ARCH 384 Competition Elective Research Paper

ARCTIC MOBILE MEDIA-CENTRIC HABITATION AND WORK UNIT

Precedents and initiatives for the architectural design process

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Fig. 1- Building Exterior View from the North

This design proposal is for a mobile media-centric facility, life support habitation and work module in the Arctic region. The architecture needs to function in extreme climates, provide basic life support for 3 people for up to 15 days and accommodate the other programs like galley, workspaces and communication station. It needs to be "towable/ drivable/ boatable/ amphibious", so that the radius of operation is 500km at least. "The unit is to serve as a model for mobile research in extreme cold environments, incorporating high tech solutions while utilizing sustainable resources." [1]

The making of new work is grounded on reflective observation, concrete experience and abstract conceptualization. "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...."[2] The works in the past offer us knowledge to be absorbed and applied, and design innovations are the result of a cycle of knowledge liquidation and crystallization; then they will influence and become the precedents for future works. Various precedents became typological or technological inspirations. Research on precedents of portable architecture has helped me visualize how the building could perform before schematic design. Structural and technical aspects of design are also influenced by work seen and learned in the past. Furthermore, the polar region is so unique and extreme that we need to reference a couple of proposed polar research stations in the past.

Portable architectures are more responsive, flexible and adaptable than fixed infrastructure, but they usually consume more energy than the static structures; the larger, heavier and more rigid a structure is,

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[1] Open Architecture Design Competition:
The Arctic Perspective Initiative Mobile Media-Centric Habitation and Work Unit
http://arcticperspective.org/architecture/call-entries-juried-open-design-competition

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

the more energy it consumes. As a result, most existing systems are moved on parts. The moving elements in architectures have a variety of degrees of freedom; some can slide, rotate or move without constrain; these simple movements can also be combined for more articulated motions.[3]

Many precedents are modular, flexible and have the potential of getting mass-produced. The "Micro Dwellings" is one of such projects. Due to its geometric modularity, this movable system allows for changes and adaptations to the design. Experimented and designed by N55, this space frame was constructed in the year of 2000 and "served as a starting point for a local initiatives and interventions, a work and living space" until 2004.[4]

Fig. 2 - Micro Dwellings by N55

Similarly, a prime objective for the Arctic habitation and work unit is to create an underlying structure for social community. In the North Polar Region, almost everything, including work fruits, is shared; communal ties are very important in their culture. The proposed programs are arranged around a large shared recreation and gallery space where researchers, hunters and local residents join together in many activities. Other programs are also response to the living and working demands of life in Arctic's extreme environment.

Every module has a plan of a hexagon with an area of about 10 metres square. The sloped roof is useful for shedding snow and collecting solar power. The modular system is inspired by structurally efficient and strong honeycomb. The use of honeycomb structure reduces the apparent and actual weight of the building and optimizes the amount of materials consumed. These modules serve migratory cultures and have the flexibility for future expansion and can be relocated with any existing transportation method.

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[3] Siegal, Jennifer. "More Mobile: Portable Architecture for Today" New York: Princeton Architectural Press, 2007. p. 10-15.

[4] Micro Dwellings by N55
http://www.inhabitat.com/2005/12/30/micro-dwellings-by-n55/

