“The works of the past always influence us, whether or not we care to admit it, or to structure an understanding of how that influence occurs. The past is not just that which we know, it is that which we use, in a variety of ways, in the making of new work…. The typology argument today asserts that despite the diversity of our culture there are still roots of this kind which allow us to speak of the idea of a library, a museum, a city hall or a house. The continuity of these ideas of type, such as they are, and the esteemed examples which have established their identity and assured their continued cultural resonance, constitute an established line of inquiry in which new work may be effectively grounded.”

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

The project brief was to design a prefabricated, freestanding dwelling unit for any urban setting. It was to be no larger than 400 square feet in order to accommodate the basic functional needs of two adult users: living, sleeping, eating, cooking, working and storage. However, satisfying these requirements was not the underlying challenge. This competition called for a design that would maximize the economic advantages of using modular construction, whilst overcoming its social disadvantages. Most known prefabricated housing initiatives have not been successful in avoiding a 'universal design', that is, a single, standardized design that repeats itself, regardless of the urban, cultural or climatic context. As a result, the prefab, factory made house is commonly perceived as utilitarian and more suited to the underprivileged in society. The second major challenge was attempting to design a flexible architecture. This meant flexibility in terms of user needs, as well adaptability to different climates and site contexts. The truth of the matter is, a lot of modern homes are inefficient, much larger than they need to be, and can accommodate only a limited configuration of inhabitants. Therefore, the two fundamental questions at hand were 1) how does one avoid creating a universal design whilst using standardized components or a 'kit of parts'; and 2) how does one design a truly flexible and adaptable space? This essay outlines the various precedents and strategies studied in order to try to accomplish these goals.

Despite the world's vast cultural diversity, everyone has a similar idea of what a house is, what a school is, a place of worship, etcetera. These ideas are formed from our own personal experiences of these buildings. Whilst basic building functions have remained relatively unchanged over the last few decades, building morphologies have developed much more rapidly in response to ever growing populations and cities, new technologies, and continually evolving

societies. The nature of the competition brief as well as personal ambitions for the project directly influenced the manner with which precedent research was undertaken. As the project posits a change in the typical manufacture, assembly, function and aesthetic of the housing typology, it soon became apparent that my research should not be limited to existing prefabricated structures and houses. In his essay Tradition and the Individual Talent, T.S. Eliot states, "*the past should be altered by the present as much as the present is directed by the past.*"[1] Holding this belief that design should strive to make history just as much as it is influenced by it, the project's precedent study looked at possibilities of currently developing digital fabrication technology, parametric design and innovative building materials. I also found it crucial to juxtapose this research with an investigation of architecture's roots, observing structures that exist in nature and traditional vernacular designs.

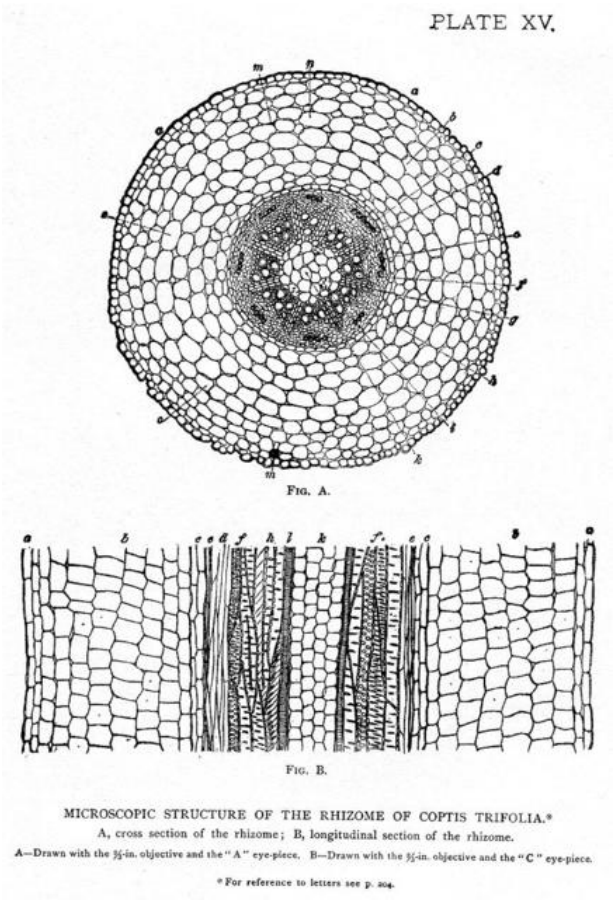

Fig. 1 Microscopic section through a threeleaf goldthread[2]

