Mackintosh School of Architecture

The Glasgow School of Art

Research Project 4

The Modernist Search for Specific Architectural and Urban Typologies in Arctic Development of XX Century.

Mstislav Kochkin (16002482) 20 Apr. 2021

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Thesis

The activity of architects, engineers and urban planners in Arctic region with changing intensity lasts for more than a century, being an integral part of formation of its environment. Even considering certain regionality of issue, architectural discourse, optimisation of structural engineering techniques, discussion of urban planning potential and development of local community did not stop. Interest towards Arctic and analysis of XX century decisions actualised in last 20 years.

This work targets at discussion of Modernist architectural and urban planning concepts of XX century, search of specific Arctic typologies and influence of Modernism on region development. To achieve this, I will cover general notion of *Arctic macroregion* joined with severely cold climate, permafrost, remoteness, specificity of urban communities, demographic indexes and indigenous lifestyle, and absence of considerable architectural heritage. It was incorporated to "Southern World" through urbanisation and modernisation, initiated by political elites of circumpolar countries **(*Appendix A1*)** and contained social engineering elements, including Inuit relocation **(*Appendix B1*)**, use of specialists' exploration virtue and changing private/public ratio for creating new Arctic community for comfortable living. Such conditions facilitated construction of pre-planned Northern cities, strong rationalisation of building approaches and radical urban and architectural transformation of environment. The analysis of paper and completed projects allowed me to work out common for different countries path from experimental domed cities with artificial environment to conventional climate-responsive settlements with outdoor spaces, characterised by reduced national particularity and acquired signs of Modernist universality. This resulted in creation of specific

typology for Arctic urbanism. Two case studies, Ralph Erskine's "Arctic City" and Soviet "Microrayon," were selected to identify similarities between Western and Soviet expressions of Arctic-specific urban typologies.

1.2 Literature Review

In my study, I used extensive search of original XX century and contemporary scholarly books and articles, that focus on Arctic architectural, construction and urban development as well as related geographic, climatic, political, economic, historic and sociological aspects in printed and digital forms. The sources are published as monographies, studies and projects published in university resources, professional journals and scientific conferences editions. Research studies and monitoring reports of intergovernmental bodies and international organisations, newspaper articles available at official websites are represented. The archive materials include XX century physical and online resources, such as dissertations, technical materials, digitalised graphic and photo works by architects. Demographic, economic and climate statistical data is found in academic studies and resources of international organisations, such as World Bank, Arctic Council **(*Appendix A2*)**, etc.

However, some challenges were faced during assembly of literature. Due to COVID-19 restrictions opportunity for physical access and quick digitalisation of resources kept in libraries and archives of Northern cities were limited. Soviet publications and occasional works and projects for professional use had scarce number of copies in libraries and still do not have digital editions. Moreover, like "real scientists", Soviet architects preferred results of their research and design proposals to be published in brochures and professional journals,[1] that are usually available only in physical form and limited to be digitalised. Unlike untranslated Soviet

[1] Ekaterina Klemeneva, "Arctic Modernism: New Urbanisation Models for the Soviet Far North in the 1960s," in *Competing Arctic Futures: Historical and Contemporary Perspectives*, ed. Nina Wormbs, (London: Palgrave Macmillan, 2018), 232.

publications in Russian (native speaker), Scandinavian publications, untranslated in English, could not be used.

1.3 Methodology

As the main goal of the work was identification of unique features and results of elaboration of typologies, suitable for Arctic cities, understanding of their relation to Modernist ideas and circumpolar identities, critical and historical analysis approaches were selected. I used following methods: comparison, contrast, systematisation, extrapolation of practices of different countries in one region, reflection and graphic representation of assembled data. The procedure of writing the study can be summarised if five stages.

In the first stage area of study, where Arctic cities are located, was determined and the notion of *Entire Arctic,* that consists of Low Arctic, High Arctic, Subarctic and some Northern territories, was worked out.[2] Derived external borders are graphically presented in two finals maps, that result from composition of official Arctic zonal, political borders', Arctic circle, 10°C isotherm maps, AMAP and CAFF **(*Appendix A3, A4*)** monitoring and SWIPA **(*Appendix A5*)** permafrost distribution maps, main urbanisation centres of 5,000+ residents and smaller settlements deemed important for study. Studying of Arctic people's relations with rest of World, their cultural identification and transnational consolidation was completed at this stage. The second stage embraced research of Modernist approach characteristics in Arctic building principles formulation, project design process and final realisation in 1950s – 1990s as well as social engineering manifestations and interrelation with Modernism. The third stage included extraction of most influential paper projects, analysis of their development evolution and comparison of design approaches in circumpolar countries. The listed projects graphic timeline and typological table were produced. The fourth stage studied partly and fully completed

[2] Peter Hemmersam, "Arctic Architectures," *Polar Records* 52, no. 4 (2016): 416.

Modernist proposals in different countries with consideration of previously formulated principles and importance of experiments and standardisation for architectural and urban results. Graphic timeline also was produced to demonstrate approved concepts and type of funding in USSR, Canada and Sweden. In the final stage of writing procedure two influencial Modernist proposals from different political, social, and economic systems, *Arctic City* (R. Erskine) and Soviet *Northern Microrayon* (V. Nepokoichitsky & A. Rastorgueva), are compared to identify principal similarities, caused by climatic and structural engineering challenges, Modernist building approaches, as well as common goal of creating comfortable conditions for Arctic residents. The comparison was based on initial paper designs, partial completion in Resolute Bay, Svappavaara and Kiruna and full completion in Fermont, Norilsk and Murmansk.

CHAPTER 2

ARCTIC AS AN ENTIRE REGION

The basic aspects of Arctic Modernist development are rooted in principal differences of the region against temperate latitudes lands. Identification of Arctic border and elaboration of its uniform definition still creates difficulties due to variety of approaches. Even geographic border is not strictly determined **(*Fig. 2.1)***. The Arctic Council, other international organisations, lawyers and scientists offer different delimitations. Arctic circle (66°34' north) is widely accepted but does not include parts of High and Low arctic and most territory of Subarctic zones. The 10°C isotherm does not cover many territories of Finland, Sweden, Russia, Canada and US within Polar circle. The 1984 US law incorporates all Aleutian Islands and wide territories outside Arctic.[3] In 1998 AMAP and CAFF proposed a collaborative multi-factor approach for border formation, taking in account geological, physiographic and bioclimatic features and assembled experience of Far North. The SWIPA study of permafrost distribution and its subwater occurrence dynamics, is an important construction aspect of results. Created based on methodology approach maps reflect Arctic territory, united by similar conditions, that defined shelter strategies and formation of urban centres. Polar day and night, seasonal contrast and annual daylight temperature fluctuation (from -68°C to +30°C) are accompanied with strong winds and blizzards when average snow drift can reach 1 meter high. The average July temperature in High- and Low-Arctic is 0°C to 7°C, and 3°C to 12°C in Subarctic. The annual wind speed in region is from 3.8m/s to 6m/s, that is not suitable for outdoor presence at temperatures -20°C and -5°C respectively **(*Appendix C1*)**.

[3] Mark P. Nevitt and Robert V. Percival, "Polar Opposites: Assessing Environmental Law in the World's Polar Regions," *B.C.L. Review* 59, 4 (2018), 1660-1661.

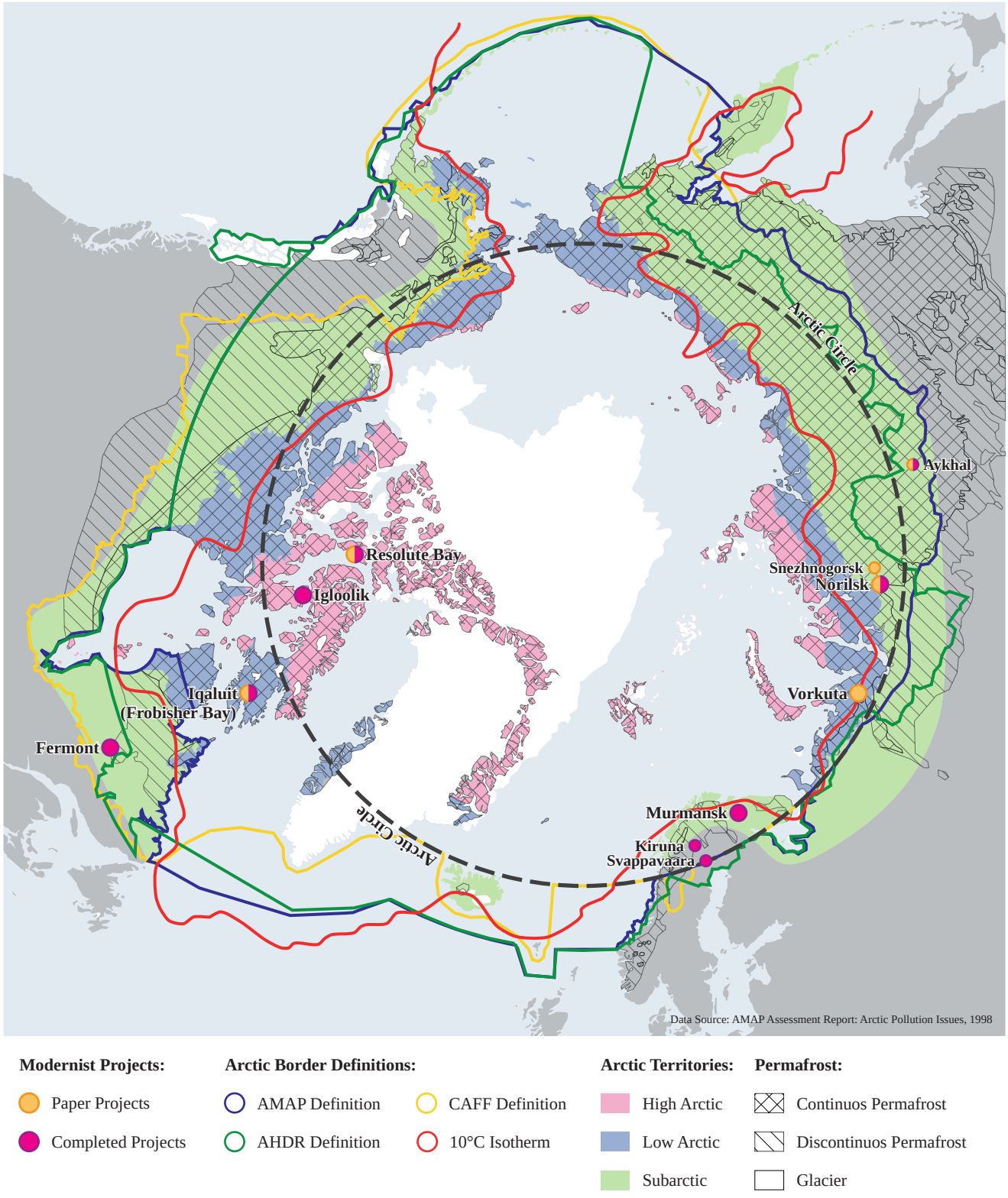


Figure 2.1: Variety of Arctic Definitions.

However, these conditions did not prevent rapid urbanisation and industrialisation of previously rural territories, that accommodated small indigenous ethnicities and specialised settlements. Indigenous dwellings were not suitable for newcomers' permanent living and did not have any value for them, despite common necessity in survival in North. During 1950s to 1990s period Arctic population grew from 3.15 million to 6.037 million (maximum Arctic share of the World Population ever) whose 2/3 concentrated in 17 major cities **(*Appendix C2*)** **(*Fig. 2.2*)**. Apart from low density, demographic characteristics included high proportion of men, low proportion of elderly, high birth rate, low life expectancy and high migration mobility.[4] Consequently indigenous people became ethnic minority everywhere except Greenland and North-Western territories of Canada during Modernist experiment, when urban population reached 80% of the whole region and newcomer urban lifestyle was difficult for aborigines to adopt.[5]

Arctic's geopolitical significancy and resource exuberance determined intersection of powerful interests in areas of possession of land and appearance of settlements around commodities fields, transport routes and scientific and military bases. Even after active extraction of fossils in discussed period, according to 2009 geological survey assessment undiscovered oil and gas north of Arctic circle may be found there a 30% and 13% respectively of World reserves.[6] A map below **(*Fig. 2.3*)** demonstrates zones of circumpolar countries'

[4] Andrey Smirnov, "The Arctic Population: Dynamics and Centers of the Settlement System," *Arctic and North* 40, (2020), 228, 232-233.
[5] Nordic Council of Ministers, *Megatrends*, ed. Christopher J, Smith, (Copenhagen: Datagraf, 2011), 22-24, https://www.norden.org/en/publication/megatrends-1
[6] Donald L. Gautier, "Assessment of Undiscovered Oil and Gas in the Arctic," *Science Magazine* 324, (May 2009), 1175.

Figure 2.2: Major Arctic Cities

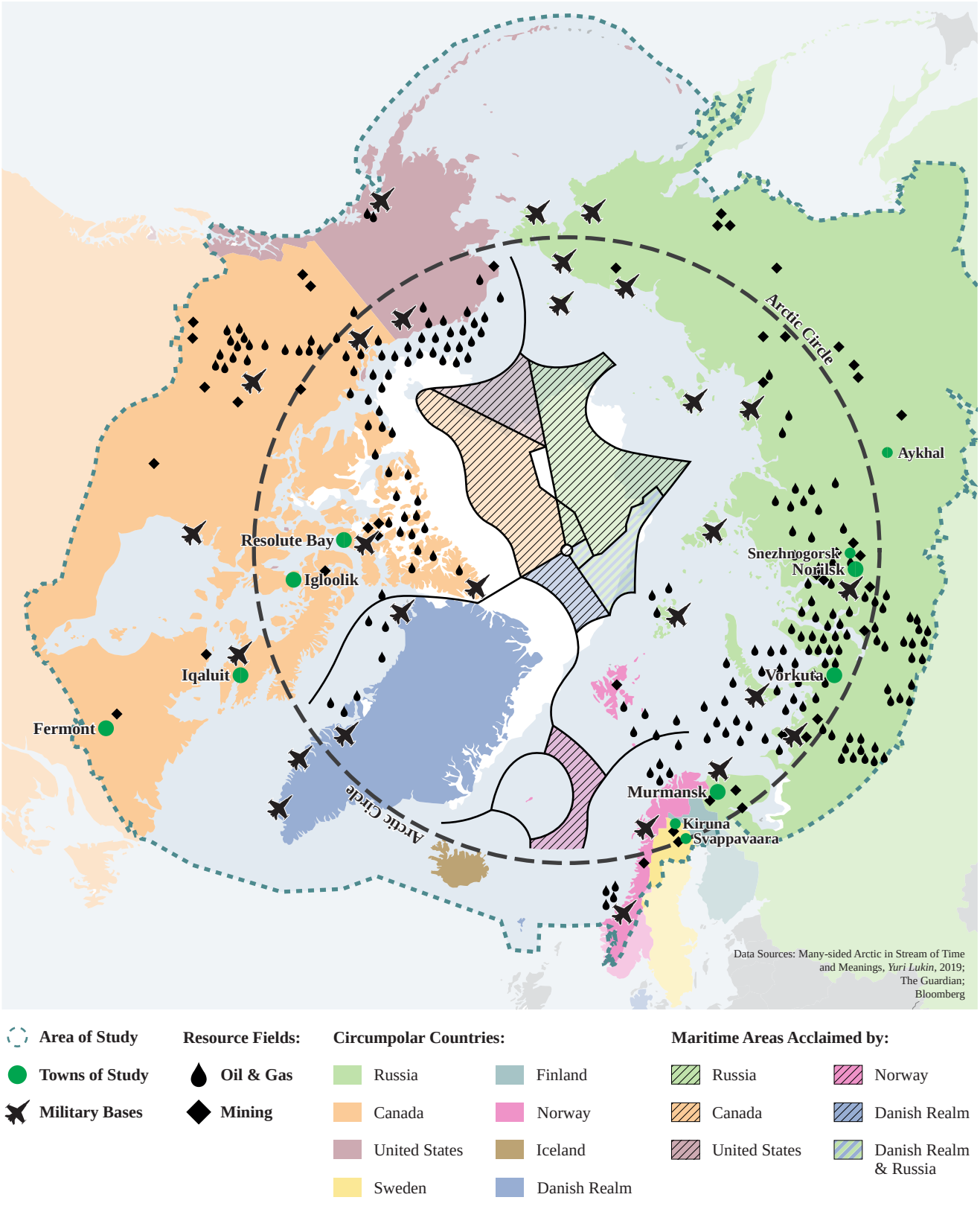


Figure 2.3: Map of Arctic Terrestrial Control

control, main resources fields allocation.[7] However, Arctic wellbeing, declared by Modernist developers, not always correlated with such level of local affluence. Economic recessions triggered fields and factories closure and abandoning of settlements. Initially permafrost was an obstacle for erection of Modernist buildings. Then its thawing due to climate change damaged Arctic settlements and infrastructure, including airports and water and waste distribution that can increase costs of maintenance and cause obligatory relocation.[8]

Arctic development with central role of governments and limited private initiatives had centre-peripheral type of connections and partly colonial character (in Russia from XVIII century). Together with unsustainable modernisation and resource extraction it destroyed traditional relationship between human and nature and caused Arctic-specific new community creation.[9] However, common problems of Arctic development in discussed period led to cross-border initiatives and later creation of international and regional organisations. The Arctic Council, including indigenous associations, the Nordic Council **(*Appendix A6*)**, the Barents Region Euro-Arctic Cooperation **(*Appendix A7*)**, and WWCAM **(*Appendix A8*)** work to eliminate controversies and mobilise people for cooperation. Now it is widely accepted that Arctic was an entire region with shared challenges, interests and values stretching over nations regardless of borders with no-state actors and multiple cultural layers. Regional and National world views may converge into unique circumpolar multilevel identity.[10]

---

[7] Yuri Lukin, *Many-sided Arctic in Stream of Time and Meanings*, (Arkhangelsk: Bulatov Publishing, 2019), 35, https://russian-arctic.info/projects/biblioteka/mnogolikaya-arktika-v-potoke-vremeni-i-smyslov-/

[8] Arctic Monitoring and Assessment Programme (AMAP), *Arctic Climate Change Update 2019*, (Odder: Narayana Press, 2019), 9, https://www.amap.no/documents/download/3295/inline

[9] Julia Lajus, "Colonization of the Russian North: A Frozen Frontier," from *Cultivating the Colony: Colonial States and their Environmental Legacies*, (Athens Ohio: Ohio University Pres, 2011), 184-185.

[10] P. Schweitzer, P. Skold and O. Ulturgasheva, "Culture and Identity," from *Arctic Human Development Report*, ed. Joan Larsen and Gail Fondahl, (Copenhagen: Nordic Council of Ministers, 2015) 131-132.

Same conditions in circumpolar countries created universal difficulties for Arctic architects, urban planners and engineers. Thus, common challenges in environment transformation and generation of Arctic-specific architecture and urbanism caused similar responses.

CHAPTER 3

MODERNISM AND ARCTIC DEVELOPMENT

The efforts in defining Modernism still provoke debates due to variety in its manifestations. In this work it is determined as cultural movement, that pursues reflection of modernity, breakup of tradition and its continuity, radical change in methods of objects creation and fundamental truth search for sake of formulation of new society principles.[11] In architectural design these visions were incarnated in respect for purity of simple geometric forms and planar surfaces, rational and straightforward building expressions without applied decorations and use of industrial materials and products.[12]

Researchers of Arctic and World examples of completely new Modernist cities actively use the term *High Modernism.* In "Seeing Like a State" James C. Scott says: "High Modernism is a strong version of the beliefs in scientific and technical progress that was associated with industrialization…" – and highlights its following signs: truly radical break with history and tradition, limitless ambition to control and transform nature to suit man's growing needs, sweeping and rational engineering of social life with avant-garde among engineers, architects, planners and technocrats. To achieve this, state power, people's enthusiasm and revolutionary hubris were used.[13]

Canadian and Soviet passionate elites formed strong demand for economic and military modernisation and social mobilisation in 1950s. To foster Polar mastering governments used specialised institutions. In Canada heavily state-funded Arctic Institute of North America

---

[11] Sam Phillips, *Isms: Understanding Modern Art,* trans. M. Visel, N. Chamina & A. Shestakov, (Moscow: AdMarginem Press, 2012), 28.
[12] M. Fazio, M. Moffett and L. Wodehouse, *A World History of Architecture*, (London: Laurence King Publishing, 2008), 518.
[13] James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Conditions Have Failed,* (London: Yale University Press, 1998), 88-94, 145.

(*Appendix B2*), that cooperated with Northern Co-Ordination and Research Centre, a part NANR **(*Appendix B3*)** produced unprecedented number of projects. Declaration of *Northern vision* by J. Diefenbaker in 1958 **(*Appendix B4*)** gave further impetus for creation of "Model Arctic Communities" with all necessary amenities. The issue of insufficient population on selected site was solved by organisation of administrative centres and Inuit High Arctic Relocation.[14] Yet in USSR Stalin period of Arctic development by GULAG camp ***(Appendix B5)*** prisoners, had ended. Hence Department of Urban Planning in Far North and Committee of Northern Issues ***(Appendix B6)*** actively started to develop projects and propagate idea of Arctic Socialist Town to employ romantic specialists. Khruschev's 1956-1965 housing reform ***(Appendix B7)*** influenced Polar urbanisation process due to development of elementary planning formations aka *Microrayon*.[15]

Arctic Modernist Architecture principles were elaborating in all circumpolar countries. Studying of works by two most celebrated Western and Soviet Arctic Architecture theorists: "Building in the Arctic" and "Architecture and Town Planning in the Far North" by Ralph Erskine and "Polyar – a Residential Complex for polar regions of the Far North of the USSR" by Alexander Shipkov, assisted in highlighting of common tenets as a starting point:

1. *Indigenous structures are not suitable for comfortable living of newcomers, hence new Arctic-specific symbolic typology should be designed.*
2. *Temperate latitudes typologies cannot be mechanically transferred and adopted to Northern conditions.*
3. *Arctic architecture is a mean of protection from Northern climate, that defines form and design.*

[14] M. Farish and P. W. Lackenbauer, "High Modernism in the Arctic: Planning Frobisher Bay and Inuvik," *Journal of Historical Geography* 35, (2009): 520, 525-526, 530-534.
[15] Kalemeneva, *Arctic Modernism*, 232-234.

4. *New Northern community culture should be created with help of enthusiastic specialists and advanced public services, education, healthcare and recreational facilities.*

The principles below were being worked out by theoretic research, experimental design and pilot construction. Urban planning of settlements located next to production area (mine, port, etc.), based on compact buildings allocation with microclimate improvement by shielding from wind and snow with residential volumes, use of meridional and latitudinal orientation for minimisation of wind-exposed streets and passageways[16] and "sun trapping" with town placement in south-elevating slope. All residential and public buildings had to follow rationalisation, functionality and availability of all necessary amenities (schools, shops, meeting spaces etc.) for comfortable living, including sun-oriented childcare facilities.[17] Architectural design required simple streamlined shapes without acute angles and large openings, air locks in front and rear door, distribution of community clusters in interior spaces or detached volumes, that could be connected with adjunctions or covered walkways.[18] Engineering solutions suggested use of new efficient technologies, industrial assembly methods, high-quality materials and secured self-sufficiency with appropriate power source, including nuclear.[19] Elevated structures on pile foundations would provide stability on permafrost, prevent its thawing and protect from snow drifts, while advanced insulation methods and multiple pane windows would keep spaces warm.[20] All communication lanes had

[16] A. Shipkov & Y. Truschinsch, *Experimental Residential House with Roofed Courtyard in Norilsk*, (Norilsk: Project documentation, 1962), 4-9.
[17] Ralph Erskine, "Architecture and Town Planning in the North," *The Polar Record* 14, no. 89 (1968), 166-169.
[18] Mats Egelius, *Ralph Erskine, Architect*, (Stockholm: Byggforlaget, 1990), 68-70.
[19] E. Gardner and W. Fancott, "Frobisher Bay: The Design of Accommodation for a Community of 4500 People," *Department of Public Works Building Construction Branch*, (Architectural Project: 1958), 3, 10.
[20] Eb Rice, *Building in the North*, 5th ed., (Fairbanks: University of Alaska Press, 2008), 21-32, 53-62.

to be placed in warm chutes. Their length and number of junctions had to be minimised.[21] Putting emphasis on human combat against harsh climate, early projects changed relationship between environment and dwelling. Confidence in contemporary technological advance facilitated change in attitude towards Polar lifestyle from temporary nomadic and scientific shelters to permanently erected cities in their place.[22] However, Shipkov pointed out economic efficiency as a provision term of Western Arctic construction and offered planning of district for minimum 1500-2500 residents and full-time women's employment by removal of household activities from daily timetable to achieve same results in USSR. Also, he argued Government's imperative towards construction of permanent towns and large development facilities in all regional production areas. Refuse of "expedition" principle of limited resource extraction and Canadian positive experience of temporary prefabricated settlement was questioned by him.[23]

Overall, modernity engrained in Arctic (especially in USSR with Avant-Garde experience) due to remoteness of vast territory without established horizontal connections between settlements and communities; extreme climate conditions as a Paradise for search of new technological solutions; space-like area for successful realisation of "human over nature" idea; absence of considerable historical and cultural background to break up with.[24]

---

[21] Vitold Nepokoychitsky, "Characteristic Aspects of Urban Development in Norilsk," *The Problem of the North* 10 (1964): 104.
[22] Juile Decker, *Modern North: Architecture on the Frozen Edge*. (New York: Princeton Architectural Press, 2010), 9-10.
[23] Alexander Shipkov, *Polyar – a Residential Complex of Polar Regions of the Far North of the USSR: The Main Issues of Spatial Shaping*, (Moscow: candidate dissertation thesis, 1971), 96-97, 107.
[24] K. Nedza-Shikoniowska, "European modernity in the Soviet Arctic – problems of planning and development of northern cities based on Igarka and Norilsk cases." *Arctic Scientific Herald journal 6*, (2019): 62.

