aluminum extrusions, this home serves as a jewel amidst a sea of contemptible dwellings. The problem is the system's lack of site responsiveness and programmatic creativity. Sure, there are folding windows in the front and the views are pleasing, but the programmatic qualities are somewhat typical and lacking in drama. The Bosh system, which makes up the structural skeleton, although light and strong, can only meet at right angles. This greatly limits its response to views, shifts in plan according to light or wind, and most importantly, from creating individual social and cultural responses for both the client and future of the home.

Adding to this issue is the fact that the floor cassettes are made of standard particleboard and wood joists. With time, weather will break down this organic material and begin to cause problems, making it no less susceptible to failures than another wood home. Timberlake used a variety of illustrations in an attempt to show how the system that makes up the Loblolly House can create multiple configurations of modernistic prefab dwellings. As one can see,
there is a redundant almost banal aesthetic, somewhat reminiscent of the international style public housing during Germany’s Weimar Republic.

Today, there are about “17 prefab companies that produce modernist prefab dwellings which are available for purchase in North America, and are actively marketed by a vendor and have had a prototype of a finished example of the dwelling constructed” (fabprefab). Despite this progress, these companies have failed to make even a dent on the housing industry. In 2006, 96 percent of the 1,654,000 single-family homes completed in the US were built in-situ (Characteristics of New Housing). This means that only 2 percent of America’s single family homes were not built on site (Characteristics of New Housing). Two of the main deterrents of the modern prefab company are said to be a lack of “balance between mass customization and mass production,” as well as the public’s mental association to the mobile home and its stereotypical low-class, shotgun toting tenants (Huang, 28).

In conclusion, prefabrication today has either become a series of small family getaways, which in no way properly respond to site or foundation, or large aesthetically redundant modern homes.
that are either too expensive for the masses, or materialistically too common to extend beyond the grasp of what is typical. Today, prefabrication must be seen as an experimental breeding ground for new materials and spatial concepts.

As Frank Lloyd Wright commented on how certain materials by their very nature must be used in certain ways, prefabrication needs to be seen and treated as a unique type of architecture altogether. An architecture that is wanting, striving and needing to express its own aesthetic and tectonic responses. Reflecting what it means to utilize new materials and methods of construction while representing new spatial concepts in regards to the next generation of artists, architects, business people, copywriters, professors, fishmongers and everything in between. The opportunity for a major shift is being missed by today’s common modern prefabricators, a return to the tectonic as a means of architectural and programmatic resolution must be exercised.

"Form and function thus become one in design and execution if the nature of materials and method and purpose are all in unison." — Frank Lloyd Wright, An Autobiography, 1932. Revised, 1943. New York: Duell, Sloan and Pearce. Copyright by the Frank Lloyd Wright Foundation
The Platform: Articulating an alternative

Challenging The Social Dynamic Of The Dwelling: Analyzing materials and the aberrant aesthetic

Challenging the current trend of domestic prefabrication requires a reflection of past and present changes in both the architectural and construction industries that have brought about shifts in the aesthetics of internal program and external spatial dynamics. New spatial concepts arise from new technologies and upgraded production capabilities. Additionally, these advancements have continuously left architects and designers questioning and challenging the idea of domestic normalcy and how spatial concepts can be pushed to either peak efficiency or beyond the socially accepted norms.

The Materials: spatial influence

Throughout history, the advent of new materials and their production processes have greatly influenced dramatic changes in program as well as sectional and spatial qualities. Two major advancements in the long history of design and construction were the improvements of iron, steel, and plate glass. Although iron came before steel and glass was previously present in all structures, both materials improved rapidly through new advancements in their production processes during the industrial revolution. The greatest advancement relating to iron was the Bessemer process, which turned molten raw iron into steel. For glass, the improved machine drawn cylindrical process allowed for large singular glass sheets to be of uniform thickness.

Fig: 66. Bessemer converter, at Kham Island Museum: http://www.banklands.com/images/Kelham2.jpg
Although skeletal frame structures had been sparsely utilized through wooden framing, it wasn’t until the early 1900’s that iron made the skeletal frame a viable and easily reproducible means of construction. Iron, and later its counterpart steel was able to achieve a tectonic expression of pure pragmatism through engineering. Although there was some expression of spatial exploration, early experimentation focused on practical applications of longer spanned structures and bridges. Cast iron’s natural ability to be poured into ornamental formworks was also applied to buildings.

The first iron structure appeared in 1779. The Iron Bridge, “George,” was constructed in Shropshire, England. Although grossly over designed, it visually portrayed a new technical expression of practical engineering which had never been seen before. Only through the advent of iron as a structural material and the exploitation of its skeletal properties could such an object be created. Eugene Viollet-Le-Duc, a French gothic revival theorist, can be referred to as the pioneer of the cast iron integrated space. Through various illustrations Le-Duc explored the possible visual qualities of iron’s lightness and strength. Although none of his illustrations were ever built, some of his aesthetic philosophies can be compared to the structural traits of the Gallery des Machines in France. This structure exemplifies a creative response to engineering, not just as a means of logical responses to structural efficiency but an aesthetic manipulation of the material. This structure, which for a time resided below the Eiffel Tower, seemed to touch the ground lightly. It

Fig: 67. “George”. First iron bridge, Shropshire, England: http://www.akademifantasia.org/wp-content/iron-bridge.jpg

explored the tapering of structural beams as a means of maximizing the efficiency of a seemingly massive structure.

As iron transformed into steel, the process of glass production improved as well. By 1830, glass extended well beyond singular apertures in the side of a building, which allowed designers to fully experiment with the idea of transparency through whole glass facades. The performance capabilities of iron and steel led to tremendous sectional changes in vertical height and horizontal spans, which in turn were complemented by vast rows of floor-to-ceiling glass. New programmatic spaces, as well as the reinterpretation of old ones, became evident as larger and larger structures were constructed in the mind 1900’s. Compare the many small apertures in Westminster Abbey to the glass and steel faced of Paxton’s Crystal Palace of 1851. The Crystal Palace effectively portrayed the new types of space which manifested from glass and steels’ performance capabilities. Through its 300,000 pieces of glass, new tectonic expressions of light and air, materials and structure directly contrast the heavy structural stone walls of the Westminster Abbey, who’s apertures, although plural, are dictated by the remaining mass of the exterior walls.

Domestic architecture eventually took full advantage of the means by which steel and glass could transform both space and program. The idea of voyeurism became deeply rooted in the new domestic steel and glass structures. Spaces became connected to the exterior in a way never possible before, leading to the transfor-
formation of diverse programmatic spaces into a few capricious entities. Possibly one of the most famous precedents is Ludwig Mies van der Rohe’s Farnsworth house. This home has become a well known example of the structural efficiency and spatial consistency that can be achieved by applying steel and glass to the modern dwelling. With their unprecedented ability to integrate light, the combination of steel and glass unintentionally provided a new concern for time. Earlier homes utilized smaller less expansive pieces of translucency but with the integration of more glass larger quantities of light could infiltrate the home throughout the day. This meant that architecture now had the opportunity to reprogram itself to track the sun’s entry/exit through new placements and orientations of spaces within the home. Alex Jordan Junior’s House on the Rock in Spring Green, Wisconsin, is a testament to how steel and glass have revised what is thought to be spatially and structurally possible in the domestic realm. With 3,264 pieces of glass and an unsupported 218 ft steel cantilever, this space extends deep within the idea of the aberrant aesthetic, standing as a monument to the future pursuit of architectural technology.

The Kitchen: spatial experimentations

The kitchen, a space not influenced solely by steel or glass, has seen interesting programmatic changes that reflect societal shifts throughout history. The only space that has evolved solely as
a means of necessity, the kitchen has transformed from an animal skin covered fire pit to a massive Corian furnished extension of the greater living space. Throughout history, the kitchen has been the study of both pragmatic spatial solutions and functionally aesthetic integrations of daily domestic life.

The kitchen became one of the first domestic spaces to deal with the efficiencies of specific daily production of various scales and means. These efficiencies often were concerned with their direct relationships to the human body. Initial domestic and professional kitchens weren’t concerned with size or height relationships to the body, extent of reach or movement radiuses, and therefore created physical problems with people who spend a better part of their day working in them.

It wasn’t until 1850 that the US Department of Agriculture set out to create a set of guidelines that made kitchen users the focus of attention (Kitchen Designs). The study aimed to find a solution to the physical problems that were plaguing kitchen workers as a result of their poor posture throughout the day. The results swiftly found their way into the domestic realm and the new work surface height measurements were quickly incorporated into kitchen designs. These findings sparked an interest in the creation of efficiently designed spaces that were often overlooked in the programmatic structure of home design. Although the heights of works surfaces in the domestic kitchen were improved upon, there were still concerns for its effectiveness in storage capacities and ease of movement.
and transition from one work surface to the next.

In 1926, Austrian architect Margarete Schütte-Lihotzky and architect Ernst May began developing housing programs that dealt with efficiency of movement and dynamic space (Frankfurt Kitchen, 2006). The Frankfurt kitchen was a result of this study and was eventually installed in 10,000 flats in Germany (Frankfurt Kitchen, 2006). The new kitchen was Margarete's response to the overwhelming time that wives spent in this area and how its lack of spatial efficiency was detrimental to one's comfort in the home. Using motion sequences with a tape measure and a stop watch, the Frankfurt Kitchen became the first known example of a standardized working kitchen design, which was based on "optimized kitchen flow, shorter distances, maximum use in smaller spaces and efficiently placed utensil drawers" (Frankfurt Kitchen, 2006).

Although the Frankfurt kitchen's trademark characteristics were criticized for having an emancipatory design, due to its small size and reclusive nature, it resembled a significant domestic programmatic shift based on efficiency studies and relationships to exterior program. The kitchen resulted in a sociological change in the setting of the home and its relationship to planed spaces which would never have manifested if it weren't for the concerns of proximity related studies. Adolf Schneck continued Margarete's studies a year later by creating a list of necessary kitchen items in relation to efficiently placed storage spaces (Bishop, Deborah, 2009). The results lead to new standards referring to required storage space for the kitchen. By the 1930's, Frank Lloyd Wright was orienting the kitchen in such a way that it became an integral part of the main living space instead of a private ancillary room (Bishop, Deborah, 2009). This effectively changed the whole notion of program as the combination of kitchen and living room allowed for a free and open plan. Cooking now became a community or family activity, not just a lone spousal task. This shift in spatial connectivity lead to the qualities expected of the today's modern kitchens. The changes Frank Lloyd Wright imparted on the kitchen made it a fundamental component of the greater domestic program, which was no longer se-

cluded from the daily activities of the home.

One of the last major additions to what we now know as the modern kitchen was developed in the 1950’s at Cornell University (Bishop, Deborah, 2009). Through a series of measurements and elapsed time calculations, the work triangle was developed and defined as a “model of the paths between the main work areas of the kitchen described as a triangle between storage, preparation with cleaning and the cooking area” (Bishop, Deborah, 2009). The change, not necessarily relating to spatial adjustments in reference to other domestic programs, informed the refinement of how architects and designers place and orient the kitchen today. As a result, designers had a new space related set of standards to refer to when dealing with kitchen design.