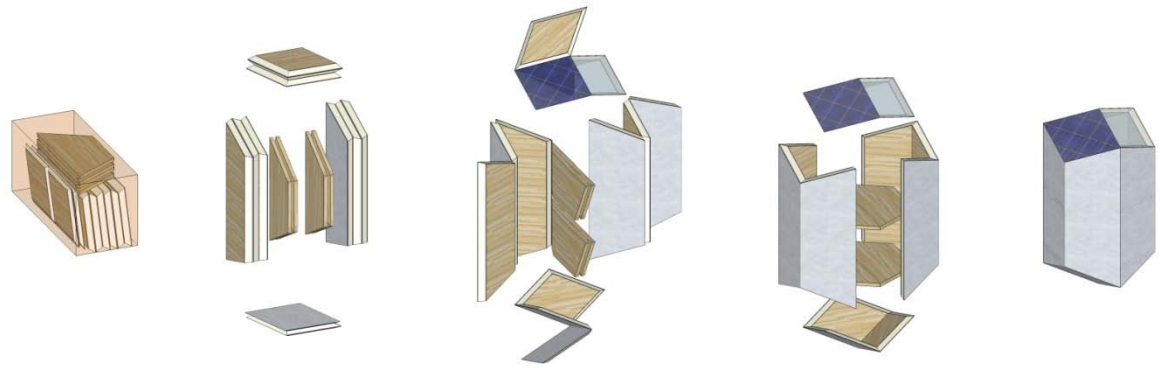
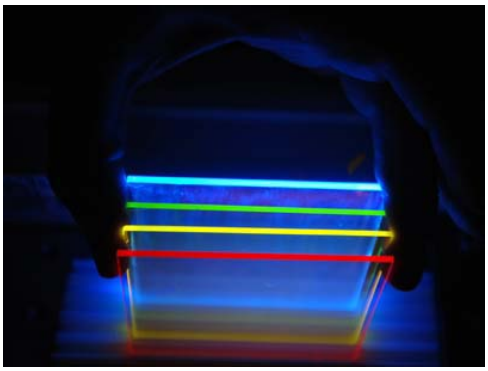


Fig.3 - Diagram shows how a module is stored in a standardized container (20'0"x8'0"x9'6") and assembled.

On top of every module, there are solar panels that generate electricity and heat. There is also a semi-transparent solar window with triple vacuum glazing illuminate rooms with natural light in summer and generates electricity in winter. The recent invention of solar window makes it possible to collect sun's energy more efficiently. "Light is collected over a large area and gathered, or concentrated, at the edges...As a result, rather than covering a roof with expensive solar cells, the cells only need to be around the edges of a flat glass panel. In addition, the focused light increases the electrical power obtained from each solar cell by a factor of over 40."[5]



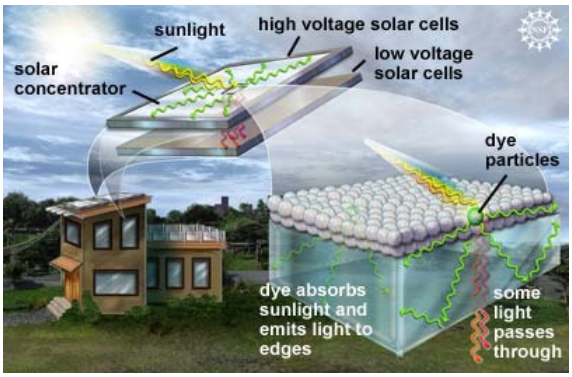
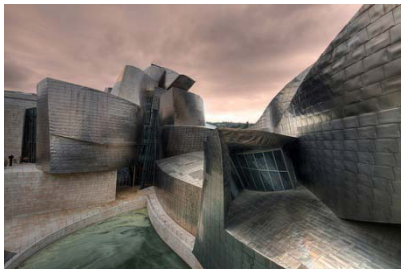


Fig. 4 (Left) - Organic solar concentrators collect and focus different colors of sunlight.

Fig. 5 (Right) - An artist's representation shows how a cost effective solar concentrator could help make existing solar panels more efficient.

[5] MIT opens new 'window' on solar energy: Cost effective devices expected on market soon
Elizabeth A. Thomson, July 10, 2008. http://web.mit.edu/newsoffice/2008/solarcells-0710.html

Exterior wall consists of 5mm titanium plate on 5mm closed-cell foam on 250 polystyrene on 20mm treated pine. Titanium is chosen to the cladding material for this design with both aesthetic and technical considerations. Titanium is light, biocompatible and recyclable. At the same time, it has high strength and great weatherability. The thermal conductivity of all titanium alloys is relatively low for a metal. Titanium applications have been significant in the aerospace industry due to its exceptional strength to weight ratio. A technical report in 2000 studies and describes titanium as an environmentally friendly and how the benefits of titanium can be effectively utilized in building industry. It was applied as building construction materials for the first time in 1980s, and was first used in many coastal and volcanic regions for its superior corrosion resistance. Later in 1997, 80 tons of curved titanium panels of the Guggenheim museum Bilbao create a distinctive modern icon. Titanium is also used in Japan to protect historical heritages and to construct marine structures.[6]