CHAPTER 4

ARCTIC MODERNIST PAPER PROJECTS

All paper design proposals followed previously formulated Modernist principles, especially streamlined shapes, raised ground floor, and stilt or pile foundations, where necessary. Degree of isolation from outdoor environment, and method of its realisation as main polemic topic determined diversity of conceptual designs, however they can be subdivided it two main groups: structures with artificial environment and sheltered outdoor spaces with microclimate ***(Fig. 4.1)***. Proposals' ***(Fig. 4.2)*** description will include visual representations and distinctive features of each design, written in telegraph style.

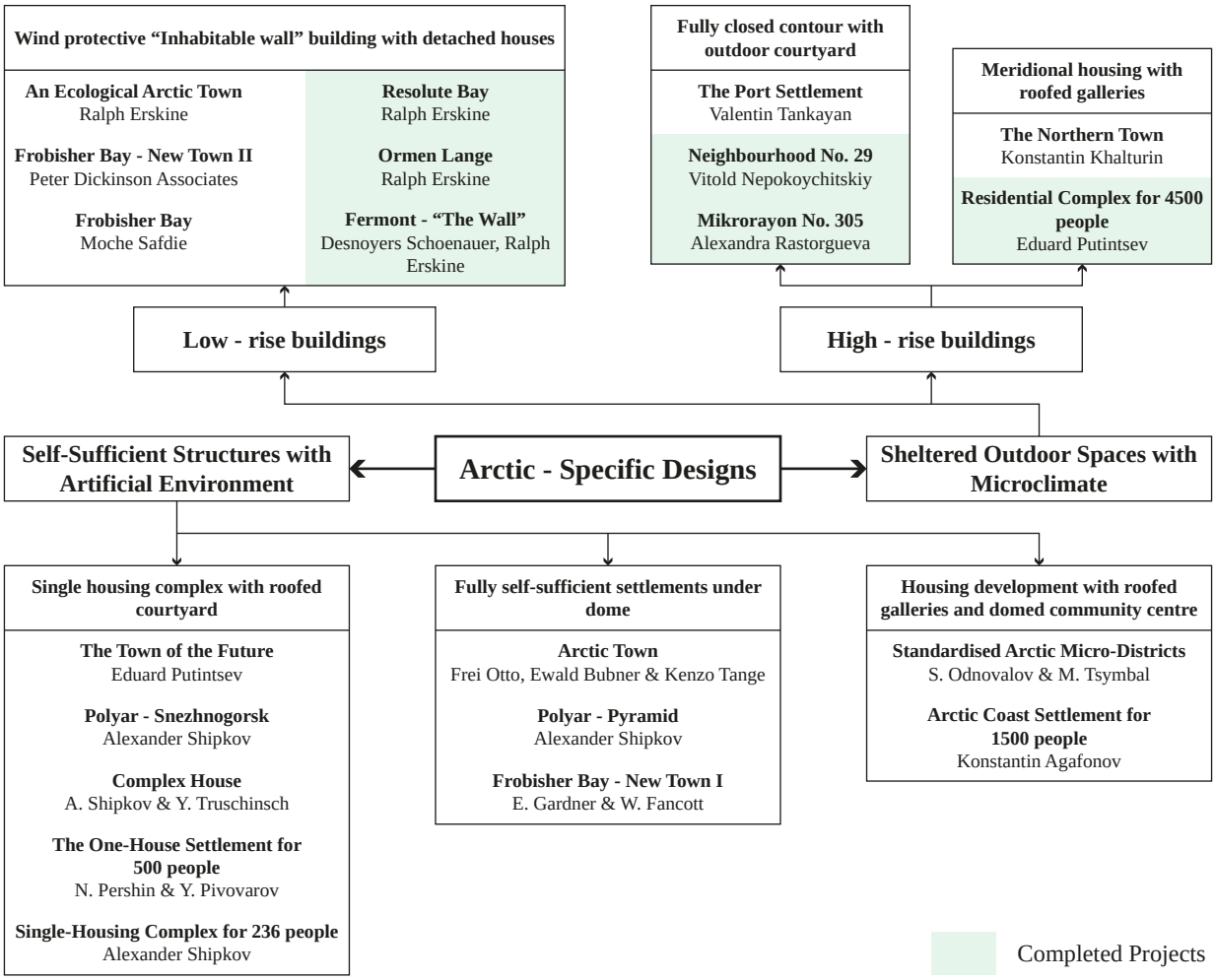


Figure 4.1: Variety of Arctic-Specified Typologies

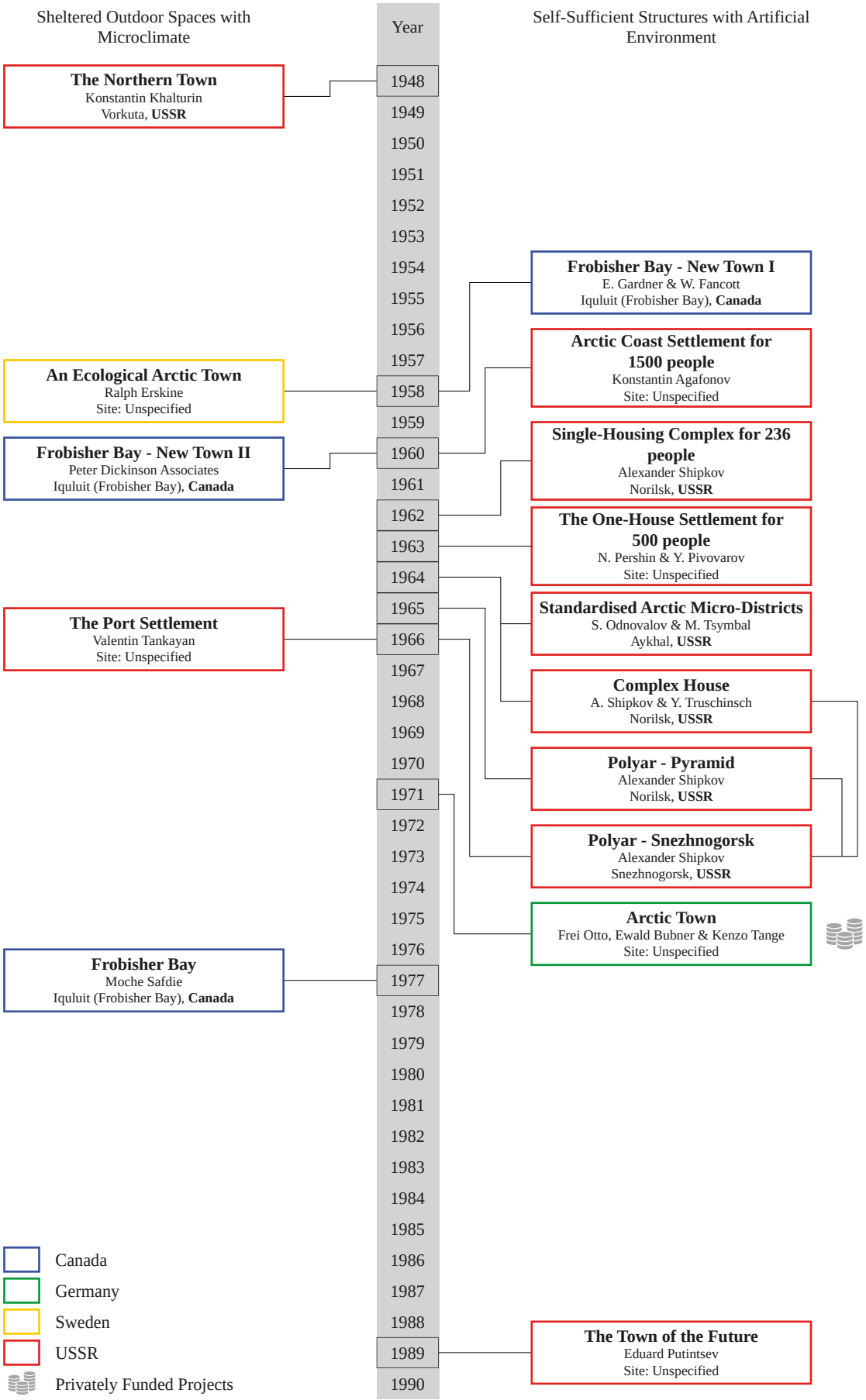


Figure 4.2: Paper Projects Timeline

4.1 Self-Sufficient Structures with Artificial Environment

Self-sufficient structures with artificial microclimate had winter gardens and extended public amenities, including administrative, business and healthcare. The difference lied in degree of isolation from extreme environment in area of construction solutions of domes, covered connections, openings, ventilation systems, high rising and number of residents.

New Town I ***(Fig. 4.3)*** is a self-sufficient town with artificial environment is powered by nuclear plant. It consists of up to thirty-six 12-storey apartment towers around domed city centre, accessed with elevators. Traffic use is minimized, electric monorail and pavements with green spaces are designed. Dome is constructed of thin shell concrete with ribs radiating from central pier like large fan vault. Window plastic is used instead of glass for lower heat loss in winter and better screening in summer. Window frosting is prevented by return warm air utilization and humid air extraction. Hydroponic vegetable garden is proposed, and household facilities are partially transferred to tower cores.[25]

Arctic Coast Settlement ***(Fig. 4.4)*** is a complex of five prefabricated round-shaped buildings with glass roof for lighting of gardens and artificial climate connected with covered galleries, providing the only way of transportation. The largest two-story building served as public centre. Four-story residential blocks accommodated fully equipped flats. Construction solutions suggested minimization of structural moisture corrosion.[26] Agafonov avoided term "Modernism" in context of design as it associated with "Western style" and preferred its description as rational, functional, climate-responsive and technologically advanced.[27]

---

[25] Gardner & Fancott, "*Frobisher Bay,*" 1-5.
[26] Konstantin Agafonov, "Problems of residential building in Far North," (Central State Archive of Scientific Technical Documentation of S. Petersburg, TsGANTD Spb F.R-17 Op. 22 D. 467 L.35-38, 1961), 10-18.
[27] Kalemeneva, *Arctic Modernism*, 228.

The One-House Settlement ***(Fig. 4.5)*** combined all urban typologies into one ring-shape house with central garden under glass dome and windows facing both sides of ring. 4-story building has several exits, that guarantee access during blizzards. Merged piping, electricity, heating and ventilation systems together with conventional shape should cut expenditures by 15-20% comparing to coeval settlements.[28]

Entire Arctic micro-district ***(Fig. 4.6)*** for bespoke capacity: up to 500 (1 tower and a dome), 1000-1500 (3 towers and a dome), 2000-5000 (8-10 towers, passage and a dome or an entire micro-district) and 10000 and above (two micro-districts). 15-story prefabricated reusable residential towers are assembled on site and transported with aircrafts and helicopters. Lightweight construction, made of insulated aluminum and plastic blocks, is fabricated in mild climate areas. The tower has two central elevators, fully equipped ship-like compartments with natural lighting and built-in furniture. A mirror curtain system provides sunlight to north-oriented flats. Windows have no panes as fresh air is delivered with air conditioning system. Towers, main passage boulevard with small public spaces, main geodesic dome with major public spaces, aircraft station, hospital and warehouses are connected with covered galleries. Helicopters, monorail, and electric cars use town's decking transport system.[29]

Arctic City ***(Fig. 4.7)*** is a Fully enclosed domed city 2 km across with artificial environment, that sits in harbour next to airport and outdoor industrial zones. A nuclear plant supplies electricity to town and hot water from cooling system into harbour, keeping it free of ice. Artificial lighting system and movable sails simulate daily cycles and provide light to interior foliage.[30] Pneumatic dome is a network of polyester fiber cables upholstered by two-layered

[28] N. Pershin and Y. Pivivarov, "The Settlement in One House," *Technika Molodezhi* no. 2 (1963): 36-37.
[29] S. Odnovalov and M. Tsymbal, "The Architecture of Inhabited Spaces with Micro-climate," *The Problems of the North* no. 10 (1964): 93-98.
[30] Lee, *Radical Arctic Proposals*, 22-24.

translucent foil, less susceptible to wind, snow and changing loads. After dome is inflated by pressurized air, city construction would take place inside. The interior ring road links housing with administration and recreation areas. There is a small forest at ground level. All buildings are connected by secure basement level, that serves as emergency exit in case of roof collapse. Unlike other paper projects, *Arctic City* was privately funded by firm Hoescht AG.[31]

[31] D. Murphy and B. Emmett, "Frei Otto's Arctic City," *Icon*, 9 April, 2014, https://www.iconeye.com/architecture/features/frei-otto-s-arctic-city.

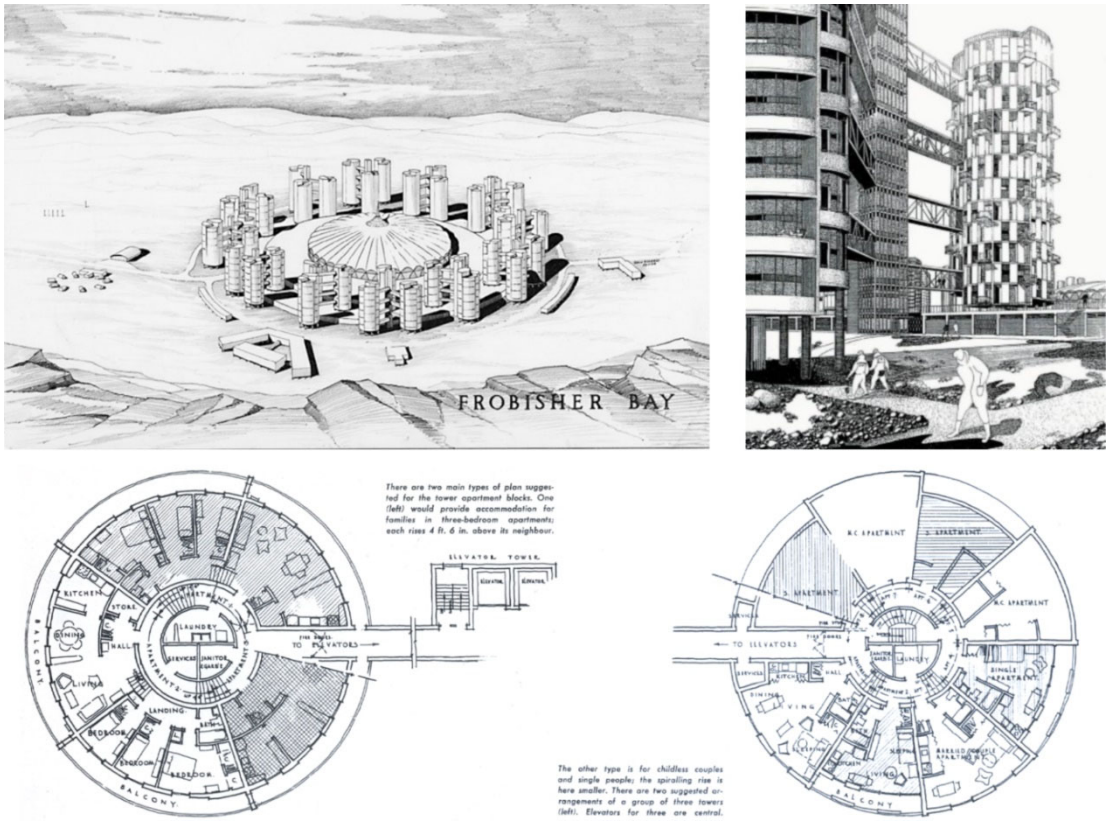


Figure 4.3: Frobisher New Town 1, E. A. Gardner & W. E. Fancott, 1958. 1000-4500 people.

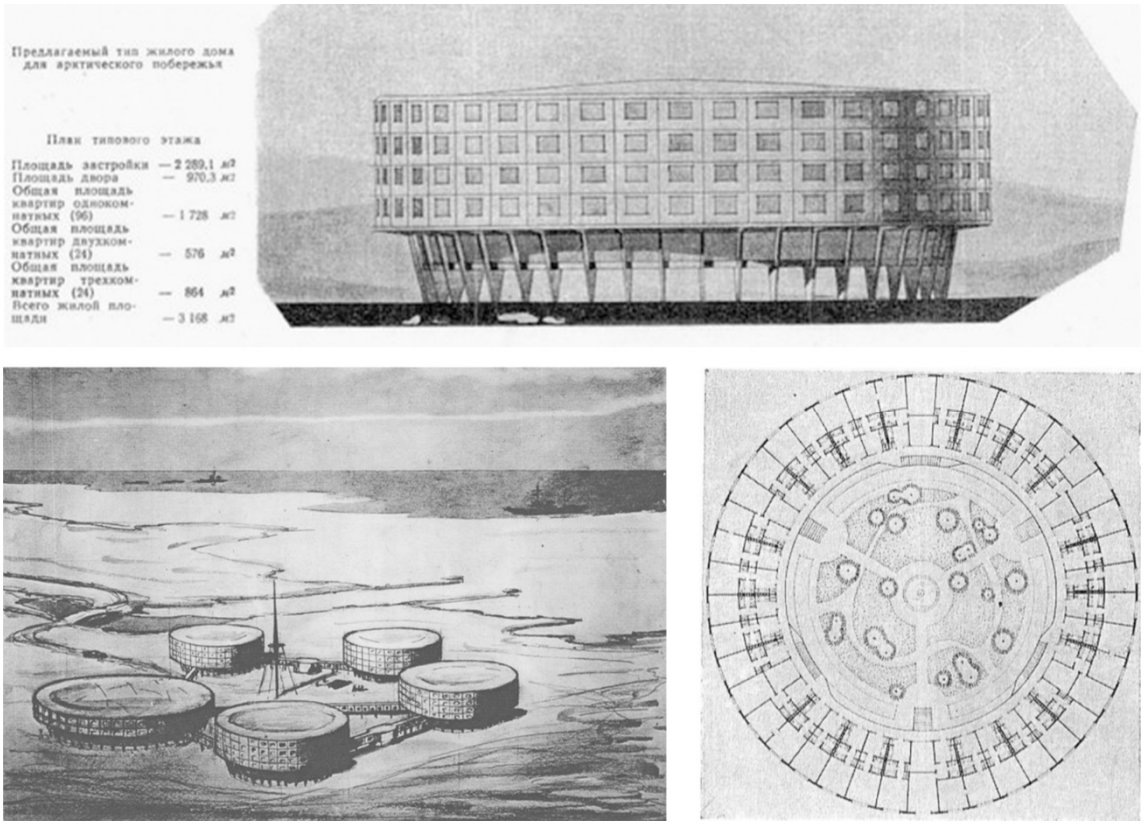


Figure 4.4: Arctic Coast Settlement, Konstantin Agafonov, 1960. 1500 people

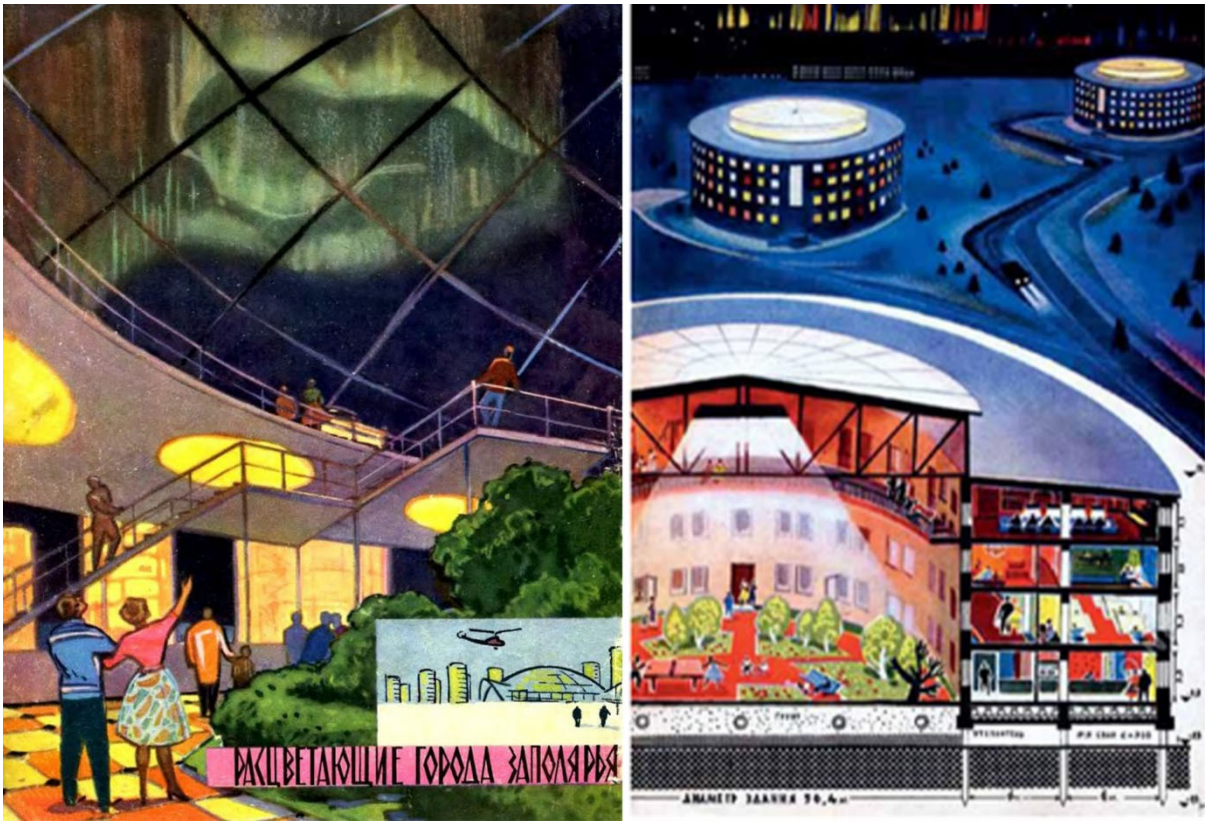


Figure 4.5: The One-House Setlement, N. Pershin & U. Pivovarov, 1963. 500 residents.