The Domestic Aesthetic: spatial and visual confrontations

Experiments with modern materials and uncommon spatial expressions in the domestic realm are currently being explored everywhere except prefabricated housing. In an interview with Architectural Design magazine, Bart Prince said, “The buildings we build for ourselves should be unlike any done before, since we don’t live as people used to, our resources, technology and lifestyles should be reflected in how we respond to these aspects of our life in the continuous present” (AD 100: Bart Prince). The challenges of daily life are plural, but prefabrication still deals with the singular in reference to the homogeneity of systematic components that engender prototypical responses to space and the aesthetic.

The creation of prefab’s new frontier for living needs to reference designers who purposely push the accepted boundaries of society and understanding of the domestic aesthetic. Although the means of technical and structural connections are important, there are times when the outward expression of surface and materiality on internal spaces outweigh those of the technical and structural. Many architects deserve reference here, but three individuals stand apart from the rest as their expressions of materiality and spatial aesthetics push the boundaries of socially accepted dwellings. Bart Prince, Robert Harvey Oshatz and Wes Jones - although some, or most, of

their designs would not suffice as economically reproducible products, their experimental mindset on what the dwelling is and should be is highly commendable and a good reference or starting point for what dwelling means in the 21st century.

When talking about the future, the 21st century has seemed to let many down. Previous expectations of flying cars, moon colonies and cures for cancer and aids have yet to be seen. A question to be considered, why is a majority of the populous fine with the constant reoccurrence for the banal and historically representative domestic aesthetic? Pressuring previous notions of house and home, Bart Prince and Robert Harvey Oshatz are a few of the only practicing architects exercising Neo-Organicism. On the surface their projects share similar aesthetic responses to environment and tectonic articulation, but most importantly they both challenge the idea of home through expressive forms, which in turn translate to the internal space that they encompass. The large curving gestures or formally intriguing material abstractions do not merely make statements on the exterior alone. Like many “modern” homes today, which experiment with material manipulation as a means of exterior application only, Prince and Oshatz create complete spatial scenarios in which the home creates artistic exterior qualities which are resolved internally through reflections of new programmatic relationships. Every project, through its sculptural notions, portrays new challenges of site, experiential needs and a new form of 21st century architecture.
Wes Jones is a creator of not just architecture, in the sense of built structure, but also the technical reinterpretation of the banal through theoretical and built exhibition pieces. Jones seems to question the technical aspects of daily life through combinations of common materials and human awareness. He has an Inclination to design with shipping containers or standing seam steel facades while integrating a high-tech, yet almost haphazard placement of translucency and electrical devices. Through the portrayal of modern technology, coupled with thoughts of modern expectations of the future, Jones is able to transition from new internal programmatic and materialistic qualities to external devices for everyday work or living. Much like his overly technical illustrations of media display devices and high-tech work desks, Jones’s 92 Chaise chair both articulates and examines what future domestic devices are portrayed to look like. His structures begin to fully challenge current thoughts of domestic life, not only through the use of unconventional materials but the integration of technical and interactive devices throughout. These devices typically reflect or manipulate the use of internal space, thus modifying or completely changing its use. It is important to realize that unlike Prince and Oshatz, Jones typically creates solutions for the modern man through domestic structures that either accommodate many people, or are reproducible singular entities.

The challenges of changing the domestic perception of home, let alone by what means the home is produced, goes much
deeper than day to day relationships to space. Cultures around the world currently live in spaces or conditions that would effectively grant safe passage to Western culture shock. Perhaps some of the best examples that challenge Western ideals of what an approved dwelling should be come from these cultural changes or passages. The Korowai & Kombai — Papua Tree people see it fit to reside in what would appear to be dangerously high, and equally dangerously built, homes in the tall tree canopies. The tree homes are usually constructed anywhere from 20 feet to 164 feet above the ground, depending on levels of tribal conflict (Korowai & Kombai Tribe). Strangely enough, these people are constructing their homes with the crudest of tools and not a crane in sight. Although this notion of home is accepted by these people, most of Western civilization would have a nearly impossible time accepting it, even if it was one day required as a result of some extreme environmental change.

Although the acceptance of such progressive changes in domestic prefabricated architecture is the topic of discussion, the idea of permanence pertains here and must be mentioned as a means of challenging the acceptance of such a change. As was mentioned in an earlier chapter, the pushing of boundaries in prefabrication is typically seen in vacation or secondary type homes. An easy and rational explanation for the acceptance of these designs relates to the idea of permanence, or in this case anti-permanence. There is a major social shift in thoughts or preconceived notions of what is acceptable to live in if it only has to be tolerated for a short period of time, especially within a “vacation” type setting. Typically thought of as sandy beach bungalows, a small cabin on the hill, or a condo in Cancun, the scenario by which these domestic spaces are inhabited are removed from the hustle and bustle of daily life.

One can prove this by referring to Canadian carpenter
Tom Chudleigh’s Free Spirit Spheres. Designed as a vacation getaway, each sphere is 11 feet wide and can sleep up to four people, including a table for eating, bunks for sleeping, a microwave and a sink (Staying in a Sphere). Typically, the lack of accommodations, and space, would not be tolerated everyday, but in a setting that is both non-permanent and offered in an atypical way, this dwelling is accepted by many as a great experience that would be “revisited again” (Staying in a Sphere). Each pod, at first made by hand, is now prefabricated and lifted into the trees where one has to access it by suspended rope bridges. The relationships to the tree houses of the Korowai & Kombai tribe are stunning, yet the spheres are accepted, but only in this type of setting that provides an unusual experience. This example illustrates how the right scenarios and the right people can activate new changes in the social paradigm of the domestic aesthetic. Although not constantly, changes in program that lead to new experiential spaces can often be accepted. The question remains then, for whom, and under what scenario will the acceptance be authentic and lasting?
**dH_deployableHOMES: Defining a change**

In the case of reinventing, or rather, re-marketing the product home, new materials, components and spatial occurrences are to be introduced as an essential component to the solution so a new set of guidelines may be revealed.

DeployableHOMES represents a proposal through which the product home is re-evaluated through the decomposition and reclassification of architectonic components and space. The solution emanates from the exploitation of under utilized, high performance composite building technologies and manipulations of current domestic programmatic experiences. These modifications will reflect observed and experienced social domestic flow as well as past programmatic, spatial and aesthetic changes that have come about after the advent of new performance based materials throughout history. The present teaches us that prefabrication of the modern home, although epitomized to be promising, has missed the bar when it comes to creating new, socially and aesthetically intriguing domestic experiences. The result of this study attempts to

Fig: 84. deployableHomes logo variations, font, letterhead and logo placement
delineate a prefabricated system that makes possible the needed changes for a new generation of product based homes, homes which challenge social expectations and allow for liberties of peripheral material integration and designer-based modifications. These future changes are delineated first, through an executable list of ideas, and second, a written manifesto which attempts to fully circumvent the solutions which deployableHOMES will render its final prototypes.

**deployableHOMES: Execution of ideas**

The anti-in situ architectural movement must...

- **RESIST** the current wasteful and exhausted materials and construction methods of both the site built and the anti in-situ. Resist un-attainable, un-integrable proprietary factory built designs.
- **ENGAGE** new and underutilized materials as a means of re-marketing and re-applying the product home.
- **REVIVE** the anti in-situ architectural movement, provide for the future of the product home. Reinvigorate the distinctions that make prefab what it is and how it performs.
- **DEPLOY** the system through the synthesis of designers and production facilities making a duplicitous effort for the client and consumer alike.

**Toward The Reflective Tectonicism Of The Anti In-Situ Architectural Movement**

This manifesto symbolizes a new guided approach to an environmentally and programmatically reflective design and construction system for the 21st century product home. These steps reflect an anti-in situ architecture which functions in a proxemicly changing environment through following ingredients as a means of motivation.

1) Production systems will provide the means to create within the realm of pre-synthesized design through product experimentation and integrated spatial and environmental responses.
2) The product home is not based on the philosophy that a good design system must ultimately create a copy of typical archaic or current styles of domestic architecture.
3) The system of production needs to respond to the economics of construction and social diversity through its efficiency
of manipulation and structural flexibility.

4) The creation of new tectonic expressions and aesthetic responses in relation to material technology is necessary.

5) The system, in all of its main parts, will reflect a formless assembly of design tools. Formless in the sense that each design piece can be integrated with another to create a structural form based on the designers aesthetic intentions and understanding of the systems capabilities. The pieces should not have a predetermined form like articulated shells or boxes. Such examples would be preformed domes, rectilinear platforms or parabolic structural shapes that must be clicked together to create a strict and repetitive design based on the one or two spatial forms.

6) The system should be, in part, based on cretin design philosophies which in turn reflect the characteristics or capabilities of the components.

7) It is important to utilize the blurring of inside and out. As a result the system should include and allow for transformable spaces which can accommodate, to varying degrees, the inclusion of portions of the exterior. This reflects the idea that natural light and air, for the sake of health to both the body and mind, is necessary to daily life.

8) The product home should not treat additional materials, (those typically not part of the main system), as merely an afterthought but as an important medium of aesthetic expression. The main system, of any pre-synthesized home, must not disregard external material identity.

8) The system must be able to respond to the natural topographical conditions with minimal disturbance to the essence of the site. This response is created through the chassis system.

10) In addition to the chassis, the product home must respect the inherent need for site specific foundations or platforms, which ultimately determine the placement and characteristics of the chassis. These platforms should create a solid connection with the system, interacting or adding to the internal program. Things like approach, transition and extension are all design philosophies which should be utilized when designing with a support system.
Material And Component Distinction

The construction of a new home in the United States typically consists of 80% field labor and 20% material costs (Characteristics of New Housing). Creating a catalogue of parts and pieces that are produced in controlled conditions, and have the ability to erect a structure quickly, will lower the field labor costs, therefore enabling the adoption of better materials.

Since the mid-20th century, there has been an accelerated, undirected expansion of new building technologies that need to be employed for the next generation of pre-synthesized dwellings. The solution is found with the subsumption of alternative high performance composite materials. Motivated by the structural capabilities of FRP pultrusion and concrete polymer technology, deployableHOMES purposes a panelized system that is comprised of dedicated parts and pieces, which can be easily manipulated by the production process to yield alternative domestic programmatic relationships for the 21st century product home.

Fiber Reinforced Plastics (FRP) pultrusion refers to a material this is pulled through an automated machine. FRP Pultrusion is comprised of multiple fiberglass strands which are pulled through a resin bath and then a shaped die. The die gives the profiles their distinct shape, and when heated cures the profile before exiting the die. FRP pultrusion is typically six times stronger than steel weight-for-weight, has a six-hour fire rating, and is mold and waterproof. As of yet, pultrusion is not used consistently in residential, or commercial projects. It is predominately used in large factory type projects for laminates or synthetic reproductions of other common materials. Pultrusion is used when steel or wood would otherwise fail due to structural, environmental, monetary or caustic characteristics of the facility itself. This material was chosen as a result of its under utilized structural characteristics and easily controlled means of production. The production process of pultrusion lends itself to new forms of tectonic expressions unique to its joining characteristics. Restricted only by the shape of the die and the size of the pulling mechanism, pultruded profiles have the ability to slide, slip, click, move, lurch and bolt together in an extensive number of configurations. Since each piece is created by a fully automated, “on the fly” system, the lack of human error makes each piece identical in shape and size. This relieves the need for significant tolerances. With the insertion of new or additional machines in the automated
processes of production, coupled with the invention of new dies, pultrusion will be able to assist in the creation of new domestic spatial expressions. With pultrusion, new tectonics of connection will come from the expression of forms. Since the forms are pulled into shape as a “running” singular piece, the profiles therefore express themselves in a repetitive linear section. This section will then serve to give concrete intentions to aesthetic design principles which are imbedded in both the manufacturing processes and the anti-in situ architectural movement. It is necessary to produce pieces that behave a certain way as they will serve as the backbone of the system which becomes the structural connection pieces, assisting in long unsupported spans, cantilevers and possibly even act as an independent system of its own.

