“FROZEN” LANDSCAPE: CELEBRATING WINTER AND BRINGING LIFE TO NORTHERN SETTLEMENTS.

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Abstract

Every northern country has problems with harsh climate, affecting local and regional development with direct impacts on the population. Remote cities face problems with the climate, as well as social and economic issues because of their isolation and relative inaccessibility in relation to other settlements. My research examines how climatic-responsive design has been used to inform urban design, city and buildings in single-industry towns. It addresses the following main question: How can the planning and design concepts of "Nordicity" be developed to optimize the "fit" between human activity and the natural environment for northern settlements?

The research is based on a comparison of the strategies that have been implemented in two Nordic mining settlements: Fermont in Quebec (Canada) and Kiruna in Sweden. Extraction of natural resources affects the development of these northern territories and attractiveness for people to visit and stay. It is important to attract investments and create good jobs in production of goods or extraction of natural resources, as is the case in Fermont and Kiruna with the mining industry. I argue that climate-responsive strategies based on the integration of human activity with winter are more effective and sustainable than technologically based "control" strategies.

The research comprises three major parts. The first part is analysis of literature consisting of three separate categories – mining towns and remote sites; new towns and total urban design; winter cities and climate responsive design. The content of the second part is a review of Fermont and Kiruna in terms of practical matters in urban design, using primary sources such as planning policies, design guidelines, and specific projects both built and unbuilt. In the last part, I comment on the strategies and methods that were used to create livable environments, to attract and to retain a stable population, and to encourage direct engagement with winter. The main objective of the work is to articulate principles and strategies that can be implemented in specific contexts that will promote the livability of the city and enable people to enjoy winter even in harsh climate conditions.

Résumé

Tous les pays compris au dessus d'une certaine latitude doivent faire face à un climat rigoureux, affectant le développement local comme régional, et ayant une influence directe sur les populations. De part leur isolement et leur relative inaccessibilité pour d'autres implantations urbaines, certaines villes sont plus sensibles face à ces problèmes climatiques, mais aussi face à des problématiques sociales et économiques. Mon travaille examine la manière dont des architectures sensibles aux contraintes climatiques ont été utilisées dans un contexte d'aménagement urbain au sein de villes mono-industrielles. Nous abordons la question principale suivante: de quelle manière l'urbanisme et de tels concepts architecturaux peuvent être développés de manière à conjuguer au mieux activités humaines et environnement naturel dans un contexte d'implantation urbaine nordique.

Cette recherche s'articule autour de la comparaison des stratégies implémentées lors du développement de deux colonies minières nordiques: Fermont au Quebec (Canada) et Kiruna en Suède. L'extraction de ressources naturelles affecte le développement de ces territoires nordiques, ainsi que leur attrait. Il apparait important d'attirer et de favoriser les investissements, de créer des emplois dans la production de biens et l'extraction de ressources naturelles, comme Fermont et Kiruna le font avec leur industrie minière. Je défends l'idée que des stratégies répondant à des contraintes de climat et basées sur l'intégration des activités humaines à l'hiver sont plus efficaces et durables que des stratégies de "contrôle" se basant sur des technologies.

Le rapport se compose de trois parties principales. La première est une analyse documentaire divisée elle même en trois catégories — cités minières et sites isolés; nouvelles cités et "total urban design"; villes hivernales et architectures adaptées au climat. La seconde partie passe en revue les deux villes de Fermont et Kiruna sur des considérations pratiques, tels que la politique d'aménagement du territoire, les critères de conception, et des projets spécifiques construits ou non. Lors de la dernière partie, je commente les stratégies et méthodes qui ont été utilisées pour créer des environnements viables, pour attirer et retenir une population stable, et pour encourager un engagement directe avec l'hiver. L'objectif principal de ce travail est d'articuler les principes et stratégies qui peuvent être implémentés dans des contextes spécifiques et qui améliorent l'habitabilité et le confort de la ville, et permettent aux gens d'apprécier l'hiver malgré des conditions climatiques rigoureuses

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Chapter 1: Introduction

Every northern country has problems with harsh climate; in smaller countries, such as Norway or Sweden, people need to cope with these severe conditions, but in large countries with continental climate, like Russia or Canada, the severe climate conditions across most of the territory can affect population density, and the greatest concentration of a settlement is often found in the areas with "gentler" environments. The more remote cities, usually in the north of these countries, face problems not only with the climate, but also with social and economic issues because of their isolation and relative inaccessibility.

The work comprises five chapters. In the first chapter, the project report introduces the theme of research and sets up the discussion. The second chapter provides a literature review with the wide range of approaches surveyed. The methodology is presented in the third chapter, where the case studies are introduced. The fourth chapter discusses two case studies in details. Conclusions and final thoughts about the topic are presented in the final chapter. The project report is mainly built on claims made by Norman Pressman, Professor Emeritus of Urban Design at the University of Waterloo and consultant in climate-responsive urban design with focus on "winter cities", Ralph Erskine, a Swedish architect and planner, and R. Francaviglia, Adjunct Professor of history and geography at Willamette University.

The main objective of this investigation is to articulate principles and strategies that can be implemented in specific contexts to promote livability single-industry towns and enable people to understand and celebrate winter. The research learns from strategies and urban design of two towns located at high latitudes – Fermont in sub-arctic Canada and Kiruna in arctic Sweden. It is important to assess how these ideas could be useful in relation to specific circumstances of chosen regions that will allow locals to stay and new people to visit. The goal is to find potential solutions that would let people dream of this season and enjoy winter even in harsh climate conditions. Due to the industry, the towns possess typical forms of architecture, especially the industrial type. The changes in landscape reveal the difficult relationship between industry and nature, which result in environmental damage. It also bears the history of progress of human being.

Various influences affect the development of northern territories and attractiveness for people to visit or to stay. In a sphere of economy, it is important to attract investors and create highly paid and qualified jobs in production or natural resources. Government/local authorities also play a

significant role in the creation of infrastructure, setting tax breaks and creating special investment zones. Social, health and education services are needed to maintain a high quality of life; while culture must also be developed to keep people interested in a place.

Winter is one of the most fascinating seasons when ice and snow covers landscape and changing perception, but people who inhabit the north "work hard at attempting to resist and deny this hostile season" (Pressman, 1995). Climate is the most constraining factor among all affecting urban form. The northern Cityscape can be an opportunity to grow a country, but it is necessary to improve the quality of life in such cities and create an environment that will attract people.

To reduce winter problems it is essential to integrate concepts and techniques to ensure human comfort, relate goals for obtaining physically improved comfort to cultural, biophysical and economic conditions to make sure that application is feasible; and to target objectives that are based on specific problem areas, relating to multi-disciplinary approach and cooperation (Pressman, 2004, p. 49). Adopting a climate sensitive approach will allow planners to make significant and environmentally responsive contribution to the creation of sustainable living spaces (Pressman, Erell, Van Der Ryn). Climate responsive approach to any sorts of construction and planning will help to improve quality of spaces and encourage people to stay outdoors.

Mining towns are "hard places", as historical geographer Richard Francaviglia described them. Making a living is a tough work, mining interest is continually struggling to outwit both nature and the economy, and miners are constantly deforming the earth, "from bedrock to boulders, from rubble to dust" (Francaviglia, 1997, p. 4). Mining landscapes symbolize "the turmoil between what our society elects to view as two opposing forces: culture and nature" (Francaviglia, 1997, p. 244). It is especially true for northern settlements and challenges that they face.

Chapter 2: Literature Review

The analysis of literature reveals three separate categories that emerge from: (1) total urban design and new towns, (2) mining towns and remote sites, and (3) winter cities and climate responsive design. The first and second categories represent descriptive empirical approach while the third one is theoretical and normative. The scan of literature revealed the wide range of approaches that were made by professionals and researchers from architectural, planning, urban design, historic and geographic fields.

Total Urban Design and New Towns

Total urban design occurs when a project is carried out under a single patronage and under the direction of an individual designer or a group acting as an individual; it is a singular piece of work from property development to design and implementation (Lang, 2005, p. 149). It includes variety of product types: new towns, urban precincts of various descriptions, new suburb, housing development, campuses and historical revitalizations. A strength of total urban design is the unity of appearance and boldness of form.

