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McGill University School of Architecture Architectural Design 3 - ARCH 677

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1. Theoretical Context

The early documented history of the Arctic begins with drawings of inspired explorers. To describe only one of the abundant fallacies, the 1569 map by Gerard Mercator depicts a frozen ring surrounding a circular ocean. In its center, a magnetic mountain arises from the sea, constructing an image known as the myth of the ″Open Polar Sea″. In reality, the complete cartography of the Arctic’s mainland and islands only dates from the beginning of the twentieth century when explorers proved Greenland to be an island. Therefore, southern researchers only begin to understand the true geographical qualities of the Arctic while misconceptions and beliefs still mark the imagination in the southern cultures.

Between an imaginative landscape and factual considerations, certain arctic forms and images remain in the collective psyche. Of course, the igloo is the first to come to mind. True vernacular icon, the southern multitudes intuitively associate its form with the Arctic. In reality, the vernacular architecture of the Arctic includes a rich variety of forms and techniques. The different Inuit groups developed different habitable formal strategies ranging from troglodytic grottos to stilts constructions. Nevertheless, southern popular culture considers the igloo as the principal Inuit vernacular habitation. The idea of an infinite flat land is another formal misconception of the Arctic. Most likely related to the image of the unbroken ice cap characterizing the Greenland landscape or the linearity of the permanent polar ice floe of the Arctic Ocean, this accepted impression contrasts the actual topography of the territory. Indeed, most mounts and plateaus of the Queen Elizabeth Islands easily reach 2000 meters above sea level. The Arctic territory is in fact a diversified land encompassing a multitude of different landscapes. From sand to snow, from dry icy ground to lakes and rivers, the diversity of its geography is only matched by its vastness.

In its physical attributes, the complexity of the geography indeed characterizes the Arctic. The territory’s undefined frontiers, remoteness, unstable geographical properties and extreme climate exemplify this complexity. For the engineers and architects, the set of constraints influencing formal research and construction systems is completely different from the technical restrictions considered in southern architecture. The midnight sun, the constant movement in the ice floe and the ice caps, the remoteness of the traditional energy sources and material supply, the difficult waste management, the strength of Arctic windstorms, the permafrost and even the polar magnetism are the main examples of challenges facing the professionals when approaching an arctic project. Nevertheless, the engineers answered these challenges with a limited range of forms throughout the modern history of the Arctic. To construct scientific stations and military bases, engineers used half-cylindrical Quonset huts, pre-fabricated steel boxes and spheroid geodesic domes. We are now entering a critical era when new high-tech architectural projects are being announced, notably, the future research base in Cambridge Bay and the new deep water port of Nanisivik, both destined to become symbols of Canadian sovereignty along the water of the archipelago. It will be up to our generation of architect to propose new forms and systems to answer the future and existing challenges of Arctic development and research and this is what this studio expects you to do.

2. Physical Context

Precisely, the proposed location and program of the studio is the actual site of the Dr. Neil Trivett Global Atmosphere Watch Observatory in Alert on Ellesmere Island, Nunavut. Built in 1986, the station is part of numerous earth's atmosphere monitoring networks such as the Global Atmosphere Watch Station Information System (GAW) and the NOAA Arctic Atmospheric Observatory Program. The latter includes four other monitoring sites in Eureka (Canada), Barrow (Alaska, USA), Tiksi (Russia), Cherskii (Russia) and Summit (Greenland), forming a true circumpolar network. Some of the latest picture of the station in the heart of winter shows it completely covered with snow. Although the federal government's actual focus is on the 400 million dollars station in Cambridge Bay planned to be opened in 2017, we can easily predict the need to replace the buried and 30 years old Dr. Neil Trivett Global Atmosphere Watch Observatory in a near future.