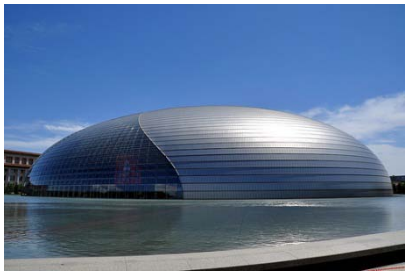


Fig. 6 (Left) - Guggenheim Museum Bilbao
Fig. 7 (Right) - Ellipsoid dome of titanium and glass, The National Centre for the Performing Arts in Beijing

The new Belgian Arctic research station is designed and operated by the International Polar Foundation. Using eco-friendly materials, the Princess Elisabeth Antarctica aims to minimize energy consumption and waste; the goal is to design the first zero-emission research station. There will be eight wind turbines and as well as approximately 380 square meters of solar panels installed to generate renewable energies. The Princess Elisabeth Antarctica is designed to use 80% less energy than a comparable station. The station will be completed by 2010.

Fig. 8 - the Princess Elisabeth Antarctica and its exterior wall Assembly

[6] Nippon Steel Technical Report. Titanium Division, No. 81, January 2000. "Titanium Products as Environmentally Friendly Materials." Mitsuo Ishii, Kazuhiro Kinoshita and Kin'ichi Kimura.
p. 103-108. http://www.nsc.co.jp/en/tech/report/pdf/8120.pdf

Another precedent is the winner of the design competition for new British Antarctic Survey (BAS) Halley Research Station, by Faber Maunsell and Hugh Broughton. The new station consists of eight interconnected building modules. They are elevated on skis and can be towed on ice. A series of modules are designed to suit the changing needs of the living and working demands. They are simple to construct and can be re-arranged or relocated.[7] There are energy modules that balance integrated energy and reduce environmental impact. It is prefabricated and shipped to the Antarctica; it is a colourful building that has variety and personality.[8]

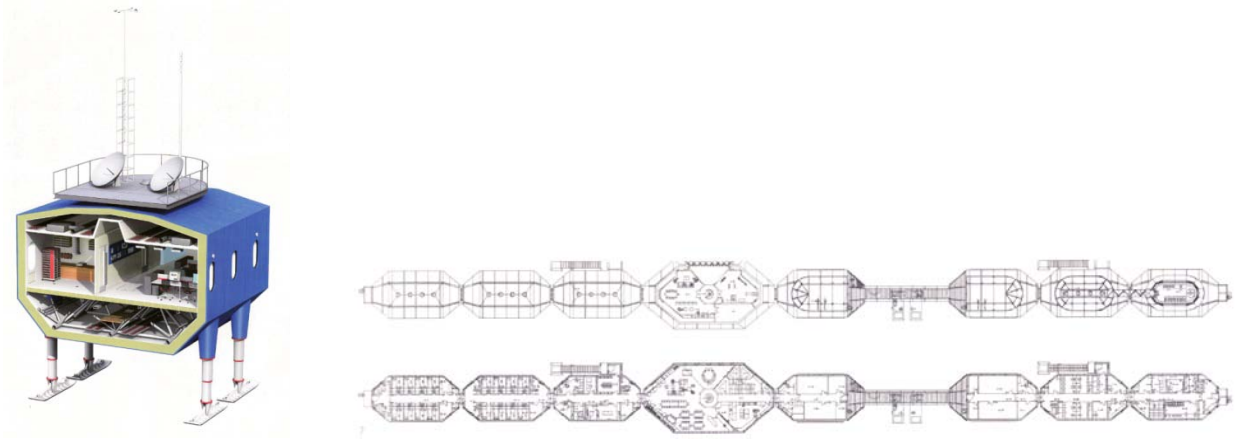


Fig. 9 - the new British Antarctic Survey (BAS) Halley Research Station and its plans

In contrast to the Antarctic, the Arctic is a huge ocean surrounded by lands. In the Arctic region, prevailing winds are polar easterlies. The proposed Arctic mobile media-centric habitation and work unit is perpendicular to the prevailing wind direction to limit snow built-up. Lifting the building above ground on metal posts avoids heat escaping through the floor and allows cold air to circulate beneath the building. It also prevents the module from buried by snow. In addition to the solar panels and windows, other sustainable strategies contribute to the final design. Recycled materials reduce environmental impact on the site. Both passive and active heating are used. In the summer solar energy is used to melt water and a sewage treatment is applied too. The proposal aims to provide as much comfort to its users as possible; many programs are considered and added for the well-beings of the occupants. There are a library and sauna around central atrium. Hydroponic garden provides fresh vegetables even in winter.