New towns, or the new town movement, refers to towns that were mostly built after 1950 and that are purposefully planned, developed and built to cope with overcrowding and congestion, to unload larger industrialized cities, rehousing people in freshly built, new and fully planned towns that were completely self-sufficient and provided for the community. The idea is widely known although there are debates of how inclusive and independent a development of the new town can be from the perspective of the activities it affords – there is a need to include all aspects of the city so they can be semi-independent units within a region (Lang, 2005, p. 149).

The New Town Movement in Europe started in Britain and was derived from the Garden City Movement, founded by Ebenezer Howard in the late 1800s, in response to the over-crowded, polluted, chaotic and miserable industrial cities that had appeared. This movement tried to describe "not only the physical characteristics of an ideal urban form, but also to define an economic, political, and philosophical basis of modern life" (Calthorpe, 2008, p. 192). Based on experience of socialist writers such as Henry de Saint-Simon, utopian planners as Francois Marie Charles Fourier from France, Robert Owens and James Silk Buckingham from England, Howard put forward schemes with an integration of agriculture and industry in new towns in which financial

equity was shared with its occupants (See Fig. 2.1). His goals were defined: "To find for our industrial population work and wages of higher purchasing power and to secure healthier surroundings and more regular employment" (Calthorpe, 2008, p. 194). The diagram of the garden city that was a Howard's proposal was symmetrical and had a single focus. Howard's proposal and garden cities had a major influence on planning in the 20th century and are relevant today as a stand against congestion and sprawl, attention to environmental issues, as social reform, as compact mixed-use towns, as vision for incorporating agriculture (Calthorpe, Fishman, Hall & Ward).

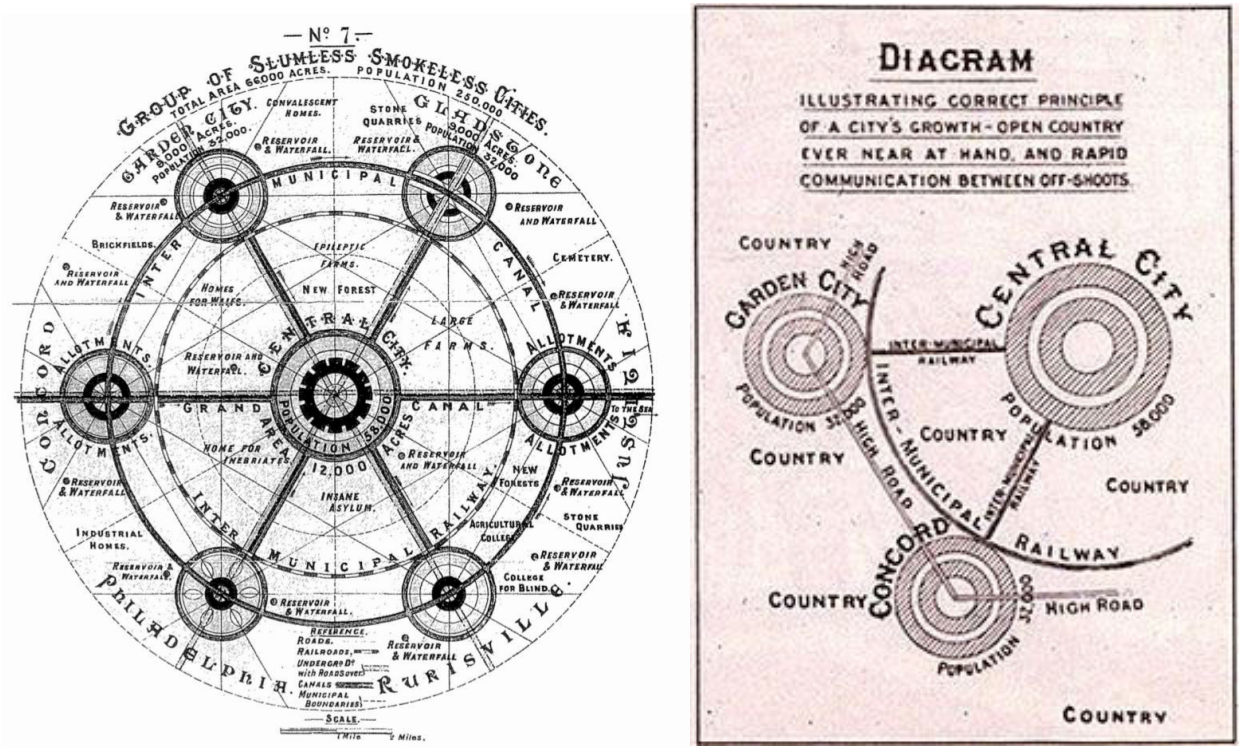


Fig. 2.1. Ebenezer Howard: Garden City (source: https://scodpub.wordpress.com/2011/03/01/garden-cities-by-ebenezer-howard/)

Another important urban planner of the times was Tony Garnier who produced a plan for an ideal industrial town (See Fig. 2.2), the Cite Industrielle in 1904. His vision was never literally realised, but Garnier's concepts had an impact on modern architecture and urban planning. Another contribution made by him was the philosophical influence of turn-of-the-century movement for regionalism and decentralisation. Both Horward's and Garnier's cities address the social implication of industrialisation – working class, its physical health and equity in the economy (Calthorpe, 2008, p. 204).

Fig. 2.2. Tony Garnier: Une Cite Industrielle (source: http://www.treehugger.com/urban-design/2012-ted-prize-winner-idea-not-individual-city-20.html)

The historian and planner Robert Fishman refers to three of urban planning's greatest visionaries, Ebenezer Howard, Frank Lloyd Wright and Le Corbusier, all whom "hated the cities of their time with an overwhelming passion. The metropolis was the counter-image of their ideal cities, the hell that inspired their heavens" (Fishman, 1982, p. 12). Despite sharing the common assumption that ideal form of any industrial society could be defined and attempted, if we are to compare schemes of Howard, Wright, Le Corbusier, we can notice that they are very different through the prism of each's own social theory and argue with each other (Fishman, 1982, p. 7). Their ideal cities resembled each other no more than they resembled real cities. Howard created the concept of the "garden city" where shops and cottages formed the centre of a geometric pattern with farmland surrounding (See Fig. 2.3); Wright conceived "Broadacre City," the ultimate suburb where the automobile was a main focus, and Le Corbusier projected "Ville Radieuse," (See Fig. 2.4) the city of cruciform skyscrapers set down in open parkland (Calthorpe, Fishman). The variety of schemes proposed by different urban utopians offers us a set of choices how we can develop society focusing on different political and social implications.

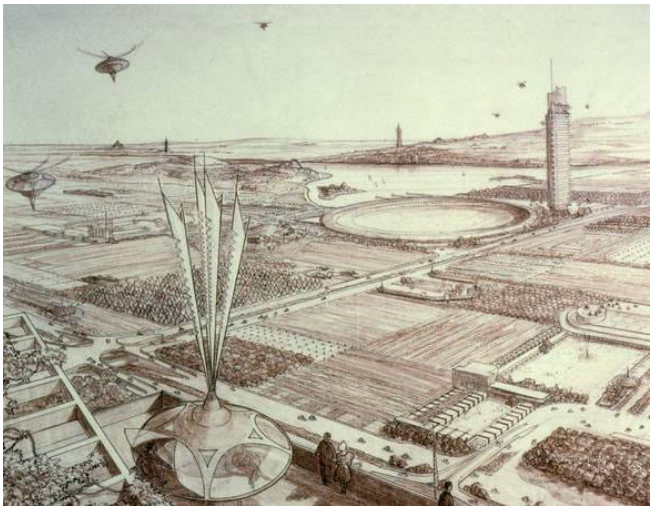


Fig. 2.3. Frank Lloyd Wright: Broadacre City (source: http://www.treehugger.com/urban-design/2012-ted-prize-winner-idea-not-individual-city-20.html)

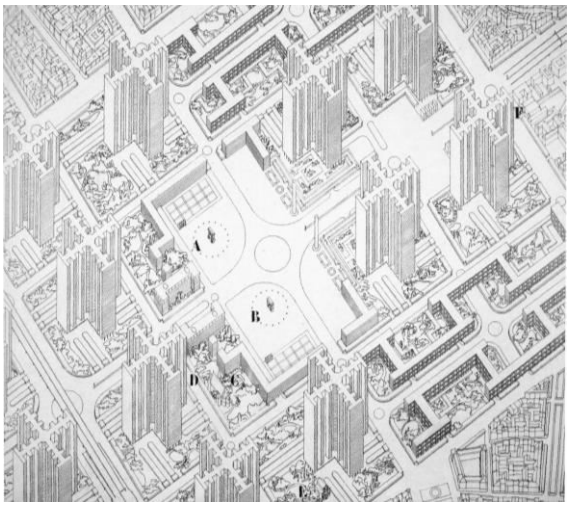


Fig. 2.4. Le Corbusier: Ville Radieuse (source: http://thecharnelhouse.org/2014/06/03/le-corbusiers-contemporary-city-1925/)

Urban congestion and depopulation of rural areas reached crisis level with the Industrial Revolution. New technologies generated not only new possibilities but also resulted in greater pollution of the city, higher populations, and denser living conditions, and concept of new towns was a response to industrialisation and its side effect (Calthorpe, 2008, p. 189).