The Environment Canada's website describes the best the site and vicinity of the station: ″ The Alert observatory is located on the northeastern tip of Ellesmere Island in the Canadian Arctic. Alert is also the site of a military station (CFS Alert) and an Environment Canada Upper Air Weather Station. The Observatory is situated 210 m above sea level; 6 km South-South-West of CFS Alert. The terrain in the vicinity is comprised of steeply rolling hills, with peaks between 100 to 150 m high and frequent deep ravines and high cliffs. Alert is far removed from the major industrial regions in the Northern Hemisphere and therefore ideally situated for monitoring changes in global atmospheric pollutants.″ As it is close to the sea level and by the Arctic Ocean, salt laden fogs sometimes occur but generally, the climate is typical of polar deserts, with dry and extremely cold temperatures. In fact, the annual mean temperature is -17. Also, the station is located north of the geostationary communication horizon. Therefore, communications have to go via satellite phone through the southern neighbor station located in Eureka.

3. Program

Programmatically, the general function of the station is to monitor earth's atmosphere. Environment Canada has a long term commitment to 50 to 100 years with the GAW for continuous monitoring of the atmosphere. Again, let's read the Environment Canada's website for a better understanding of the history of atmosphere monitoring: ″ The greenhouse gas measurement program began at Alert in 1975 with a simple flask sampling program to assess the concentration of carbon dioxide in the arctic atmosphere. Over time, other measurements were established until, in 1986, Canada's first research station for the continuous monitoring of greenhouse gases and aerosols was opened. Many collaborative international sampling programs for greenhouse and other trace gases are also conducted at Alert. The Alert station also serves as one of the three international greenhouse gas intercomparison sites. These intercomparison activities provide an on-going assessment for network comparability amongst agencies conducting similar greenhouse measurement programs at other locations around the globe. Alert is the most northerly site in the World Meteorological Organization's (WMO) Global Atmosphere Watch (GAW) Network.″ Also, the data taken from the station played a major role in the discovery and the definition of the Arctic haze, a result of the interaction between pollution chemical and snow surface altering the chemical composition of the atmospheric boundary layer.

Although the station is not located on an icecap or an ice floe, mobility is one key of the program. First, as snow accumulation is important during the winter months, a vertical mobility from the ground level to the snow level is mandatory. Also, as the construction of the station cannot be completely realized on-site, a certain initial mobility of the structure and systems, from the shop to the site, is necessary. We can take advantage of the runways of the nearby CFS military base, transporting the station with charter planes but we are open to any other means of transportation such as aerial craning, tracked vehicles or cargo boats.

A particular attention will have to be given to energy sources and management. The idea here is to use technology to connect to the environment in different ways. We are encouraging technological speculative solutions formally but also operatively. The station has to be as energetically autonomous and efficient as the site is fragile and resource-limited.

The technology used to achieve the different angles of observation is diverse. It of course includes exterior equipment but also interior apparatus. Therefore the station will have to accommodate and allow for the storage of different pieces of equipment such as communication systems, surface sensors, ozone surface detectors, meters and sensor tower, ozonometers, persistent organic pollutants sampling instruments, sun photometer, methane measuring system, aethelometer, albedo rack with downward looking radiometers, upward looking radiometers and solar tracker, solar radiation sensor, aerologic radar-tracking complex and climate reference network station. Pictures of each instrument will be posted on My Course for your use. As the data is not analyzed on site but sent to different laboratories depending on the research program, there is no need to include a laboratory.

Of course the station also hosts scientist and researchers at different period throughout the year. Therefore, the station will have to accommodate compactly but efficiently a group of 16 scientists and technicians for a period of 3 consecutive weeks while allowing for a more comfortable space for a team of 4 permanent staffs. Besides the hygienic program embedded in such a task, the station will have to allow for group meetings but also personal desk and computer work.