The Panels

The second composition of materials makes up the panel system. These panels are the fairly recent discovery of Simon and Malcolm Parish of Abersharn Technologies Inc. This panel is made of an inner concrete polymer core, comprised of recycled glass bead and resin with an exterior flat sheet on either side made of FRP pultrusion. The finished panel is three times stronger than concrete weight -for-weight, hurricane 4 rated, 6-hour fire rated, has an R-40 insulation rating, and is mold and water proof. Currently being produced by Ambiente Housing Systems Midwest©, the panels are being utilized as a typical S.I.Ps (structurally insulated panels) system to make 1,000 to 1,200 square foot homes for poor communities residing in environmentally austere areas. Ambiente’s system of construction is currently capable of making only this style of home with no current plans to change this. The result is a high performance panel system that is extremely underutilized. Like the opportunities that FRP pultrusion offer, these panels will never see their full potential if they are not reinterpreted to create space or structure that extend beyond their current singular usage.

A result of implementing a panelized component system means the dwellings size does not have to be bound by the road ready 16x42 size, as do the fully modular and sectional. This is because each piece of the structure can be broken down into multiple panel and connection pieces. Instead, the new concern is how much weight can be carried on a truck to keep it road legal.
This allows for larger, more complicated structures to be delivered in a minimally extravagant method. Through the currently existing and theoretical manipulation of both production processes, the wall panels, coupled with pultruded components, can serve as the next material revolution within the prefabricated industry; a change which aims to serve as a future domestic revolution all its own.

The Foundation

Kieren Timberlake said, “The difference between the automotive industry, shipbuilding or airplane construction is that architecture…in its final product, is rooted to the ground, It has to be fixed to the earth” (Timberlake, 2008). Likewise, Michael McDonnough said that prefab buildings should not be considered as isolated objects. Its profoundly important to understand how they are connected to the ground and the sky, and how they are connected to the culture of an era and especially the social nature of the consumers (Mau 2004,38). Modern prefabricated home design completely negates the idea of foundation, that is, they don’t fully accept their dependence on it. Most either hover above the ground, resting on concrete footings, or sit atop a concrete slab never realizing their inherent dependence on the foundation which can
serve as an opportunity for spatial expansion or integration through their connection to the earth. The modern product home needs to see that the foundation allows for creative interface. It is the first move and the most important to the system. It needs to respond directly to the needs of the structure above, reflecting the moves of the floor track or chassis. The foundation assists in the design philosophy; therefore it is important that the system of construction doesn’t act independently from this.
Conceptual Design

P.S Workspace: Concept realization

An investigation of materiality and space needed to take place to set the stage for future analysis and prototype design. Physically working with composite materials, exploring their production process and investigating material integration was necessary to understanding the opportunities for the pragmatic and theatrical aspects of the future program.

The Pre-Synthesized Workspace (P.S Workspace) was an attempt to gain a better understanding of the design process and how it may alter when dealing with size and material constraints, as well as the workability of FRP pultrusion and its ability to combine with other materials.

From the beginning, it was important that parts of the composite housing system could be integrated with other materials and methods of construction, to create a greater impact on the building industry over time. As a project that dealt with experimentation, the three materials that were chosen needed to be in constant tension with each other, both with their internal make-up and external haptic qualities. FRP pultruded hollow 2x2 rod, wooden pine 2x2’s and steel bolts, as the means of connection, were chosen to create a habitable structure with the objective of being easily constructed and portable.

Material Constraints

Materials were chosen carefully, as their individual qualities would greatly affect the actual process of making. The 2x2 FRP pultrusion was chosen as the composite plastic because it is rela-

Fig: 91. P.S Workspace Rendering
tively small, lightweight, very strong and can be directly related in size to the standard wooden 2x2’s. The second material, wood, was chosen as the starting point of exploration for a variety of reasons, one being that it is the industry standard for the typical dwelling, and has been for many centuries. Structures of many different sizes have been constructed with wood, everything from large barns to 200 sq foot fishing shacks, which demonstrates the material’s ability to adapt to different situations. Additionally, wood is very reactive to its environment and is one of the only continuously used, fully organic building materials. Wood can split, crack, check, bend, knot, swell and shrink depending on the humidity of an area, and how well it was dried at the harvesting plant. Its very nature directly contrasts FRP Pultrusion, which is fully grown in a factory, and given that the machines are set up and working properly, will always remain consistent in size, shape and structural performance. Most importantly, FRP pultrusion is inorganic; a product of science, not nature. The last material, or component, was chosen as a means of connection. The steel bolt is a common and easily accessible means of connection, both self explanatory in their use, and fairly inexpensive.

Catalyst For Design

The idea of the P.S Workspace came at a time when our thesis studios were very short on space. It has always been important that each student is able to make his or her studio space their own, therefore transforming it into a workable, and sometimes
livable, creative extension of themselves. As a result of this lack of space, it was a challenge to find enough room to arrange a workspace tailored to our needs.

The plastic Workspace both refers to thoughts from Theo van Dosenburg’s paper, Towards a Plastic Architecture, and the idea of a standardized, habitable workspace that could be easily tailored to an individual’s needs. Students could easily alter his or her space by adding, removing or moving the wood 2x2’s. The altering process would also serve as an important tool through a means of exploration with materials.

The space is broken into a 36” grid. This size was based on space needed to accommodate for extra students, as well as ease of movement and storage for each student’s materials. The finished size is 6’X6’X5’ high. A 5’ height was chosen so that the top half of the space could also be used for storage and still be within reasonable reach. The components also have the ability to be reconstructed based on its 36” grid. The shorter 36” horizontal pieces may be connected to the verticals to create smaller storage spaces, or simply cut down and added to a larger piece.

Connection points were the reinterpretation of a multifunctional rack made of lashed tree limbs used by Chinese nomadic peoples. The Kazak peoples of China are an ambulant group who move up into the mountains in the summer and back to the base in the winter. These racks are often 5ft above the ground and are used to hang and dry food, clothes and as a temporary workspace.
They are sometimes disassembled and transported for travel, but at other times they are reconstructed from new limbs once a destination is reached. The idea of a nomadic, transformable space directly related to both.

**Meditation Of Construction**

My experience with the construction of the workspace came at an unfortunate time. The day before I was to begin the project, I broke my ankle. Although this situation may have altered my perception of the design and construction process, it was still very satisfying to see that things came together quickly, especially while being confined to a chair. This makes me believe that the design is a success, in that it is fairly quick to produce and easy to assemble.

As with any factory-built product, the speed of completion is determined by the manufacturing time of each component and the machines or people that assemble them. To be able to design within the constraints of such a product, the design process must begin with an understanding of the machines that make each component and which ones are best suited for a new task when changes in the design are made. In the case of the P.S Workspace, it was very important that each component would be cut to almost its exact length, and holes would be drilled likewise. The decision was made to cut as many pieces of like material at once so the chance of dissimilar sizes would be minimized. It was interesting to see how one machine could expedite the construction process so gracefully. I had

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**Fig: 96. (3) Profiles after cutting**

**Fig: 97. (4) Multiple pine 2x2’s cut**
access to a metal band saw which had the ability to cut 8 2X2"s at once. This machine ensured that each piece would be cut quickly and precisely under a controlled condition.

It is important to note how much was learned just from cutting the two different materials. The pultruded pieces were very easy to cut; all were the exact same size and shape. In the case of the wood 2X2"s, not only were they all slightly different in shape, but some were warped or bent. This made it more difficult to ensure that each piece of wood was cut to the correct length. It was made clear that when the pieces were cut and the structure started coming together, these warped pieces created unforeseen pushes or pulls in the shape of the structure. It was then the need for tolerances was much more apparent when dealing with these two opposing materials. Working on paper or with a computer can never fully predict the outcome of a spatial structure that relies on an otherwise unreliable material. As with the production of pultrusion, each piece is the same so tolerances only need to be minimal. It was obvious that this lesson is paramount while attempting to design using a factory-made kit of parts and also integrating outside ones.

With the skeleton up (the four corners and the top and bottom connections), there was still some slight slanting due to the warps in the wood. As the middle pieces and some of the shelving components were added, the structure began correcting itself. A correction was made with the structure of the main work desk after noticing that more support was needed. The structure consists of
three wooden 2x2's, but the back is the only place where it was connected in the middle as well as the sides. The front length showed too much deflection, so the decision was made to substitute only the front length with a pultruded piece instead. This resulted in a considerable increase in strength. This was a significant point in the learning process, where one material, as a result of its inherent structural properties, was able to take over for another out of necessity. This proves that not only new technologies, but in this case composites, be used in tandem with other traditional materials. In fact, there are times when they should. In this case, without the use of a new material, the design would have changed significantly as a result of the need for a wood support in the middle of the P.S Workspace.

Once the space was completed, the structure was broken down and prepared to be shipped to Florida from Wisconsin through Fed-Ex. This process was also a learning experiences which directly
translates to the idea of transporting a prefabricated home. Size, weight and available resources all greatly contribute to the success, and level of stress, that such a process provides. One picture was provided to show amount of studio stuff can be fit in and around ones academic space.
Fig: 106. (11) Packed and ready to be shipped

Fig: 107. Studio space, Architecture building, 3rd floor University Of South Florida
Fig: 108. Kazak woman in front of work space
Illustrating The Objectives: Architectural ideals through graphic communication

With a product oriented approach to the re-marketing of the domestic prefabricated dwelling, techniques were employed to suggest a relationship with the client through a common form of language in our society, advertising and propaganda. Always overlooked by the modern prefabrication designer, the product home needs to be treated and explored just as a product is. Creating a series of displays helped to pin down what made deployableHOMES different than any other prefabricated home or system offered today. The pictures, illustrations, words and even the font chosen needed to consider the demographic who would be interested in making and accepting a change for the 21st century product home. In our overly technetronic society technology industries fill TV, magazines, billboards and radio with advertisements of all shapes and color, which attempt to portray what the product is, who makes it, who it is for and why it is different. The product home should be no different. There are many techniques to creating such a product endorsement and three are explored in the next sections.]
The name deployableHOMES came from thoughts of where prefabrication is heading today, and how it needs to change. From doing historical research on the prefabrication of domestic structures and how the process and aesthetic has changed today it became obvious that society is and has been stuck on a continuous path, always leading back to past types and forms. Even today the common modern flat roof is still a scary thing to a majority of Americans. Most people think that they constantly leak and getting one will surly lead to a lifetime of expenditures as a result. It doesn’t matter that nearly every type of building besides the home uses a flat roof, still, people opt for a pitched with sky lights in the bathroom and kitchen which are notorious for leaking as well. It was then the realization occurred that if prefabrication is going to re-market itself as the future of modern construction with aesthetic and design principles all its own, it needed not a push forward, but a violent shove into the realm of socially eccentric domestic design. It would be only then, through challenges of program and space that something beautiful, and unique could emerge. This set of images is that violent response to a needed change in the housing industry as a whole. The “Act Now” series is a call to arms, a request to rise up and take action. They are done in a style of advertising commonly known as gorilla advertising in which images are used to invoke a certain emotion or feeling. In this case the war images referred to the already, war like words in the previous deployableHOMES execution of ideas section. One poster was created for each word, Resist, Engage, Revive, Deploy, but the explanation was left as an ancillary piece placed next to each for a reason. In order to get a visual response the single word, accompanied by the picture needed to invoke a thought which in turn would leave the onlooker questioning themselves as to what such a powerful image had to do with its associated word. After this took place, the explanation was placed next to or beneath that particular poster to give proper explanation.