Another response to the social and physical effect of this technical revolution was state socialism and its town-planning ethos. The utopias' decentralisation was substituted by "efficiency, progressive technology and centralized political structures" (Calthorpe, 2008, p. 190). After World War II, demands for housing in America and European countries were exceptional. England, Sweden and Finland boosted a massive new town development program, meanwhile in America the suburban development was done by the private-sector, lacking the balance and planning of Europe but supplying the same needs (Calthorpe, 2008, p. 226). Satellite towns of Stockholm in Sweden, Levittown of United States and Milton Keynes in England demonstrate the range of all the post-World War II experiences. The Swedish New Town in Vällingby incorporated higher density housing, significant retail areas, balanced job opportunities, and mass transit by means of railways (see Fig. 2.5). Some design principles were successfully implemented – the plan attempted to balance housing and employment in the 'walk-to-work' program, the developed path system for pedestrians created the communication between areas – 36 percent of the total trips made on foot in comparison with 30 percent by car (Calthorpe, 2008, p. 228).

Levittown, built at the same time with Vällingby and roughly the same size, shows the opposite result. The suburb was done on principles of Radburn, but lacked its garden city ideology. It eliminated the auto-pedestrian separation, was totally car-dependent, employment opportunities were missed and the planning itself was not thoughtful – poor insulation and solar orientation of houses (Calthorpe, Bloom) (see Fig. 2.6).

Fig. 2.5. Swedish community of Vällingby (source: https://pricetags.files.wordpress.com/2011/01/800px-1.jpg)

Fig. 2.6. Building the American dream: Levittown, NY (source: http://travelstudies.org/long-islands-changing-landscape/)

Located forty-five miles from London, Milton Keynes represents "a new generation of town planning at a new scale" (Calthorpe, 2008, p. 230). Its density and auto-orientation were close to Levittown but the pedestrian open-space network provided an access to activity centres. Milton Keynes, being not so energy efficient as Vällingby, represents a social diversity and concern beyond the typical suburb (Calthorpe, 2008, p. 232).

The 'new town' movement in America of the 1960s sought to transform the physical and social environments of American suburbs by showing that idealism could be profitable (Bloom, 2001). Bloom offers case studies of three of the movement's famous examples — Reston in Virginia, Columbia in Maryland, and Irvine in California. In each case, innovative planners mixed land uses and housing types; refined architectural, graphic, and landscape design; offered well-defined village and town centres; and pioneered institutional planning. As Bloom (2011) demonstrates, these efforts did not succeed, and attempts to reshape community life through design notably faltered. New towns, being without history, lacked such things as memories that would bond the community together (Calthorpe, 2008, p. 191). However, the residents have kept the new

town ideals alive for over four decades and produced a vital form of suburban community that is far more complicated and interesting than the early vision promoted by the town planners.

There were similar problems for New Towns in other areas of the world. In Hong Kong, the new towns were developed as an initiative from the British colonial government (Zacharias, 2005). In other areas, they understood the concept and approved in large numbers, but planners had trouble convincing their own governments or agencies of the merits of the proposal. In the former USSR, more than 800 New Towns were founded after the 1917 Revolution, but their growth was not constrained by specific limits (Osborn & Whittick, 1969). For this reason, it was argued that these towns did not meet the criteria for New Towns since planned population and size limitations were an important part of the New Town idea. Other European countries such as France, Germany, Italy and Sweden also had some successes with new towns, especially as part of post-war reconstruction efforts (Osborn & Whittick, 1969). The value of history of new towns shows the progression of ideas, and demonstrate the wide range of choices (Calthorpe, 2008, p. 234).

Most of the twentieth century new towns, being from times of industrialisation, had to cope with "an unheard of material abundance, economic growth, and the transformation of new technologies rather than a sense of physical limits or ecological balance" (Calthore, 2008, p. 191). Calthorpe (2008) highlighted two main issues for creation more sustainable communities in these towns – ecological stability should be reinforced as well as it is important to treat common space and shared facilities. "New towns designed for ecological stability would certainly be a new chapter in the evolution of town planning" (Calthore, 2008, p. 191). Although some towns of post-war era were trying to deal with ecological issues, eventually they were focused on social and economic prosperity.

New Towns are contemporary – they are planned, built and operates to serve present-day needs and conditions (Stein, 1957, p. 217). New towns are essential – existing sites cannot fit the need of a certain period without complete reconstruction, it requires new forms, and relations between them must be radically revised (Stein, Bloom). The planning of the towns is an integral part of a procedure that creates a complete, solid and living community. The new town should remain contemporary for a very long period – they have to be planned so "to limit difficulties we now face in the redevelopment of our old cities, which require extravagant destruction and the rebuilding of vast areas" (Stein, 1957, p. 224).

The total urban design schemes, especially housing, from 1950s and 1960s, based on the modernist ideology that sunlight and air are the crucial factors but no longer worthy for the personal identity and the variety of behaviour settings that many areas of cities own. One of major distinct character of settlements built on this wave is strong geometrical ideas, powerful symbolic statements to boost people's self-esteem. There are also some problems associated with total urban design. Most common of them is negative association when the symbolic statement is perceived by people to present a poor image of them, and when art prevails on life. It happens especially when design power is centralised. The success and failure result from the goals set and the nature of the program assumed (Lang, 2005, p. 203). In some cases, the schemes celebrate civic pride for citizens and enhance their self-image; in other cases, the creators set out to celebrate themselves. It is impossible to meet the requirements of people who use this design. Total urban design towns were conceived to be completed within a short period of time, when the decision-making power is centralized so that it is possible to take actions quickly.

Some projects are seen as a work of one person, but in fact they started as total urban design on the drawing board, and were continued as piece-by-piece urban design with involvement of many people. Chandigarh in India, for example, is perceived as a work of Le Corbusier, but it was the work of many people. The category of total urban design includes a national capital city, a number of state capitals in their initial stages, many cities built *de novo* to redistribute population within a country and company towns – Brasilia, Chandigarh, Washington, many cities of the former Soviet Union, some in the United Kingdom *etc.* (Lang, 2005, p. 151). Brasilia is the example of state capital guided by strong political and architectural ideologies (Holston, Lang).

Company towns are planned settlements for workers of single-industrial organization. Many were constructed in the Americas and Western Europe during 19th century as a response to the 'coke towns' of the industrial world (Lang, 2005, p. 157). Others company towns have been resource-oriented, many are located on the source of mines. Private enterprise company towns became unnecessary with the improvement of transportation and the provision of government funded housing programs during the 20th century. Nevertheless, mining towns are still being built and will continue to be built while the earth's resources are exploited.

Mining Towns and Remote Sites

The mining industry is a major force in the world economy, holding a primary position at the start of the resource supply chain. In many countries, the mining and metals industry is gaining recognition as an "important contributor to the critical policy objectives of job creation and poverty reduction" (International Council of Mining and Metals, 2010). The ongoing demand on the global mineral and metal markets gives northern countries extraordinary position with their favorable investment climate and mineral-rich bedrock.

Mining towns are often small, isolated communities built around resource-based industries; they are also called resource towns. Resource development has long been recognized as a significant factor in shaping patterns of countries' development ("Resource towns," 2006). A significant number of new towns was built in the north since the turn of the century, most of them after World War II (Lang, Sheppard). If we are to look at cities and settlements located in Arctic and Sub-Arctic – majority of settlements was built because some industry takes place – mining, agriculture, forest or water. The vast majority of new towns are one-industry towns created to service mining companies, government agencies, or utility corporations. These new settlements were built as straightforward and pragmatic solutions for housing needs of workers and their families (Sheppard, 2012). The concern for the actual buildings always mattered more than the design of the town. Most of manufacturing-based company towns, even thoroughly considered, are designed in a "hurried fashion" because they are expected to be ephemeral – speed of construction and savings in costs mattered (Lang, Sheppard).