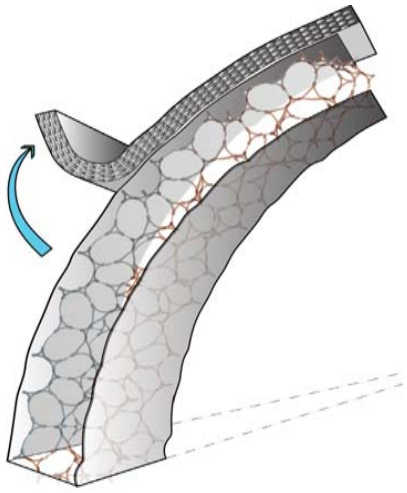

Fig. 2 Axonometric diagram of prefab house wall

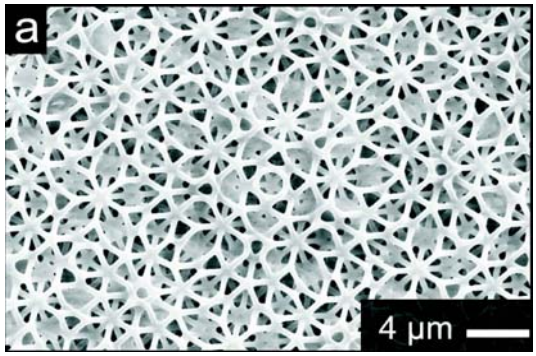

Fig. 3 Quasicrystal[3]

The schematic design of the prefab house was entitled 'Any House' to imply that its form and site are changeable. The key concept behind this free-form, organic design was biomimicry; the act of designing in imitation of nature. With a desire to be as structurally and spatially efficient as possible, it seemed only natural - no pun intended - to look to nature. Figures 1,3 and 4 are just a few examples of structures and skins found in nature which are extremely relevant to the creation of a structurally sound, compact design that minimizes the use of materials. A domed space has a smaller surface area than the cubic equivalent, furthermore, the absence of corners and edges would help make the space feel larger for the user.

Like the cell structure of the rhizome in Figure 1, the dwelling's walls were envisioned to be flexible structures composed of interlocking units, sandwiched with the appropriate flexible layers of insulation, waterproofing, and outer skins.

Employing standard block units for the kitchen and bedroom for example, would not prevent each house from looking and feeling like a factory made product. Instead, a modular system of *smaller* components would be better able to assemble into multiple configurations, making each dwelling unit customizable. Different forms would be determined by the users' needs as well as physical and climatic constraints. With the ability to be re-designed or manipulated by users, these units have the opportunity to become new platforms for social growth within a community.

Fig. 4 Walnut shells

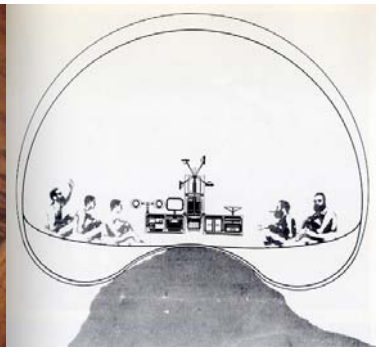

Fig. 5 The Environment Bubble[4]

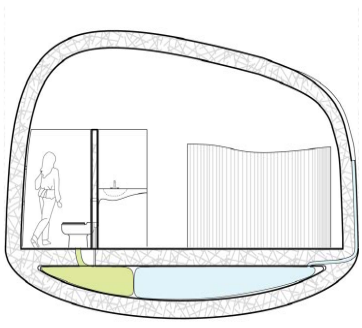

Fig. 6 Dwelling unit cross section

In order for the prefabricated unit to be easily distributed to different sites, a goal consistently maintained throughout the project was to keep the structure as lightweight as possible. The shell

of a walnut is an example of an intelligent and efficient structure in that it is a thin shell that thickens only along the outer edges and central spine. The Environment Bubble project was one of several pneumatic structures researched as they are extremely lightweight and easy to disassemble, transport and reassemble. Banham argued that houses require so much service equipment that these alone should be used for structural support, thus the air conditioning provides the pressure that keeps the bubble dome inflated.[5] The designed prefab unit behaves similarly by using the service core and water storage as the main structural supports.