“Act Now”: Graphic series one
RESIST the current wasteful and exhausted materials and construction methods of both the site built and the anti in-situ. Resist proprietary factory built designs.
ENGAGE new and underutilized materials as a means of re-marketing and re-applying the product at home.
REVIVE the anti in-situ architectural movement, provide for the future of the product home. Reinvigorate the distinctions that make prefab what it is and how it performs.
DEPLOY the system through the synthesise of designers and production facilities making a duplicitous effort for the client and consumer alike.
“Manufacturing The Product Home”: Graphic series 2

This series of images are very straightforward. With no hidden messages, each graphic has a different reasoning as to why dH is different or what it has to offer that others don’t. Each title is intended to directly interface with the image chosen therefore creating a story or connection between the two. The sentences below became explanations or further descriptions of why the image and title were put together. At the bottom of each image is the deployable homes logo but this time it says “manufacturing the product home”. This was done so this series of images could stand alone and have the ability to properly suggest what the image is for and what deployable homes does and is trying to do. The titles all share the common “Time To” phrase because these images are meant to suggest that what you have or would like to have isn’t sufficient and this is why deployableHOMES can help you.
Time
To Change

Through the integration of new technologies and construction methods, deployable Homes will change the way dwellings are made and designed. From consumers to designers its time for a change.
Time
To Upgrade

deployable Homes will have the ability to retrofit or integrate with most any structure. Interacting within parameters that allow rapidly produced components that are customizable and precise dH Systems can assist any structure.
Time
To Respond

Coupling site responsive attributes and high performance materials dH Systems lead to both a greater quality of life and economy of construction. Prefab will now respond to environmental scenarios.
Time To Believe

deployable Homes brings aspects of materiality, site responsiveness program, system integration and production capabilities that are easily manipulated. Time to believe in the success of prefabrication.

Fig: 121. Time to believe graphic
“Make An Impact”: Graphic series 3

This is the last of the graphic series. Series 3 uses different techniques of illustration by layering hand drawn images over a real picture and further manipulating both in the computer. The utilization of hand drawn images in this series was to portray a fundamental aspect within architectural language, the drawing or illustration. The intent was to produce pictures that seemed like a human dictated the design with intent and response to each individual site. The images needed to show that no matter where the home is put deployableHOMES could respond in an interesting and unique way. The pictures that were illustrated over were chosen for their barren, almost lonely feel. The idea was to show that any place, no matter how empty or destitute, could maintain a beautiful, fully functional dwelling through deployableHOMES. The titles are all the same reading “Make An Impact”. This title suggests that deployableHOMES can help to stop the intrusive housing developments that do not concern themselves with design, individuality, local aesthetics or relation to the site. With the utilization of dH Systems any one can begin to make an impact. The untapped potential of each site was shown throughout each graphic, demonstrating the idea that with the right design, anywhere can be home, and deployableHOMES has the system to do so.
Fig: 123. Make an impact graphic _1
Make An Impact

deployableHOMES
Make An Impact

deployableHOMES

Fig: 126. Make an impact graphic _4
Initial Preliminary Design

This section presents the platform by which deployableHOMES construction systems are built upon. These guidelines commence future parameters and systems that inform future pragmatic and aesthetic design solutions. The following three sections provide the means by which deployableHOMES construction systems can be assessed. The first section declares the various major components that make up the construction system as a whole while the second announces the series and systems that actively act and react throughout the thesis process and the third looks at the two inaugural dwellings constructed from initial system components.
Finess can be described as the breaking down of the “gross fabric of building into finer and finer parts such that it can register small differences while maintaining an overall coherence” (Reiser 2006,1).

dH Systems as a whole is broken down into three main parts and one ancillary design ideal that is incorporated into the design process, which in turn reflects design ideals. Each piece, profile change or adaptation is the result of its use and capacity to perform both aesthetically and structurally within the system as a whole. It should be noted that some pieces will have the ability to move from one system to another as it is important that certain components have the ability to serve more than one purpose, thus getting more out of less.
**Parallel Dynamic Chassis, (PDC)**

The Parallel Dynamic Chassis represents the tracks or guides made of FRP pultruded profiles which set up and inform where and at what intervals the CSSC’s, or wall panels, are placed. These make first contact with the footings, therefore they have the most opportunity to interact with the structures immediate surroundings, like environmental properties and topography. Parallel refers to the chassis direct line of interaction to the columns below and wall panels above as a one to one reflection of both. The chassis is therefore a dynamic entity as a result of its ability to actively interact with both the ground and the system above.
Integral Linkage System, (ILS)

The Integral Linkage System (ILS) is comprised of FRP pultruded composite connection pieces; therefore it is the backbone of the system as a whole. The ILS uses new and adaptive profiles that link walls and carry systems within, such as plumbing and or HVAC chases. The ILS will also have the ability to stand alone allowing for the incorporation of more traditional/ systems to interact with or within this system. The ILS is first step to making FRP pultrusion a viable design and construction material for architects outside of deployableHOMES. ILS refers to this systems need to be integrated within the wall panel and chassis system in order to structurally link each component to create new tectonics of expression based on ILS’s profile capabilities. With this being said the ILS will eventually become able to be a structural entity on its own acting some what like steel with bolted moment connections. This opens the door for Charles Eames supporters to create typologies like the case study
Combined Structural Surface Components (CSSC)

The combined structural surface components are the concrete polymer structural wall panels. This system provides some of the structural support, fire/hurricane protection, insulation and accommodates for technical aspects with internal electrical classes. These panels are made of a recycled glass bead and a resin mixture for the core and an external layer made of FRP pultruded flat sheet. Combined structural surface refers to the panels inner core being made of a combination of materials which provide for some of its performance qualities with the panels need for the combination of two pultruded flat sheets on the surface to give it additional strength.
External Systems Inclusion, (ESI)

The external system’s inclusion is the arrangement and modus operandi to eventually include external materials or systems into dH’s System. This is to relieve the constant need for ad-hoc resolutions for all external systems, structural or not, which could bring varying benefits to dH’s System. These systems or materials will be developed or brought into the scope of the ESI on a needed basis at first. The use of the new systems may assist with passive cooling through the inclusion of a lightweight secondary shade roof, flora screens, or mechanical property assistance as the ILS becomes a structural system.
Just as the act of creating architectural space/structure is a representation of a very personal and individualized process, so too is the act of systems analysis, creation and production. Showing a short visual description of such is helpful in describing the process of movement from one profile into another. This same process is carried through for all profile changes and improvements from one system to another.

The graphic on the right side illustrates the movement from one particular profile into another in a semi-finalized process which Systems 1, 2, and 3 all follow throughout this thesis. As each profile makes a transitional change it will either serve a different purpose all together, or become an improved version of the shape it was derived from.

S represents the start of a particular profile shape, E represents the end of that particular profiles manipulation and

**Spék’tre Series: A retronym for future anti-in situ architectural progression**

*Transition From The Germina To The Complex*
the number correlates to that particular profile series. S.1 started as a shape that would be able to hold a chassis piece, floor piece and wall piece all in one. Changes were made to either make it stronger for the floor connection, or change the depth of the connection which could offset for a gain in the wall sections. S.2 is the perfection of a shape that allowed for a 40 degree response in the vertical plane of space. S.3 is the creation of a piece that is needed if one side of a structure contains more box beams than the other, therefore E.3 could account for this. The extra space also can serve as an additional service chase. Finally S.4 is a piece that was intended to become an intermediary between dH_Systems and other common materials of construction. It is intended to support both sides of a floor plane cantilever which then connected itself to another common building material through a bolt. By E.4 it had become a detailed floor connection which allowed for a reveal line of pultrusion as part of a floor to floor connection. This last piece begins to expose the possibilities of new tectonic expressions through which the inherent capabilities and connection means of pultrusion are utilized.
Dissecting Spēk’tre Series: Developing a brand linkage

Branding is a common technique of product orientation which serves to create some form of social or mental connection with its current or potential clientele. The brand attempts to make a visual relationship with a physical or abstract product which reflects the type or variation of said product within a company’s profile. Spēk’tre Series represents a brand linkage through differing systems of construction by creating a series of dwellings representing those individual systems. The use of multiple systems within the Spēk’tre Series allows for the tracking of improvement and discovery through a thesis that strives to constantly refine the coherence and adaptability of a future prefabricated system.

As a means of creating a dialogue or understanding of the systems working within deployableHOMES a comparison will be made with the BMW car manufacturer. Today, BMW, much like every other large product manufacturer today, offers a selection of specific products that attempt to accommodate for potential customers’ likes, dislikes, lifestyles and monetary situations. In the case of car manufacturing this is done through a series of different, yet controlled, custom changes in each cars production. These changes are most definitely in direct relation with the capabilities of the manufacturer as well as the intended design aesthetic of each car. In order to make sense of all this BMW has created different series of cars which then branch off into different styles of cars that then reflect the specific series intended clientele, income and aesthetic response. BMW’s most popular car collection is the M Series which includes the M 1, 3, 5, 6 and 7. The M Series is merely an umbrella reference for to the different smaller M type categories. Each of the M categories, be it 1, 3, 5, 6 or 7, offer various body styles and sizes of car or suv which also have additional options that can be added or taken away at the buyers discretion. As the M number increases so does the price tag, options and change in aesthetic. Although each car is made of a set of pre-determined parts and pieces, which serve different purposes, some pieces are better then others in quality, performance, ease of connection and system maintenance. These pieces are then utilized in one of the M Series vehicles which relate to the intended aesthetic, performance objective, demographic or price point of that particular series.