In some respects, all mining towns resemble other towns based on the extraction or processing of resources throughout the world (Francaviglia, 1997). Typically the resource towns are complements for an industrial enterprise, lacking control over its own economic development. Outside corporations or government control the financial basis that determines the origin and extent of the extractive or processing activity and define the size of the local work force and the degree of local prosperity ("Resource towns," 2006). Another feature of resource towns is the simplified occupational structure in them. The middle class is weak and "includes only a small group of managers, merchants and professionals who are oriented […] to organizations outside the town" ("Resource towns," 2006). Workers often migrate between mining towns looking for an employment.

Several factors negatively influence the development of a diversified economy that generate a more heterogeneous work force. “Isolation from major markets, relatively high wages paid by resource industries and high development costs combine to prevent the influx of secondary industry” (“Resource towns,” 2006). Mining towns are often perceived as isolated territories, but in this case, the isolation is ‘both unintentional and ironic, for they are often the most cosmopolitan of our communities, bringing a great deal of sophistication to a region’ (Francaviglia, 1997, p. 69). No matter what the importance or how interesting they are, normally people would not travel there. Several mines nearby create mining district and their settlements usually concentrated close to the mines (Francaviglia, 1997, p. 78). The big mining district usually has its own developed system of transportation.

Other characteristic is that most mining towns are small – only a few are over 10 000 people in population. Thus, they have many similar features of any small town, especially the economic base. A final common characteristic is physical appearance. “Although recently built resource towns resemble the new suburbs of large cities, older towns are generally unattractive communities with a townscape dominated by a mine” (“Resource towns,” 2006). Mining has an irreversible effect on landscape; it creates its own distinctive topography for thousands years (Francaviglia, 1997). Mining industry has been one of the most important occupations in many countries creating a cultural landscape. In the United States in particular, mining is a widespread activity. Mining landscape is a legacy of different processes – it varies from place to place, but creates the distinctive look of mining country. There are different types of mining – placer, underground hard rock, surface or open pit and various types of leaching operations. Each of them has various impact on the landscape.

Canadian resource towns have a great deal in common both with each other and with towns in other countries, but there are still several distinctive characteristics (“Resource towns,” 2006). The first distinction is the origins of the population. The industrial population of many of the industry towns of the Atlantic provinces and Québec is drawn from the surrounding fishing, lumbering and agricultural population. Nonetheless, the workforce and management of the resource towns of Ontario and western Canada are drawn from populations remote from the town or from outside the country (“Resource towns,” 2006). Indigenous people are affected by presence of industries. New Towns created in largely uninhabited areas have no physical or cultural rural connections. The second distinction is based on the decision-making process involved in

maintaining the community. “Some towns are the products of decisions made by a single company or a government; others represent the outcome of a number of decisions made by a number of companies or by the residents of the community itself” (“Resource towns,” 2006).

The physical appearance and function of mining towns depends on who is responsible for planning and building the town. The modernization of some service centres and the designs of some of the new towns “dramatically illustrate the advances made in resource-town building since the first-generation towns appeared in the 19th century” (“Resource towns,” 2006).

Many mining towns have a limited time of existence, and prospects for activity and growth beyond the initial function rarely happen. In some cases, the resources deplete, or market conditions change or an international corporation moves its operation to another territory or country (“Resource towns,” 2006). As mines close, deindustrialisation of the mining district begins. As communities with a single industry dependent on the extraction of non-renewable resources, “mining towns often fail to survive deindustrialization” (Robertson, 2010, p. 3). Hundreds of northern communities have disappeared in this way. In other cases, the industrial plants become obsolete (“Resource towns,” 2006). The town may regroup to find other economy, such as tourism or other service-related industries, to sustain itself (Francaviglia, 1997, p. 166).

Resource development has been identified as a considerable factor in shaping countries’ development. Life in the company town could often be fulfilling, but never determined. There is an exclusion of most of mining towns from the economic benefits derived from the resources because the extracted minerals and metals are usually shipped outside. “Boom and bust fluctuations depend on the changes of the international market for resources, or under government or corporate decisions, and not on local initiative” (“Resource towns,” 2006). The fluctuations generate feelings of insecurity and uncertainty in the community by the awareness that the resources will ultimately be depleted. The city needs to generate other resources to support the economy even when industry is over – it can be tourism or manufacturing, as in the case with Kirkenes in northern Finland (Viken, 2008). The city was established as a harbour for an iron-ore mining venture in what today is the municipality of Sør-Varanger. Kirkenes has been transformed within “bordered” relationships of civil society, business and a combination of high-level and local political activities, the transformation started before the industry was closed down during the 1990s (Viken, 2008).

One of the main problems is environmental crisis and geologic disaster. Mining industries change topography dramatically – the industrial footprint spreads into nations' decreasing wild lands. Few industries have such a troubled and visible impact on the environment. Mining was recognised as a destructive force in Europe in early sixteenth century, such problems came into concern in North America only in the 1880s. The environmental impact of mining includes erosion, formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater, surface water by chemicals from mining processes. It is not only about environmental damage, the contamination from leakage of chemicals also affects the well-being of the inhabitants ("Environmental impact of mining," n.d.). In urbanised environments, mining produce noise, dust and visual pollution. The nature of mining processes creates a negative impact on the environment during the mining operations and for years after the mine is closed. It was a trigger to adopt regulations in many countries to reduce the negative effect of mining. Mining companies in most countries are following environmental and rehabilitation codes to make sure that the area mined is returned to its original state. Mining industry can become more environmentally sustainable by developing and integrating strategies that reduce the impact of operations on the environment. They include such measures as "reducing water and energy consumption, minimizing land disturbance and waste production, preventing soil, water, and air pollution at mine sites, and conducting successful mine closure and reclamation activities" ("Mining Facts," 2015).

What is happening to mining landscape of the 20th century is a result of the history that shaped it as well as because of a growing appreciation of history that characterizes post-industrial societies (Francaviglia, 1997, p. 167). Mining "provides powerful visual settings in which "technostalgia" – the romanticizing of the industrial past – can thrive" (Francaviglia, 1997, p. 167). Nevertheless, the vast majority of ghost's towns are former mining towns.

Mining communities are also gendered spaces (Francaviglia, Robertson). The majority of the population of mining towns is usually men, so the values placed in such towns are also determined. Although women have worked underground and live in mining settlements, their presence in these jobs is highly unusual, often only for a short term. Women generally are "excluded from the major occupations of mineral production and processing," but they play an important role in life of the towns and general economy (Francaviglia, 1997, p. 112). The issue of age also has an influence on place perception – elderly people have deeper sense of attachment to the place than youngest

ones and new generation leaves to seek for education and employment opportunities (Francaviglia, Robertson).

Economic development focused on non-renewable natural resources has grown to an enormous scale. Development of oil and gas that depends on world supplies and on national and international politics, have experienced major changes across the North. Arctic tourism "has made it possible for a wide variety of affluent visitors to visit hitherto remote areas, affecting the ecology" (Wonders, 2003, p. 456). While environmental diversity can be commendable from both an ecological and an economic perspective, the effects for tourists can be a landscape that presents a fractured and disjointed visual character (Clay & Daniel, 2000, p. 2).

The reading of landscape identifies how the things relate visually and show the significant patterns of aesthetic meaning. The landscape of mature mining districts open an interesting change and offer a legacy of architectural design, thus they also need preservation. One of the most famous examples is the Cornwall and West Devon Mining Landscape. It is a World Heritage Site, which includes select mining landscapes in Cornwall and West Devon in the south west of England.

Visualization of landscape starts with "the idea of place and explores the manner by which different kinds of places are identified by different kinds of people in search of various sorts of satisfaction" (Jakle, 1987, p. 4). Places have spatial context and temporal dimensions because they are open and close at set points in time and function for a certain period. These places are occupied by people and by activities, and they can be a "limited array of furnishing supportive of those behaviours" (Jakle, 1987, p. 5). Meanings are attached to the place in relation to the expectations developed by people in their repeated rounds of place encounter. Scenically significant landscapes do not simply benefit the person who experiences them, they represent "an important contribution to the overall desirability of an area" (Clay & Daniel, 2000, p. 1).