Basic program elements:

Dormitory rooms (8 rooms for 2 people or 4 rooms for 4 people): ±7m2 each or ±12m2 each
Permanent staff rooms (4 rooms): ±7m2 each
Bathrooms (2 bathrooms including 3 toilets and 2 showers in each): ±12m2 each
Kitchen: ±12m2
Dining room: ±30m2
Meeting room (including 4 desk spaces for personal computer work): ±55m2
Vestibule (buffer space between the exterior and the interior): ±5m2
Mechanical room: ±18m2
Monitoring equipment storage: ±18m2
Monitoring equipment room: ±18m2
Waste storage: ±7m2

4. Design Protocol

The interaction between both functional and formal discourses requires a theoretical and practical standpoint that will be shaped by the use of three design protocols, each revealing a particular aspect of the project.

> ***Week 1 & 2 | Form-making*** will focus on the analysis of historical and current projects located in the Arctic and Antarctic regions. Based on a *form-making* process, team members will establish a strategy of superimposition of information originated from drawings, scale models and computer simulation. This first design phase will lead to a specific research track and design topic to pursue. 25 case studies will be investigated and will lead to the building of a lexicon to be shared in the class. Each case study will be approached in terms of the following 5 aspects or parameters: Programmatic distribution, structural solution, material definition, construction process, and environmental responsiveness.
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> Case studies to be investigated:
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> 1. The Ridge Lab of the Polar Environment Atmospheric Research Laboratory (PEARL), Eureka, Ellesmere Island, Nunavut, Canada
> 2. BAR-1 Auxiliary DEW Line radar station, Yukon, Canada
> 3. Ward Hunt Island Observatory Research Station, Ellesmere Island, Nunavut, Canada
> 4. Bylot Island Research Station, Baffin Island, Nunavut, Canada
> 5. Flashline Mars Arctic Research Station (FMARS), Devon Island, Nunavut, Canada

6. Canadian Forces Station Alert, Ellesmere Island, Nunavut, Canada
7. Russian-German Research Station Samoylov, Samoylov Island, Siberia, Russia
8. Sverdrup Research Station, Ny-Ålesund, Svalbard, Norway
9. Svalbard Satellite Station (SvalSat), Svalbard, Norway
10. Svalbard Global Seed Vault, Svalbard, Norway
11. Tiksi Weather Station, Tiksi, Siberia, Russia
12. North Greenland Eemian Ice Drilling Station (NEEM), Greenland
13. Summit Station in Greenland, Greenland
14. Greenland Institute of Natural Resources, Greenland
15. Sermilik Station, Greenland
16. Zackenberg Research Station, Greenland
17. Vostok Station, Antarctica
18. The British Antarctic Survey's New Research Station Halley VI, Halley Bay, Antarctica
19. Princess Elisabeth Station, Antarctica
20. Neumayer Station III, Antarctica
21. Concordia Base Dome C, Antarctica
22. Sanae IV, Antarctica
23. Amundsen-Scott South Pole Station, Antarctica
24. North Pole-39 Ice Drifting Station, Russia
25. IMS Building Palmer Station, Antarctica

Week 3 to 6 | Form-finding aims at transforming the architectural object from a static to a dynamic condition. Here, the protocol will lead to the development of a computational engine that propels architectural morphologies. While the development of the building design and its relation to the computational procedure is an important aspect, the association of parameters will provide a handle on complexity as it hints to directions in which the solution can be developed.

Week 6 to 8 | Form-manufacturing will unite efficient techniques to investigate consequences of envisioning the architectural object as a sensitive system that reacts to its extreme environment. This last phase will culminate with the fabrication of full scale prototypes using digital fabrication technologies such as multi-material 3d printing and CNC milling. Here, the prototype is used to define the connection between the formal definition of the object, its material definition and construction process. Through the use of generative design techniques, the produced architectural system will aim at analyzing the notion of complexity produced by a wide range of parameters put in motion.

All along these three phases, the project will gradually take shape as a result of a constant re-assessment of the various protocols and architectural models being produced. It is therefore essential that the production of information, treatment and cross-analyses of the various architectural models reflect an intense investigation in the design process both in the theoretical and practical discourse.

Each one of these three protocols will be analyzed on the level of ontology (the principles shaping the discourse), design strategy (design organization and process) and the approach toward technological tools. These three subjects will be analyzed in a broader context of theories and practices related to technology and in particular its influence on the architectural object.