Spēk’tre is the phonetic form of the word spectra, which means “a broad range of varied but related ideas or objects, the individual features of which tend to overlap so as to form a continuous series or sequence” (“spectra.” Def. S. Theasurus.com). The phonetic form was
chosen to properly represent a system, and ultimately a thesis, which is in constant tension with completion and modification. Spēk'tra Series follows a similar modus operandi as BMW in the way it breaks down specific construction systems. DeployableHOMES is the larger entity under which Spēk'tra Series represents three systems whose inherent design and construction capabilities make each unique. Each system represents a new set of components or profiles that are an improvement upon that last set. Therefore, each system is a delineation of the architectural process through the design and construction capabilities each new system yields. Likewise each systems design and construction capabilities are personified through the design of a dwelling or prototype. The Spēk'tra Series logo also represents the typical connection methods of the systems. The ILS profiles see the most change and upgrading through each system therefore the Spēk'tra Series represents this. The two half circles represent the positive and negative of a profile which are shown to be connected in the middle by a universal joint or connection method as this type of integrable system profile is the ultimate goal and achievement throughout the thesis.

System 1

The profiles and connection details of System 1 are the subsumption of all the previous process work with connection parts and pieces coupled with working section and floor plan designs throughout. System 1 is the representation of a test which aimed to utilize the process profiles through the materialization of two working designs which are discussed later. These designs are the first tectonic explorations through System 1. Additionally, System 1 is the adaptation and controlled manipulation of the profiles offered by Ambiente Housing Midwest®.
System 2 and System 3

System 2 and System 3 are explored in the next chapter when the means by which the profiles are connected begin to become increasingly integrated and eventually interchangeable post construction completion. The attempt to make profiles respond to both the horizontal and vertical planes of space is also explored. Further investigation and profile explanations are analyzed in the following chapter.
Assessing System 1: Component testing through design

Testing preliminary components is a necessity in finding out the weaknesses and problems of a construction system in its early stages. This was done through the creation of two domestic designs, D-0 and D-1. Even though both dwellings have different design solutions to different programmatic and topographical conditions they share a common bond through the design and tectonic capabilities of System 1, which they both are using. The common design constraints and intentions were as follows; the total square footage should be no less than 1,000 square feet; and no larger than 2,200, the designs must respect the inherent qualities of the system up to this point by utilizing unmodified panel sizes which will in turn dictate floor and wall sizing; last the designs must explore the innate strength of the components by utilizing a degree of transformable openings, which are then integrated into the internal program to become external extensions of such. The designs as a whole were to be subtle in their aesthetic qualities; they were to be a starting block for future designs by expressing themselves as modern interpretations of the shotgun and camel back domestic typologies.
Design-0 (D-0)

D-0 is a visual reinterpretation of a shot gun home with some key differences both spatially and aesthetically. As the first design with System 1 the intention was to produce a visually acceptable dwelling which synthesized, for the first time, the connection between profile conception and the understood abilities of actual material/component production. As a result D-0 is first a pragmatic design solution with subtle, yet spatially invested aesthetic communications and second, an abstract expression of the new Anti-In Situ Reflective Tectonicism.

This design was intended to adhere to the most common topographical solution of ground and foundation relationships by utilizing the common concrete slab. Traditional to the common American dwelling, the flat concrete slab can tame a great majority of land that, under most circumstances, has already been bulldozed and flattened by land speculators. Instead of a straight "shot gun" plan two short arms, or wings, were placed symmetrically near the rear.

Fig: 140. D-0 model
of the plan to specifically represent two important transition spaces in the short axis, the entry and the additional external dining space. Likewise, the opposite long axis of the plan has a secondary porch/dining space and a large living room extension/engawa serving as additional internal-to-external programmatic additions. The internal program is split down the middle of the plan with one side sharing the bed rooms and bathrooms and the other containing the living, dining, kitchen and circulation. The wall splitting the program in half is required to hold the ridge beam, a reused profile from Ambiente Housing Midwests’ system, is running down the center of the roof, connecting the panels together from the soffit beam. These “spine” walls are serving two functions, on one side they serve as the walls for the bed rooms, and on the other side provide additional storage in the form of built in shelving, cabinets etc. The dining is the most flexible space in the home, having three spaces it can transition to. The dining table would be retrofitted with steel v groove wheels with locks, and placed on small imbedded pre-curved steel v tracks in floor panels in the areas shown on the plan. These tracks would allow for easy and controlled movement of the dining table to either exterior dining spaces. These spaces allow one to take advantage of the change in light direction and intensity throughout the day as well as varying levels of privacy, depending on exterior conditions or activities.

The size of the plan, roof and symmetrical “wings”, are
all based on the panel line’s production capabilities. With the ability to produce a 4 ft wide by 40ft panel (realistically as long as the size of the factory will spatially allow), the structure as a whole was based off this width as well as the 6 inch three way panel to panel or panel to corner connectors. In doing this a design would be produced that could take the raw panels right from the machine and use them in a final cohesive dwelling. The use of the “raw” panels would lead to the decision to keep the panels unfinished, or true to their nature, on the exterior. This would then produce a prototype which glorified, or wholly accepted the panels as both a structural material and an aesthetic design decision. Because the panels, once connected, would have seams at their connection points the addition of an external system/ material was needed to visually mediate the seams. Wooden 2x2’s (as in the P.S Workspace) were to be fixed to a light steel frame and attached to the external surface of the panels, delineating themselves according to the internal programs need for either privacy or light infiltration. The use of these horizontally placed wooden 2x2’s properly juxtaposed the vertically oriented seams on the panels.

It was also decided that the ridge beam, roof spine, would not be capped or covered at the top so it could serve as an environmental imprinting tool. The ridge beam’s shape, and water proof nature, made it perfect for catching small amounts of rain, and acting as a scupper, would then exit over a rain mea-
Fig: 147. D-0, exterior living room extension & water measurement device. The rain measurement devise is quite simply a one foot deep, poured concrete, half circle with measurement marks, to the 1/8 inch, so the inhabitants can leisurely track the rainy season with some precision.
Design-1 (D-1)

D-1 is a visual interpretation of the camel back domestic typology with spatial and programmatic changes which attempt to express how the profiles of System 1 could further integrate a seamless flow of space, connected to the exterior, that would subtly assimilate with the foundation and entry. The stretching, or extending, of the first floor forward with the second floor rising up behind is the starting partí and the initial semblance the camel back. Access and internal responses to the site/ exterior is the integration of System 1.

This design was intended to respond to the new found interest in prefab, resulting from the Dwell® Homes series, both in external material surfacing and treatment of space through the 90 degree fold. In other words this was an experiment with System 1 to see how it could produce an aesthetic that could potentially 'nest' within traditional modern prefab, yet express interesting programmatic relationships by holding dear portions of the manifesto for the
Anti-In Situ Reflective Tectonicism. Additionally new connection profiles were to be tested to see how they can help achieve individual responses to things like light, view and trees to acknowledge an individual site's characteristics.

Connection to the entry and the structures connection to the ground were to be analyzed through their transitional relationships with each other. While the main structure is raised 3.5 ft above the ground, to take advantage of either passive cooling or flooding, its base plate created an L shape which hugged the entry platform. The raising of the main space juxtaposes the two forms of entry which both lead to the solid entry platform. One form is through the common stair while the other is an elongated ramp which follows the angle of the dwelling and extends forward with large planters on either side to create a ‘hallway’ or transition from the car. The platform is the main exterior space through which all programs circulate around. Once inside, the main living room and adjacent kitchen both have large openings, or sliding doors, which spill out onto the entry platform creating an almost seamless unified space. Additionally the platform entry accommodates for the planting of trees, flowers or small gardens through the utilization of multiple sized planters, which are dictated on the first floor plan. Both the kitchen and the living room can have direct contact with external space to properly portray the integration of unified transformable spaces. The living room has large openings in the form of sliding doors, on both the front and back sides with the front exiting onto
the entry platform and the back exiting to the living room deck. Likewise, the kitchen has sliding doors at the front which exit on to the entry platform, and adjacent, through the large folding doors to the front of the dining room.

A transition from the ground to the entry platform was important, as was the transition from the first floor to the second. The stairs were placed in a singular piece all their own. This area also houses a kitchen pantry to the right of the stairs and takes advantage of the panels shading properties by extending two pieces horizontally and vertically to help cool this section of the home. The panels were arranged in an alternating fashion, solid/void and so on, so the ascender, or descender, would experience the external world through singular tall openings at specific intervals, therefore controlling both views and light infiltration.

The second floor has two important spatial occurrences. The first happens at the end of the hallway terminating at the den, studio or office space. This area is a quasi-private space, as it is an open air design which shares the same vertical section as the dining room, which it looks onto. This was done to create an uncommon relationship with the dining area and its external transitional space through its depression into the home and its visual and audible connection with the typically semi-private space, the dining room. The second spatial occurrence happens in the master bedroom with the external viewing platform. This space was to contribute the master bed by allowing for an external connection to the entry platform.
through the use of a narrow ‘bridge’. The size of the platform was dictated by its necessity to feel like a private extension of the bedroom, so the small space is to only accommodate for a couple to either stand, sit or sunbathe outside while still being integrated into the shared space below.

Lastly, D-1 explored the use of profiles which allowed for changes in the horizontal plane of space. Responding to both site views and the flora and fauna, a 40 degree profile was created to test the success of a system that could respond to said concerns with an off the shelf piece. This profile made it possible to kink in the transition space between the kitchen and dining room which allowed for better a view and sun light entry to this space.

Although the profile testing of System 1 through D-0 and D-1 seemed tectonically successful, it was obvious that this system needed to become better integrated with its self by creating an arrangement of predetermined pieces that could serve more than one purpose and most importantly serve in both the vertical and horizontal planes of space. If this could be achieved, new spatial concepts and responses to the site could become unparalleled in their ability to produce meaningful yet prefabricated designs.
Critical Shift In a Manafestic Theory

A Social Approach To System Development, (SASD)

Challenging the philosophies and influences of our culture’s domestic requirements demands questions concerning the effects of our growing population and how our society is becoming increasingly technetronic. These changes strive to question and ultimately reflect the socially adaptive growing populous of the 21st century. To create a system that ventures to serve as a new trend in the future of the anti-in situ architectural movement, addressing production and construction is not enough. Injecting a social component will lead to programmatic and aesthetic changes which will manifest a set of guidelines. These guidelines aim to achieve a responsive system of construction which in turn produce the needed changes.

To properly integrate the social dynamic, a series of steps were created to control the intended flow of progress. In System 1, components were created to respond only to site or views and only in the horizontal plane of space. Like wise they were not the

A SOCIAL APPROACH TO SYSTEM DEVELOPMENT

1) material distinction

2) demographic
   + social perception
   = programmatic changes

3) system development during
   spatial/structural prototyping

4) deployableHOMES

Fig: 158. A social approach to system development graphic
manifestation of a social or programmatic agenda, as each profile was created to serve only one purpose for that one specific design. This meant that the inherent strength of each component wasn’t being utilized to create new spatial relationships based on these strengths. As the decision for a new approach was recognized it was important that Systems 2 and 3 would follow the new social approach to system development.

The first step in the social approach to system development is to properly articulate the materials to be used within the system. In the case of dH_Systems high performance composites such as FRP pultrusion and concrete polymer panels were chosen as the main structural components. These components, and how they work within the system as a whole, are expressed in previous chapters.

The second step calls for a chosen demographic or set of like social conditions through which programmatic and social changes are declared based on their needs or willingness to accept change. Just as the diagram states, taking a chosen demographic and articulating their social perceptions of the home will yield the necessary means to create programmatic change.