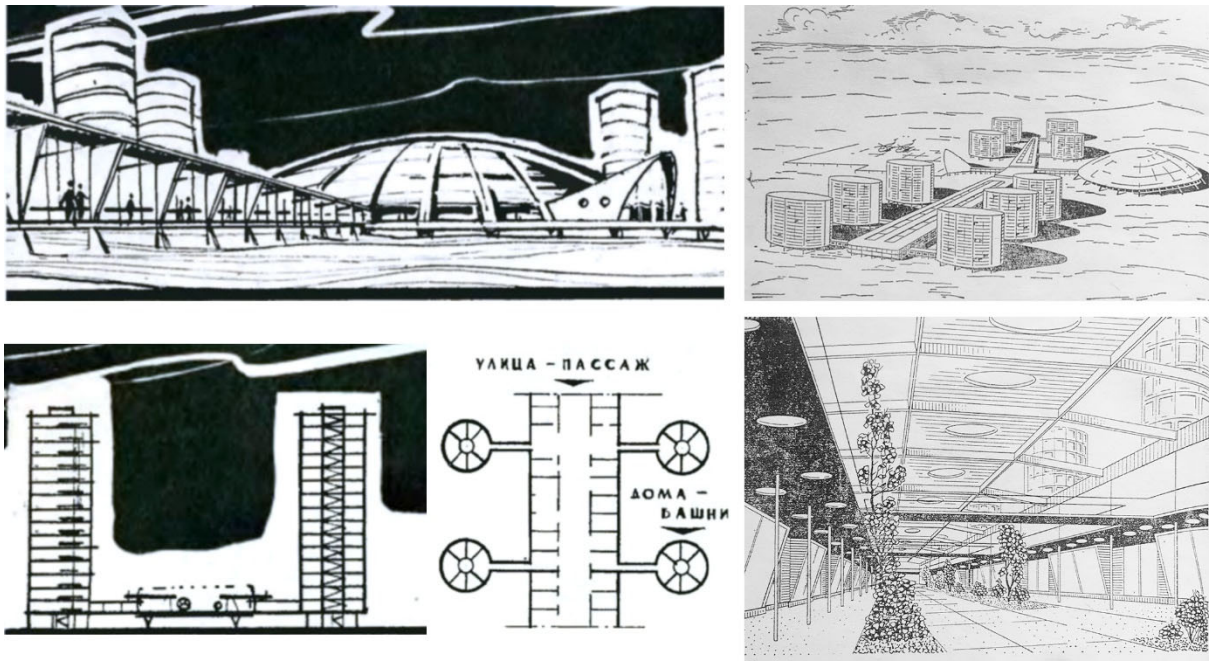


Figure 4.6: Entire Microdistrict, S. Odnovalov & M. Tsymbal, 1964. 5000 residents.

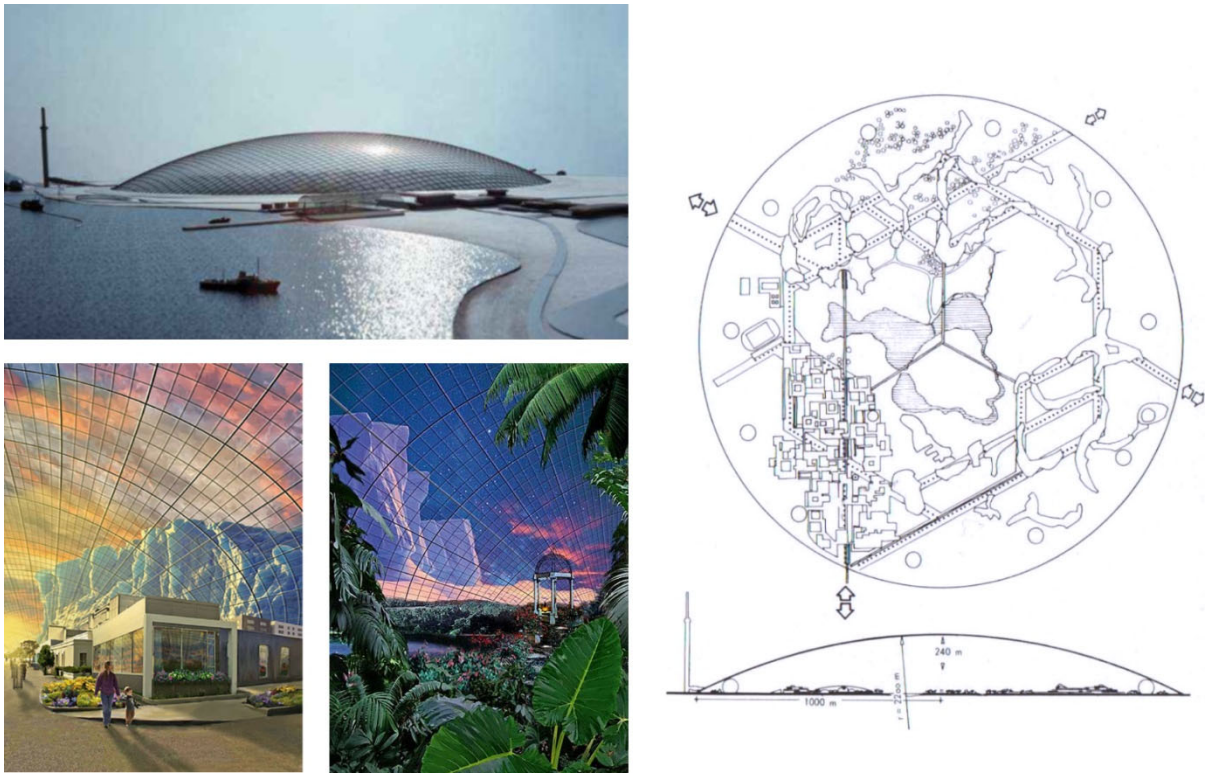


Figure 4.7: Arctic City, Frei Otto, Ewald Babner, Kenzo Tange & Arup, 1971. 40000 people

4.2 Projects with Sheltered Outdoor Spaces

The projects with sheltered outdoor spaces are presented in broad range of designs. However, refuse of full isolation principle was common for them all.

The Northern Town ***(Fig. 4.8)*** was first concept of Arctic development in USSR is to design a contemporary Polar city based on combination of new constructive approaches, accurate site selection, adaptation of city plan to weather conditions, provision of comfortable infrastructure for living and refusal of "alien neo-classicism, that contradicted with Soviet principles and common sense."[32] Constructivist buildings with indigenous façade ornaments connect with covered walkways at attic floor level. Compact building arrangement along directions of major blizzards, minimization of thermal loss by elimination of right angles, control of dimensions of doors, windows and staircases and number of floors, were proposed.[33]

An Ecological Arctic Town ***(Fig. 4.9)*** was Ralph Erskine's theoretic project, that defined his approach in further completed projects. Erskine questioned psychological aspect of domed structures, so his town was a first prototype of sheltered town with microclimate. The town sits on southeast slope to maximise solar gain in conditions of low sun. An inhabited horse-shoe shaped "wall" erected in the north on top of hill protects from wind and snow. Buildings have compact form to minimise heat loss but are distant to prevent shading. Windows sizes vary on orientation, roof shapes are designed with regard for best snow pocketing and removal qualities.[34]

---

[32] Central State Archive of Literature and Arts, (St. Petersburg, TsGALI SPb F. 347, Op. 2, D. 43, L. 25.
[33] Ekaterina Kalemeneva, "The Northern Climate as "an Enemy" and a Resource in Soviet Urban Planning Projects for Arctic Towns in the 1940s," *Surgutsky Governmental Pedagogical University journal* 6, no. 51 (2017): 91-93.
[34] Egelius, *Ralph Erskine, Architect,* 68-70.

Frobisher New Town II ***(Fig. 4.10)*** includes three residential buildings from six to eight stories surrounding town centre with public spaces, raised plaza with commercial and government spaces, school, nursery, hotel and cinema underneath. Residential units are arranged in a long wall-building, that serves as weather barrier and shields plaza's outdoor courtyards from wind and snow. The project proposes use of precast reinforced concrete and lift-slab floors.[35]

Moshe Safdie's *Frobisher Bay* ***(Fig. 4.11)*** proposes prefabricated and structurally independent two-story octagonal modules, arranged in rows, that replace government staff housing unsuitable for indigenous population.[36] They are terraced on a slope, facing the bay and extend vertically, horizontally or diagonally surrounding enclosed public centre. Modules are made of stress-skinned panels covered by fiberglass gelcoat and built on piles with only cold room and vestibule at grade. Using prefabrication as key method Safdie intended to create a new architectural identity for the arctic region.[37]

From 1963 to 1970 Alexander Shipkov proposed four projects for Norilsk and Snezhnogorsk. The first proposal was *Single-housing Complex* ***(Fig. 4.12)*** with roofed courtyard, consisted of four standardized 4-story residental blocks of eight types. Two options of connection with other development by covered galleries with communications into a building complexes existed: up to 1200 people (4 blocks + 1 service centre + kindergarten for 140 seats) and 2400 people (8 blocks + 2 service centre + kindergarten for 280 seats).[38]

---

[35] Lola Sheppard and Mason White, "Arctic Architecture: Standards, Experiment and consensus," in *Canadian Modern Architecture: 1967 to the Present,* ed. Graham Livesey and Elsa Lam (New York: Princeton Architectural Press, 2019), 360-362.
[36] "Frobisher Bay Housing for the Inuit Community," *The Moche Safdie Archive*, McGill Library, accessed December 25, 2020, https://cac.mcgill.ca/moshesafdie/fullrecord.php?ID=10924&d=1.
[37] Sheppard and White, "Arctic Architecture: Standards, Experiment and consensus," 368-371.
[38] Alexander Shipkov, "A Residential House with Roofed Courtyard," Norilsk, 3-4, 15-17

Complex-house ***(Fig. 4.13)*** designed with Yakob Truschinsch consists of two parallel six-story terraced houses, connected with transparent roof and has artificial environment and public service, including workshops and rental. The enlarged courtyard provides not only allocation of main amenities, natural ventilation through interior windows of two-sided flats, but also 2.5 times increase of volumes per person.[39] *Pyramid Polyar* ***(Fig. 4.14)*** with 120x120 m footprint, three residential and one fully glazed side, 20 residential floors, necessary amenities and garden of 6 m^2/person. Use of energy-efficient materials and heat-proof glass would make this building 10 times warmer than average house. Inner suntrap system increased sunlight time in flats from 3 to 11 hours per day. Public household block to transfer housing shores. A year later he developed *Polyar Snezhnogorsk* ***(Fig. 4.15)*** by combination of parallel volumes principle from Compex-House and Pyramid sides. It was the only paper project discussed, that received prepared site and funding, and passed project documentation stage. This proposal was awarded governmental bronze medal and was exhibited in "Man & Polar regions" pavilion in Expo 67.[40]

The Port Settlement ***(Fig. 4.16)*** reminds an amphitheater with open centre, consisting of three segmented rings with mutual centre point. The 7-9 floors tall shielding surfaces have a specified inclination, that enhances direct sunlight penetration, providing lighting of apartments and interior courtyard, and preventing snow loads sticking. The associative connection between interior objects is achieved thanks to transparent visual axis within the courtyard. The winter gardens had artificial lakes and long closed-loop pedestrian routes. The accommodation, kindergarten and school were in southern part.[41]

The last original Arctic Modernist concept was a 1989 competition entry of *The Town of the Future* ***(Fig. 4.17)*** by Eduard Putintsev. The architect developed multistory skyscraper

[39] Alexander Shipkov, "A House-complex with Controlled Climate for 1000 People", 10-15.
[40] Shipkov, "Polyar," 113-126, album 3, page 12, album 5 page 5-24.
[41] Nikolai Chuklov, "The Space-Planning Elements Succession of the Arctic Cities with Climate Control," 255-256.

Monoblock inspired by vernacular local dwelling. Placing on hexagonal stylobate, raised above ground with pilons is a reiteration of previously used foundation slab. With a small footprint, large population density is achieved by vertical orientation of the town.[42]

Conclusion to Chapter

During experimental period of search for climate-responsive Arctic-specific typology, architecture and urbanism demonstrate their strong interrelation in design proposals. They are designed for urban centres and small settlement and characterised by Modernist technological advance, use of non-local forms,[43] transnational universality, futurism and connotation with Avant-garde commune housing of 1920s.[44] Large-scale high-cost projects and state funding prevail.

[42] Eduard Putintsev, "Town of Future in Far North," *Eduard Putintsev Arhive, last modified 2016, http://eduard-putintsev.ru/future_habitation_nord*
[43] Sheppard and White, "Arctic Architecture," 353-354, 357.
[44] Nedza-Shikoniowska, "European modernity," 65.

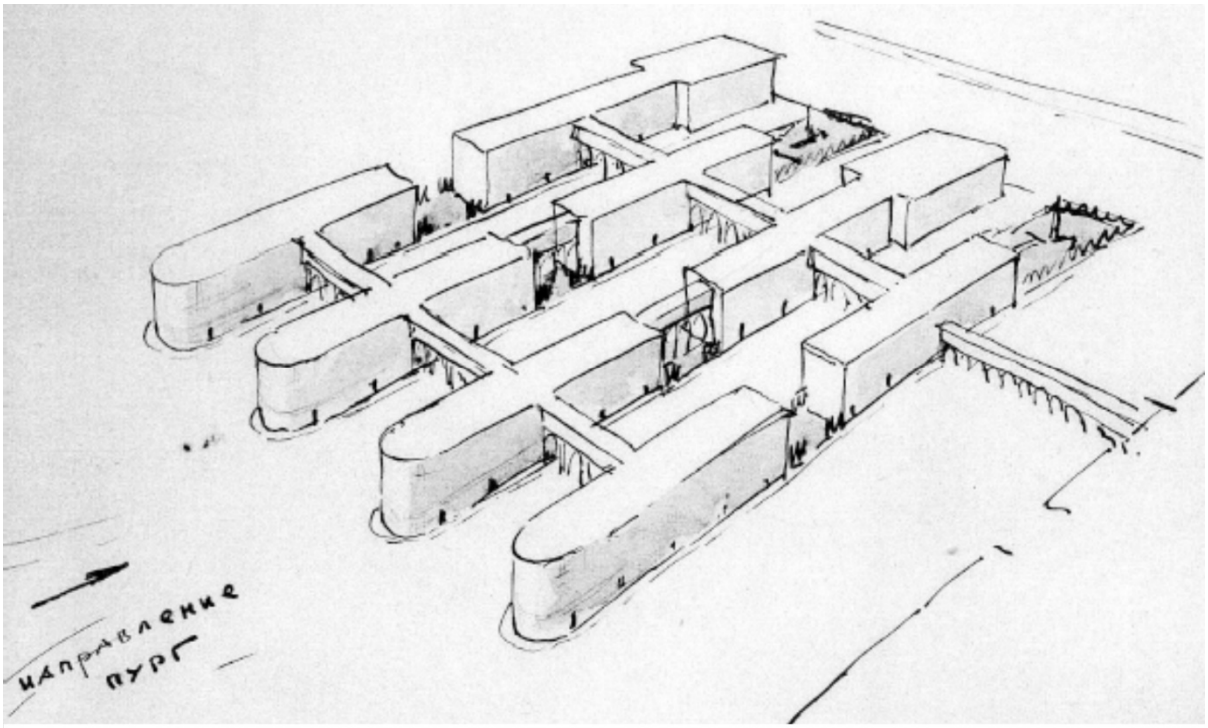


Figure 4.8: The Northern Town, Konstantin Khalturin, Vorkuta, 1948.

Figure 4.9: An Ecological Arctic Town, Ralph Erskine, 1958.

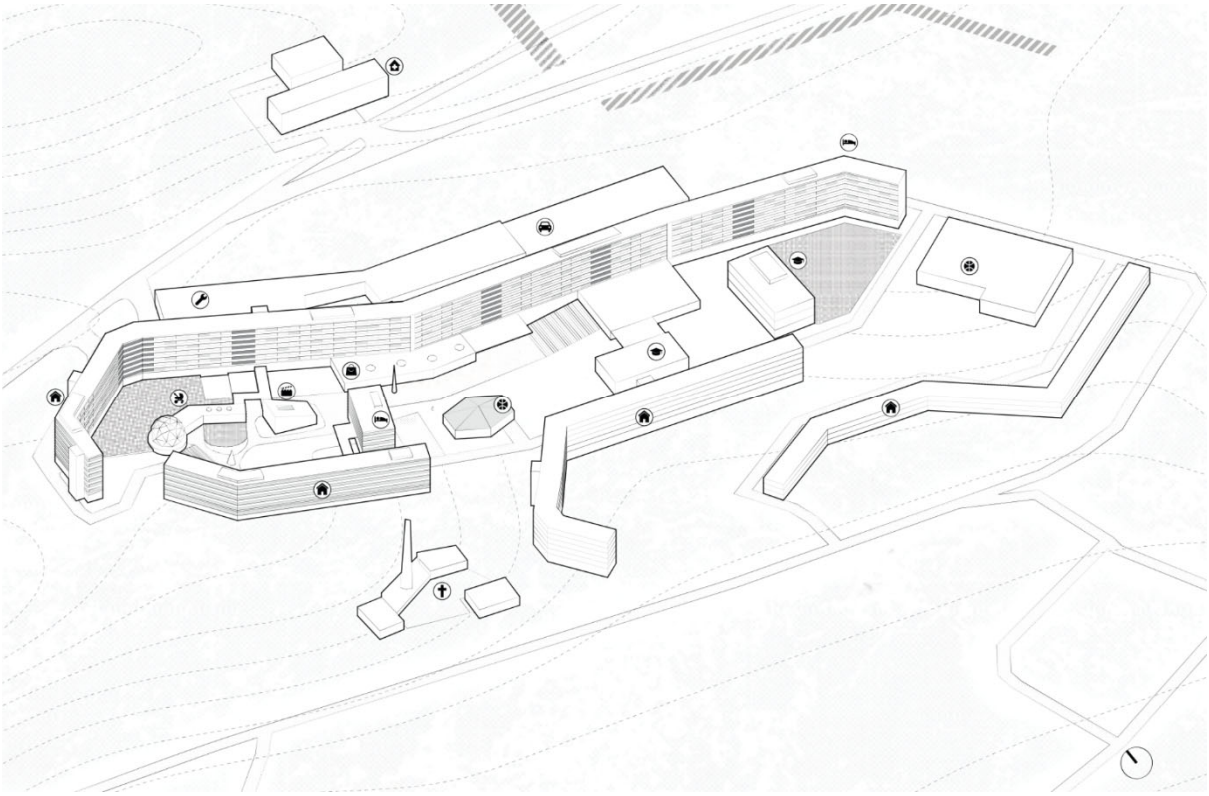


Figure 4.10: The Frobisher New Town II, Peter Dickinson Associates, 1960. 1000 people.

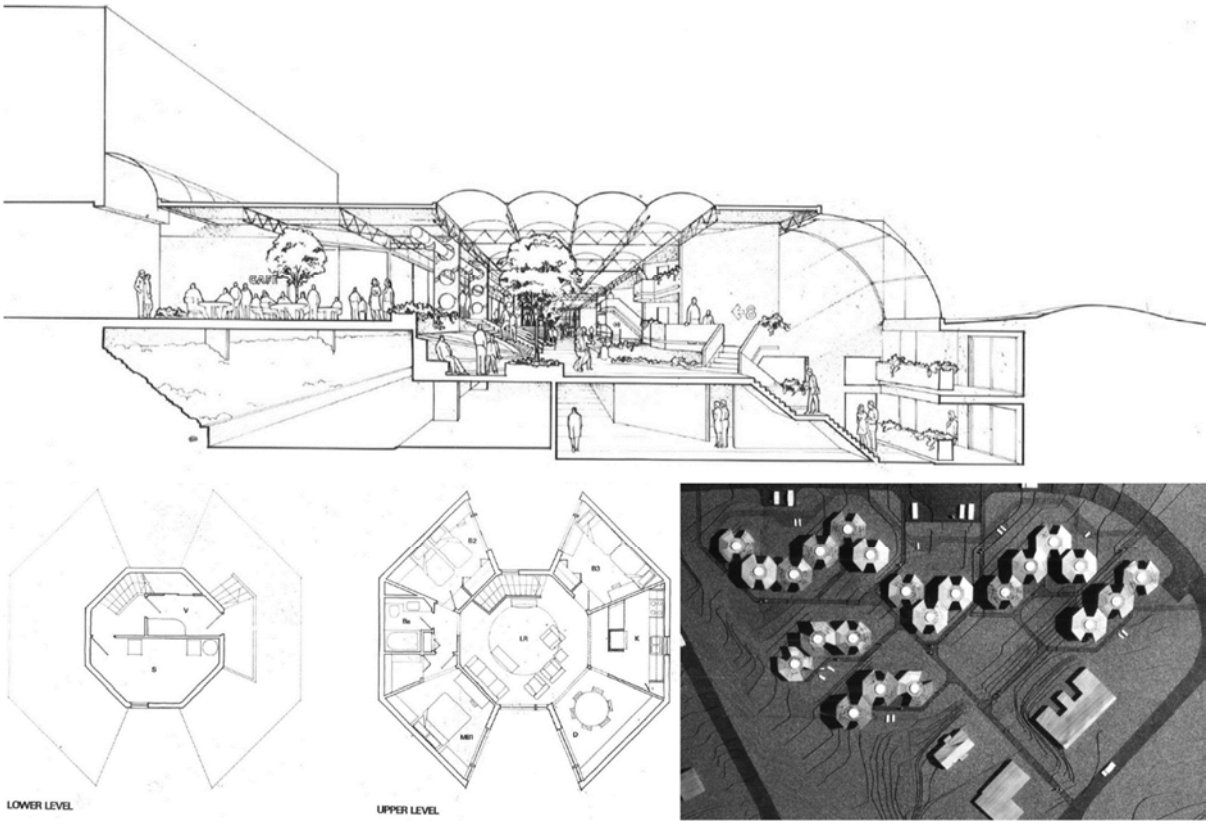


Figure 4.11: Frobisher Bay, Moshe Safdie, 1977.

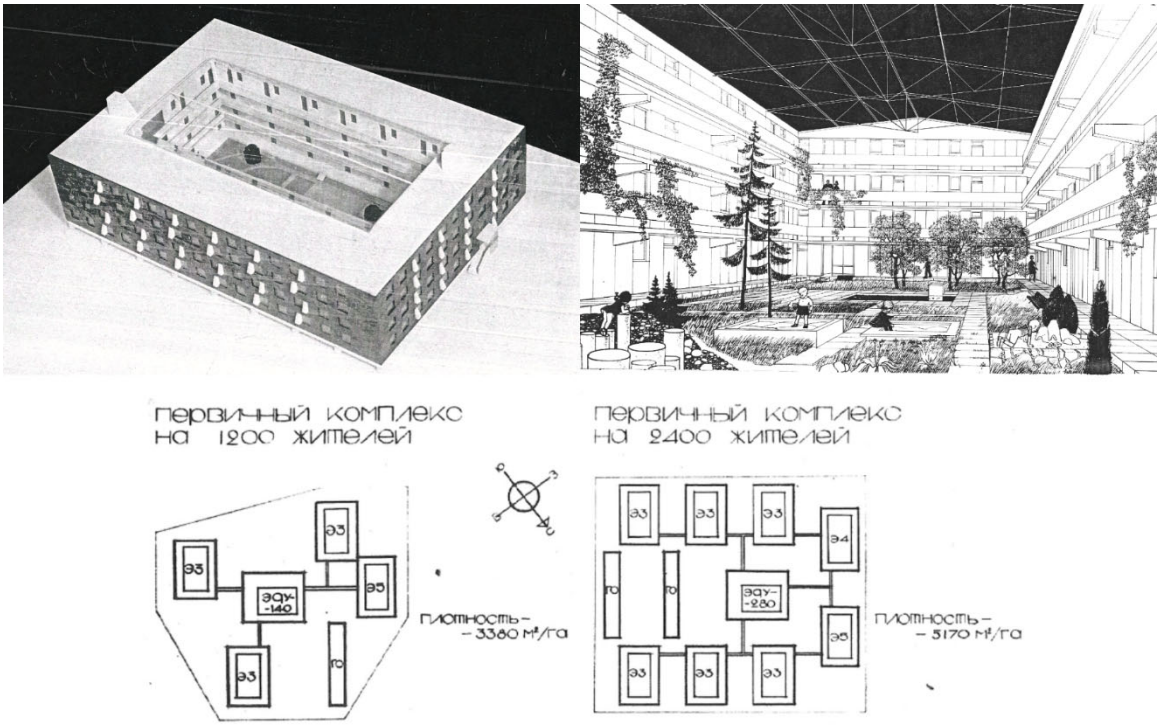


Figure 4.12: Single-Housing Complex, Alexander Shipkov, Norilsk, 1963. 256 people.