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[7] Press Release - Futuristic design wins competition for new Antarctic Research Station http://www.antarctica.ac.uk/press/press_releases/press_release.php?id=63

[8] Kronenburg, Robert. "Portable Architecture: Design and Technology." Basel: Birkhauser, 2008. p. 146-151.

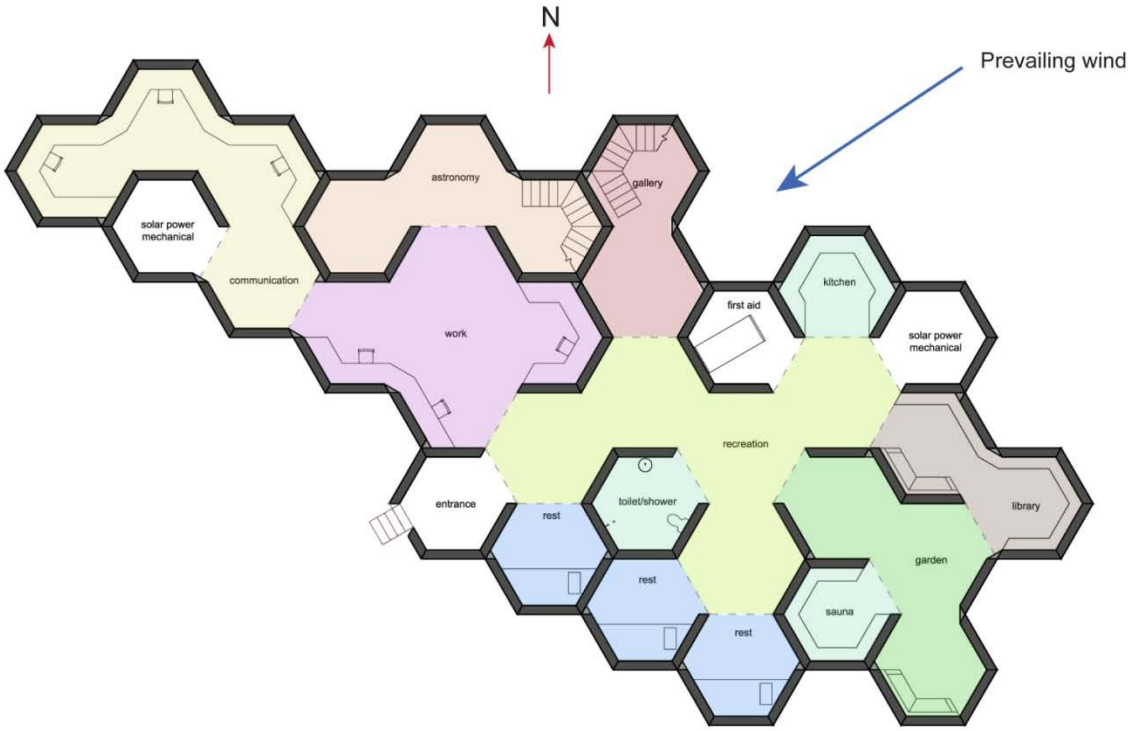

Fig. 10- First Floor Plan

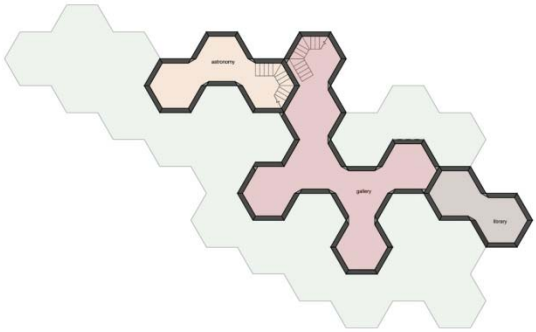

Fig. 11- Second Floor Plan

Fig.12- Sectional Perpective through the building

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