The third step is crucial to the whole. This is where the system is developed in a semi post-rationalized manner. Instead of the typical scenario where a system and its working components are first articulated and then designs arise out of them, this approach suggests the exact opposite. Here, a series of domestic prototypes or designs, which reflect the necessary programmatic changes, defined in step two, determine how the chosen materials will alter and connect themselves to create a new system. This system is therefore completely tailored for the production and construction of the spatial, tectonic and programmatic desires. Through the creation of this system adaptability will come from the unknown, or the unforeseen tectonic capabilities of the initial components.

The last step suggests that the compiling of steps one through three will result in the creation of the product home specific to the producer or company. In this case the company is deployable-HOMES and its product is the system that creates the prototypes in
“Over 95% of American housing construction is in the detached home” (Mau 2004,34). A change is needed that confronts society’s current opinions of the prefabricated home. Making this change will require a modus operandi much like the technological products that engulf our culture. Treating the home as both an artistic and pragmatic product will lead to questions that challenge society’s expectations and predispositions of what domestic architecture should be. The product home must see the importance of the necessities of consumer and place. The future lays not in the general population, but the generation whose thoughts and ideas are relevant to the present manifestations of culture and polemics. Since the end of WW II, there has been an incremental inflation of the population. As a result, there is an increasing number of young, educated home buyers who are apt to an open-mindedness that begs a change in modern domestic aesthetics and flow of program. This population increase has spiked college attendance and therefore domestic changes must be made as current programmatic qualities do not suffice for this demographic anymore. Surrounded by the aesthetic and spatial outcomes of Levittown, the present generation needs change that relates to the economic, environmental and spatial references in their daily lives. The new product home should have the ability to individualize architectural objectives within prefabricated system components.

The objectives stem from common living conditions and scenarios that most of today’s first and second time home buyers are most recently accustomed to. With college dorms, single apartments and shared communities having notions of small private and large shared spaces, the inhabitants commonly accept the lack of overall privacy yet retain the need for communal entertainment. This, coupled with the constant ebb and flow of environmental awareness, technology and communication changes, this demographic has a willingness and flexibility to accept changes that challenge notions of environment, light, air and spatial relationships. With interests in communal spaces and the breakdown of largely dedicated private ones, the new pre-synthesized domestic home will lead the present generation to accept a new aesthetic and tectonics of expression.
These changes began with the examination of a study done by Professor Kent Larson at MIT called House_n. For this study two mock rooms were built in which sensors were placed throughout. These sensors then tracked the mock family which stayed there for some time. As a result real-time movement patterns could be studied in an effort to see which rooms in a home are most typically utilized and how often. Even though this was a very useful diagram from which to draw conclusions it did not address the significance of time. With my own experiences and observations, along with those of the book House Lust by Daniel McGinn, it was obvious that time is an issue with increasingly large bedrooms. As homes have evolved into the massive entities that they are today, so too has the internal program. For the most part the increasing size of the kitchen and living room has had little effect on the interaction of the inhabiting family compared to the bedroom. As the bedroom has increased in size so too has the time spent in them. This notion of large, nonadaptive sleeping quarters have turned into singular zones of privacy in which the inhabitant can do everything except cook a proper meal. This has lead to the decrease in spouse to spouse, child to parent, etc, communication. The current generation living in the typical college apartment, common rental space or shared community is accustomed to a similar yet slightly different scenario. In most of these cases there are two to four bedrooms a kitchen and living room. Typically the bedrooms accommodate for almost every function except stove top cooking. In the most extreme cases each bedroom will come with a bathroom and full shower, TV/cable, a secondary counter with another sink, located in the bedroom area, and a built in microwave for light cooking. The reason being is that the assumption is the two to four inhabitants don’t know each other and don’t ever have the intention to do so. This is oddly juxtaposed by the use of the main living space. This space, often empty, becomes filled with activity and communication if an inhabitant has friends visiting or is planning on having or going to a communal event or party. This change of programmatic use validates the need for multi use entertainment spaces which can be transformed by the user to adapt to the current situation.
The final programmatic changes came as a result of the realized social perceptions of space with the need and opportunity for change. Through these changes, or guidelines, the framework for the future of the Anti-In Situ Reflective Tectonicism arose. The graphic to the right takes a typical floor plan, with a generous amount of deck/porch space, and, through spatial color relationships, change is expressed below through new spatial configurations with relating color. The whole home is broken up into only three spaces and one ancillary exterior integration. All other traditional program should be left unmarked on the plan, with the exception of utility rooms, etc. Even though a space’s uses can be suggested, through orientation, size and section height, it is ultimately the inhabitants decision to choose the best space for them.

The bed and bathrooms are represented as smaller singular entities. The decision was made that the bedroom should no longer be a place of daily lingering. Their small size attempts to keep their use to a minimum, allowing the user to take full advantage of the other integrated program through social interaction during the day.

Next is the kitchen, or the ‘common’ space, as it is used for both entertaining purposes and private dining. The kitchen is now the first space of the house as one enters the front door. As the kitchen or “common space” is now considered the hub, or interior meeting place, it is important that this space be entered first serving as a starting point for daily work or visiting exploration.
The third space is the largest. This space serves as the 'entertainment' space. This is where the needs for a multi-gathering space is met. The 'entertainment' space is oriented or integrated into the 'common' space through a seamless connection. This is also where the common living room, dining room or external den would be, but their placement is only suggested by spatial changes through ceiling heights or boundary interventions. It must be mentioned that the dis-labeling of these interior space will lead to user specific/open source program. In addition to the traditional living/dining room, left over space could be internally tailored to any number of specific spaces, such as a recital room, aqua lounge, alchemy or botany lab, trophy room or lan party lair. This space must also have adaptive qualities so the inhabitants can rearrange their chosen program at will to experience new spatial, light, etc qualities throughout the years. As a result this space takes advantage of a primarily open plan in which the boundaries shift or kink to create spatial excitement.

Last are the integrated external spaces, often referred to as the porch or patio. The main difference is that these spaces are directly tied to internal programmatic uses to become external extensions of such. Additionally these external spaces must infiltrate the exterior from within to have the ability to become entirely new external program, serving a new purpose and function. These spaces must not be an after thought in the design process, rather an internal integration with the external environment, having strong connections to the site, foundation and especially existing or planted flora.

These changes are in no way attempting to serve as a band-aid solution to the future of prefabrication, they are merely a series of chosen solutions to make prefabrication stand out in its own right. Through these changes modern domestic prefabrication will have a style or aesthetic quality all its own. This style can then be modified and changed through the course of history as new systems and programmatic ideals are realized by architects and designers around the world. Through this new prototypes for the future will arise.

Step 3: Addressing System Development

Once the programmatic changes are addressed the system can begin transmitting the means by which the program will take shape. As stated earlier, it is not enough to merely take into account the construction system and its production, the same is true for the integration of programmatic changes. Therefore the third step must first address the spatial and aesthetic outcomes of the modern domestic prefab industry. Doing so will lead to a set of changes or tolerances the new system must take into account and therefore allow. These tolerances or spatial and aesthetic allowances, will serve to increase the success of the new socially driven program.

Current modern prefab manufacturers are producing homes that follow strict gridded and orthogonal processes of production
and design, therefore the typical prefabricated home is unable to acknowledge fluctuations in environmental, spatial and consumer needs. The new product home should employ a system of construction that does not inhibit shifts, kinks, openings and turns in both the horizontal (plan) and vertical (sectional) planes of space. Deviating from the common square or rectangular ‘shoe box stacking method’ will allow for specific controlled responses to light, views, wind or boundaries within the site, which were often neglected before. In turn, domestic structures could begin to express new tectonics of connection through the synthesis of new construction technologies and new programmatic responses to the environment.

The next diagram displays all of the changes that have been deemed necessary to make prefab a reasonable means of expressive architectural language. The changes, as they are described, related to the notion of immediate spatial perception. As it was noted, these changes are currently un-reproducible by any one prefab manufacturer today with out the use of custom components and materials.

Immediate spatial perception can be defined as the connection the inhabitant has to a domestic space as it relates to ones ability to rapidly perceive immediate areas. Immediate spatial perception is a term or idea that begins to make clear the difference between public and private space and how one perceives them. For example, ones ability to perceive space, or spaces, in a park, art museum, library, retail store, cathedral, mall or commercial lobby.
is much slower than in a domestic setting. Because these types of public spaces are so large it is impossible to directly relate to every spatial change that occurs around you in a personal way. As a result many beautiful spatial moves or changes often go unnoticed by the conventional user or passersby. In the domestic setting this is not the case. Unless you live in a home with absolutely massive ceilings and 100 foot hallways the space that surrounds you is immensely more intimate; therefore even the slightest spatial change, or unchange, is noticed. In this case the suggested spatial moves to be integrated into dH_Systems are designed to create different feelings or notions of spatial use by altering the sectional or planar qualities through the manipulation of existing boundaries. Immediate spatial perception can be understood by taking a look at how a space changes when a vertical plane is altered. Taking a fully rectangular space with flat roof will not create any interesting spatial perceptions, but, for instance, if you angle the roof down to lower the ceiling height at one end that space now has an entirely new feeling and therefore will be given an entirely new use by the inhabitant. This small change in the ceiling plane has such a powerful effect over just that one small space because in a domestic setting the user can perceive or immediately acknowledge the change in space due to it’s convenient relationship with the human body.

**Fig: 164. Immediate spatial perception graphic**
Theoretical Spatial Proclamations 1 & 2

Fig. 165. Theoretical spatial proclamation graphic
Theocratical Spatial Proclamations 1&2

The next two models represent, in one form or another, the ideals set down during the manifestic shift. As the name states, they are merely theoretical spatial descriptions of aesthetic and suggested programmatic space. They were created as a clearing of the mind so further investigations could take place within the new social dynamic of the thesis. While Spatial Proclamation 1 deals with material strength as it expresses spatial relationships with the site, Spatial Proclamation 2 is a collection of spaces, structural integrations and site responses as they relate to the new social programs set by the manifestic shift. They both were very valuable to the process of spatial creation and theory as well as how and where Systems 2 and 3 would proceed next.
Theoretical Spatial Proclamation 1: The block and cantilever

The intent of this assemblage was to materialize, in one entity, the inherent qualities of dH_Systems connection properties, new spatial and foundational responses to site, performance capabilities of the composite structural system and show the integration of external building materials as a means of furthering dH_System’s integration into the building industry. This model is made of cut and prepared solid pieces of wood with the vertical and horizontal planes being differentiated by the different wood. The red, made of African Padauk, represents the panels in the horizontal plane while the purple, made of Purple Heart, represents the panels in the vertical plane. Each panel piece, both horizontal and vertical, was notched out to create a tongue and groove in which Poplar strips were cut and inserted to serve as the tongue pieces. This is representative of how the walls are connected throughout the Spēk‘trē Series.