Fig. 7 Teahouse by Kengo Kuma[6]

Fig. 8 1960's inflatable by Jersey Devil[7]

It also challenges the notion that every building should have a foundation or a permanent site. The use of 'leftover' spaces in the urban fabric - such as alleyways, rooftops and parking lots - would help to instigate a revitalization of what are often bleak, dirty or dangerous spaces. The precedents shown in figures 9, 10 and 11 imply a 'plugging in' of architecture directly into underutilized urban contexts. For example, the Spacebuster dome "*expands and organically adjusts to its surroundings, be it in a field, a wooded park, or below a highway overpass.*"[8]

Fig. 9 paraSITE by Michael Rakowitz[9]

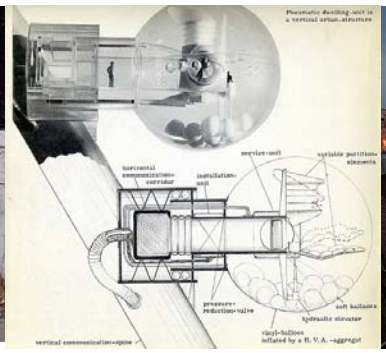

Fig. 10 Pneumakosm by Haus Rucker-Co

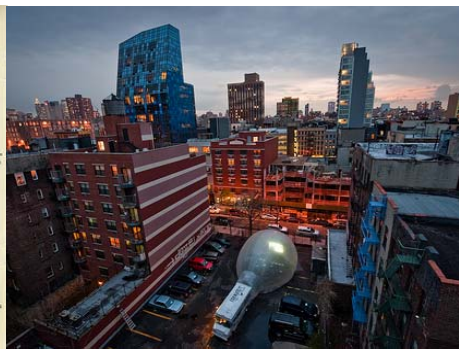

Fig. 11 Spacebuster by Raumlabor[10]

The prefab dwelling project anticipates that the agglomeration of these units in dense urban environments would begin to establish new kinds of community spaces.

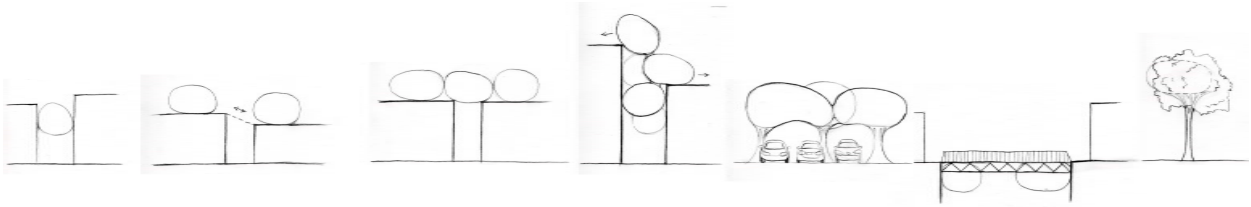

Fig. 12 Site Diagrams

The use of parametric modeling and digital fabrication is developing at a continually increasing rate. The growth of scripting software programs such as Grasshopper have opened up a new array of possibilities in architectural design that could not have been realistically considered before this technology appeared. The only conceivable to manufacture and assemble diverse, organic and customizable housing pods with standardized system of material components would be through computational design.

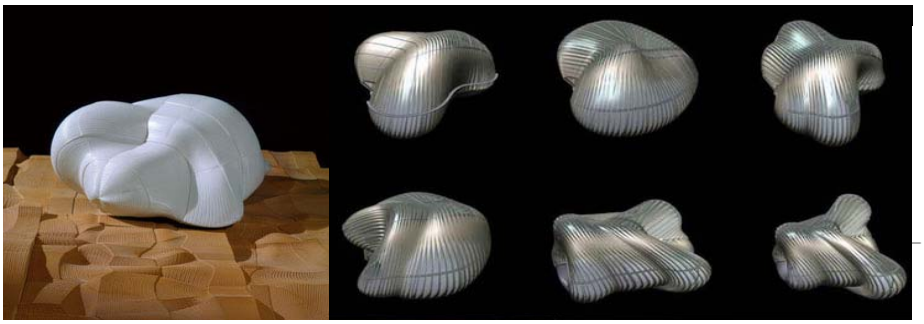

Fig. 13 Embryological House and variations by Greg Lynn[11]

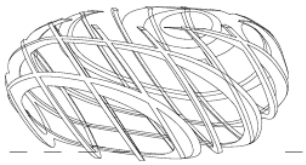

Fig. 14 Parametric study

The Embryological house is a theoretical prefabricated house inspired by biological forms. Rather than utilizing a standard kit of parts, Lynn enables the computer to calculate the complex curvatures and components required for each unit, based on mathematical formulae.[12] The parametrically designed wall entitled Migrating Formations (fig. 16)[13] reveals the potential to create custom wall cavities determined by scripting factors such as light intensity.