5. Course Organization

The course will be organized on the basis of a series of 11 research groups. *Phase #1 | Form-making* will be produced individually whereas Phase #2 and #3 will be produced in teams of 2 students.

Lecture-based visits of researchers whose work is related to the Great North have been organized.

Alessandra Ponte, Professor, École d'architecture de l'Université de Montréal:
Wednesday May 29th at 10:00am

Alain Fournier, architect:
Date to be confirmed

Matthew Biederman, Artist, Artic Perspective Initative:
Wednesday May 15 at 10:00am

Bruno Tremblay, Associate Professor, Department of Atmospheric and Oceanic Sciences, University McGill*:*
Monday June 7 at 10:00am

Students are required to be equipped with computers using the following software packages: Rhinoceros 4.0 at least, VRAY or any photometric rendering software, Adobe Indesign and Illustrator.

The studio will be organized according to an open source system: all students and groups will share information. The quality of the project will highly depend on the amount of information being produced, translated and shared with other research groups. As such, the course will act as an experimental laboratory located in a design studio space where computers and required material will be set up. Due to the importance of interaction in the design process, it will be mandatory to perform all works within the studio while sharing information at all moments with members of other groups. Similarly, it will be required to be present at all time during the sessions.

Due to the use of digital information, each group will perform a daily backup of all information being collected, analyzed and produced.

Each group will produce the following items at the end of each phase:

- One multi-page PDF file that follows a template to be specified. The PDF will gather all information produced during the design process with an explanatory set of diagrams and text. (it is therefore essential to keep all information being produced and collected from the first minute of the course to the last moment of the experiment)
- One representative image with a resolution of at least 2400x1800 dpi, .TIF format with saved alpha channels
- One-page essay that describe the design process and engaged protocol (.doc file)
- Each team will produce a full-scale prototype for the final presentation.

Each team will get 10 minutes talk maximum at each of their presentations.

Each group will provide the instructor with a hard copy of the PDF file along with a CD-Rom or DVD of all material described above on the final review day.

6. Expectations and Objectives

This semester will reinforce and extend issues introduced in your past academic and professional experiences (critical theory, history, technology, and media). The lessons and experiences of the earlier studios were directed at introducing architectural issues, skills/techniques, design methodologies, and texts fundamental to an understanding of architecture and the processes of design. You learned to see and record the physical environment, develop basic research and presentation skills, produce specifically architectural work (plans, sections, diagrams, models, formal analyses, etc.) and explore compositional strategies and spatial ideas. You were also introduced to notions of architecture as both a participant in and product of culture. The studio will introduce you to new issues, theories, environmental and

architectural strategies. We will stress an understanding of the relationship between intentions, devices, and media and their architectural implications as it builds upon the concepts and design methods you have developed in the past. The primary concerns of this semester include promoting an understanding of the critical role that architecture plays in the creation of, and intervention in the natural environment, as well as an increasing sophistication regarding building design. The generation of form will be discussed as a conceptual and cultural response to determinants such as program, site, tectonics, language, type, precedent, new technologies, and building construction. It will be explored in a series of issue-oriented and research-intensive design problems. This discourse is expanded through attention to transdisciplinary opportunities and didactic vehicles that develop the understanding of design theory and processes and their relationship to generating architecture.