The large cantilever in the front represents the high strength characteristics of the FRP pultrusion and how the exploitation of such could eventually lead to new spatial and aesthetic characteris-
tics of built form. The cantilever and the extension of the lower red plane over the base represents the idea that prefab homes need to be able to respond to the site which reflect new characteristics of space and foundation. The large cantilever is doing this by extending over the part of the base that angles down in the front, thus illustrating its response to site characteristics. The other extension of the red plane is hovering over the center of a half circle shape drawn onto the base. The half circle is representing a spatial ground configuration in which the cantilever above it is responding to its condition with another space. The purple blocks in the vertical plane represent the wall panels which are being utilized as an expanded fulcrum for the roof. Lastly the large wood block in the back represents a solid concrete section which would be suspended by the extended pulltrusion (poplar strips) pieces in the back to serve as a counter weight for the massive cantilever in the front. This represents the inclusion of other materials and methods as a means of making dH_Systems a means of construction that can and will utilize the characteristics of other building materials to allow for creative interface.
Fig: 174. Platypus intro graphic
Theoretical Spatial Proclamation 2: The platypus

The Platypus: (Ornithorhynchus anatinus)...“the bizarre appearance of this egg-laying, venomous, duck-billed, beaver-tailed, otter-footed mammal baffled European naturalists when they first encountered it”...Platypi: plural form of platypus (The Platypus, Unique Australian Animals)

Just as the platypus is an amalgamation of diverse mammalian features so too is this model. The platypis is a hodgepodge of spaces which, although seem to form no connection to each other, are deeply rooted in the new programmatic and spatial changes that have been laid out. The model as a whole represents a cleansing of the mind, a way to properly lay out, all at once, spatial and programmatic ideas resulting from the new social dynamic of the thesis. This is the first complete spatial response to many spatial and aesthetic qualities which have not yet been worked out. This creation of space was very helpful as a trial and error spatial construct. As spaces
began coming together new ideas of construction as well as means of connection, as they relate to the spaces they make, manifested themselves through aesthetic expression.

The illustration at the beginning of this section was first created as a way of visually expressing the new spatial responses that had not been formally dealt with. The use of perspective as a design tool was utilized as a way of visually portraying relationships and the expressiveness of tectonic connections based on the possible capabilities of the prospective systems. Intended to be purely concept driven, the model then became an extension of the illustration, taking subtle forms and shapes and carrying them thought when necessary. The major goal of the model was to create a structure which had integrated concepts from the immediate spatial perception diagram with the programmatic changes of the critical shift. The binding concept would additionally test the aesthetics of a high strength structural system that outwardly expressed itself as a means of creating a visual identity through tectonic creativity. Many external systems and connection methods and materials were shown through the use of fishing tackle and string. These were to express the future connection capabilities of FRP pultrusion as well as the high tensile strength of pultrusion rod. This model also set the stage for a few major spatial and aesthetic instances which would follow through to Systems 2 and 3. This was the first time that blocks, representing either bedroom or bathroom pods, were expressed as a series of repetitive entities with chimney like extrusion from the top. The series
of spaces set up a much needed linear repetition and rhythm which then terminated above, with the extension of the outlook platform. The dark wood served as a spatial datum which set up its own repetition on one side and created the means by which the roof could begin to hold itself up on the other. The roof also explored the aesthetic and spatial qualities of angles working in the horizontal plane. Above the roof, thin structural profiles, which extend the length of the site, were to juxtapose the thick walls below by supporting the mass of the cantilever in front through the seemingly weightlessness of the thin cables. The model as a whole perched itself at the edge of a cliff like site, precariously extending forward. An important part of deployableHOMES is that the systems do not need specific site conditions to properly stand. This site is the expression of an atypical topographical condition, giving the model the ability to express its adaptability.
Terminal Architecture
Terminal Architecture: Prototyping systems and spatial compositions

The Seminal Trajectory

The final steps of development follow a new guided approach in a two step process. The first is the creation of small bug models, which focused on spaces derived from the theoretical spatial proclamations allowing for the spatial creativity needed for the last two systems. The second found spatial and technical testing through prototyping.

This first step found justification in what is known as the telescope rule. Also known as Thompson’s Rule for first-time telescope makers, Thompson stated that “It is faster to make a four-inch mirror than a six-inch mirror than to make a six-inch mirror” (Programming Pearls, 1985). This thesis follows the same path by first taking the necessary precautions to understand the nature of a new system and how it can intelligently increase the potential success of prefabrication in both the design and consumer environment. This is hopefully achieved, first, through spatial relationships and new tectonics of construction.

Fig: 185. Telescope rule graphic
tectonics of construction and second through the manifestation of two final prototypes accompanied by spatially specific models and technical production graphics. Following this process ensured that the systems and spaces in the final designs could be the product of a multifaceted process. These following four bug models labeled A through D each have a different spatial goal which are tested by known programmatic and aesthetic goals to be achieved with Systems 2 and 3. Each model brings something different to the process and each one has had something cross over to one of the final models, therefore cross pollination of ideas has been achieved.
Adopting The Prototype

A prototype is a necessary tool within the process of product design. It sets out to question whether or not the design will do what is intended. Throughout this process design alternatives are explored, theories are tested and the pragmatics of reality are disputed, battled and grappled with. The translation of this process into the product home intends to yield new theories, programmatic relationships and material unions for the re-marketing of an anti-in situ architecture. Therefore prototyping and the processes it yields are appropriate for the testing and design of the future product home. There are three types of prototyping which are followed throughout the terminal process of the thesis; the proof-of-principal prototype, the visual prototype and the form study prototype. Each one has specific requirements intending to produce specific results. In the case of architectural prototyping some parts of the design process do not fall directly within a specific area of prototyping. Even so, each category requires the revaluation of typical design evolution therefore resulting in new solutions. Descriptions of the prototype categories are displayed on the following presentation graphics.
proof-of-principle prototype

This type of prototype is used to test some aspect of the intended design without attempting to exactly simulate the visual appearance, choice of materials or intended manufacturing process. Such prototypes can be used to “prove” out a potential design approach such as range of motion, mechanics, sensors, architecture, etc. These types of models are often used to identify which design options will not work, or where further development and testing is necessary.
visual prototype

These are intended to capture the design aesthetic and simulate the appearance, color and surface textures of the intended product but will not actually embody the function of the final product. These models are suitable for use in market research, reviews and approval, packaging mock-ups, and photo shoots for sales literature.

Fig: 196. Visual prototype presentation graphic
This type of prototype will allow designers to explore the basic size, look and feel of a product without simulating the actual function or exact visual appearance of the product. They can help assess ergonomic factors and provide insight into visual aspects of the product’s final form. Form Study Prototypes are often hand-carved or machined models, without representing the intended color, finish, or textures.
Establishing System 2

Prototypes usually come in two versions in the testing phase, the alpha and the beta. This first design is therefore VA-20, meaning Version Alpha-20, with the 20 standing for the number of individual adjustments made to each profile of System 2, which VA-20 is constructed of. System 2 is a semi-integrated system of construction. Through the process of System 2’s design the ‘a ha’ moment came when doing research as to how the profiles could become further integrated. Juhani Pallasmaa’s Moduli-225 was constructed of off the shelf components that were integrated into standard wood columns. The component that caught my interest was the French cleat which served as the connection point between each wood column or beam. A French cleat is best known for its use in hanging pictures and other objects against a flat wall. In this case a stronger version of the cleat was utilized to create a clean beautiful structural connection. Assessing the shape of the cleat lead to the adoption of the single dovetail joint as a means of intersecting and integrating components to each other. As different dovetail depths were experimented with a process of experimentation produced
new shapes and pieces which no longer had to be of a single use, some could now begin acting in different planes of space. System 2 eventually became the intermediary between a fully integrated structural system and a fully independent one through the use of linking and non linking profiles.
Fig: 200. VA-20 front, north west corner. Scupper runoff to the left,
VA-20 took full advantage of the new semi-integrated System 2 through various design moves and boundary relationships. Although angles in the vertical plane are not possible with System 2, multiple responses to light, air and existing site conditions could be made in the horizontal plane throughout the whole structure. VA-20 lays the ground work for a system that proves it can be utilized by architects and designers to create both a custom or fully commercialized domestic structure with one system of construction.

The whole first floor is raised three feet six inches off the ground plane specifically to adapt to warm, or possibly floor prone, climates as well as variable topographical conditions. The floor plan follows the ground work laid out by the social approach to system development. Following the floor plan reviles that the entrance of the house is up a short set of stairs and the entry platform or deck. From the beginning there are multiple spaces interacting with the body just from this platform. To the left, there is a four foot high wall only physically separating the prospective visitor from the kitchen deck.
on the other side. Immediately in front of the stairs is the front door and to the right is a 5 foot exterior walk way which leads directly to the private internal court, complete with a large space for gathering on the grass and the planting of a medium sized tree which can grow up thought the roof opening above. Additionally, this walk can be closed off by opening the large louvered panels right along the inside right wall. Once inside the inhabitant would enter directly into the kitchen ‘common’ area, to the left, and to the right is the long louvered panel wall. This wall is comprised of four panels which can be adjusted to varying angles depending on how much sun, air or seamless space is needed between the kitchen the external walkway deck. From the back left side of the kitchen there is also a set of sliding glass doors which leads to the kitchen deck and then back to the four foot wall adjacent to the entry. Each of these spaces have a variety of integrated and variable connection methods with each other and the exterior environment. Proceeding past the kitchen reveals the last two main spaces. The left side of the plan houses the private spaces, i.e. bed and bathrooms. These spaces are separated from the large entertainment space to the right by an angled wall which in turn creates an internal private breezeway which terminates at the end with a single rotating louvered panel. Both bathrooms were placed at the other end not to inconvenience, but provide the opportunity for visitors to experience the length of the home and all of the interesting spaces it offers. This results in the inevitable transition from the common space to the other end of the home at some point of the visit. As for the inhabitants, the bathrooms are placed at the coolest end of the private breeze way and they are both in one common place. The pipes extending
Fig: 203. VA-20 model _2

Fig: 204. VA-20 model_3. Kitchen deck

Fig: 205. VA-20 model_4. Opening in roof for tree

Fig: 206. VA-20 model_5 Ro-
from the top of the bathroom pods are the vent stacks becoming a glorified design integration. The entertainment space is labeled with a #2 and freely flows from the common space to the opposite end of the plan. At that far end, there are two independent exterior deck spaces. These can both open, through a series of multiple sliding track doors, to become direct extensions of the entertainment space. The one at the front is smaller and therefore a bit more private while the right one is quite large. This large deck space extends out from the plan like an arm creating the top end of the private internal courtyard. Ascending down the steps will lead you to the communal gathering space adjacent to the large planted tree and the exterior entry walkway therefore coming full circle to the beginning of the home. The design A-0, of System 1, found the use of its scupper reappear in this design also. There is a scupper that runs the edge of the entry roof running the length of the plan and ending right over the large circle at the front side of the large entertainment deck. The difference is that the water that flows into the circle then exits into a grey water holding tank which is then used for the flushing of the bathroom toilets or lawn care. This detail can be seen in the introductory rendering, sticking out from the structural leg which is extending into the circular rain catch.
Fig: 218. VA-20 entertainment space, adjacent to kitchen. Looking toward the front door.
Visual Prototype

Visual prototypes are intended to capture the design aesthetic and simulate the appearance, color and surface textures of the intended product but will not actually embody the function of the final product. These models are suitable for use in market research, reviews and approval, packaging mock-ups, and photo shoots for sales literature.