One perceives mining areas as individual towns, but these towns exist in the context of mining districts that can embrace hundreds of square kilometres. The mining district consists of many visual elements – the natural and manmade topography, vegetation, structures and buildings of different types (commercial, residential, institutional and industrial), the location of these buildings, the street pattern, the transportation routes, and the property parcels (Francaviglia, 1997, 10). Mining activities often concentrate many characteristics in a comparatively small space.

The mining landscape "bears a certain brand or visual identity". There are a few types of mining that have various and equally important impact on landscape – placer, underground hard rock, surface or open pit, and various types of leaching operations. Open-pit mines obviously have vastly different visual impacts on the landscape than do deep-tunnel shaft mines. Company houses often dot the landscape in small settlements interconnected by roads and "frequently paralleled by railroads whose roadbeds are stained in the exotic rainbow hues of mineral oxides or smelted slag" (Francaviglia, 1997, p. 9). Very close to these settlements stand impressive mine buildings, headframes, and ore bins. The density of structures increases, and unfamiliar types of buildings and structures may appear. The repetition of standardized architectural and engineering features contrasts with the natural setting.

The reading of landscape in very "kinetic" – it accounts for the necessary motion that is involved as we experience places by moving through them, as workers, inhabitants, or visitors (Francaviglia, 1997, p. 13). Mining landscapes are visually complex and there could be too much information unless the user is selective (Francaviglia, Robertson). Simplifying or abstracting can help for the better understanding of the complexity what we see. As Francaviglia says, categorizing mining landscapes as "wasted" involves elitism that prevents an understanding what such places really signify to people who create and inhabit them. It is better to compare the mining landscape with the surrounding countryside, because it can help to determine distinctive features and see these landscapes as creations that "reveal deep-seated cultural attitudes toward land and life" (Francaviglia, 1997, p. 11).

The visual characteristics of mining landscape can be unpleasant for some people and maybe beautiful for others. For people who live there, these landscapes simply become a part of visual perception of their everyday life. Wheeler illustrates it on the example of the remnants of mining activity within the Swedish Askam landscape – even disused and abandoned sites can be powerful activators of memory. Memories create the feeling of place identity, the landscape acts out an agency of its own by evoking and remembering the past. The perception of landscape vary from person to person, but as geographer John Jakle argues, these views are not mutually exclusive, they are in fact a single continuum (Jakle, 1987, p. 166). Spaces are also filled with people, their activities, and their activity creates the vibrancy that is very important for livability of any settlement.

Winter Cities and Climate Responsive Design

Winter City is a concept for communities in northern latitudes that encourages them to plan their transportation systems, buildings, and recreation project around the idea of using their infrastructure during all four seasons, rather than just summer and autumn. Usually the definitions of the North and "winter city" go together. To be a "winter city" the city should possess certain qualities.

There are many interpretations of the "winter city". Certainly, this city has winter. From the astronomical point of view – winter is a period between winter solstice (22nd of December) and the vernal equinox (21st of March). From climatological, the December through March quarter is known as winter. From perception of some people, winter starts with frost and snow, the season that enable special outdoor activities like ice skating, skiing, snowmobiling, ice-fishing *etc.* Generally speaking, the winter city usually is located above 45 degrees latitude, has an average January temperature below 0° C, and gets some amount of snow. A harsh, cold, winter climate embodies five main elements: temperature (below freezing), precipitation (usually snow), restricted hours of daylight, prolonged periods of the first three elements, and seasonal variations. In addition, the average temperature of 0° C should be for a period of two months or longer (Manty, Pressman, 1988, p. 20). The physical character of the winter city and the North is undergoing change, as has been demonstrated by current climate change. It shifts all these definitions changing temperature regimes, amount and quality of precipitation in different regions, has impact on permafrost, on animal populations, on sea ice conditions, the higher sea level *etc.* (Wonders, 2003). Planners and their customers usually ignore important climactic, social, and aesthetic realities of the North (Sheppard, 2012). In order to create a more sustainable world, buildings, landscapes, and cities need to be designed with a greater understanding of ecology and climate. Ecological design is defined as "any form of design that minimizes environmentally destructive impacts by integrating itself with living processes" (Van Der Ryn, Cowan, 1996, p. 18). The principles of ecological design begin with gaining a better awareness of the seasonal context. It is always informative to observe vernacular architecture. Folk architecture is a response to living in a specific place, it arises in diverse regions as a result of specific methods of construction that are "due to available building materials and technologies" as well as "to the desire to accommodate building to a local context" (Norberg-Schulz, 1996, p. viii).

There is a vast literature on the north dealing with the issues from different perspectives. Music, literature and painting manifest the Nordic World. Nordic built-form is founded in a "combination of representation and complementation" (Norberg-Schulz, 1996, p. 17). Nordic art of building exists and it manifests the Nordic world. "The Nordic build work does not stand as an independent body but opens towards the environment, simultaneously adsorbing it within" (Norberg-Schulz, 1996, p. 197). Nordic world and architecture both own qualities of "openness, interplay, and dynamism, and modern architecture sought to rid itself of the stylistic dogmatism of the past" (Norberg-Schulz, 1996, p. 197). Norman Pressman has contributed to the idea of working with winter. He highlights concepts, principles and strategies to promote an understanding of the critical variables affecting sustainable design and development in northern regions.

There are different ways of living with winter and of perceiving it. The rhythm of urban life changes according to climate and season (Pressman, Norberg-Schulz, Erell, Wonders). Designing and building in both sustainable and climate-responsive ways can establish livable, dynamic and vital city form, especially in the northern environment. Architecture, urban planning, urban design and policies have to take into account all constraints related to the North to help northern dwellers to benefit from the built environment – "reducing the negative impact of winter while enhancing its positive characteristics" (Pressman, 2004, p. ix). Large cities are usually not located in northern regions, except countries that have most of their territory on the North – Sweden, Norway, Denmark and Finland. Nevertheless, northern settlements have common elements: a population lives on the edge of urbanized region; the climate is unfriendly, challenges of achieving the need to enrich multi-seasonal lifestyle. Therefore, the northern cities have to be more innovative to take the full advantage of the winter season. Climate unites people at the same extent as separates them – the unity occurs in the common challenge of living in harsh climatic conditions, but the quality of outdoor environment does not allow people to interact how it happens in the south. Northern lifestyle is seasonally variable and highly dependent on climate reality. Use of outdoor spaces and socialization patterns in the urban north are different from the south. Usually, there are efforts to create 'summer city' conditions in most northern cities with harsh climatic conditions, but this is a poor solution – to hide people from winter instead of highlighting unique characteristics (Manty, Pressman, 1988). Meaningful solutions to deal with winter cross with our summer perception of dealing with things. Cold should be an inspiration in the decision making process. Working with nature rather than against it will contribute towards enjoyment of seasonal variations (Hough,

Marsh, Pressman, Norberg-Schultz, Rice, Erskine). There is a connection ‘north-south’ that was emphasized by Norwegian architect Norberg-Schulz. The architecture of both regions sensibly related to their environments; but whereas the South lends itself to abstraction, the North is marked by variation, openness, and dynamism – by low light, forests, and space (Norberg-Schulz, 1996). Light gives an environment its primary character and informs us the location; it defines the manner of things’ appearance. The Nordic light creates the space of mood. If we maintain that light defines the Nordic environment, it is to imply that we understand ‘climate’ qualitatively light as conjunctive with weather, and in the North, weather plays a more important role than in the South’s more stable world. “The North is truly a midnight world” (Norberg-Schulz, 1996, p. 6).

Exploration of city-building techniques suited to northern climates requires careful planning and certain strategies. Living in harsh conditions is not easy and concepts that work well in the south, and even in mild climate, cannot be applied. Ralph Erskine was one of the most famous architects who built with the consideration of climate. Arctic design was one of the major directions of his work. Erskine has constantly emphasized the building's function as climate protection, both when he drew and when he wrote. One of his famous drawings is concept projects to arctic town – the town turns as an ancient theater to the sun and away from the cold north winds (see Fig. 2.7).

According to Erskine Arctic designs, the orientation, shape, structure, materials and building components determine the climate's impact (Egelius & Erskine, 1988, p. 68). The shaping of a new settlement is the result of a complex interaction between many factors.