The future of prefabricated housing and perhaps other building typologies lies in computational design, however not without the presence of open-source communities. Open-source software,

scripting codes and designs strengthen communities through constantly sharing and expanding knowledge and ideas.

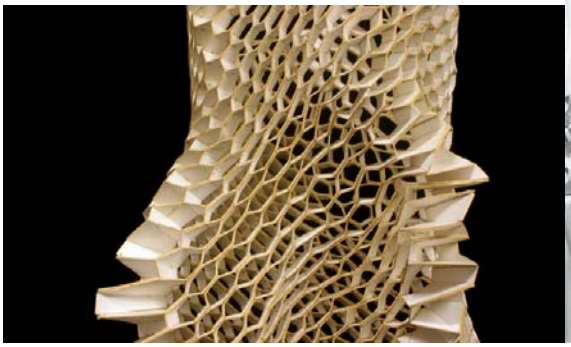

Fig. 15 Parametric honeycomb wall prototype[14]

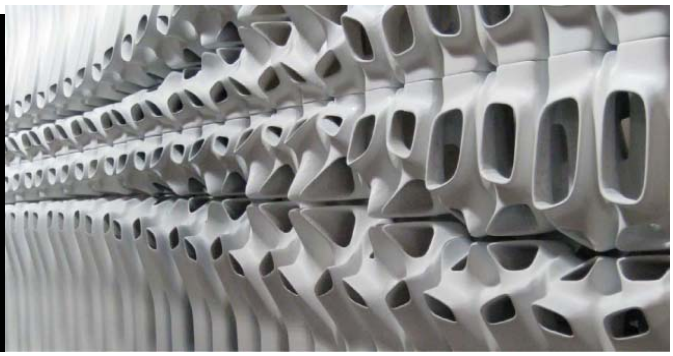

Fig. 16 Migrating Formations, Ali Rahim and Hina Jamelle[15]

I wanted to use materials that are durable, lightweight, possess minimal embodied energy and are either biodegradable or readily recycled. Wood framing is not very applicable to prefab because of the labour involved, whilst steel framing would be high in embodied energy. The proposed unit instead favours the use of laminated fibre based materials. Although this composite material is yet to be fully developed, it is certainly within reach of material designers and fabricators today. Fibre based materials are not only strong but they are also physically flexible in a non-deformational manner. Bendable internal walls that expand and compress would allow the interior spatial organization to accommodate changes in the users' lifestyles.

The structure in fig. 17 is composed of reused hemp sacks that have been sewn together to create a habitable space. A lightweight dwelling, with an extremely low embodied energy, and like all plant based materials, it is biodegradable.

Fig. 17 Low-tech balloon system[16]

Fig. 18 Thatch roof

Fig. 19 Cellulose Insulation

BMW's vision of a car draped with cloth has challenged the typical idea of a car's appearance, materiality and fundamental manufacturing process. A seamless fabric skin envelops the car's metal frame, making each movement morph its entire shape.[17]

Although the unit uses predominantly fibre-based materials, there is necessarily a differentiation between structure and skin, between what is membrane and what is fill. In so doing, the structure is able to twist and morph, whilst pulling and pushing the layers that cling to it.

Fig. 20 BMW's GINA Light Visionary Model[18]

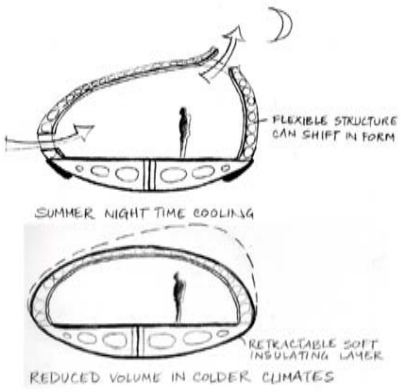

Fig. 21 Dwelling unit seasonal variations

Despite an inherent desire to be innovative; researching various building projects, structural systems and materials was crucial to the development of the design. There is no such thing as a completely new idea, because we are always influenced by our predecessors. T.S. Eliot says, "*No poet, no artist of any art, has his complete meaning alone. His significance, his appreciation is the appreciation of his relation to the dead poets and artists. You cannot value him alone; you must set him, for contrast and comparison, among the dead.*"[19] Likewise, attempting to design the new prefab home of 2020 could not disregard the continually evolving housing and modular designs that came before, for every design is a reflection of its time. It acknowledges the need to use an existing typology in a new way, to meet needs that did not exist before as readily as they do now.

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