The following three models, labeled A through C are the representation of a structural and technical fascination, the unsupported span. Each model attempts to capture the architectural process, as it relates to systems architecture, by creating the three graphics on the right. Each component was prepared and then photographically captured right before the assembly took place. The arranged pieces of each model were to create a relationship with an architecture that must understand and properly articulated system components before production and construction.
Until now, the structural profiles have been directly integrated into the edges of every floor span which then resulted in a structural footing every 8 or 12 feet. These next three models dissolve this idea by experimenting with a series of working profiles which would allow the FRP pultrusion to express its inherent strength to accommodate for longer unsupported spans. These spans would yield a light structure that incorporates external systems of aesthetically, yet pragmatic, additional support. The main structural supports, through which the floor panels are connected, are extended away from the edge and then post tensioned. The idea of post tensioning gave the proper pressure needed to lock the panels into place but as was found with the first bridge, it wasn’t enough to produce a strong span. The last two experimented with profile to panel as well as profile to profile connections at right angles to dictate a stronger floor support system which still relied on the post tensioning to lock the panels together. Models B and C utilize string and fishing tackle to represent external systems of construction or ones not part of the dH_Systems catalogue. These external systems were used in conjunction with the pultrusion to strengthen the upright columns knowing that a roof plane would pull the uprights inward and therefore need to be accommodated for in future designs. Model C became an influential systems model for the last domestic prototype, VB-40.
Establishing System 3

System 3 is designed to produce the beta version of the Spēk'trä Series, Version Beta-40 or VB-40. This thesis ends with a beta version symbolizing that the exploration does not end here nor does this thesis come to a close. VB-40 is merely a starting point for future projects and theories. As system 2 was moving toward the use of fully integrated profiles, System 3 picks up and refines the use of the dovetail by deepening the connecting points and making them more robust. Additionally System 3 translates the components needed to achieve longer unsupported spans resembling the ones in the visual prototype section. Each profile, in some way or another can interact with a new universal profile called the Scopic Beam. This profile can accept all other components and even be combined with another of its self to create larger stronger beams. The Scopic Beam is taken from the 6” by 6” corner beam to create a four sided interactive connection point or joint through which all other profiles act in multiple planes of space. The design of this beam came from a reoccurring problem in which every new beam created to make a new angle could only act in the horizontal plane of space because it couldn’t orient its self differently on its own.

At the very end of the initial design process for VB-40 a major systematic development occurred from advice given to me by a fellow student. It was suggested that new bed room pods should be able to be added to predetermined places after the home is constructed. Before the Scopic Beam was created this was not a possibility but with this beam and the creation of only two other profiles

Fig. 226. System 3, new profiles. Appended to portions of System 2
the Deferred Panel System began to take shape. With this system an open air bedroom pod in VB-40 could be turned into the bedroom at a later time with the addition of new floor panels.
Throughout this thesis, it became increasingly obvious that the production of any real system of construction was the result of a series of steps which are tracked, recorded, and then finely tuned to produce the best product with the least effort or monetary contribution. This is true when looking at all the effort that goes into finely tuning a machine which needs to produce the components necessary, and then have those components come together as intended. The process in flux diagrams are extensions or elaborations of the process tracking that took place with the visual prototypes. With the help of a self tracking program, different steps of the design process, for the last prototype VB-40, could be frozen in time. Each diagram is a still image of a different three and a half to four hour evolution of the design, from the beginning all the way to model production. The self tracking program tracks the movement of the mouse on the computer screen and displays them as continuous thin black lines. The circles represent the mouse's position when it sits still for more than two seconds, and gets bigger the longer it stays in that one place. Each individual graphic represents the whole screen size; therefore all four corners represent the four corners of the actual computer monitor.
Fig: 229. Process in flux graphic_3: Cad+3D spatial manipulation, 3.8hr

Fig: 230. Process in flux graphic_4: CAD + 3D panel layout calculation, 3.5hr

Fig: 231. Process in flux graphic_5: Laser cut components/ 3D layout, 4hr

Fig: 232. Process in flux graphic_6: Component 3D + CAD final layout, 4 hr
Fig: 233. VB-40 North east front corner. Outlook platform above
Announcing Spěk’tra Series Version Beta-40

VB-40 is the last of the prototypes which ventures to finally verify that a system comprised of prefabricated components can extend beyond standard production friendly repetitious designs to become a meaningful aesthetic extension of one’s creative self. VB-40 uses the final catalogue of components from the Spěk’tra Series, System 3. This final system challenges the idea of spatial manipulation through sectional relationships as they relate to vertical boundaries. Being fully integrated allows the system to exploit multiple pieces in both the vertical and horizontal planes of space, manipulating the ceiling and walls. These manipulations allow for maximum environmental, aesthetic and spatial acknowledgment while retaining a catalogue of parts which are created in a factory setting. Furthermore, VB-40 pulls from the bridges in the visual prototype section and the site conditions of the Platypi and combines then into one interactive site and structural response.
VB-40 begins much like VA-20, but once on the main entry deck there are some major differences. As the plan suggests, the main entry is on the back right side of the plan. As one ascends the stairs looking to the immediate right will provide a view, thought the planted flora, of the raised kitchen deck and the pulley mechanism which operated the exterior louvered panels on the far side. The entry deck is quite large and is a main access point for multiple spaces of relaxation or programmatic creativity. The left, after main stair ascension, is a large gathering space which leads to an external hallway bound on one side by the bathroom wall and the other by the in ground planter, and trees, and the large set of louvers meant so control sun infiltration to the pool area. Once in front of the pool area there are two ways to actually enter the pool. The first is by the stairs leading directly into the pool itself. The second requires the inhabitant to walk to the end of the pool deck where there is another set of small steps leading to the ground level, where the pool is. Along this walk is another large built in tree planter to the one’s left, but this one is raised 18” from the deck floor so it can become integral seating. The small trees in this planter serves as a shading mechanism for the deck space. There is also a rain scupper intervention designed into this prototype as well. Above this planter is an extended scupper which catches all the rain off the butterfly roof above and empties it into the planter which empties its excess into another grey water tank to be used for toilet flushing, etc. Backing
up to the entry stairs, and this time turning to the left will bring you in front of the two large main entry doors. These two doors, although quite are hinging on two large car wheel bearings, on above and below, to make opening the door an effortless task. Like VA-20 the first space one enters into is the common space or the kitchen. To the right of the kitchen are two large sets of multiple track patio doors which open on to the external patio doors. To the side of the doors is a medium sized double sided gas fireplace. This can be used in the kitchen for entertaining purposes or on the external deck side if the weather is cold. The rotating louvered panels are also present in this design but on the opposite side of the kitchen deck. This deck is also a semi covered space, so it can add five extra feet of space and circulation. The louvered panels give a whole new experience through their ability to not only control light but also view/privacy and perceived space when they are fully opened. As a way of integrating external building systems the louvered panels are controlled by a custom designed set of ratchets and pulleys which can rotate each panel individually to six predetermined angles. This system utilized a designed cable transfer box which takes the two cables pulling on each of the five panels, resulting in 10 cables, and transfers them into five cables and then one as it enters the main pulley mechanisms. This system is most definitely inspired by architects Tom Kundig, Carlos Scarpa, and the machines of Leonardo da Vinci. The private areas are along the left side of the plan labeled with a #3.
bathrooms are not so far away now. There is one bedroom pod that is left open. This was done for two reasons. First, there needed to be an example of how the Deferred Panel System would be able to transform an open space into another room. In this case a pod was built without a floor, just the walls and half a roof. This became a private space right off the kitchen on the pool level. A pair of sliding glass doors open to display a set of stairs that leads down to the pool edge. To the left of the stair is ample space for a six person table or two tanning chairs. Built into the ground at one side of the open pod is another in ground planter for taller robust plants like bamboo. At the theoretical time of construction this space serves as a kitchen accessible external pool area, but if another bedroom is needed in the future the Deferred Panel System could allow for the insertion of floor panels and then glazing to create another pod. The space labeled #2 is the large entertainment space. On the left side of it is an external raised outlook platform accessed by three stairs and another doorway. This is a spatial gesture that responds to the proven health benefits of the outdoors, as well as periods of self-reflection. This space accommodates for only two people at once and therefore is a private space which takes advantage of site related views that are only attainable from that particular space. The very front of the entertainment space has a set of sliding track doors that lead to the integrated entertainment deck. The right side of this space has one single louvered panel which can be open on its...
Fig: 243. Louvered panel rotation gears.
Exploded gear detail, front elevation of gear composition, details of transfer box (from left to right). Pencil on marker paper
own to take advantage of air movement throughout the day without having to open the track doors. This space also accommodates for the track of the louvered track panels to move over and help keep the south sun from infiltrating this external space. Last is the external floor extension for the entertainment space. This space, to the right of the plan, only extends the floor space by 3 feet, but when the two sets of sliding track doors are opened two louvered track panels are on the other side. These panels can either stay in front of where the doors were, therefore shading and keeping private the internal program while still being directly connected to the outside, or slide them completely out of the way to create an undisturbed open space, seamlessly bringing the outside in.
Deferred Panel System

Prototype vs. 40 open pod

Fig: 254. Deferred panel system 1

Deferred Panel System
Insertion of floor panels

Fig: 255. Deferred panel system 2
Fig: 256. VB-4-0, Rear pool/entry deck
Works Cited


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Appendix
Fig A-5. Visual prototype C mid construction

Fig A-6. Visual prototype C model_1

Fig A-7. Visual prototype C model_2
Fig A-10. VA-20 presentation board set
Fig A-11. VB-40 presentation board set
deployableHOMES
an anti-in situ architectural product

1) deployableHOMES offers both a series of prototypes and a unique catalogue of components which offer maximum plasticity of design by allowing for distinctive environmental, spatial and programmatic responses while utilizing high performance structural materials such as FRP Pultrusion and Concrete Polymer Composites.

2) deployableHOMES is a panelized structural system comprised of three parts. First the Parallel Dynamic Chassis allows the structure to interact with any terrain through its sliding track system that can be repositioned on site if needed, thus allowing for inconsistencies in foundation placement. Next is the Combined Structural Surface Components made up of 4ft wide wall panels which are keyed for connection and routed to allow for system chasses. Last is the Integral Linkage System which serves as the structural connections but also has the ability to act on their own as an independent system.

3) deployableHOMES attempts to reformat domestic prefabrication by creating a system which allows for the reflection of changes in societas perspecites of understood programmatic space and aesthetic of domestic tectonic pragmatism, thus ushering in an anti-in situ architectural movement which no longer just imitates individuality and sound design.

Fig A-12. Jury hand out images. Each of these were cut out and bound with a center paper rivet which then splayed open like a paint swatch.
Fig A-13. Jury hand out images. Each of these were appended to the above
Fig A-14. Jury hand out images. Appended to above images.
Fig A-15. Proof-of-principal displays. Ones containing orange are System 3, ones only in blue are System 2.
Fig A-16. Ones containing orange are System 3, ones only in blue are System 2
Fig A-17. FRP pultrusion production process diagram: http://pultrix.com/images/pultrusion_machine_products.jpg

Fig A-18. Filament roving racks, rear of FRP pultrusion production line, Ambiente Housing Midwest©
If your never willing to be criticised
you never going to produce anything meaningful