The choice of location is a balance between many factors – such as local topography, existing buildings, town planning regulations, views and climate factors. It was important to avoid heat loss in the North by setting up windshields and solar radiation. It is easier to select the most favorable position than try to improve a bad one. Ideal town should be built on a south-facing slope that always has the most sun in the northern latitudes, where the winter sun is low. Protection from wind is of high importance in the north because they are generally cold winds (Egelius & Erskine, 1988, p. 68). The wind speed is combined with temperature and humidity. Erskine proved that the location with the highest temperature is not necessarily the best for habitation. Strong winds at the mountaintops and high humidity must also be considered.

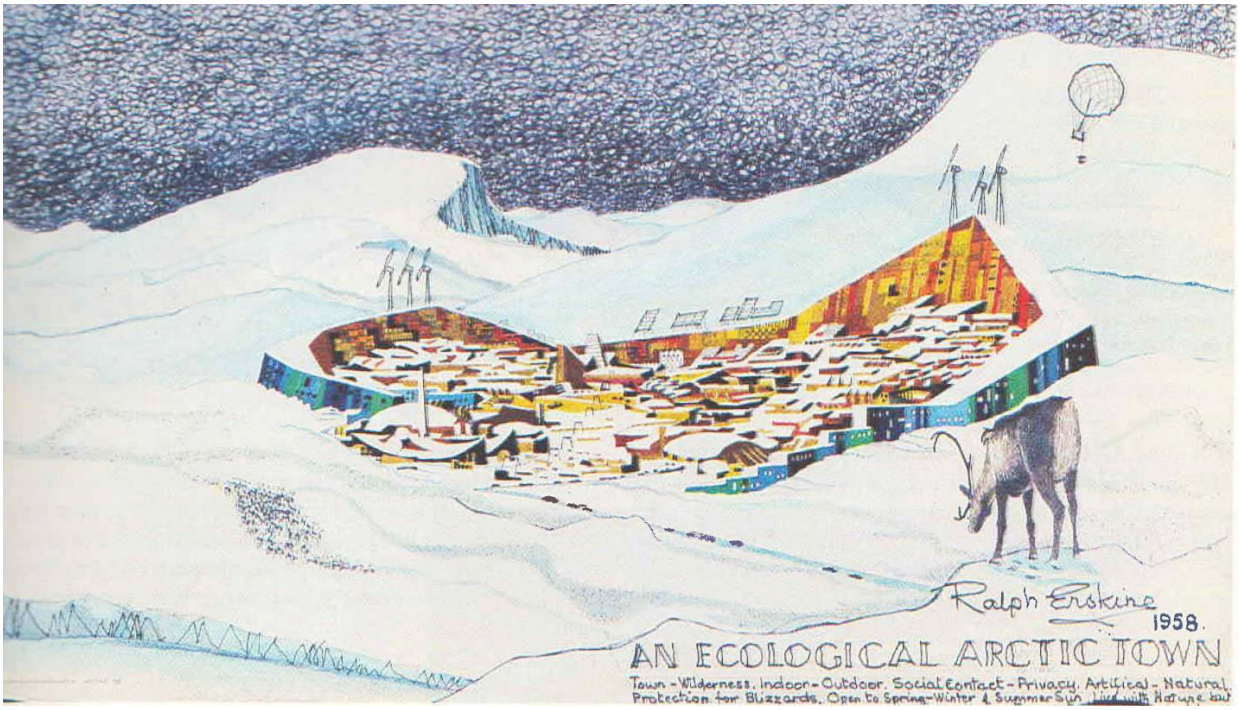


Fig. 2.7. Ralph Erskine's "Ecological Arctic Town" (source: Egelius & Erskine, 1988, p. 68).

Both in concept projects and real buildings Erskine aimed that entire settlement will serve as a great collector of the tallest buildings to the north, often perched on a hillside. The settlement takes the form of an ancient theater that protect from northerly winds. It is compact, has simple shapes and small windows to reduce radiation. Nevertheless, the indiscriminate use of small windows have been overtaken by some research, which shows that the window facing the sun receives more heat than they lose. Nor is the city round shape ideal because some parts are not facing the sun and may cause unnecessary shadows (Egelius & Erskine, 1988, p. 70). Erskine had an argument to gather many functions under one roof because it gives the closed form of a sense of community and belonging in an isolated part of the world (Egelius & Erskine, 1988, p. 70). A radical solution to create these intense communities would be to provide the city with artificial climate by means of a dome or a plastic bubble. Erskine's interest in climate change has not taken him to ignore the psychological aspect of living in a totally controlled sphere, and the risk of creating an Arctic mole burrow (Egelius & Erskine, 1988, p. 70).

Erskine emphasizes two structural concepts that emerged from climatic considerations: structural protection and structural separation. Both are based on the notion that it is important not to break the structural casing to reduce the risk of frost attacks and avoid thermal bridges. The

thermal bridges occur in the transition between the inside and the outside when a floor of a conductive material in steel or concrete continues out to form balconies. For that reason, Erskine separates such building components as balconies and stairs from the house body by making them hanging or freestanding. The loose elements of the building body enrich the facade while it is more economical than creating interesting shapes by modeling the facade.

Erskine's knowledge of the material for harsh climate is not showing his strength. He tries to take advantage of snow's good insulation properties, creating the conditions for it to be put on roofs and north walls. Erskine focuses on form and appearance, and he relies on the heat-absorbing dark instead of pale colours. He chooses rather material for their plastic characteristics than for their insulating qualities. The plastic forms helps, however, to hold heating costs down due to the dome or the round corner making less resistance to the wind and exposing less outer surface. Another advantage of these shapes is that they mediate feeling of protection. In Erskine's architecture is often the solution symbolic gesture (Egelius & Erskine, 1988, p. 71).

Erskine was very interested in building details. He often develops an aesthetic quality in any detail, like placing a movable cover outside the windows. The device can be turned either to keep the cold out or to give a protection of heat or excessive light. Light is projected into the house through the reflective window cover and roof reflector. Another typical Erskine device also derived from his climate studies is the use of the ventilation hoods on the facade. They are used to keep out the snow in Sweden and to protect tundra from a noise highway entering the house in England. Strong snowdrifts and snow accumulations should also be counted in Arctic settlements.

Winter has its own poetry: it should be emphasized to appreciate and value positive aspects of seasonal beauty (Pressman, Norberg-Schulz). There is "the need to generate a climate-sensitive northern urban form, especially under severe conditions" (Pressman, 2004, p. 7). In order to respect, appreciate, and celebrate winter, we have to improve livability in cities during lengthy and harsh season "in a way that can help us enjoy its beneficial qualities" (Pressman, 2004, p. 7). It is important to enjoy the opportunities provided by ice and snow and celebrate the season with winter carnivals and festivals. The winter city approach needs to be imperative – to preserve those quality-of-life factors that make winter communities special places, and to enrich lifestyles. Such region will attract people and businesses to deter those who intend to leave.

Norman Pressman identified main points of both negative and positive ways of perceiving winter. The former is about generating inconvenience and extra cost, health expense, lack of daylight and connected to it problems, limited outdoor activities, cold temperature, problem with public transportation, lack in colour and warmth. The positive way of perceiving winter includes overcoming challenges in an innovative way, healthy lifestyle, specific outdoor sports, and ability to confront difficulties of life, developed public art in a form of ice and snow and indoor cultural activities, holding winter festivals, seasonal variation and diversity of activities during the year (see Fig. 2.8 and Fig. 2.9).

Fig. 2.8. Ice skating rink in Quebec City

Fig. 2.9. Winter festival in Montreal

Winter cities should have identities on their own taking into account all cultural, social and climatic factors. There are a lot of solutions how to reduce the severity of climate if they are applied properly. Among them are the use of heliotropic principles, exposure to sunlight and wind-protection for public spaces, installation of energy-conservation systems, efficient and cost-effective snow removal way, creative ways of using snow and ice, paying attention to snow drifting in urban planning and design, encouraging pedestrian movement, reducing inconvenience and propose protection from harsh climate conditions, emphasizing inside-outside relationships, and changing the perception of winter in a positive way (Pressman, 2004, p. 28).

Norman Pressman states that there are two ways of coping with climate – mitigation and adaptation. While the former offers action to reduce the severity of the climate, hiding from winter costs money and consumes many resources; the latter proposes modifying individual and social

activity in addition to the surroundings as can be seen by some winter cities, across the North. Thus, there are two fundamental approaches of living in the cold environment:

- Overprotection from nature is not desirable – meaning the learning how to live in the north, be an integral part of the nature;
- Protect from undesirable elements – shelters should be integrated in the urban environment, to diminish and protect inhabitants from undesirable weather like as harsh wind and low temperature.