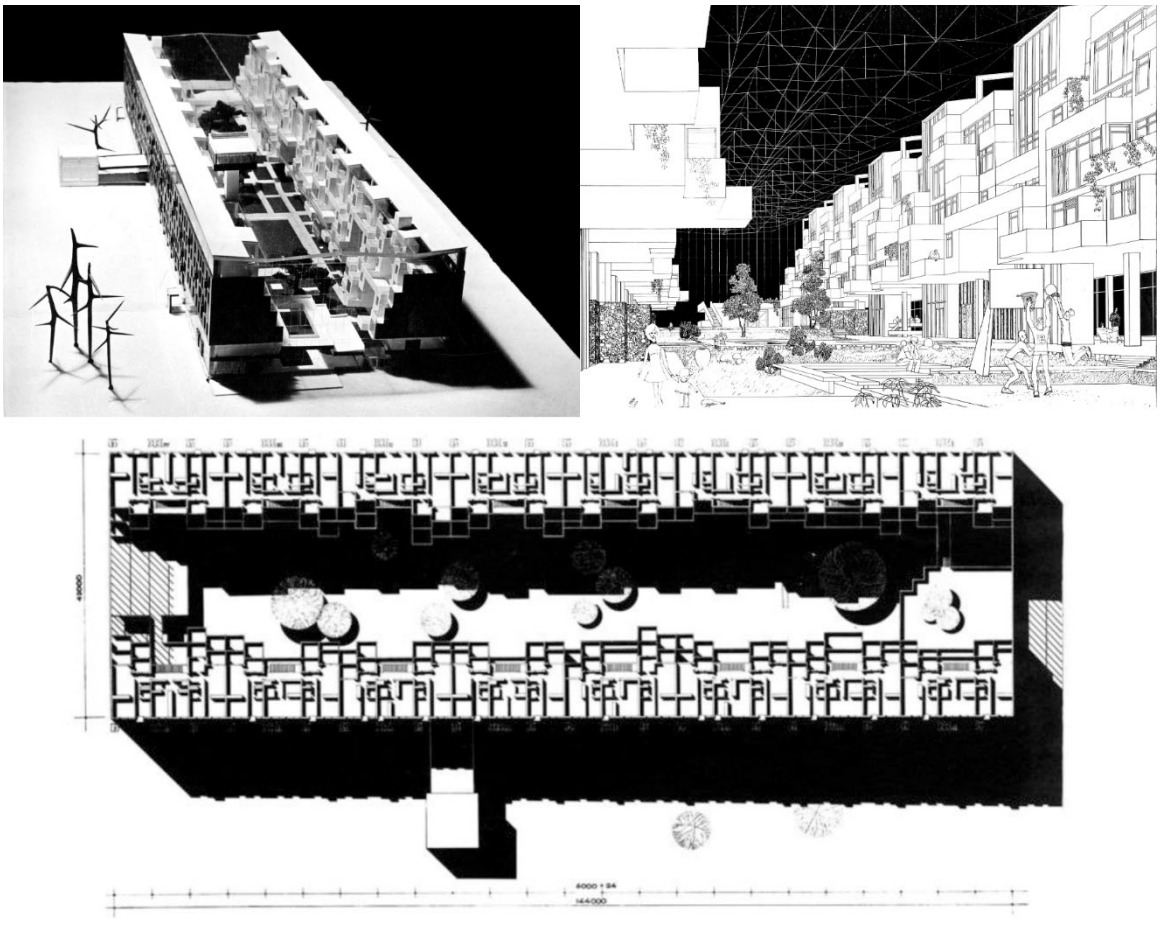


Figure 4.13: Complex-house, A. Shipkov & Y. Truschcinch, Norilsk, 1964. 1000 people.

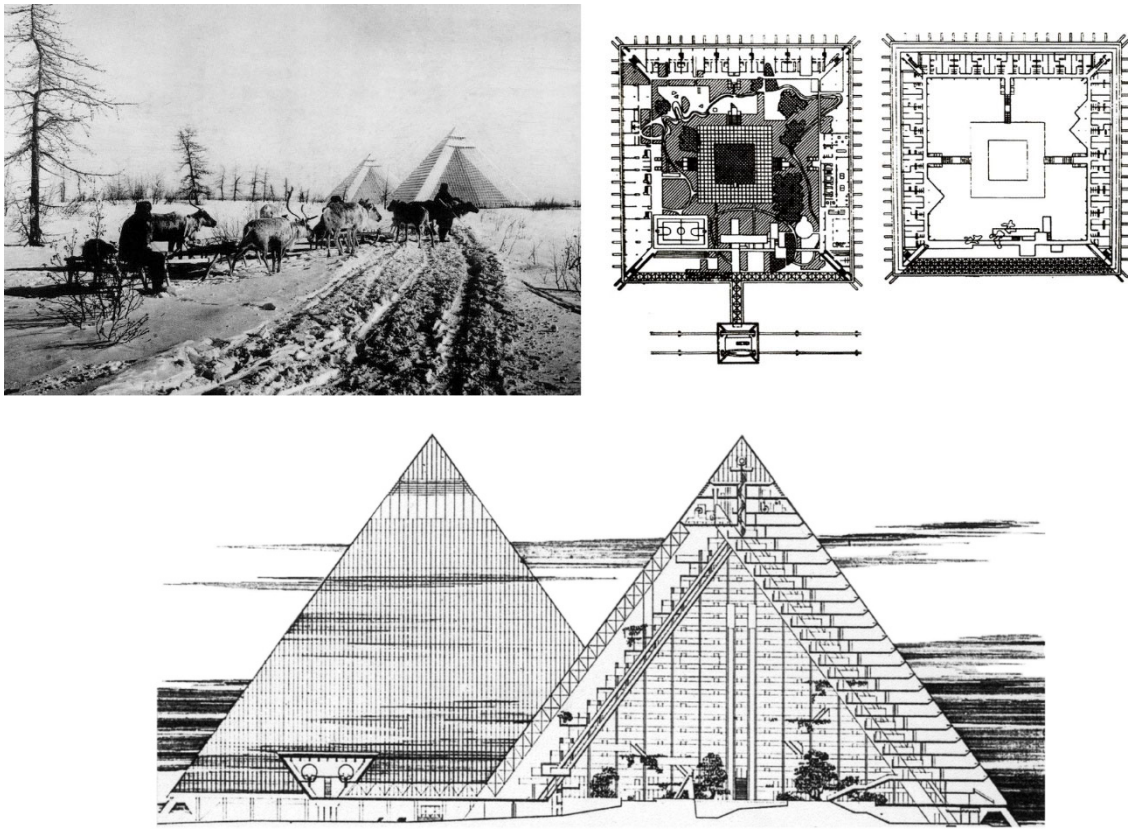


Figure 4.14: Alexander Shipkov, Pyramid, 1964, 2000 people

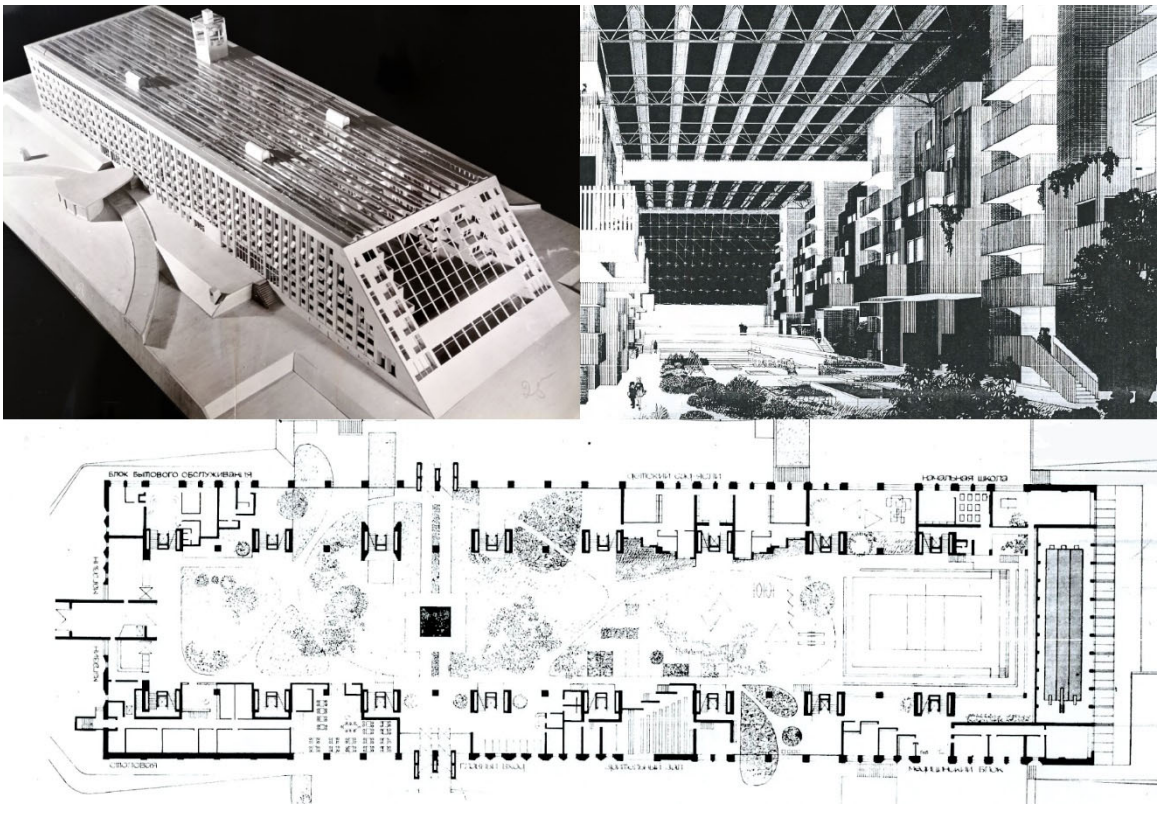


Figure 4.15: Alexander Shipkov, Polyar Snezhnogorsk, 1964. 2000 people.

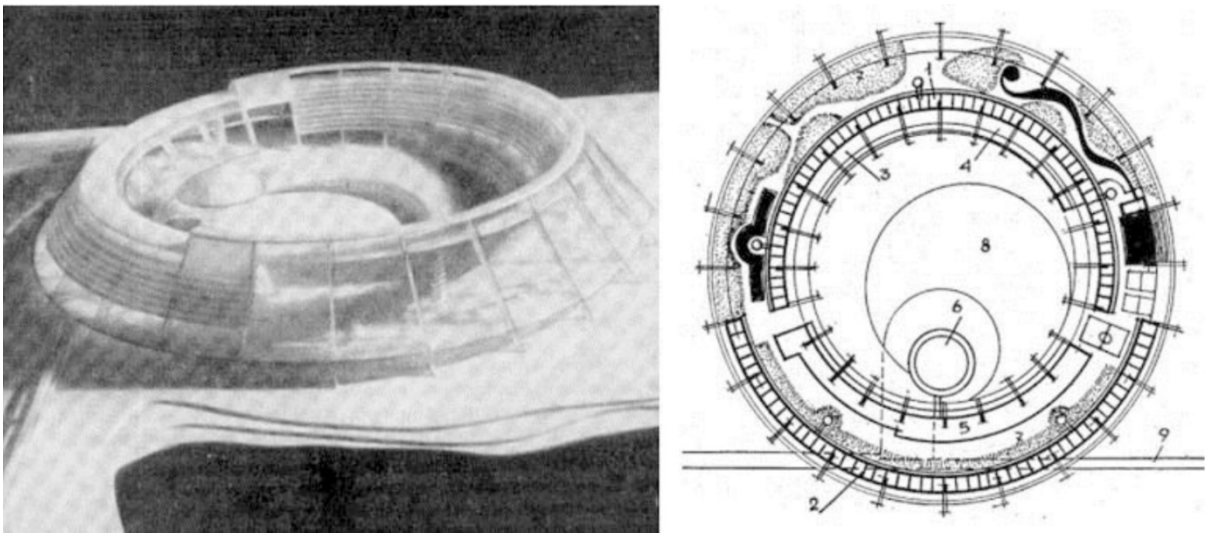


Figure 4.16: The Port Settlemnt, Valentin Tankayan, 1966. 3500-4000 people.

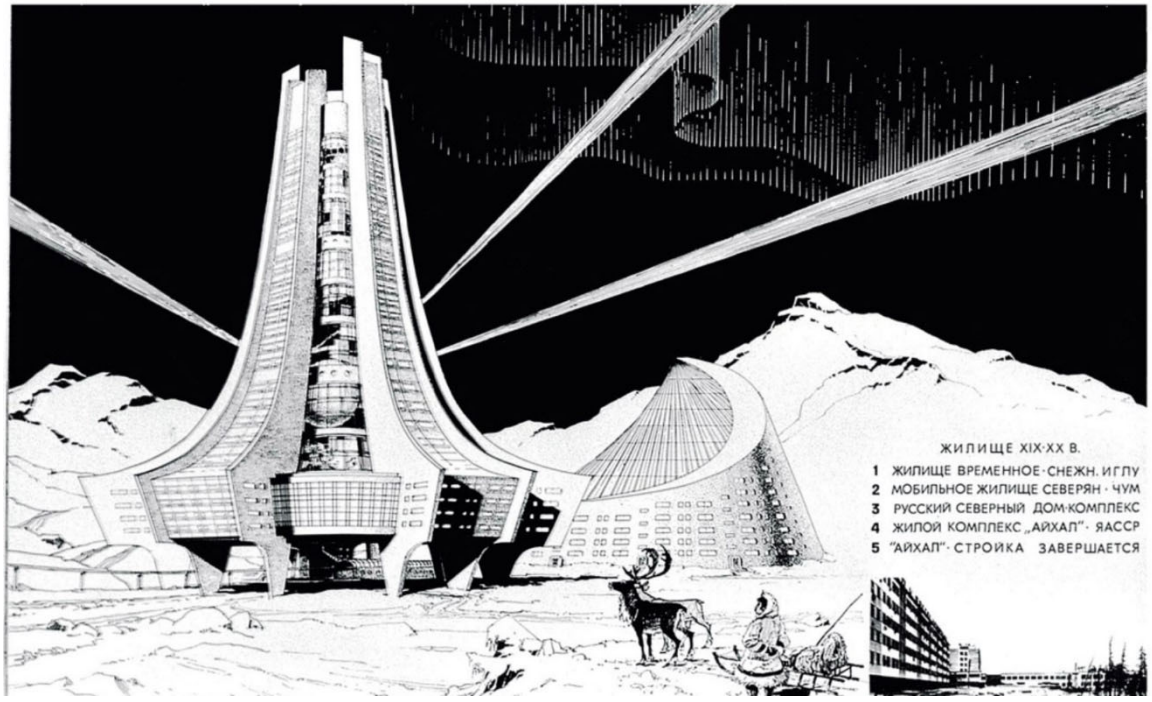


Figure 4.17: The Town of the Future, Eduard Putintsev, Aykhal, 1989. 5000 People

CHAPTER 5

COMPLETED PROJECTS

Introduction to Chapter

1959 can be considered a start of realisation period with Inuvik pilot development, that tested out technologies of new Arctic settlement construction on permafrost with all utilities and application of contemporary technologies in Arctic environment (with first ever warm maines).[45] However, in next two chapters I will discuss works of Ralph Erskine and Soviet microrayons, as most influential case studies of Arctic Modernism **(*Fig. 5.1*)**.

5.1 Kvarteret Ortdrivaren, Kiruna, Sweden, 1965

Kvarteret Ortdrivaren in Kiruna **(*Fig. 5.2*)**, a Swedish iron-ore mining town, north of Arctic Circle with winter lasting for eight months when temperature can drop to -40°C and wind speed reaches 15m/s, is a first discussed case study. Unlike other cases it sited on a small spot, being only a piece of redevelopment plan of town centre, proposed by Erskine **(*Fig. 5.3*)**. Project was funded by state-owned mining company LKAB.

In residential development Erskine followed Modernist principles outlined in "Arctic City." Five compactly allocated buildings (two high-rise and three low-rise) sit on southern slope of Loussavaara mountain and interconnect by warmed circulation street and basement garage **(*Fig. 5.4*)**.[46] Although wind shielding wall principle is not accomplished over site size, Erskine placed tallest buildings up the slope and equipped the roofs with steep north-facing pitches, that maximised south facing facades' solar gain by minimisation of shadows and deterred heat loss in north facades by reduced surface area. In north large volumes of thawing

[45] P. F. Cooper, "Applications of Modern Technology in an Arctic Environment," The Polar Record 14, no. 89, (1968), 150-151.
[46] Peter Collymore, *The Architecture of Ralph Erskine*, (London: Granada Publishing Ltd., 1982), 84-87.

snow sliding from pitched roof to ground floor are dangerous. Ortdrivaren roofs possessed snow pockets against that.[47] Erskine, together with employers, pursued economic stability and welfare of labour community so development also accommodates offices, shops, and a church.[48]

Advanced materials were used in Ortdrivaren. Structural prefabricated concrete columns and cast-in concrete bracing exempted façade from load-bearing functions. Insulated with foamed polystyrene building envelope has curvy shape without corners to minimise heat loss and timber sideboard finishing. Warm finish colours: red, terracotta, ochre and yellow enhance sunlight absorbing. The area of triple-glazed windows is minimised,[49] while balconies are designed for winter food freezing.[50]

5.2 Ormen Lange, Svappavaara, Sweden (1965) & Resolute Bay, Nunavut, Canada (1970)

Svappavaara ***(Fig. 5.5)*** and Resolute Bay ***(Fig. 5.6)*** urban developments were Erskine's attempts to incarnate 'Arctic Town'. In both cases Erskine was commissioned by governmental bodies, that pursued resource extraction and social engineering goals. As new mine in Svappavaara village (40km east of Kiruna) opened, its population grew from 400 to 1000 people in three years. Erskine designed a new town to build up a healthy mining community by provision of miners and LKAB employees with accommodation and amenities for comfortable living.[51] Yet in Canada Resolute Bay was a settlement of maximum 500 people next to a research base 800km north of Arctic circle. Relocated there Inuit families were in

[47] Thomas Murray, "Ralph Erskine: The Interaction of Man and his Environment in Northern Latitudes," Diploma Dissertation, (University of Glasgow, 1976), 25.
[48] Mats Egelius, *Ralph Erskine, Architect*, (Stockholm: Byggforlaget, 1990), 74.
[49] Collymore, *The Architecture of Ralph Erskine,* 87.
[50] Leo Friedmann, "Saving Erskine: An Example in Circular Heritage," Stockholm: KTH School of Architecture, Master Thesis, 2020, 24.
[51] Elin Haugdal, "Apartment Blocks in Harsh Climates: Horseshoe Block in Hammerfest and Ormen Lange in Svappavaara," *Nordlit* 36, (2015), 86.

severe poverty due to unreadiness to new lifestyle and poor living conditions. In 1970, with new oil fields discovery, Erskine was to design accommodation for 1200 (with expansion to 3000) new residents and reintegrate indigenous people to new urban society.[52]

Both urban plans suggested placement on a south slope, directly facing south and followed windshield strategy ***(Fig. 5.7)***. In Svappavaara a long snake-like 4-storey perimeter building was erected on top of the hill. It would accommodate public spaces connected with a ground level indoor street and apartments for staff and their families in floors above. Bus stop, schools, shops and hospital could be accessed from it via glazed walkways. This building would shelter space with low-rise detached homes for administration from wind and snow.[53] In Resolute Bay perimeter wall with residing newcomers would accommodate commercial spaces and sport facilities, while public amenities would locate in separate buildings. It would also protect detached family houses for Inuits. Unlike its Swedish counterpart it would be 2 to 3-story tall and remind a horseshoe in plan. The sheltered principle had to extend comfortable outdoor climate season by six weeks, while compact housing allocation had to improve social interaction between newcomers and locals.[54]

Some architectural design and engineering solutions for these projects come from Ortdrivaren. The Ormen Lange wall was constructed of lightweight prefabricated concrete slabs with warm yellow finish. Northern façade has curvy shape without acute angles to advance wind protection and small openings to reduce heat loss, while south façade has simple surface with large windows and black wooden balconies ***(Fig. 5.8)***. Concave roof shape serves as a snow pocket and generates low pressure zone south of wall. The apartment range would

[52] Matthew Jull, "Toward a Northern Architecture: The Microrayon as Arctic Urban Prototype," *Journal of Architectural Education* 70, vol. 2 (September 2016), 218.
[53] Egelius, *Ralph Erskine, Architect*, 77.
[54] Jull, "Toward a Northern Architecture," 219.

include one-, two-, three- and four-rooms to diversify groups of future residents.[55] The detached houses had compact shape and provided necessities for miners, however, instead of concrete were made of timber, making design more integrated to existing village structures.[56]

Unlike Kiruna and Svappavaara Resolue Bay all structures would raise on steel piles above ground to remain stable on permafrost and avoid snow drifts. Perimeter residential wall encircles detached houses with aerodynamic spaceship-like shape ***(Fig. 5.9)***.[57] Open plan of detached houses would allow flexibility in occupiers and use.[58] Like Ormen Lange wall has black and yellow color finish but made of timber instead of concrete.

Unfortunately, both developments ended in failure. Due to overestimation of mine production Svappavaara population (including workforce) froze at 1000 people and construction halted at early stages. Eventually it declined as employees preferred to travel from Kiruna daily. Only a 220m long section of wall and a group of separate detached houses were constructed. None of public amenities were built and no communication between wall and housing was set up, so the town did not operate as integrated community. Svappavaara was never given a second chance after mine closing in 1984.[59]

Similar events happened in Resolute Bay. Oil crisis dissuaded government from expanding Resolute bay, so only a small part of wall building with ten apartment units was built. The existing part of wall stands out among modern poorly designed houses, imported from South ***(Fig. 5.10)***. The roof pitch faces north, maximizing sun exposed façade surface**.** Small openings below eye level, air locks in front and rear doors, polar day window shutters

[55] Haugdal, "Apartment Blocks in Harsh Climates," 88.
[56] Egelius, *Ralph Erskine, Architect,* 100.
[57] Alan Mercus, "Place with no Dawn:A Town's Evolution and Erskine's Arctic Utopia," *Windsor Liscombe* (2011), 288.
[58] Murray, "Ralph Erskine," 55.
[59] Egelius, *Ralph Erskine, Architect,* 100-101.

and ventilation ports were to combat Arctic climate.[60] Moreover, the project received criticism as it struggled to integrate Inuit people to new society as no connections established between wall residents and Inuit, whose lifestyle still suffered, although Erskine actively consulted with them at site selection.[61]

5.3 Townsite of Fermont, Quebec, Canada, 1976

The final case study in this chapter is a Townsite of Fermont, a mining town, designed by Desnoyers Schoenauer with Erskine's involvement as lead consultant. Like in previous examples it was erected at iron ore field, however, was funded by a private firm, Quebec Quartier Mining. Despite being outside Arctic circle, it has attributes of Arctic climate. Winter lasts for 8 months, when temperature may fall to -57°C, with average low of -30°C and snow drifts up to 85cm. The average wind speed reaches 5.7m/s, that, according to Shipkov's study is unacceptable for outdoor stay at temperature below -20°C. Unlike Svapavaara and Resolute Bay Fermont is considered a successful Western Subarctic urban development, whose sponsors managed to overcome financial and climatic challenges and accomplish design proposal, based on Erskine's Modernist principles, that he vainly tried to introduce in two previous cases.[62]

In the town for 5000 residents occupying 76 hectares, compact building urban improved living conditions by reduction of walking distances. Streets have only T-shape junctions, while the main promenade runs along the perimeter of town. Pavements are located only on roads' north and west sides with south and east serving for snow damping. Windscreen principle is also followed as a 1.3km long 3 to 5-story building is erected in northwest boundary with the rest of town sitting on southeast slope ***(Fig. 5.11)***. Fully equipped accommodation and

[60] Matthew Jull, "South Camp Inn," *The Site Magazine*, Accessed March 27, 2021, https://www.thesitemagazine.com/read/south-camp-inn
[61] Jull, "Toward a Northern Architecture," 219.
[62] Adrian Sheppard, "Fermont: The Making of a New Town in the Canadian Sub-Arctic," *FRAIC*, (Montreal: McGill University, 2012), 12.

amenities had to attract new employees to new cold and isolated area and establish a healthy labour neighbourhood. Apart from 330 apartments and guest rooms in upper floors, the wall building serves as main community centre with shops, town hall, school, cinema, gym, swimming pool and fire and police stations. Having a boomerang shape, it creates a sheltered area for 600 individual houses, that include townhouses, semi-detached and detached. Such variety aimed at diversification of incoming new residents.[63]

Housing units were assembled of prefabricated timber modules delivered on site by truck and barges. Each house consisted of up to four modules, installed on in-situ cast foundations. This construction method was deemed efficient as for each house foundation was the only complicated element, that allowed to assemble houses quickly in conditions of limited number of qualified workers. However, to provide stability on frosted soil, foundation footing had to be 3.6m deep, that caused challenges and additional expenditures to contractors. The exterior and interior finishes, household appliances and piping systems were also installed in factory.[64] The photos of Fermont clearly demonstrate Erskine's typical design of wall with simplistic north façade with small openings and inviting south façade with large openings and balconies and selection of warm façade colours (black, brown, ochre and orange) to enhance sunlight absorption ***(Fig. 5.12)***. The roof has a north facing inclination.