This studio will address the complex, multifaceted issue of meaning and its transmission through architectural form as a criterion in the design process. To these ends, you will be asked to develop a critical (and self-critical) relationship to the architectural knowledge you are acquiring, and its application to your work. Issues in this studio include promoting a consistent design development of architectural ideas within a complex building type; promoting an appreciation for the critical interrelationships that exist among design, history, theory, structures and building technology; and context as both determinant and consequence. This studio proposal should help students clarify relationships between four aspects of design thinking: research, criticism, production and discourse. Individually and in groups students will pursue research that will directly inform their design work and contribute to the discourse of the studio; research is to be understood as a necessary component of design and a basic component of graduate education. Informed speculation and experimentation are encouraged; research, criticism, production and discourse are to be understood as simultaneous endeavors. Drawing, digital and physical modeling allows one to respond to research and raise architectural questions that may lead to subsequent inquiry. Using one's own work as a lens through which to study historical and methodological problems is to situate oneself in a contemporary debate. ARCH 677 is a single studio where students share research studio exercises, pin-ups and presentations. All reviews are considered an open forum for clarification, discussion and debate. Previous technical and theoretical knowledge will be intensively exploited during this studio. Your ability to fully engage in the exploration of your design work is of paramount importance. This includes active participation in discussions of readings and projects. You are expected to be decisive in addressing the issues raised in each project and demonstrate a great willingness to explore new design methodologies. Individual initiative throughout a project, evidenced by productivity in the design process and self-directed research outside the studio, represents your effort to assume critical responsibility for your work and the learning process.

7. Evaluation

Studio work is graded on the basis of actual performance rather than potential. Performance, in this case, is defined as a combination of intention, participation, production and anticipation. Evaluations are based on a student's capacity to direct and engage her/his own work and participate in studio discourse. Students should be able to discuss the ideas embedded in their work and question and respond to and interpret suggestions and ideas that emerge during the various moments of criticism. In addition to complete and competent projects executed over the course of the semester, engaged, intellectual pursuit is expected. Students will be expected to speculate and advance their project without daily or individual contact with their professor. Do not wait to be productive. Being prepared with new work in order to anticipate every studio session is also an expectation of this studio.

Project Performance: 50%
Group Participation: 30%
Daily Preparation: 20%

Interim grades will be issued for all students. Work performed during the course of the semester will have equal bearing on the final grade. Grades will reflect evaluation of both the product and the process of a studio problem. If, at any time, a student is unable to meet the outlined requirements, or has problems or questions concerning this course, s/he should see the instructors immediately. If a student is performing below an adequate level s/he will be informed and a meeting will be scheduled to uncover the difficulties.

8. Attendance

Students are required to attend all studio sessions including reviews, discussions, films, and studio related field trips. Missed classes without a medical or religious observance excuse are not allowed and may result in a lower grade. **To benefit from classmates in your studio and others in the school all students should work within the studio**. The studio environment, at this school and others, depends on mutual respect by all members of the academic community. The studio is a space shared by all – it is a place of research, active discussion, and production. The ability for all individuals to focus on their work must be respected.

9. Readings

A copy in PDF of each article will be posted on My Courses for you to download or print.

Reading for Wednesday May 8th:
Bravo, Michael T. *Arctic Science, Nation Building and Citizenship*. In Collective. *Northern Exposure. Peoples, Powers and Prospects in Canada's North.* Proceedings of the Conference The Arts of the State IV. Montreal, The Institute of Research on Public Policies, 2009. P.141-168

Reading for Wednesday May 15th:
Biederman, Matthew and Marko Peljhan. *Fieldwork Journal: Foxe Basin 2009*. In Collective. *Architecture*. Arctic Perspective Cahier. Vol. 1, Ostfildern: Hatje Cantz, 2010. P.115-141

Reading for Wednesday May 22nd:
Walker, Marylin. *Circumpolar Shelters*. In Collective. *Architecture*. Arctic Perspective Cahier. Vol. 1, Ostfildern: Hatje Cantz, 2010. P.61-81

Reading for Wednesday May 29th:
Emmerson, Charles. Chapter 7.Consequences: Reworking Geography. In: *The Future History of the Arctic*. New York: PublicAffairs, 2010. P151-165

Reading for Friday June 7th:
Pfirman,Stephanie, Tremblay**,** Bruno**,** Fowler, Charles. Going with the Floe? In: American Scientist; November/December 2009, Vol. 97 Issue 6, p484-493.

Reading for (date to be confirmed):
Ponte, Alessandra. "Journey to the North of Quebec." *AA files* 63 (November 2011 2011). P46-55