To encourage the sense of place is very important. The environment needs to be built to achieve this sense of belonging. “Genius loci must be conserved”, it will occur when ordinary space is elevated (Norberg-Schulz, Pressman). Attractive and well-managed streets and open spaces form the essence of urban life. Active and passive outdoor space should be provided and sheltered to keep people warm during cold days and cold during summer. In winter cities, it is “imperative to provide alternative microclimatic zones within the same spatial area – permitting choice regarding exposure to the sun’s rays or protection from them” (Pressman, 2004, p. 26). It is important to extend the outdoor season. As Pressman emphasizes, urban public spaces should be designed using microclimatic principles to protect people from wind and extended exposure of sun.

The question of what makes a space successful from a climate point of view was observed by such famous American urbanists and professionals as W. Whyte and P. Bosselmann. It is between buildings, not inside them as we often think, that much social interaction takes place, therefore it is vital to create a climate responsive environment that will encourage people to stay and cooperate outdoors (Erell & Pearlmutter, 2011). One of the main priorities for urban design taking into consideration climate is to create compact urban forms. The orientation of footpaths, streets and buildings should be designed to mitigate adverse climatic forces and maximize exposure of the sun. Enclosed residential courtyards can help to create micro-climatic conditions within dwellings. It is advised to take into account wind tunnel testing, solar access, shadow pattern impacts and snow drifting studies on the early stages of design projects. Moreover, increasing densities of the area can help to reduce space heating requirements and transportation energy demands minimizing the need for spatial displacement. Buildings should contain the diversity of

users and functions to minimize potentially movement under harsh climatic conditions. Mixed land use in various districts within the urban configuration will reduce the need for commuting. More intensive use of land that is vacant and awaiting development. Public transportation should serve relatively high-density areas to be cost-effective, transit-oriented development is a required approach for sustainable urban form. Partial climate-protection could be useful in some areas of the settlement to connect buildings between each other with help of arcades, colonnades, canopied pavements leading to the most usable destinations like bus stops or shops.

To sum up, the primary goal of designing cities for winter is to aspire social enjoyment, visual pleasure, climatic comfort, security, strong identity, contact with nature and sensory stimulation. The ideal winter city should have many quality microclimate urban spaces, the ability and infrastructure to accommodate the needs during this season for the vulnerable groups, and education to teach the inhabitants how to enjoy winter. In this way, the theories for designing winter cities include interest in sustainability, improvement of “fit” of human activity with natural environment (the nature-culture nexus), celebration of winter and climatic-responsive design.

Chapter 3: Methodology

The key objective of this investigation is to articulate principles and strategies that can be implemented in specific contexts that will promote livability single-industry towns and enable people to enjoy winter in harsh climate conditions. Extraction of natural resources affects the development of these northern territories and attractiveness for people to visit and stay. It is important to attract investment and create good jobs in production or natural resources, as are the chosen cases with the mining industry. In such towns every aspect of inhabitants' life is affected by the presence of mining company – if there would be no industry, such town would not exist. Settlements need to attract people not only for jobs but also to provide vibrant life and opportunities for future development.

The main questions are these:

- What concepts and methods have been developed to optimize the connection between people and nature in cold climate?

A scan of literature was undertaken to find approaches that were developed by professionals.

- How can the concepts and methods be applied to the case of 'winter' cities in any context?

The aim is to assess how these ideas could be useful in relation to specific circumstances of chosen regions.

- What specifically can be done to increase and diversify activity in Nordic cities to both retain and attract people?

I am going to investigate opportunities and perspectives that will allow locals to stay and new people to visit.

- How can one transform existing patterns (attitudes, perceptions, activities) to celebrate winter life?

The key objective is to find potential solutions that would let people dream of this season and enjoy winter even in harsh climate conditions.

The research uses both primary and secondary sources. For Kiruna, primary resources include field observations, planning policies, design guidelines and specific projects, both built and unbuilt. A field visit to Kiruna in Sweden in June 2015 allowed studying the site first hands. A few interviews were conducted, also information was obtained from inhabitants and newly arrived people. Maria Persson, the project manager of Kiruna Municipality, was the main informant providing answers about urban design of the city, public life and the future transformations. In addition, city planners shared key information, and some printed materials on the future projects. Photos were taken in the middle of June. For Fermont, Prof. Adrian Sheppard was the main informant, although there was no special interview conducted but the personal communication through several meetings provided information about the city. In addition, the information obtained from an archival recording of CBC of interviews with inhabitants of Fermont was used.

Secondary sources are taken from the theoretical background. The analysis of literature comprises three separate categories – (1) total urban design and new towns; (2) mining towns and remote sites; (3) winter cities and climate responsive design. The first and second categories represent descriptive empirical approach while the third one is theoretical and normative. The scan of literature shows the wide range of approaches that was made by professionals and researchers. Publication related to chosen case studies are also used to gather the theoretical background behind.

Reading the landscape

There are the basic elements that characterize the landscape of a particular mining town. Combined features help distinguish the mining landscape from non-mining, certain features are "almost as symbolic as the standard miner's symbol – the crossed pick and shovel" (Francaviglia, 1997, p. 59). Three fundamental categories can be identified (Francaviglia, 1997, p. 14):

- Site (the configuration of the natural or manmade topography and vegetation)

Site is one of fundamental aspects used in reading of any landscape. The natural topography can be classified into several basic categories (flat-open, flat-dissected, hilly, mountainous *etc.*) and the artificial topographic features (open pit mines, ore dumps, slag piles) can be described in terms of the types of processes that created them (extractive or accretionary) and their shape of morphology (conical, tabular, irregular). Each feature is a result of specific processes and is one

of the most distinctive aspects of the site. The vegetation can also be documented through mapping. The cover can be plotted on a density continuum (barren, sparse, scattered, grassy-shrubbed, scattered trees, forested) or in a mosaic of plant communities by percentages of species. The distribution of vegetation can help to reveal interrelationships (Francaviglia, 1997, p. 29-30).

- Layout (the arrangement of streets and property parcels)

The character of the mining districts is also defined by the distribution of towns, the pattern of roads and streets, and the layout of property parcels within the region. Communities can be clustered, scattered, or located in any particular pattern; they can be laid out in regular, geometric patterns, helter-skelter or combined patterns within one area. Individual property parcels can be small or large, geometric or irregular. These abstract spatial arrangements are revealed by such features as roads and streets, sidewalks, fence and electronic/telephone lines (Francaviglia, 1997, p. 30). The variety characterizes the layout of any district.

- Architecture (the design of the buildings, structures and objects)

There are two basic architectural forms in the landscape: those that house people and their activities (buildings), and those that people use for the processing or storage of commodities.

Commercial architecture is a first type that should be observed because the character of mining towns is dependent on the business buildings. The main street of a mining town usually hosts the core of development and offers a system of visual signals and clues. The commercial district usually offers a range of services. Francaviglia identified six categories how can most commercial architecture be classified visually: its position in relation to the street; the number of stories or floors; the shape of its façade; the relation between solid and voids; and the building materials.

Institutional buildings and their location can show a lot about the organisation of public or social space in mining towns. They are usually designed as freestanding structures, ‘the spires of churches and the towers of schools become strong landmarks when the community is viewed’ (Francaviglia, 1997, p. 43). Mining communities are richer that surrounding non-mining towns in buildings that shows a cultural diversity. Church architecture gives a good clue to ethnic and social diversity. The institutional architecture is the “architectural ingredient that give the cultural landscape of mature historic mining towns such an urban character” (Francaviglia, 1997, p. 43).

Residential architecture consists of two different types – detached homes and attached houses consisting of more than one unit under one roof. The mining-related housing is usually quite different from housing found in non-mining communities within any particular region. One of the most common distinguished features is that it is usually standardized and is not highly ornamented; it varies from small cottages to the largest and longest attached row houses.