[63] Sheppard, "Fermont," 7-10.
[64] Sheppard, "Fermont," 10-11.

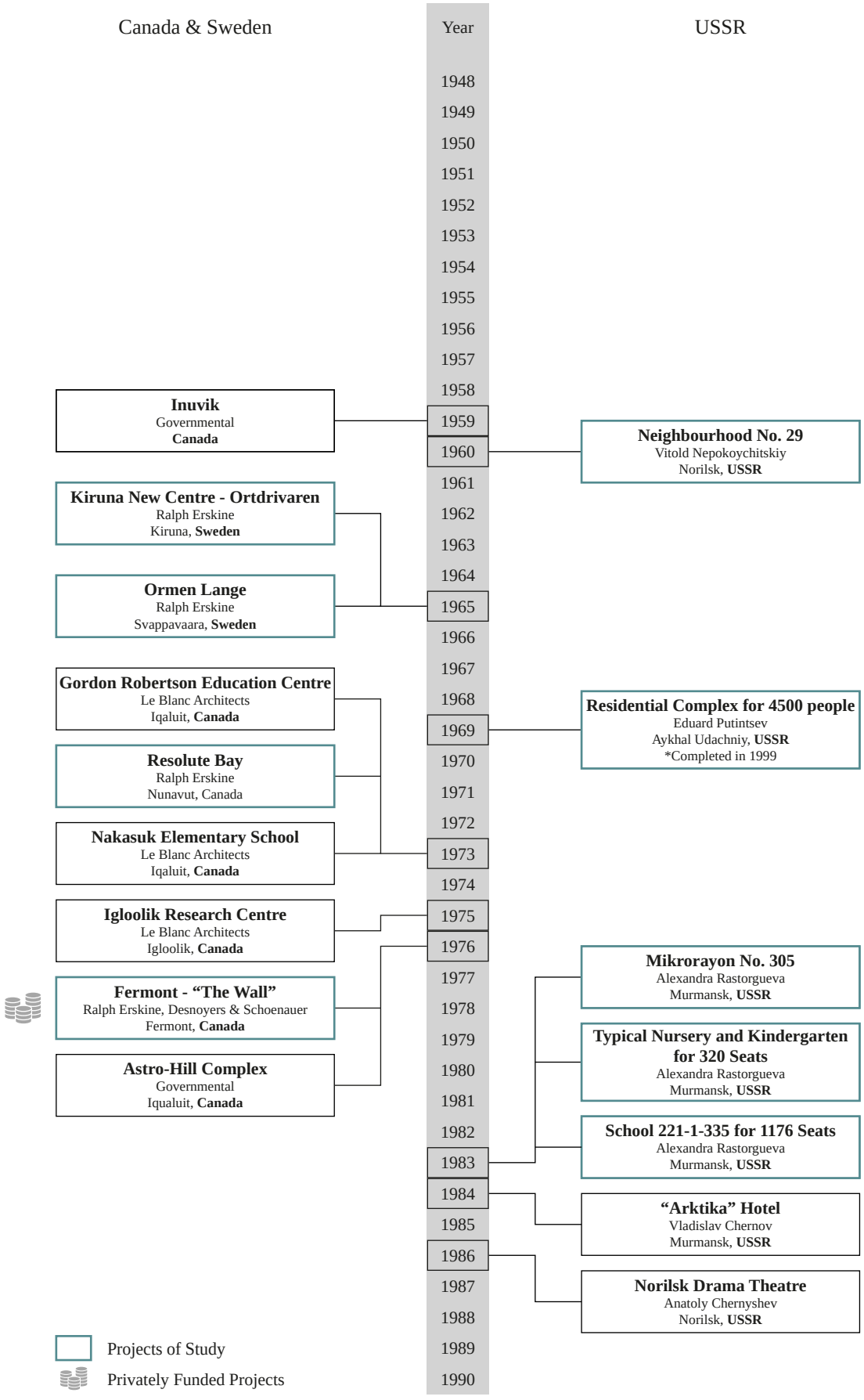


Figure 5.1: Completed Projects Timeline

Figure 5.2: Kvarteret Ortdrivaren (aerial view).

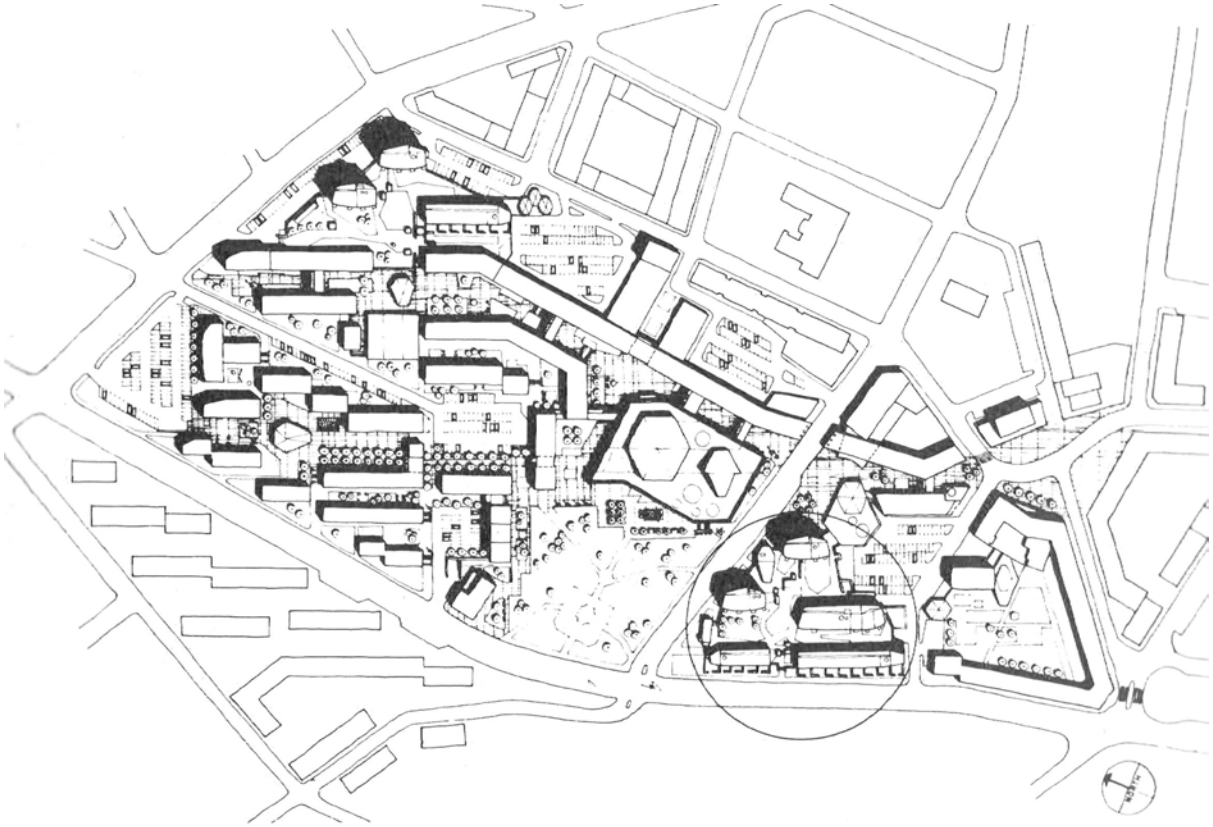


Figure 5.3: Erskine's Kiruna town centre redesign proposal. Ortdrivaren is encircled.

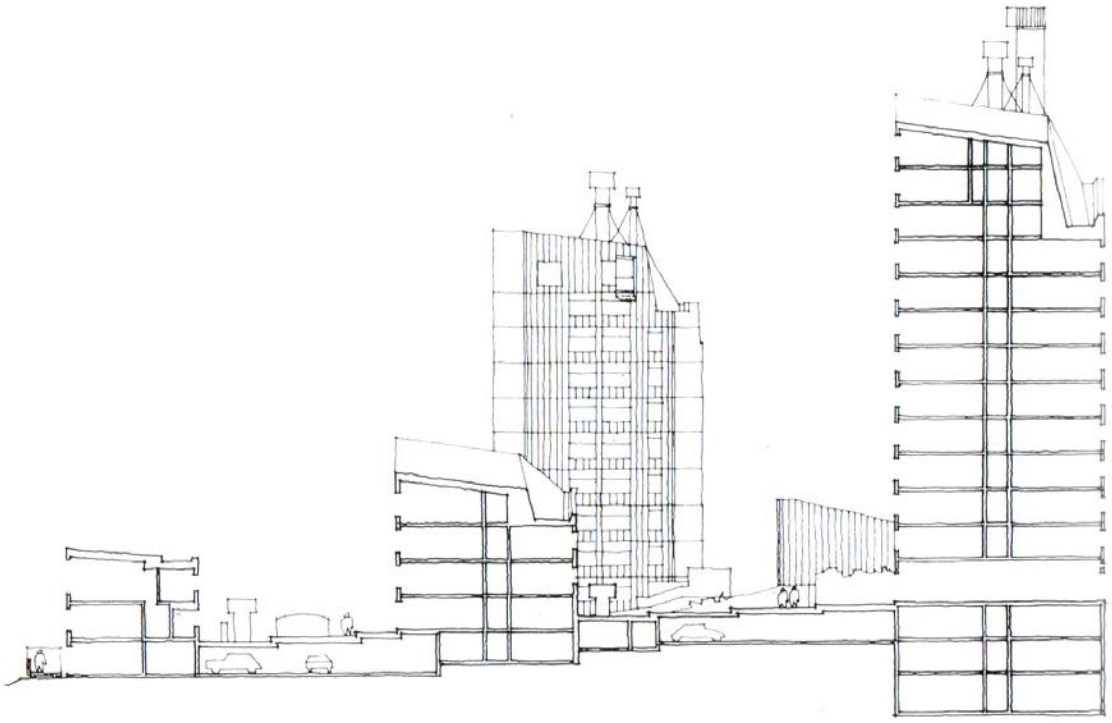


Figure 5.4: Ortdrivaren section, that demonstrates building heights differences, underground spaces and roof shapes.

Figure 5.5: Svappavaara Proposal.

Figure 5.6: Resolute Bay Proposal.

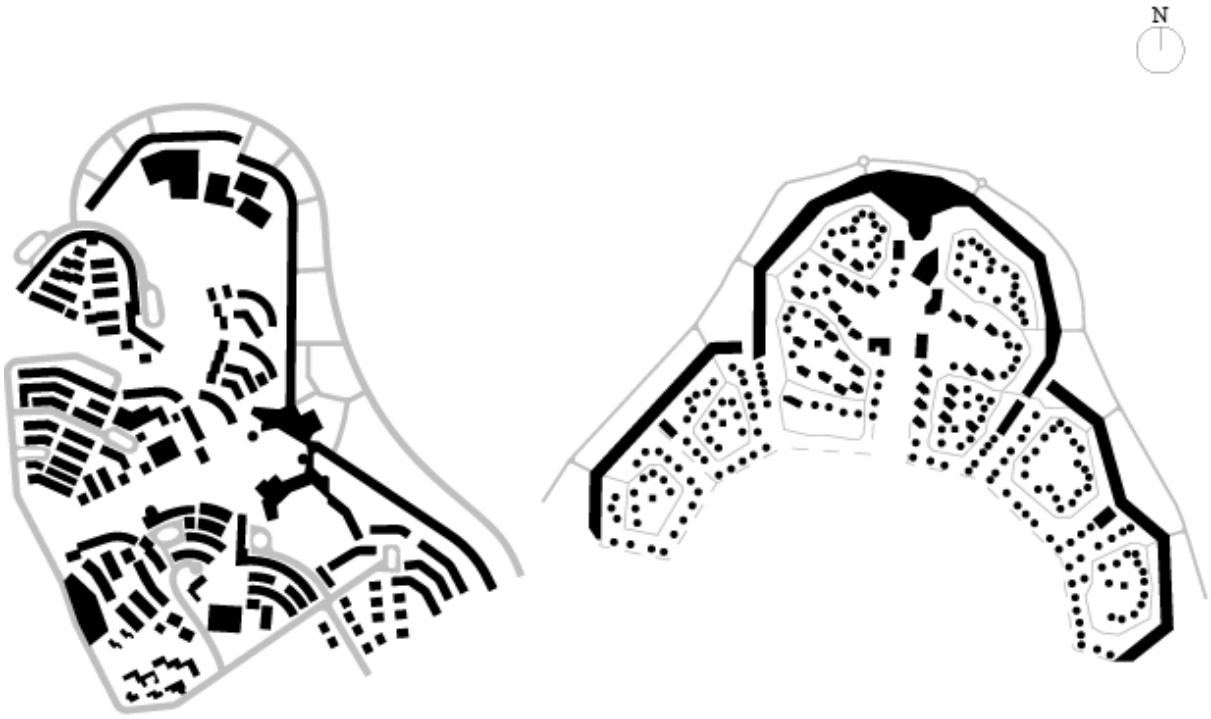


Figure 5.7: *Left*, Svappavaara proposal figure ground. *Right*, Resolute Bay proposal figure ground.

Figure 5.8: *Above*, Ormen Lange South façade. *Below*, Ormen Lange North façade.

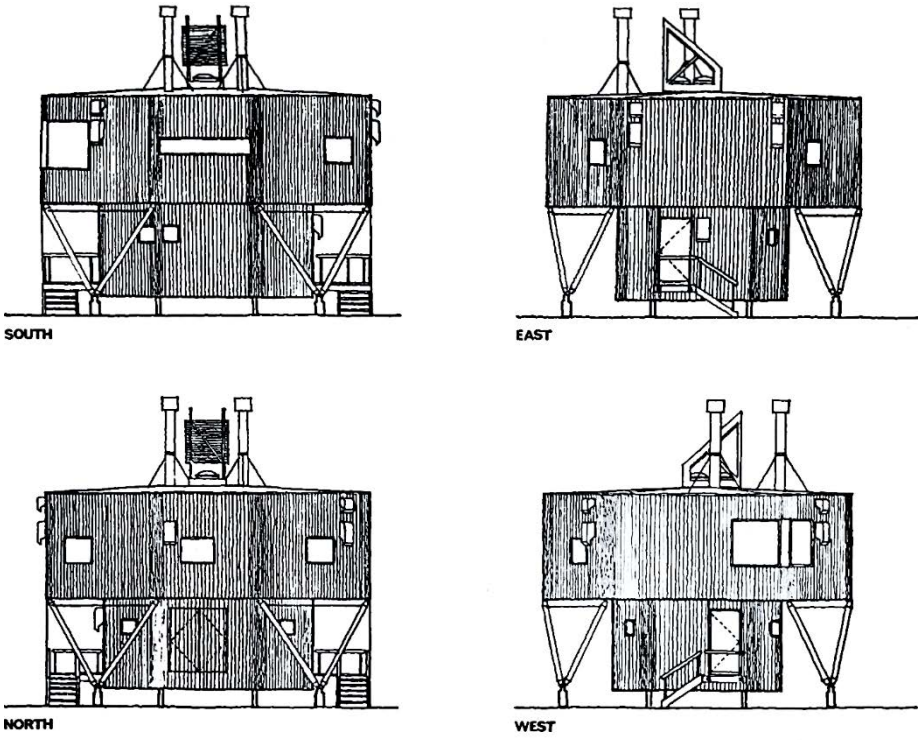


Figure 5.9: Resolute Bay detached houses design.

Figure 5.10: Resolute Bay wall.

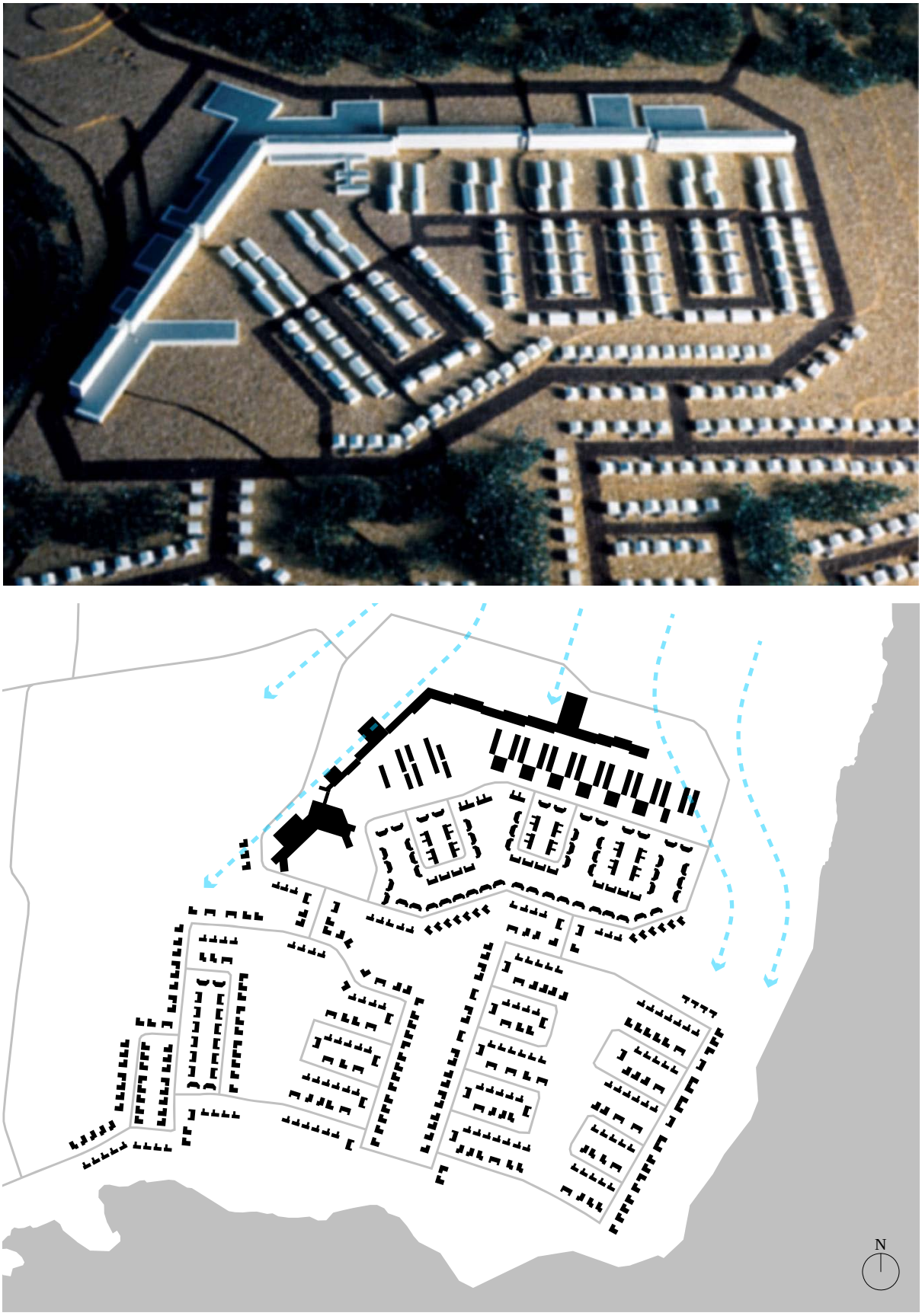


Figure 5.11: *Above,* Fermont model with site topography. *Below,* Fermont figure ground with wind study.

Figure 5.12: *Above*, wall South façade. *Middle*, wall North façade. *Below*, detached houses.

5.4 Residential Complex for 4500 People, Eduard Putintsev, Aykhal Udachny, 1969, completed in 1999.

Aykhal Udachny ***(Fig. 5.13)*** locates next to volcanic conduit (diamonds source) in Yakutia. It was erected on the only bedrock site in swampy permafrost region (more than 300m deep) for domed paper project by Odnovalov and Tsymbal. Initially accepted proposal was waivered due to Soviet position that person living under domes would not fit to be an Arctic conqueror. Therefore, Putintsev proposed more conventional Modernist design, with outdoor spaces and covered galleries, further adopted even in temperate latitudes across USSR.[65] Winter in Aykhal, located in 16km from Arctic circle, lasts there for eight months, while temperatures may drop to -60°C.[66]

Aykhal uses meridional row volumes allocation ***(Fig. 5.14)***, where buildings serve as barriers against prevailing western wind (up to 6m/s). Such planning is also efficient in their reduction by 30%.[67] Occupying 18.75 hectares the development would accommodate 4500 residents. It consisted of eight 5-story apartment blocks, two kindergartens for 220 seats together, school for 576 pupils, community centre, sports centre and administration. All volumes were interconnected with covered galleries 340 m long, that protected against draft wind. To diversify demographic groups, housing provided one-, two- and three- room flats. Outdoor stadium and surrounding walking promenade were accessible for vehicles and from buildings ***(Fig. 5.15)***.

The housing blocks are 15m deep instead of typical 9-12m for better energy efficiency. The buildings floors are raised on stilts by 1 meter for reduction of heat loss and stretch of

---

[65] Eduard Putintsev, "Architect's thoughts," *Eduard Putintsev Arhive, last modified 2016, http://eduard-putintsev.ru/ severnoye_zhilishe*
[66] Eduard Putintsev, "The Diamond Aykhal," *Eduard Putintsev Arhive, last modified 2016, http://eduard-putintsev.ru/aihal_almaz*
[67] Nepokoychitsky, "Characteristic Aspects of Urban Development in Norilsk," 104.

utility lines in chutes underneath covered gallery. To develop sustainable design buildings would be produced of local materials, including prefabricated concrete silo. However, concrete silo was replaced with prefabricated concrete panels due to lack of knowledge about its qualities in Northern climate. Contemporary photos demonstrate, that instead of dull grey, buildings are painted in pastel colours (***Fig. 5.16)***.[68]

Unlike Aykhal settlement microrayon was a typology for large cities. Absence of unified Arctic urban planning approach and unsuccessful attempts of temperate latitude typologies integration in Norilsk necessitated introduction of new Arctic-specified typology, that *Microrayon (lit. Micro-district)* had become.[69] Originating from late 1920s Krasnoyarsk stone quarters, first microrayon prototypes were presented in international competition 'Building & Reconstruction of Cities 1945-1957' in 1958.[70] Opposing against traditional planning, microrayon thesis based on simplicity, functionality and neighborhood residents' equal use of public land, previously designated for private economic activity. Eventually main microrayon principles were formulated:

1. *An enlarged (up to 20-40 hectare) elementary planning formation for a rapidly growing city.*
2. *Easy pedestrian and transport accessibility of working space within 500m radius.*
3. *Absence of through traffic and isolation from major transport routes.*
4. *Residential units of 100-200 sqm footprint with garden (10% of area) and service and educational facilities within 300-400m.*

[68] Eduard Putintsev, "Aykhal - The Town with no Streets," *Nedelya* 3 (1966), http://eduard-putintsev.ru/aihal_gorod_bez_utits
[69] Jull, "Toward a Northern Architecture," 216.
[70] Irina Fedchenko, "Humanistic Idea of a Micro-District in the XX Century," *Journal of Siberian Federal University. Humanities & Social Sciences* 5, no. 5 (2012): 708-709.

5. *List of community facilities directly depended on neighborhood population (5000-10000-15000 residents).*[71]

5.5 Neighbourhood №29, Vitold Nepokoichitsky, Norilsk, 1960.

Located North of Arctic circle Norilsk is one of World's largest mining centres, that fully sits on permafrost and has a severe climate with average yearly temperature of -8°C, that can drop to -51°C and prevailing southern wind with average speed of 6m/s.

Neighbourhood №29 ***(Fig. 5.17)*** was a development, that explored shelter strategies in pilot regime, resulting in "closed-contour" principle ***(Fig. 5.18)***. Twelve 6-story rectangular residential buildings were blocked on 600m x 150m site. Eight of them were around perimeter and four placed perpendicularly inside forming five courtyards, designated for green spaces and playgrounds. Drainage systems for melting snow were in T-shape junctions between houses. Such buildings arrangement reduced air circulation speed inside courtyards by 60%, turning them in low-pressure zones without drafting. Good living conditions for young diverse labour was one of architect's goals, so housing included single family flats and dormitories. Service spaces, garages and pedestrian through passing were in ground floor with vehicular access from roadway side and through single closing gates. The childcare facilities were in individual volumes in courtyard.[72]

Being a pilot project, Neighbourhood №29 contained three housing typologies at once: concrete constructivist block, masonry 'Stalinka' ***(Appendix B8)*** and modification of 'Khruschyovka' ***(Appendix B9)*** made of prefabricated concrete panels. Their roofs were adjusted to equal height, as Nepkoychitsky prepared microrayon for Shipkov's and

[71] Irina Kukina, "Elementary Planning Residential Formation," *Housing Construction* 8, (2005): 26-27 (In Russian).
[72] Vitold Nepokoychitsky, "Characteristic Aspects of Urban Development in Norilsk," *The Problem of the North* 10 (1964): 106, 107.

Truschincsh's Complex house concept with roofed courtyard. The housing is engineered with reinforced concrete pile foundation. Ground floor was raised by 2 meters to combat snow drifts, heat loss and permafrost melting.[73] Optimisation of utility lines improved building stability. They were placed in chutes under roads outside neighbourhood and perpendicularly branched to houses avoiding stretching under courtyards.[74]

Neighbourhood №29, as microrayon prototype, assigned typology's main tenets: "closed-contour" principle, increased buildings density, public amenities and utility optimisation. However, the psychological aspect of looped buildings spatial organisation was questioned. In 1962 Gevorg Kochar suggested modified concept with closed contour opening in, meridional orientation (like in Aykhal), naturally lighted galleries and uninhabited angular connections between housing blocks with utility facilities. All childcare and education spaces would be in separate buildings inside shielded areas with orientation of classrooms to the south.[75] Some principles were accepted for microrayon, selected as typical urban typology. Norilsk map demonstrates ***(Fig. 5.19)*** that Neighbourhood №29 remained the only microrayon with fully enclosed perimeter, while more recent counterparts boast intermittent building organisation.

5.6 Neighbourhood №305, Alexandra Rastorgueva, Murmansk, 1983.

During 1980s urban planning was no longer dependant solely on industrialisation. Number of employees in administration, service, science and other disciplines started to grow rapidly. Hence larger emphasis was put on residents' consciousness and Soviet architects

[73] Stanislav Striuchkov, "The Search for Eternal Summer. An attempt to create an all-weather Territory in Norilsk," *Arctic Science Herald* 6, (2019), 68-70.
[74] Nepokoychitsky, "Characteristic Aspects of Urban Development in Norilsk," 104.
[75] Gevorg Kochar, "Planning and Building of Residential Quarters in Districts of Far North," *Architecture of USSR 6* (1962), 21, 22.

started to work through environmental design solutions on large sites.[76] Microrayons obtained new shapes and public typologies, such as theatres, libraries, clubs and sports facilities. However, principles of "closed contour," utilities optimisation and use of rectangular block as main component remained.[77] Murmansk is World's largest city and port north of Arctic circle with milder climate than in Norilsk due to location in a harbour, that never freezes. However, city's climate is still severe with winter lasting for seven months, average annual temperature of 0.6°C, that can reach -40°C and prevailing south wind average speed 4.4m/s.

Neighbourhood №305 ***(Fig. 5.20)*** consists of enclosed 1490m long residential development and a snake-like development next to it, consisting of series interconnected apartment blocks. Consolidation of blocks into one wall-like structure and extension of height from 6 to 9 stories allowed to reduce wind speed inside microrayon by three times. To ensure that architects placed design model in an aerodynamic tube. Generated low pressure zones allowed to place school, kindergarten and sports stadium in courtyards ***(Fig. 5.21)***. The improvement of microclimate also allowed to provide rich foliage, that is difficult to accomplish in Arctic climate. Enlargement of floor numbers facilitated compact building principle by increase of population density.[78] However, unlike Neighbourhood №29 this microrayon reminds a honeycomb, instead of rectangle and subdivided in three courtyards, that are, though still merged into one joint space due to larger site area. The kindergarten for 320 people sits in the central courtyard and consists of eight interconnected blocks, while the school for 1176 pupils is placed between a honeycomb and a snake and contains two compartments.

Standardized apartment blocks were assembled of prefabricated concrete panels and contained glazed balconies. Conscious about people's negative attitude towards grey and dull

[76] Fedchenko, "Humanistic Idea of a Micro-District in the XX Century," 714.
[77] Jull, "Toward a Northern Architecture," 217.
[78] I. Nerush, T. Nemolieva, A. Rastorgueva, L. Klepnikova, "Socio-Residential Complex 305 in Murmansk," *Architecture of USSR 7* (1983), 6-7.

concrete, Rastorgueva introduced colourful varnished façade thermal panels, indigenous patterns into school and kindergarten tile façade finish and Avant-garde murals with prevailing yellow colour at apartment blocks end faces ***(Fig. 5.22)***. The flats were equipped with panel heating. Although Murmansk does not sit on permafrost, its placement next to harbor led to serious waterlogging of soils, so Neighborhood №305 was erected on 22m deep pile foundation able to take up to 85tons each. The ground floor is elevated to combat snow drifts.[79]

5.7 The Problems of Microrayons

However, continuous and unopposed sprawl of microrayons speeded up Arctic urbanisation and intensifying of production volumes, that led to ecologic aggravation and pollution in Soviet Arctic cities. This neglected positive health effects from urban solutions applied in microrayons.[80] Establishing microrayon as urban standard led to landscape being covered with homogenous cities, industrially constructed of cheap materials. Educated and inspired by pioneers of Modernism (that had previously succeeded in traditional styles), young architects were obliged to deal with one-type mass housing construction, that had lost Modernist passion.[81] Soviet Modernist ideas were mostly expressed in individual public buildings, such as Arktika Hotel in Murmansk and Norilsk Drama Theatre, rather than in urban residential building.

Arktika hotel ***(Fig. 5.23)*** in Murmansk by Vladisalv Chernov is one of symbolic Modernist projects: an 18-story 72m tall tower with 635 rooms for a 1000 people. It remains the tallest building north of Arctic circle (68N). In shape of triskelion, it dominates city's main square and can be viewed across entire town. The chief engineer I. Koloshin constructed it on foundation, that consisted of 1380 25m deep piles. He stated that 2009-14 reconstruction did

[79] Nerush, "Socio-Residential Complex 305 in Murmansk," 6-7.
[80] Jull, "Toward a Northern Architecture," 217.
[81] Kalemeneva, "Arctic Modernism," 221-223.

not have capital importance because structure was fine. Renovation was required for improvement of fire safety, insulation and profitability and addition of underground parking.[82]

The second notable project is Mayakovsky drama theatre in Norilsk by Anatoly Chernyshev ***(Fig. 5.24)***. (1983-1986). The theatre accommodates 600 seats, has double floors, pilons and finished with marble, making it very prominent. Steep roof pitch provides snow pocketing. The only weakness was small incline of seating, so the whole scene could not be seen, that was removed in 2002 during restoration.[83]

Conclusion to chapter

The process of completion of Arctic development projects allowed to find Arctic-specific urban typology, that achieved main goal of Modernist approach – to construct permanent Northern dwelling that can provide comfortable living conditions in harsh climate. Comparison of Western and Soviet expressions of Arctic urban typologies demonstrate that projects maintain elements of Modernist universality at latest stages of production. The working style and degree of architect's modernity, political agenda, common practices in countries and funding type are more noticeable, than national particularities.

[82] "Murmasnk's Arktika Hotel Will Open in Seven Month," Komsomolskaya Pravda, 23 January 2014, https://www.murmansk.kp.ru/daily/26185.4/3073752/
[83] "Norilsk on A do Ya: Theatre," Norilchane, http://norilchane.ru/norilsk/-/asset_publisher/W0Gy0SowOh9G/content/id/26830

Figure 5.13: Aykhal Udachny historic photo.

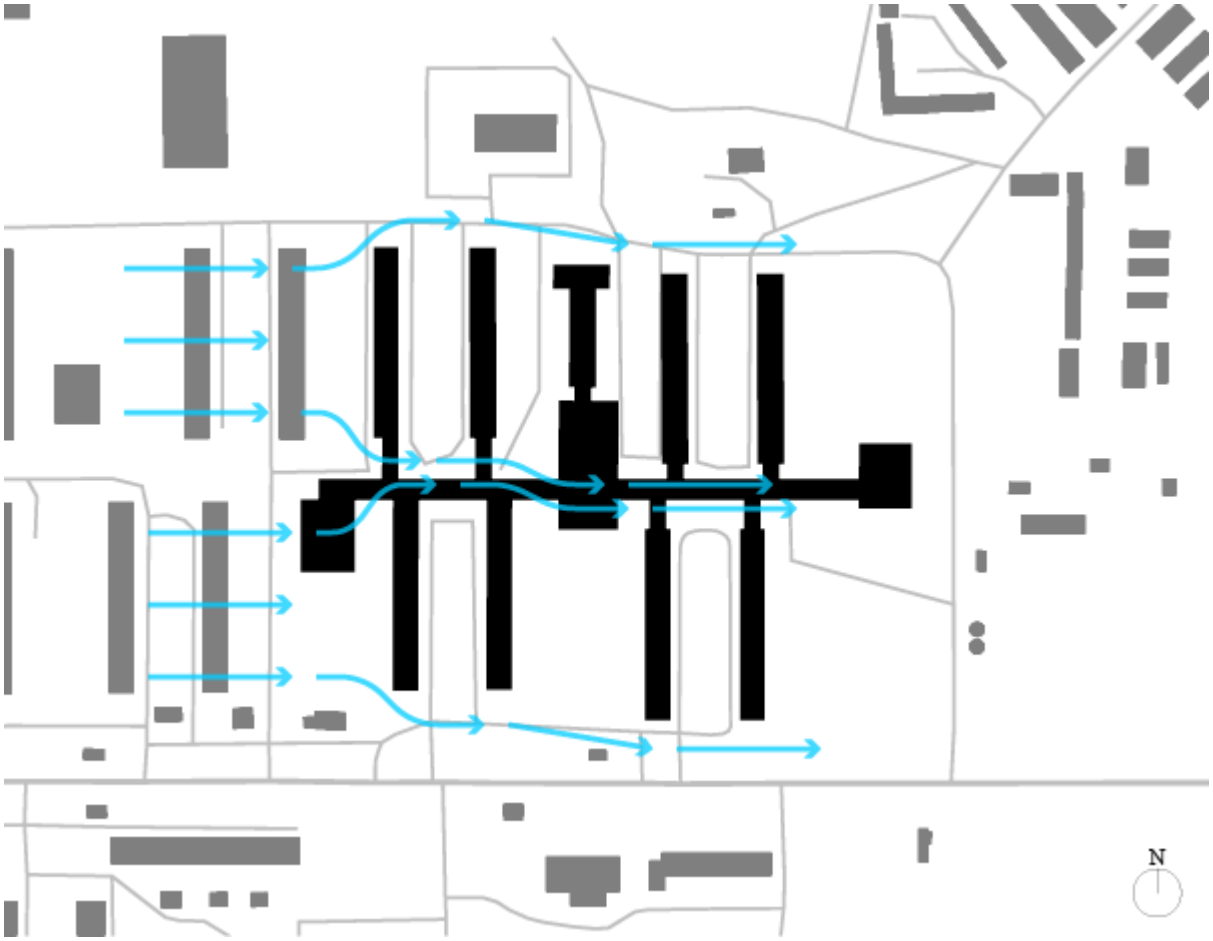


Figure 5.14: Wind protection at meridional housing allocation.

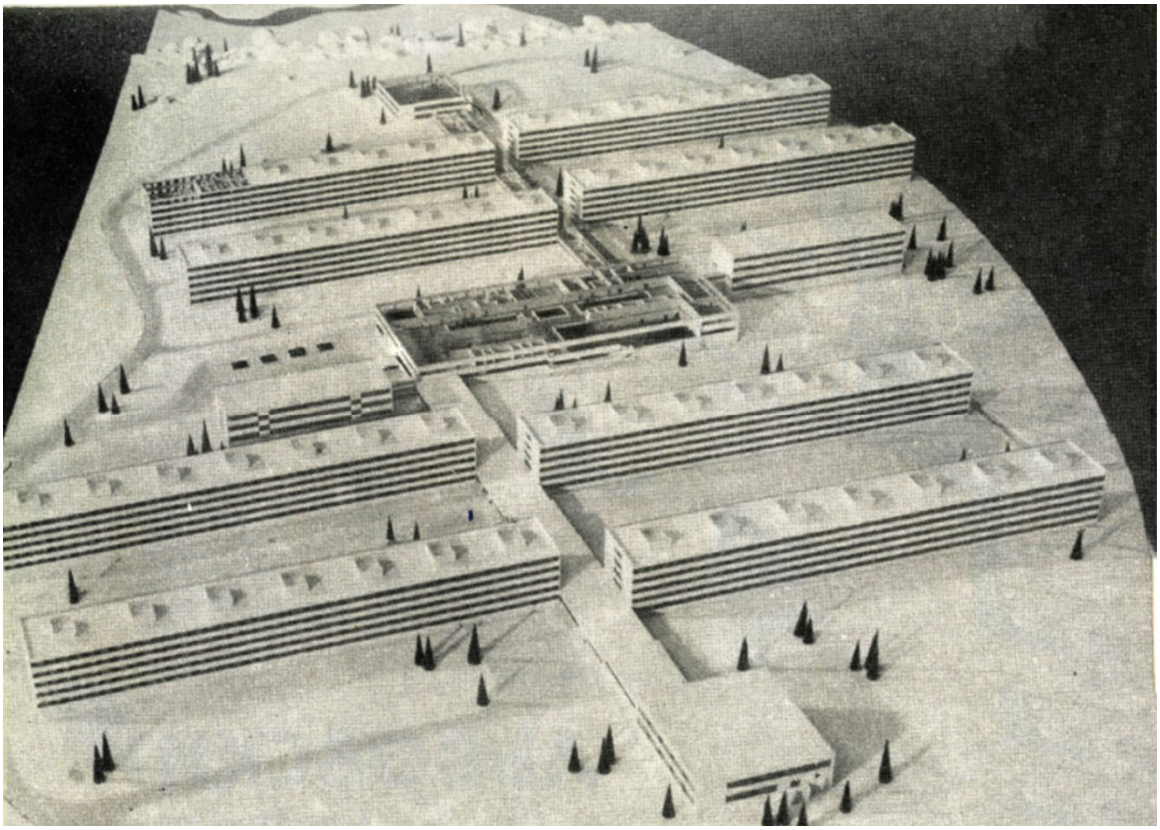


Figure 5.15: Aykhal Udachny 3D model. Residential and public blocks, covered gallery and outdoor promenade are clearly seen.

Figure 5.16: Aykhal Udachny present-day photo.

Figure 5.17: Neighbourhood №29 construction.

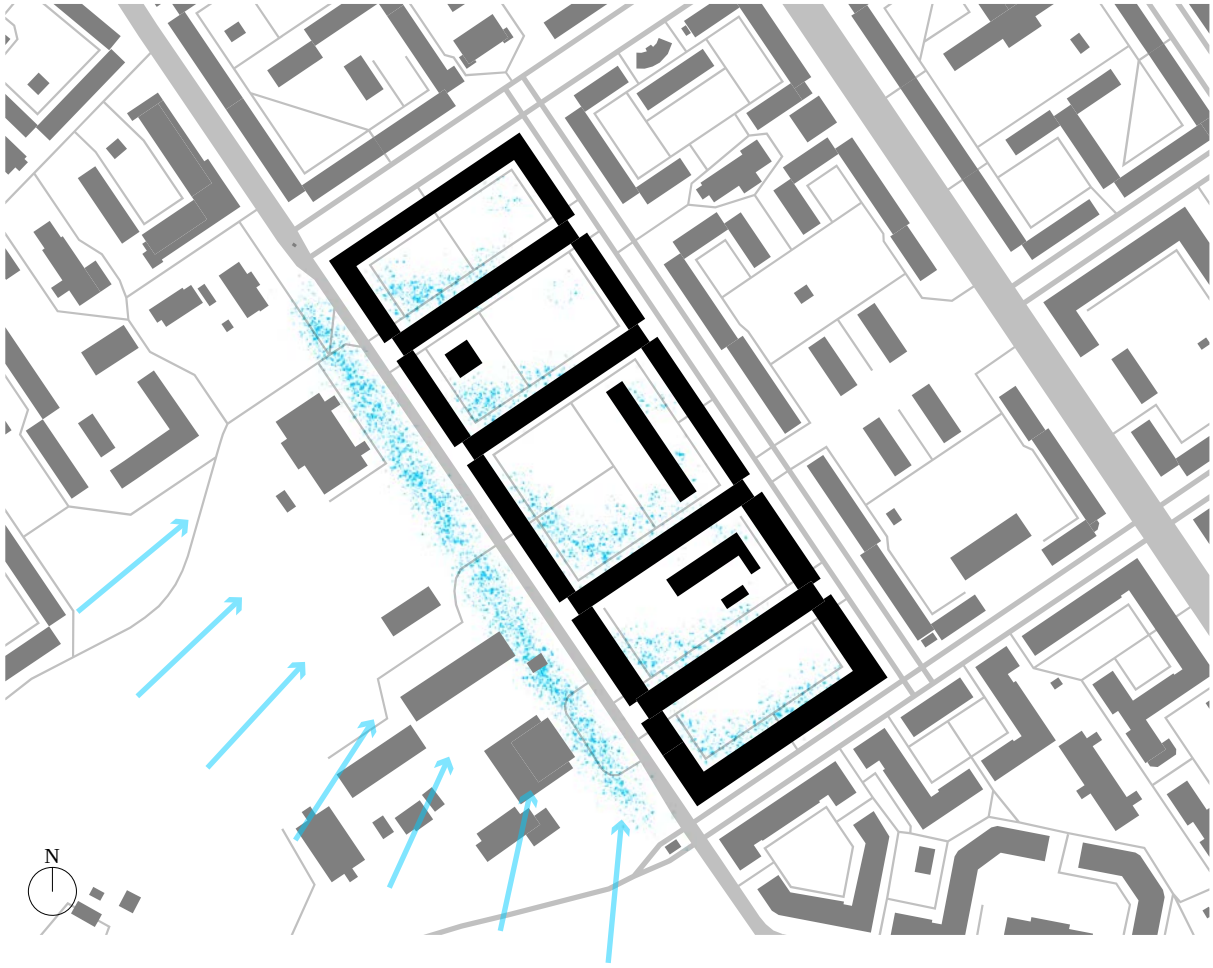


Figure 5.18: Wind and snow accumulation in Neighbourhood №29.

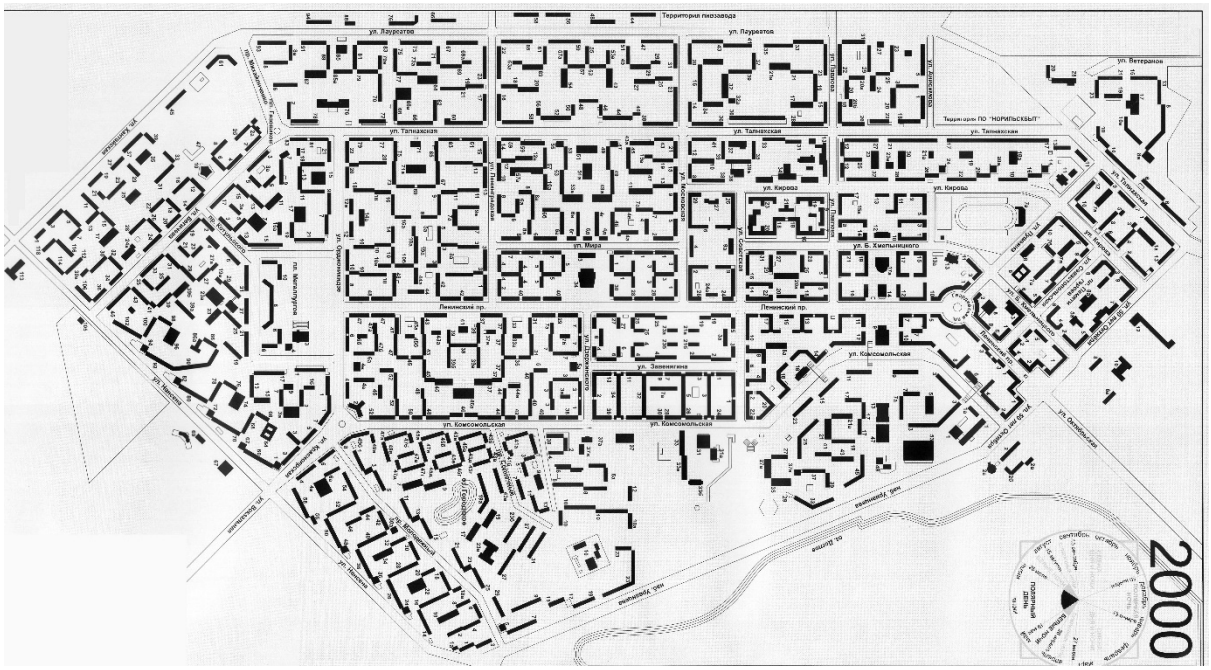


Figure 5.19: Map of Norilsk

Figure 5.20: Neighbourhood №305.

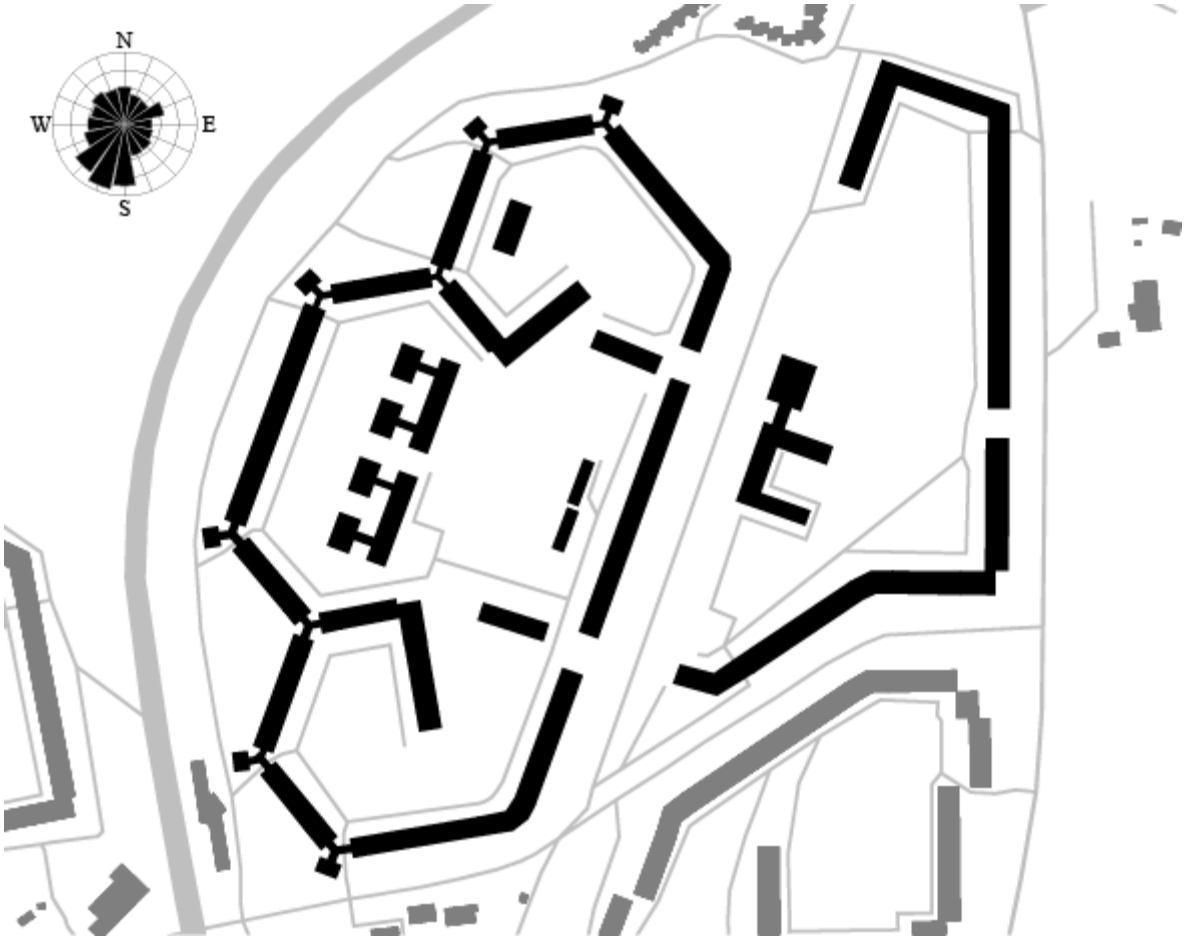


Figure 5.21: Neighbourhood №305 figure ground.

Figure 5.22: Neighbourhood №305 courtyard.

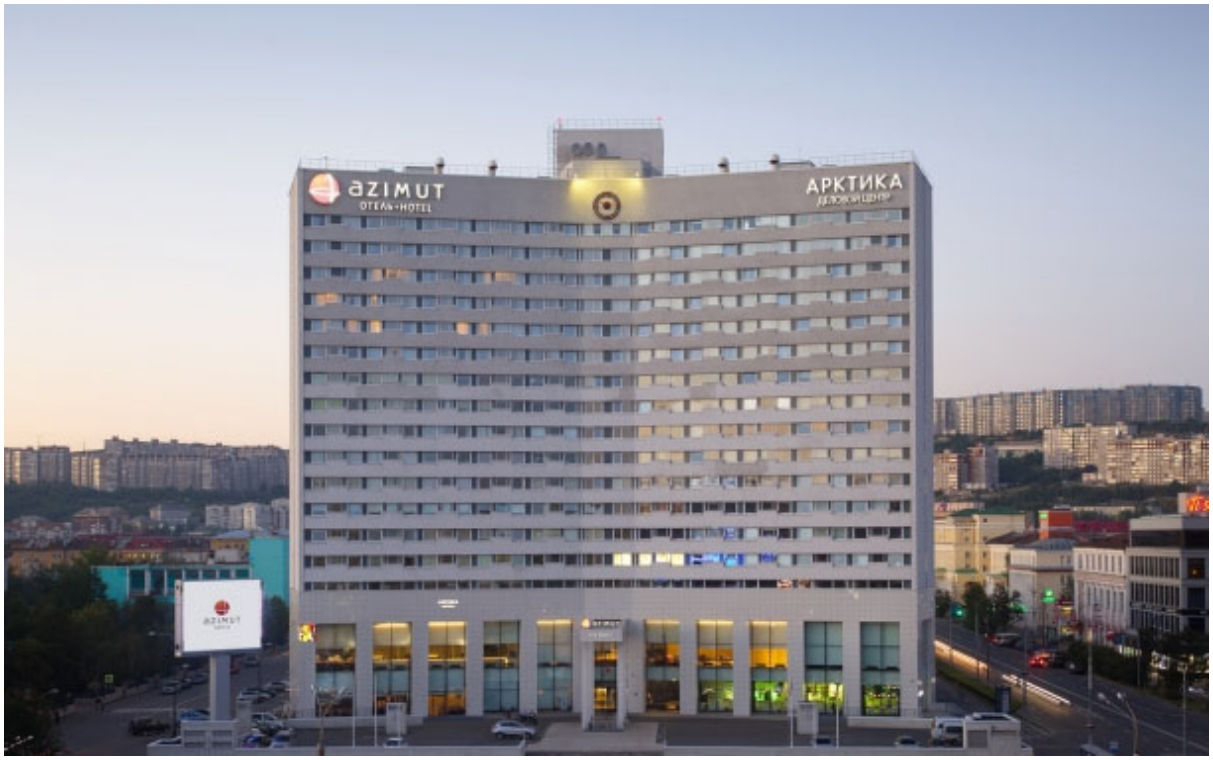


Figure 5.23: Arktika Hotel

Figure 5.24: Norilsk Drama Theatre.

CHAPTER 6

COMPLETED PROJECTS COMPARISON

Previously demonstrated creation of Arctic-specific urban typologies resulted from completion of Ralph Erskine's Arctic Town and USSR's Microrayon. In this chapter, discussed case studies by Western and Soviet architects will be compared to prove similarity between their design solutions despite first impression of complete difference.

Realised specific typologies of Arctic Urbanism testify consensus between Erskine and Soviet colleagues that residents are unable to live in fully artificial indoor environment due to hard psychological and physiological consequences. Such lifestyle contradicts with nature of human, who evolved in open space conditions, and is possible only for temporary living.

Major Modernist principle for Arctic settlements defines architectural, engineering and urban planning solutions: climate-responsive development must protect inhabitants from extreme conditions and provide microclimate for comfortable stay. Thus, both Arctic typologies are characterised with sheltering contour for inner spaces and construction with precise massing allocation. The windscreen principle in Svapparvaara, Resolute Bay and Fermont and "closed-contour" principle in Norilsk and Murmansk are different embodiments of identical idea – conversion of apartment building into a wall barrier against wind and snow, creating a sheltered zone with microclimate for comfortable outdoor stay. Some difference in solar orientation is caused by prevailing wind direction. All projects with Erskine's participation dealt with prevailing northern wind. This allowed him to place urban developments on south facing slope, where wind barrier would stand on top of hill, while sheltered area benefited from sunlight. Architects of microrayon faced a more difficult task, as Erskine's concept was impossible in Norilsk, Murmansk and Aykhal with south and west prevailing winds respectively. Placement of microrayon on a slope would not work, hence, to

achieve best results in wind protection without reduction of solar gain architects tended to experiment with massing allocation, resulting in vast diversity of Soviet settlements urban plans. It worth mentioning, that in 1967 Schhipkov and Trouschinch, inspired by Erskine's works proposed a large-scale redevelopment of Norilsk with erection of 2km long 16-story windscreen inhabited wall at southern border of city.[84] All projects were developed using compact building organisation to increase protectiveness, energy efficiency and communications optimisation.

Microclimate regulation and control allow to create second level of protectiveness – sheltered inner space with indoor amenities and additional housing. The minimum number of amenities in each development included childcare and education facilities, while more advanced and self-sufficient projects included commercial, public, sports and healthcare spaces. The architects experimented with connection between buildings, so all proposals feature either covered galleries or inhabitable junctions between residential volumes. It was an important part of physical and social wellbeing of residents, especially younger, and part of integration of indigenous people to create health community.

Extreme conditions, difficult access to site and lack of skilled labour led to similarities in construction and engineering solutions. Both Western and Soviet architects advocated use of prefabricated materials, such as concrete panels that could be produced in more comfortable factory conditions and assembled on site. Erskine successfully applied concrete panels in Kiruna and Svappavaara, while in USSR concrete panels were the main construction material. Architects also did not hesitate to use bright and warm colours to enhance sunlight absorption and dilute dull grey and white landscape with more pleasant colours. Combatting with snow

[84] Jull, "Toward a Northern Architecture," 220.

drifts, heat loss and instability of soil, both experimented with foundation solutions. Most discussed realised projects (except Kiruna and Svappavaara) have raised ground floor.

The main differences between Erskine's and Soviet urban planning approach lied in areas of juncture of residential building design and urban planning, mass housing and project scales and ecology. Erskine had more freedom for experiments with architectural form. Despite following same principles, outlined in "Arctic Town," each of his projects has unique design, where straight and functional forms combine with smooth and curvy surfaces. They feature great variety of solutions in number of floors, roof shapes, window grids and footprints, caused by Erskine's careful work with climatic factors at every specific site. During Arctic development Soviet architects used the most simple and functional building shape possible – 4 - 9 story rectangular apartment blocks with minimum façade decoration. They were highly standardised and had little architectural value, that nullified creative nature of Modernist approach and residential design overall. Despite being a Modernist, Erskine desired to live in an ecological town, where residents could remain connected with nature and never proposed urban developments for more than 5000 residents. In USSR, although earliest microrayons were developed for approximately 5000 people, they were used as "jigsaw puzzle pieces" for assembly of large industrial, often polluted, cities, especially for more than 100000 people. Erskine's strive for creation of architectural "space" that inhabitants could convert into "place"[85] helped to successfully realise his concept in Fermont, that is described as "…most compelling site-specific and purpose-built modern experiment in urban form to be found in the subarctic and Arctic regions." [86]

Modernist approach in Arctic development led to parallel, relatively independent formulation of Arctic-specific urban typologies, expressed in different forms, but unified by

[85] Erskine, Architecture and Town Planning in the North, 165.
[86] Sheppard and White, Arctic Architecture, 366.

same major principles: use of closed contour, composed of residential spaces to protect sheltered space with detached volumes and microclimate. Constrained by climate-responsive building standards, technological and logistic challenges, architects had little space for offering residential typologies, that operate well in architectural, cultural and social scales.[87] Moreover, in case of Soviet microrayon housing unification reached maximum degree to be used as construction medium for urban grid, rather giving opportunities for diversification of residents' private lifestyle. The only real variety was offered only in number of public amenities, depending on microrayon capacity.

[87] Jull, "South Camp Inn."

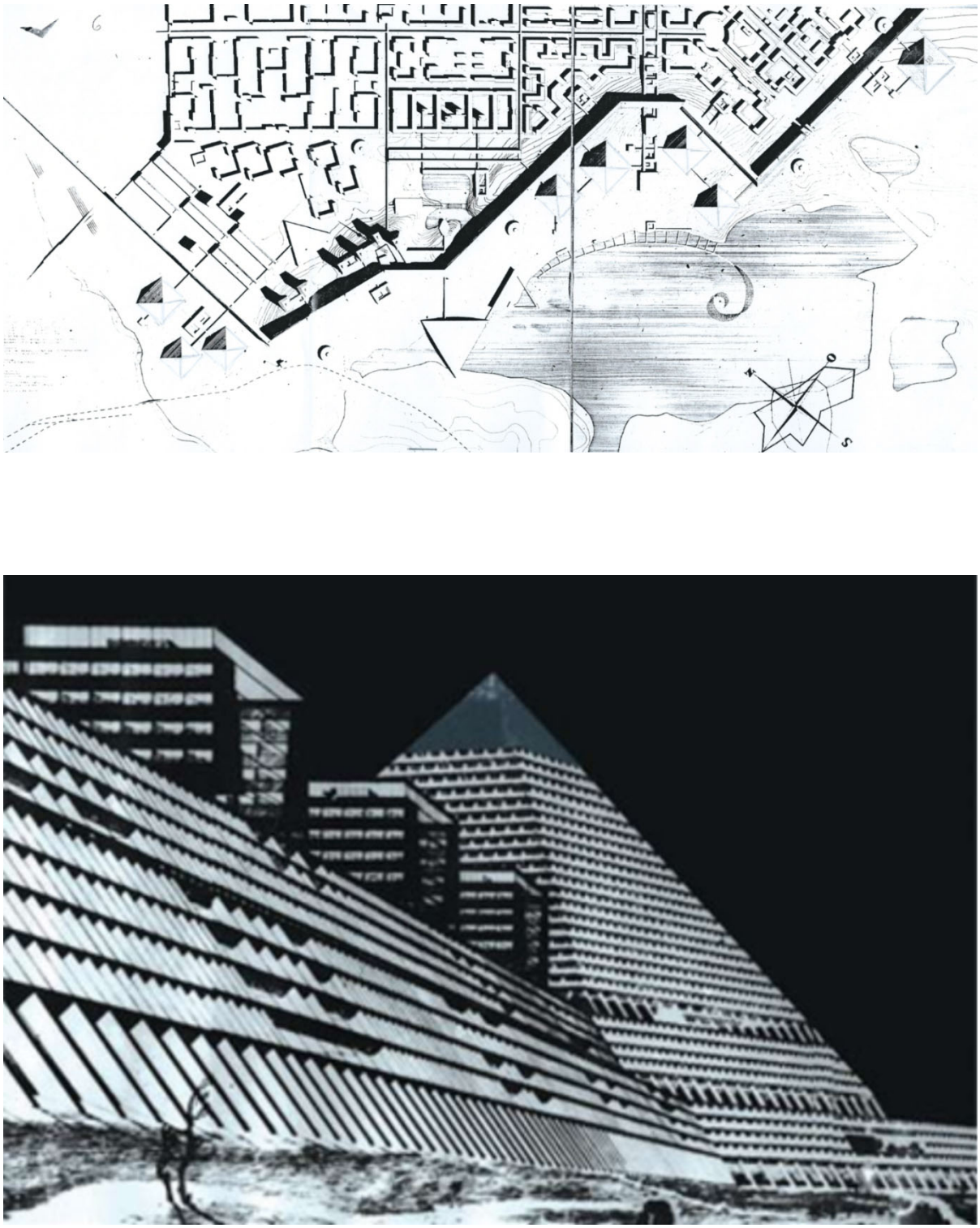


Figure 6.1: Shipkov's and Trouschinch's proposal for Norilsk Redevelopment. *Above*, Plan. *Below*, Visualisation

CHAPTER 7

CONCLUSION

This work supports my statements about Modernist development of Arctic in XX century. In wany ways this process based on North/South division. Arctic was rich and geopolitically important entire region with extreme climate conditions and limited accessibility of most territories. Considering its status of “empty” and undeveloped area without sufficient cultural heritage, it was destined to conquest in space-like manner. Passionate political elites in circumpolar countries, especially in Canada and USSR, formed demand for North modernisation in 1950s and to achieve it, social mobilisation of ground-breaking specialists such as architects, engineers and other technocrats. Absence of numerous steady communities with horizontal connection, small indigenous population with no influence of Arctic agenda and previously formed “trailblazer” mindset and colonial attitude among specialised professional and military staff were background for inner Arctic cultural relationships. Altogether these circumstances were a good ground for newcomers’ passion, modernity and desire to transform this territory and build new innovative lifestyle here.

Modernist ideas instantly started to dominate among architects, engineers and urban planner, who were searching for new technological forms and solutions for protection against extreme conditions. Usual temperate latitudes habitat had to be reproduced in unique Arctic environment. This process started with elaboration of North-specific standards, without which region development would be impossible. Southern typologies were impossible to adapt, especially in areas with permafrost and large snow accumulation. This applies not only to foundations and utility lines, but also to massing, interior planning and surfaces finish and decoration. Thus, first urban planning strategies and principles of building were developed same time. The question “Isolation from nature or interconnection with it?” was the main topic

of arguments, that caused division in design proposals.[88] Two main trends were self-sufficient megastructures with artificial environment and sheltered outdoor spaces with protected microclimate. Broad range of proposals were designed in all circumpolar countries from 1950 to 1990, but they did not demonstrate distinct national particularity. Instead, Modernist universality is traced in them all. Initially, architects received carte blanche in iterative design process and were promised stable state funding, therefore futuristic domed large-scale developments prevailed. From earliest designs, a strong connection between architectural dwelling design and urban planning is noticed. A clear dependence of separate buildings on protection qualities of entire urban Northern planning is noticed due to wind, snow, low temperature and permafrost.

Reality left most Arctic projects as unrealised Utopian intellectual heritage of Modernism.[89] Changed conditions at completion stage and consensus over isolation degree defined refuse of futuristic structures with artificial climate in favour of more conventional outdoor settlements. Project completion faced many problems, so number of fully constructed design proposals is very low. However, Artic-specific urban typologies with workable shelter strategy for permanent living appeared among these few completed settlements. Protective contour from residential blocks with sheltered outdoor inner space underpinned this typology and was incarnated in Ralph Erskine's Arctic Town and Soviet Microrayon. Despite visual differences, their analysis proves application of similar principles and urban solutions in protection from elements, microclimate control and provision of amenities for community operation. The socio-climatic urban structure for human wellbeing became convergence point of Western and Eastern trajectories of Arctic urban development.[90] In this juncture of

[88] Shipkov, "Polyar," 13.
[89] Rodri Liscombe, "Modernist Ultimate Thule," *Canadian Art Review* 31, no. 1/2 (2006), 64.
[90] Jull, "Toward a Northern Architecture," 219.

architectural residential design and urban planning, the balance is shifted to latter. Within Modernist urban planning typology even innovative, climate-responsive, well-constructed and engineered residential blocks with efficient material selection did not have enough qualities to be considered architecturally valuable.[91] While Erskine attempted to iterate unique architectural solutions for each residential project, in microrayon residential typology is a simple, highly standardised component of urban plan. Arctic-specific residential typology is still a challenge for architects and XX century experience is being rethought nowadays. An "Arctic Adaptation Exhibition" in Canadian pavilion at 2014 Venice Biennale demonstrates continuing search for architectural Northern dwelling for permanent living, while models of settlements demonstrate use of protective contour principles, formulated in last century ***(Figs. 7.1-7.2)***.

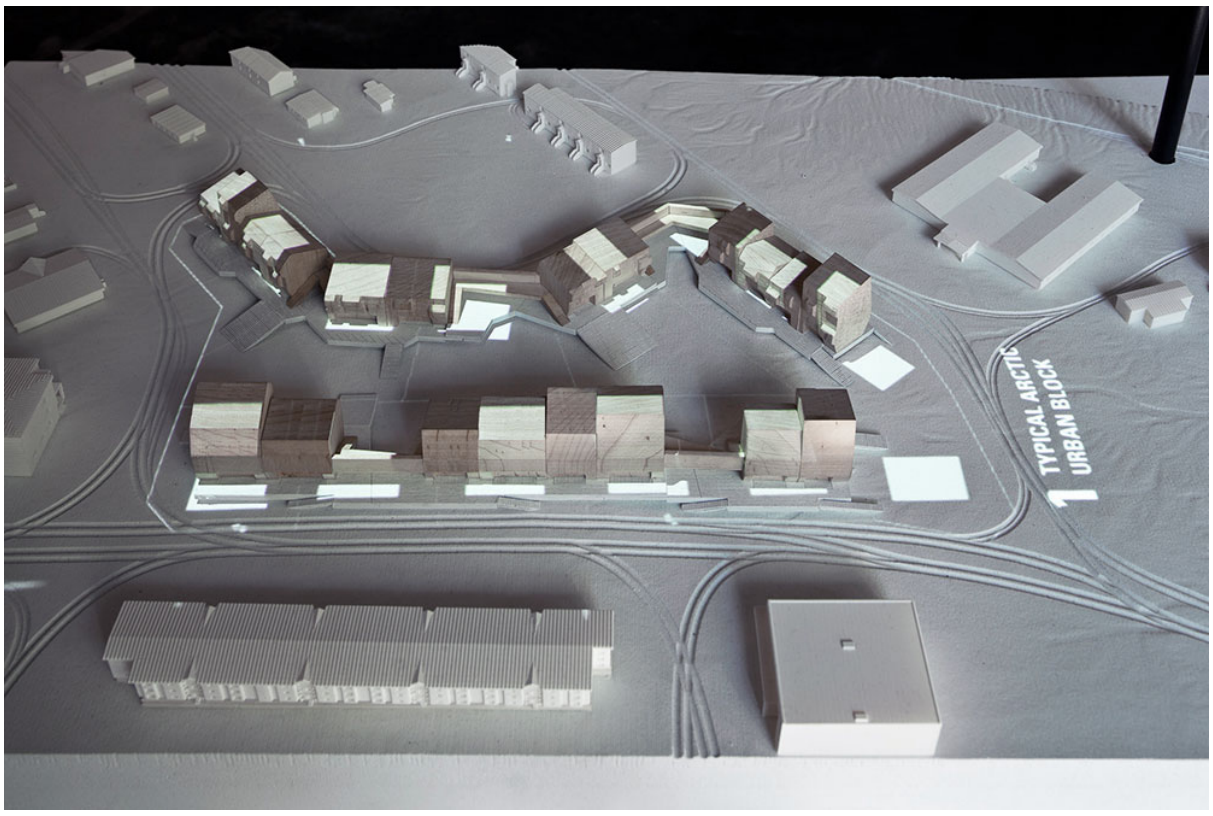


Figure 7.1: Contemporary Arctic urban development proposal.

[91] Sheppard and White, Arctic Architecture, 354, 382.

Figure 7.2: Contemporary Arctic architectural typology proposal.

LIST OF FIGURES

Images from *The Moche Safdie Archive* (1977)

Figure 4.12: Single-Housing Complex, Alexander Shipkov, Norilsk, 1963. 256 people.
Images from *Shipkov* (1971)

Figure 4.13: Complex-house, A. Shipkov & Y. Truschcinch, Norilsk, 1964. 1000 people.
Images from *Shipkov* (1971) & *TATLIN Publishers* (2021)

Figure 4.14: Alexander Shipkov, Pyramid, 1964, 2000 people
Images from *TATLIN Publishers* (2021)

Figure 4.15: Alexander Shipkov, Polyar Snezhnogorsk, 1964. 2000 people.
Images from *Shipkov* (1971) & *TATLIN Publishers* (2021)

Figure 4.16: The Port Settlemnt, Valentin Tankayan, 1966. 3500-4000 people.
Images from *Chuklov* (2019)

Figure 4.17: The Town of the Future, Eduard Putintsev, Aykhal, 1989. 5000 People
Image from *Eduard Putintsev Archive* (2016)

Figure 5.1: Completed Projects Timeline (Author's Own Illustration).
Based on analysis of discussed paper projects.

Figure 5.2: Kvarteret Ortdrivaren (aerial view).
Photo by *Arild Vagen* (2017)

Figure 5.3: Erskine's Kiruna town centre redesign proposal. Ortdrivaren is encircled.
Image from *Collymore* (1982)

Figure 5.4: Ortdrivaren section, that demonstrates building heights differences, underground spaces and roof shapes.
Image from *Collymore* (1982)

Figure 5.5: Svappavaara Proposal.
Image from *Egelius* (1990)

Figure 5.6: Resolute Bay Proposal.
Image from *Egelius* (1990)

Figure 5.7: *Left*, Svappavaara proposal figure ground.
Right, Svappavaara proposal figure ground. (Author's Own Illustrations).
Information from *Collymore* (1982), *Egelius* (1990) & *Jull* (2016)

Figure 5.8: *Above,* Ormen Lange South façade.
Below, Ormen Lange North façade.

Appendix A

List of International Bodies and Organisations

1. **Circumpolar countries:** eight Arctic States that have territories within the Arctic and thus carry the role as stewards of the region: Canada, The Kingdom of Denmark, Finland, Iceland, Norway, The Russian Federation, Sweden, The United States. Their national jurisdictions and international law govern the lands surrounding the Arctic Ocean and its waters. By 2009 eight circumpolar countries occupy 27% of World terrestrial land, 7% of World population and 30% of World GDP.

   Data source: *Arctic Council*, Accessed 20 October 2020
   https://arctic-council.org/en/about/states/

2. **The Arctic Council** consists of the eight Arctic States had territories within the Arctic: Canada, The Kingdom of Denmark, Finland, Iceland, Norway, The Russian Federation, Sweden, The United States. Their national jurisdictions and international law govern the lands surrounding the Arctic Ocean and its waters. The Arctic Council established in 1996 (1991-ARCTIC ENVIRONMENTAL PROTECTION STRATEGY (AEPS)-a non-binding agreement between the 8 Arctic States and Indigenous peoples organizations representing Inuit, Sami, and Russian Indigenous peoples) Thirteen Non-arctic States have been approved as Observers to the Arctic Council: France, 2000; Germany, 1998; Italian Republic, 2013; Japan, 2013; The Netherlands, 1998; People's Republic of China, 2013; Poland, 1998; Republic of India, 2013; Republic of Korea, 2013; Republic of Singapore, 2013; Spain, 2006; Switzerland, 2017; United Kingdom, 1998. The Council's activities are conducted in six Working Groups. It is the responsibility of the Working Groups to execute the programs and projects mandated by the Arctic Council Ministers.

   Data source: *Arctic Council*, Accessed 20 October 2020
   https://arctic-council.org/www/en/about/observers/non-arctic-states/

3. **The AMAP (Arctic Monitoring and Assessment Programme) Working Group** of the Arctic Council (1991): Measuring and monitoring pollutants and climate change effects on ecosystems and human health in the Arctic.

   Data source: *Arctic Council*, Accessed 21 October 2020
   https://arctic-council.org/en/about/working-groups/amap/

4. **CAFF (Conservation of Arctic Flora and Fauna) Working Group** serves as a vehicle to cooperate on species and habitat management and utilization, to share information on management techniques and regulatory regimes, and to facilitate more knowledgeable decision-making. It provides a mechanism to develop common

responses on issues of importance for the Arctic ecosystem such as development and economic pressures, conservation opportunities and political commitments.

Data source: *Arctic Council*, Accessed 21 October 2020
https://arctic-council.org/en/about/working-groups/caff/

5. **The Nordic Council** is the official body for formal inter-parliamentary co-operation. Formed in 1952, Denmark, Finland, Iceland, Norway, Sweden, the Faroe Islands, Greenland and Åland.
   The Nordic Council of Ministers is the official body for inter-governmental co-operation in the Nordic Region. It was set up in 1971 and, despite its name, actually consists of several individual councils of ministers.

   Data source: *Arctic Council*, Accessed 21 October 2020
   https://www.norden.org/en/nordic-council

6. **The AHDR (Arctic Human Development Report):** an assessment of the state of Arctic human development; to highlight the major trends and changes unfolding related to the various issues and thematic areas of human development in the Arctic; and, based on this assessment, to identify policy relevant conclusions and key gaps in knowledge, new and emerging Arctic success stories.

   Data source: *Arctic Council*, Accessed 21 October 2020
   https://www.norden.org/en/publication/arctic-human-development-report

7. **The Barents Euro-Arctic Region Cooperation:** Cooperation in the Barents Euro-Arctic Region was launched in 1993 on two levels: **intergovernmental Barents Euro-Arctic Council (BEAC)** and **interregional Barents Regional Council (BRC).** The Barents Region includes the following counties or their equivalents: in Finland: Lapland, Oulu Region, Kainuu and North Karelia; in Norway: Nordland and Troms og Finnmark; in Russia: Arkhangelsk Region, Murmansk Region, Karelia, Komi and Nenets; in Sweden: Norrbotten and Västerbotten
   The overall objective of Barents cooperation has been sustainable development. **The Barents Euro-Arctic Council (BEAC)** meets at Foreign Ministers' level in the chairmanship country at the end of each BEAC chairmanship term. The chairmanship rotates every second year between Norway, Finland, Russia and Sweden.

   Data source: *Barents Euro-Arctic Cooperation*, Accessed 22 October 2020
   https://www.barentscooperation.org/en

8. **The World Winter Cities Association for Mayors (WWCAM)** is a network that brings together winter cities of the world to meet and learn from each other about winter technologies and experiences under the slogan "Winter is a Resource and an Asset."

Formerly called the Northern Intercity Conference, the association was initiated by the City of Sapporo in 1981 and the first Mayors Conference was held the following year. In 2004, aiming for further development of the association, the name was changed to World Winter Cities Association for Mayors.

Data source: *The World Winter Cities Association for Mayors*, Accessed 22 October 2020
https://wwcam.org/en

Appendix B

List of Definitions

1. **Inuit High Arctic Relocations in Canada:** In 1953 and 1955, the Royal Canadian Mounted Police, acting as representatives of the Department of Resources and Development, moved approximately 92 Inuit from Inukjuak, formerly called Port Harrison, in Northern Quebec, and Mittimatalik (Pond Inlet), in what is now Nunavut, to settle two locations on the High Arctic islands. It has been argued that the Government of Canada ordered the relocations to establish Canadian sovereignty in the Arctic, and proposed to Inuit the move, promising improved living conditions. The Inuit were assured plentiful wildlife, but soon discovered that they had been misled and endured hardships. The effects have lingered for generations.

   Data source: *The Canadian Encyclopedia*, Accessed 15 November 2020
   https://www.thecanadianencyclopedia.ca/en/article/inuit-high-arctic-relocations

2. **Arctic Institute of North America (AINA):** Canada's first and longest-lived Arctic research institute created in 1945 to advance the study of the North American and circumpolar Arctic through the natural and social sciences, the arts and humanities, and to acquire, preserve and disseminate information on the physical, environmental and social conditions in the North. A part of the University of Calgary since 1976.

   Data source: *University of Calgary*, Accessed 20 December 2020
   https://arctic.ucalgary.ca/

3. **The Northern Co-ordination and Research Centre of the Canadian Department of Northern Affairs and National Resources** was established in 1954, at the recommendation of the Advisory Committee on Northern Development, and reports to government through the Secretary of this committee. It has three main functions—co-ordination, information and research.
   Ministry (the Department) of Northern Affairs and Natural Resources (NANR) established in 1953 with responsibility for Northwest territories and Yukon, Eskimo affairs, and Canada resources.

   Data source: *Polar Recor, Cambridge University Press (2009)*
   Data source**:** *Acts of the Parliament of Canada (1953-1954)***,** Accessed 12 January 2020

4. **The "Northern Vision"** proclaimed by John Diefenbaker (Canada prime minister 1957–63) that figured in the rhetoric of the 1957 and 1958 elections increased public awareness of the Far North. It also led to some economic development in that region.

   Data source: *The Canadian Encyclopedia*, Accessed 15 November 2020
   https://www.thecanadianencyclopedia.ca/en/article/inuit-high-arctic-relocations

5. **GULAG:** an acronym (used from 1930) for **G**lavnoye **U**pravleniye **LAG**erey, or Main Camp Administration, which was a special division of the secret police and the Soviet Ministry of the Interior overseeing the use of the physical labour of prisoners. Alongside criminals and recidivists, the majority of Gulag prisoners were completely innocent people locked up for a broad variety of political reasons – on the basis of trumped-up charges or ethnicity, or even without apparent cause. After Stalin's death in 1953, the number of prisoners declined considerably, and the Gulag was officially done away with in 1960.

   Data source: *GULAG Online*, Accessed 12 January 2020
   http://www.gulag.online/articles/historie-gulagu?locale=en

6. **Department of Urban Planning in the Far North –** was created in 1950 on the basis of Leningrad Branch of the Soviet Academy of Construction and Architecture responsible for development of standards, planning principles and projects of northern towns.
   Committee of Northern Issues was established in 1955 as a part of the Soviet Academy of Sciences for systematic research on resource potential and creating economical projects for development of the region. **"Northern Issues"** – the interdisciplinary annual research journal published by Committee of Northern Issues to discuss Arctic development.

7. **Khrushchev housing reform: (**1956-1965) mass housing program started from the decree of Nikita Khrushchev (the Party Chairman 1954-1960) "*On liquidation of excesses in projects and construction*" 1955 with the aim of implementation of industrial methods of construction of prefabricate standardized apartment blocks liquidation of "excessive decoration of facades" and use of cheap materials. About 30% of SU population moved into new private small-sized apartments called "Khrushchyovka" from shared ones and barracks.

8. **Stalinka:** the common name of capital apartment buildings from 2 floors height with walls from incombustible materials, provided with all municipal conveniences, including waste chutes, in the style of Soviet neoclassicism (Stalin's empire) that were built from 1935 to 1960, when industrial mass housing construction started. Stalin's comfortable apartments has three or four separate rooms. Typical apartments have a total area of 32-50 m^2 (one-room), 44-66 m^2 (two-room), 60-85 m^2 (three-room) and

80-110 m^2 (four-room), separated bathrooms, big kitchens, and storage with height of the ceilings at least 3m.

Data source: *Academic Dictionary*, Accessed 25 January 2020
https://dic.academic.ru/dic.nsf/ruwiki/376984

9. **Khrushchyovka (negative – Khruschyoby *(lit. Khrusch-slums)*:** the common name of a type of low-cost brick or prefabricated concrete-paneled 3-to 5-storied apartment buildings without elevators developed in the Soviet Union in 1960-1971. Typical apartments have a total area of 30 m^2 (one-room), 44 m2 (two-room) and 60 m^2 (three-room) combined bathrooms and kitchens of 6 m^2.

   Data source: *Academic Dictionary*, Accessed 25 January 2020
   https://dic.academic.ru/dic.nsf/ruwiki/104059

Appendix C

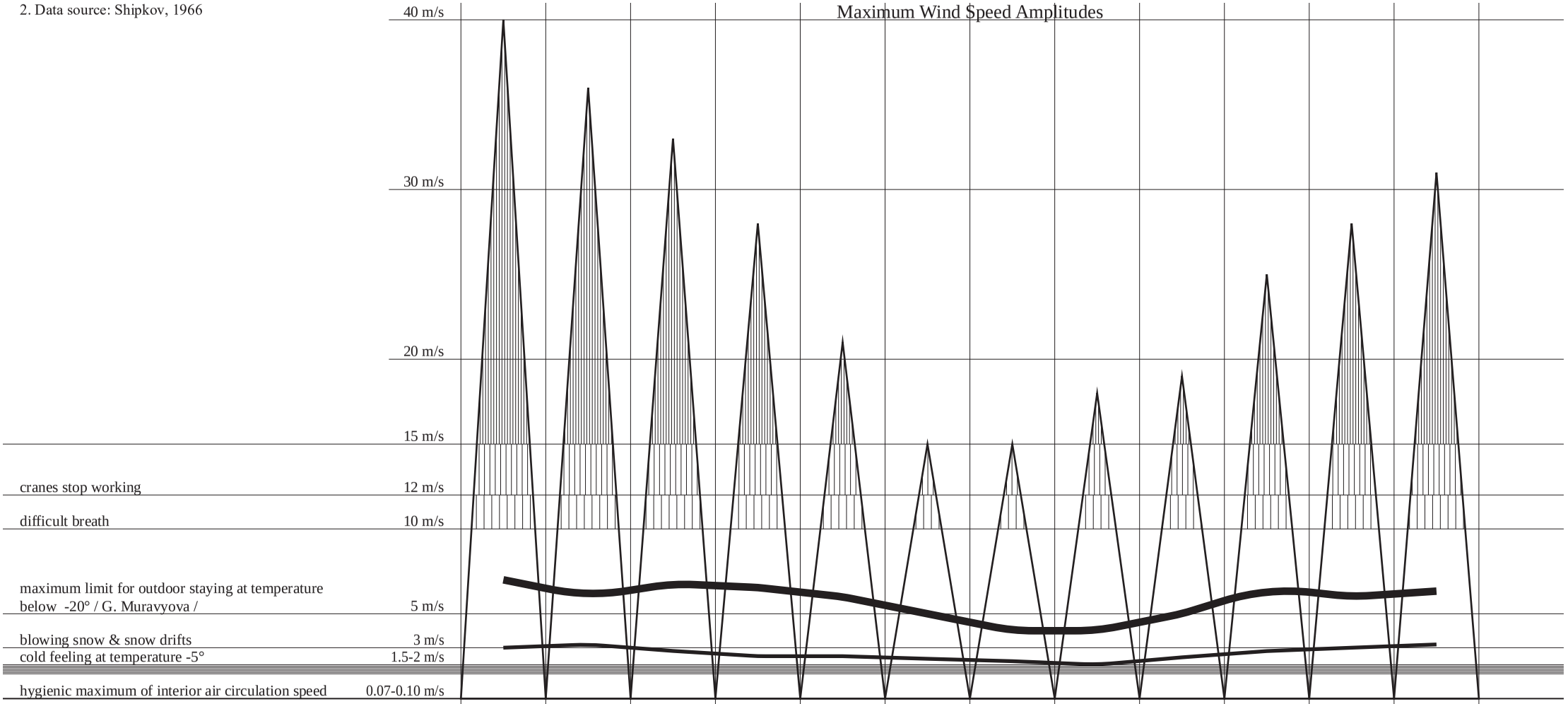
Additional Information

1. Largest Arctic Urbanisation Centres (2017)

Town	Country	Population	Town	Country	Population
Archangelsk	Russia	351,488	Kandalaksha	Russia	32,034
Yakutsk	Russia	307,911	Kirovsk	Russia	28,863
Anchorage	United States	298,192	Whitehorse	Canada	28,225
Murmansk*	Russia	298,096	Boden	Sweden	28,024
Reykjavík	Iceland	212,385	Labytnangi	Russia	26,500
Oulu	Finland	200,637	Mo i Rana	Norway	26,186
Severodvinsk	Russia	185,042	Onega	Russia	26,070
Norilsk*	Russia	178,654	Harstad	Norway	24,853
Nakhodka	Russia	152,294	Naryan Mar	Russia	24,654
Umeå	Sweden	122,892	Kiruna*	Sweden	23,167
Novy Urengoy	Russia	113,254	Dudinka	Russia	21,513
Noyabrsk	Russia	106,879	Molde	Norway	20,892
Magadan	Russia	98,930	Alta	Norway	20,521
Vorkuta*	Russia	80,061	Fort St. John	Canada	20,155
Luleå	Sweden	76,770	Yellowknife	Canada	19,569
Skellefteå	Sweden	72,266	Narvik	Norway	18,721
Rovaniemi	Finland	62,234	Akureyri	Iceland	18,342
Apatity	Russia	56,732	Nuuk	Greenland	17,036
Bodø	Norway	51,110	Polyarny	Russia	16,956
Severomorsk	Russia	50,905	Aikhal*	Russia	13 898
Salekhard	Russia	48,794	Tórshavn	Faroe Islands	12,713
Yamburg	Russia	47,711	Nikel	Russia	12,055
Ålesund	Norway	47,336	Anadyr	Russia	8,288
Monchegorsk	Russia	46,205	Iqaluit*	Canada	7,740
Nadym	Russia	44,660	Fermont*	Canada	2,474
Tromsø	Norway	34,283	Snezhnogorsk*	Russia	666
Fairbanks	United States	32,751	Svappavaara*	Sweden	417
Juneau	United States	32,468	Resolute Bay*	Canada	198

Source: Developing Metrics to Guide Sustainable Development of Arctic Cities: Progress & Challenges, *Arctic Yearbook*, 2017
* Towns, deemed significant (presence of studied Modernist Projects)

2. Data source: Shipkov, 1966



	month 1	2	3	4	5	6	7	8	9	10	11	12	year
Average Monthly and Yearly Wind Speed / m/s /													
Norilsk	6.4	5.8	6.7	6.5	5.9	5.2	4.3	4.2	5.1	6.5	5.7	6.1	5.7
Moscow VDNKh	3.0	3.1	2.9	2.6	2.6	2.4	2.3	2.1	2.4	2.8	3.0	3.1	2.7
Average Number of Days with Strong Wind / >15m/s /													
Norilsk	10.3	8.4	9.3	5.5	4.4	2.6	1.2	1.9	4.5	8.7	6.0	8.5	71
Moscow VDNKh	0.4	0.2	0.4	0.0	0.3	0.5	0.4	0.2	0.2	0.8	0.2	0.3	4
Maximum Number of Days with Strong Wind													
Dudinka	18	16	14	17	16	13	15	17	11	17	16	13	144
Moscow, Mezhevoy Institute	6	4	8	3	4	3	4	7	3	4	6	4	19

BIBLIOGRAPHY

Agafonov, Konstantin. “Problems of Residential Building in Far North.” Candidate dissertation, Central State Archive of Scientific Technical Documentation of S. Petersburg, TsGANTD Spb F.R-17 Op. 22 D. 467 L.35-38, 1961.

Arctic Monitoring and Assessment Programme (AMAP). “Arctic Climate Change Update 2019.” Odder: Narayana Press, 2019. Accessed October 12, 2020. https://www.amap.no/documents/download/3295/inline

Arctic Perspective Cahier No.1. *Architecture: A Project of the Arctic Perspective Initiative,* edited by Andreas Muller. Ostfildern: Hatje Cantz, 2010.

Chuklov, Nikolai S., “The Space-Planning Elements Succession of the Arctic Cities with Climate Control.” *Architecture and Modern Information Technologies,* no. 2(47) (2019): 251-266. https://marhi.ru/AMIT/2019/2kvart19/PDF/16_chuklov.pdf

Collymore, Peter. *The Architecture of Ralph Erskine.* London: Granada Publishing Ltd., 1982.

Cooper, P. F. “Applications of Modern Technology in an Arctic Environment.” *The Polar Record* 14, no. 89, (1968): 141-163.

Decker, Juile. *Modern North: Architecture on the Frozen Edge*. New York: Princeton Architectural Press, 2010.

Egelius, Mats. *Ralph Erskine, Architect.* Stockholm: Byggforlaget, 1990.

Erskine, Ralph. “Architecture and Town Planning in the North.” *The Polar Record* 14, no. 89 (1968): 165-171.

Erskine, Ralph. “Building in the Arctic.” *Ekistics* 10, no. 59 (1960): 152-155.

Farish, Matthew and P. Whitney Lackenbauer. “High Modernism in the Arctic: Planning Frobisher Bay and Inuvik.” *Journal of Historical Geography* 35 (2009): 517-544.

Fazio, Michael, Marian Moffett and Lawrence Wodehouse. *A World History of Architecture.* London: Laurence King Publishing, 2008.

Fedchenko Irina. “Humanistic Idea of a Micro-District in the XX century.” *Journal of Siberian Federal University, Humanities and Social Sciences* 5, no 5. (2012): 707-719.

Friedmann, Leo. “Saving Erskine: An Example of Circular Heritage.” Master Thesis, Stockholm: KTH School of Architecture, 2020.

Gardner, E. A. and W.E. Fancott. “*Frobisher Bay*: The Design of Accommodation for a Community of 4500 People.” Project, Department of Public Works Building Construction Branch, 1958. https://assembly.nu.ca/library/Edocs/1959/001419-e.pdf

Gautier, Donald. “Assessment of Undiscovered Oil and Gas in the Arctic.” *Science Magazine* 324. (May 2009): 1175-1179.

Hagudal, Elin. “Apartment Blocks in Harsh Climates: Horseshoe Block in Hammerfest and Ormen Lange in Svappavaara.” *Nordlit* 36, (2015): 79-106.

Hemmersam, Peter. “Arctic Architectures,” *Polar Records* 52, no. 4 (2016), 412-422.

Hemmersam, Peter and Andrew Morrisson. “Place Mapping: Transect Walks in Arctic Urban Landscapes.” *Spool* 3, no. 1 (2016): 23-36.

Jull, Matthew. “South Camp Inn.” *The Site Magazine.* https://www.thesitemagazine.com/read/south-camp-inn (Accessed 27 March 2021).

Jull, Matthew. “Towards a Northern Architecture: the Microrayon as Arctic Urban Prototype.” *Journal for Architectural Education* 67, no. 1. (September 2016): 214-222.

Kalemeneva, Ekaterina. “Arctic Modernism: New Urbanisation Models for the Soviet Far North in the 1960s.” In *Competing Arctic Futures: Historical and Contemporary Perspectives,* edited by Nina Wormbs, 213-241. London: Palgrave Macmillan, 2018.

Kalemeneva, Ekaterina. “The Cities under Domes: Soviet Architectural Development of Far North in 1950s-1960s.” *Deutsches Historiches Institut Moskau Bulletin* 7 (2013): 93-108.

Kalemeneva, Ekaterina. “The Northern Climate as “an Enemy” and a Resource in Soviet Urban Planning Projects for Arctic Towns in the 1940s.” Surgutsky Governmental pedagogical University journal 6 no. 51 (2017): 89-95. https://publications.hse.ru/mirror/pubs/share/direct/215653253

Kochar, Gevorg. “Planning and Building of Residential Quarters in Districts of Far North,” *Architecture of USSR 6* (1962), 21-26.

Lajus, Julia. “Colonization of the Russian North: A Frozen Frontier.” In *Cultivating the Colony: Colonial States and their Environmental Legacies,* edited by Christina Folke. Athens Ohio: Ohio University Pres, 2011.

Lateral Office. “Arctic Adaptations: Nunavut at 15.” Accessed October 20, 2020. http://www.lateraloffice.com/ARCTIC-ADAPTATIONS-2013-14

Lee, Brian. “Radical Arctic Proposals.” Independent study, University of Rice, 2012.

Liscombe, Rodri Windsor. “Modernist Ultimate Thule,” *Canadian Art Review* 31, no. 1/2 (2006), 64-80.

Lukin, Yuri. *Many-sided Arctic in Stream of Time and Meanings.* Arkhangelsk: Bulatov Publishing, 2019.

Marcus, Alan. “Place with no Dawn: A Town’s Evolution and Erskine’s Arctic Utopia.” In *Architecture and the Canadian fabric,* edited by Rhodri Windsor-Liscombe, 283-310. Toronto: UBC Press, 2011.

Murphy, Douglas and Bruce Emmett. “Frei Otto’s Arctic City.” *Icon,* 9 April. 2014. https://www.iconeye.com/architecture/features/frei-otto-s-arctic-city (Accessed 15 January 2021).

Murray, Thomas M. “Ralph Erskine / The Inter-Action of Man and His Environment in Northern Latitudes.” Diploma Dissertation, Mackintosh School of Architecture, University of Glasgow, 1976.

Nedza-Shikoniowska, K. “European modernity in the Soviet Arctic – problems of planning and development of northern cities based on Igarka and Norilsk cases.” *Arctic Scientific Herald journal 6,* (2019).

Nepokoychitsky, Vitold. “Characteristic Aspects of Urban Development in Norilsk.” *The Problem of the North* 10 (1964): 102-111.

Nevitt, Mark P. and Robert V. Percival, “Polar Opposites: Assessing Environmental Law in the World’s Polar Regions,” *B.C.L. Review* 59, 4 (2018), 1660-1701.

Nerush, I and T. Nemolieva, A. Rastorgueva, L. Klepnikova. “Socio-Residential Complex 305 in Murmansk.” *Architecture of USSR 7* (1983), 6-7.

Odnovalov S. and M. Tsimbal. “The Reigning Cities of Arctic.” *Technika Molodezhi* 9 (1961): 45. http://zhurnalko.net/=nauka-i-tehnika/tehnika-molodezhi/1961-09--num45

Pershin, N. and Y. Pivivarov. “The Settlement in One House.” *Technika Molodezhi* no. 2. 1963. 36-37.

Phillips, Sam. *Isms: Understanding Modern Art.* Translated by M. Visel, N. Chamina & A. Shestakov. Moscow: AdMarginem Press, 2012.

Putintsev, Edward. “City-complex "Aikhal" for 4,500 Residents in the Diamond Field in Yakutia.” *Eduard Putintsev Arhive,* last modified 2016. http://www.eduard-putintsev.ru/aihal_putintsev_archiv (Accessed October 15, 2020.)

Eduard Putintsev. “Architect’s thoughts,” *Eduard Putintsev Arhive,* last modified 2016, http://eduard-putintsev.ru/ severnoye_zhilishe (Accessed Accessed October 15, 2020)

Eduard Putintsev. “The Diamond Aykhal,” *Eduard Putintsev Arhive,* last modified 2016, http://eduard-putintsev.ru/aihal_almaz (Accessed Accessed October 15, 2020)

Safdie, Moshe. “Frobisher Bay Housing for the Inuit Community.” McGill Library. Accessed December 25. 2020, https://cac.mcgill.ca/moshesafdie/fullrecord.php?ID=10924&d=1.

Scott, James C. *Seeing Like a State: How Certain Schemes to Improve the Human Conditions Have Failed.* London: Yale University Press, 1998.

Schweitzer, P. and P. Skold, O. Ulturgasheva. “Culture and Identity.” In *Arctic Human Development Report*, edited by Joan Larsen and Gail Fondahl. Copenhagen: Nordic Council of Ministers, (2015): 106-150.

Sheppard, Adrian. “Fermont: The Making of a New Town in the Canadian Sub-Arctic.” *FRAIC*. Montreal: McGill University, 2012.

Sheppard, Lola and Mason White. “Arctic Architecture: Standards, Experiment and consensus.” In *Canadian Modern Architecture: 1967 to the Present,* edited by Graham Livesey and Elsa Lam. 353-365. New York: Princeton Architectural Press, 2019.

Sheiko, Rena. “A House in Arctic.” *Yunost* 7 (1976): 90-94. https://unost.org/wp-content/uploads/2019/11/1976_07.pdf

Shipkov, Alexander and Yakob Truschinsch. *Experimental Residential House with Roofed Courtyard in Norilsk*. Norilsk: Project documentation, 1962.

Shipkov, Alexander. *Polyar – a Residential Complex of Polar Regions of the Far North of the USSR: The Main Issues of Spatial Shaping*, Candidate dissertation thesis, Moscow, 1971.

Smirnov, Andrey. “The Arctic Population: Dynamics and Centers of the Settlement System.” *Arctic and North* 40, (2020): 227-245.

Smith, Christopher J, ed. *Megatrends.* Copenhagen: Datagraf, 2011. https://www.norden.org/en/publication/megatrends-1

Striuchkov Stanislav. “The Search for Eternal Summer. An attempt to create an all-weather Territory in Norilsk.” *Arctic Science Herald* 6, (2019), 68-74.

Rice, Eb. *Building in the North.* Fairbanks: University of Alaska Press, 2008.