Industrial architecture is associated with actual mining, milling and smelting ores that gives strong visual definition to the mining landscape. Francaviglia points out that headframes, ore bins, concentrators, and smelters form the backdrop for all settlement and transportation patterns and are among the strongest visual signatures of the landscape. In metal mining landscape a mill or concentrator stands in addition to the main building, it increases the concentration of metals by removing waste rock. In such a way, the ore is transformed into a higher-grade commodity that can bear the cost of transportation to the smelter. A number of techniques have been used to crush ores to the thinner sizes for ease in separating out metals that leave a legacy of industrial features in the landscape. The number of mechanisms determines the size of a mill. The mill has a long sloping roofline and stepped foundation. In big mining districts, one of the largest buildings is a smelter that stands at the end of the ore reduction. The railroad is another important industrial feature. A maze of trackage connects mine to mills, concentrators to waste dumps, and coke ovens to smelters. Flumes may be an important feature in mining districts where materials are moved by water (Francaviglia, 1997, p. 56). They are open structures through which tail water carries the waste from the concentrating process to the tiling dumps or tailing ponds.

Cemeteries are also distinctive and defining features of the mining landscape. They identify the degree of temporality of the community, even if the industry is over at least the memories will keep inhabitants on the place and “force” them to find other ways to develop the economy and maintain life. Most of cemeteries are located on the edge of the town, “the location of graves and the design of tombstones reveal ethnic and economic segregation, the acceptance of high styles, and the persistence of vernacular traditions” (Francaviglia, 1997, p. 58). It also reflect cultural values and social status.

Case Studies

The choice of case studies was influenced by several factors. Both cities are located in remote areas of the countries and are the single-industry towns. Most of municipal revenues come from the exploitation of the mines and the mining industry is the reason why they were built. The cities were designed to respond on harsh climatic conditions due to their location – Fermont is located in Canadian Sub-Arctic and Kiruna is in Swedish Arctic (See Fig. 3.1 and 3.2). Swedish architect Ralph Erskine had an influence on both cities – he built a few structures in Kiruna and "the Wall" in Fermont was inspired by his earlier work in another mining town Svappavaara in Sweden.

Fig. 3.1. Fermont

Fig. 3.2. Kiruna

The chosen case studies have even more things in common – the product and type of mining is the same, the production capacity is similar (see Table 1). Both mining landscapes have open pit mines. Surface mining often removes huge amounts of overburden to exposure and then remove the entire ore body. This method creates one of the most spectacular human-made features. The case studies are analysed according to fundamental aspects emphasized by Francaviglia – site (in terms of the configuration of the natural, manmade topography and vegetation), layout (the arrangement of streets) and architecture (main buildings and distinctive features).

Table 1

Case Studies

Case study	Year of establishment	Coordinates	Population	Area, km2	Density	Average annual t° C	Activity
Fermont, QC, Canada	1974	52°47'N 67°05'W subarctic	2,874 (Canada, Census 2011)	495.50 (land 470.67)	6.1/km2	- 3,8 (July +13,2 January - 23,2)	Mining industry
Kiruna, Sweden	1898	67°51'N 20°13'E arctic	23,241 (Sweden, Census 2014)	16.53	1,098/km2	- 3,0 (July +12 January – 16,9)	Mining industry + Tourism + Space physics

Table 2

General Information about the Mines

Facility	Year of opening	Operator	Location	Product	Production capacity	Process	Status	Source
Mont-Wright mine	1970s	ArcelorMittal Mines Canada	Fermont, northeastern QC	Iron ore	125 000 t/d	Grinding and spiral separation	Active	Mont-Wright Mining Complex, 2013
Kiruna Mine	1898	Luossavaara-Kiirunavaara Aktiebolag (LKAB), Sweden	Kiruna in Norrbotten County, Lapland	Iron ore	100 000 t/d	Sublevel caving mining method	Active	Kiruna Iron Ore Mine, 2010

The cities are also analyzed in terms of urban design strategies that were implemented to promote livability. Norman Pressman reiterated six dimensions of winter experience: enduring, accepting, tolerating, appreciating, respecting and celebrating ("Welcoming winter," 2005). In each of chosen sites, those six dimensions are represented in a different ways. As Pressman says, endurance, toleration and acceptance come in any case to create more or less livable environment, respect might come from hard lessons, but appreciation and celebration of winter are not usually emphasized and can be expressed in diverse ways. To understand it, the sketch map for each city is created – the key buildings, main streets, and landmarks are pointed out and analyzed separately. The public life of the towns was examined as a main engine that promote livability of any settlement.

The work also critically analyzes current conditions of the chosen case studies and offers possibilities how to improve the quality of life, to diversify urban design and promote livability in the single-industry cities in harsh climate conditions in chosen case studies.

Chapter 4: Analysis

The urban design of a mining town on the North may seem typical taking into account harsh climate and including homes, community buildings, town's stores designed to benefit the residents, and some public spaces. Nevertheless, this formula brings a great variety of choices in combination of all those components in different quantity and quality that is proven by boom of company towns in 19th century all other the world. Once the population of a particular mining town was grown to a certain extent, a mining company had to provide other type of community architecture, such as schools, medical and sport facilities, religious architecture, and even cemeteries. The culture of migrated workers and a particular country where a town X is built brings its own identity to urban design and planning, architecture, landscape and the perception of the place. Since mining towns were mostly a necessity for the developing industry in the region, there are particular problems inherent to all of them despite the difference in location and culture.

The best mining towns demonstrate another type of living that is not subordinated to a company itself. The mining company creates not only appropriate working environment but also provides education, enriches public life and livability of the place, in other words – makes life as in any usual city. The cold climate conditions also adds up to the constraints. The climate-responsive design becomes vital in such settlements.

Fermont

The city is located in Canadian Sub-Arctic in Quebec a few kilometres from the Labrador border. Fermont is one of the eccentric settlement poles whose birth resulted from the growth of the market for raw materials (Simard & Brisson, 2013). The city was founded in 1972 by private investment. After a period of economic stagnation, the multinational ArcelorMittal that now operates iron ore on Mount Wright site recently released many expansion plans for Fermont and neighboring sectors (Government of Quebec, 2011a). Fermont is full of activities and industrial projects that are nevertheless concentrated in extractive activities. The city is the largest urban agglomeration in northern Quebec (2874 inhabitants / Statistics Canada, 2012).

In 2011, the 'Plan Nord' of the Quebec Government (2011b) confirmed the renewed interest of large private companies for the exploitation of resources of northern Quebec. The mining industry was the ideal economic activity to challenge the economic agents operating in this remote, cold and wild area. Moreover, it seemed to be the only activity for creating substantial financial resources to ensure the existence and development of human settlements in the north.

Fig. 4.1. Fermont city (source: http://www.desnoyersmercure.com/projet-VilledeFermont.html)

The History Behind – Ephemeral and Isolated north

From 1947, the North Shore of the St. Lawrence and northern Quebec have experienced a boom that promoted important mining sporadic settlement territories portions within regions that was still in a natural state. In less than two decades, "mining corridors" were established through the implementation of three railway lines in a north-south axis (Proulx, 2009). First, a long path connecting the Knob Lake deposit near Schefferville to Sept-Îles was established passing through the Newfoundland Labrador. Second, a smaller line connected the Lake Allard deposit to the city of Havre-Saint-Pierre. Third, a railway enabled exchanges between the deposit Lac Jeannine (Gagnon) to the town of Port-Cartier. The latter route was extended to the Mont Wright deposit in 1972. Finally, the towns of Sept-Îles and Port-Cartier have been provided with deep-water port facilities and pelletizing plants for the processing of iron (Simard & Brisson, 2013).

Fermont was founded as a company town in the early 1970s to exploit rich iron ore deposits from Mont Wright located about 25 kilometres to the west from the town. Québec Cartier Mining Company began to develop the Mont Wright Mine once the Jeannine Lake Mine at Gagnon started to be depleted in the late 1960s (Fermont, 2012). This was a large-scale project that involved mining, processing, and transporting iron ore. About 1600 employees were needed, and the town of Fermont was constructed to house them and their families. Since Fermont was built specifically to replace the then existing mining town of Gagnon and the majority of population accepted to move to the new town, many of people among the city's future inhabitants were know, this allowed to them to be included in the public participation process (Sheppard, 2007, p. 1). By the end of 1972, the first people moved in. That same year, the Fermont post office opened, and in 1974, the place was incorporated as Ville de Fermont (Fermont, 2012). The company towns are relatively numerous in Quebec. However, elsewhere on the North Shore, development of Québec has been profoundly marked by industry (Simard & Brisson, 2013).

Dependency in Company Towns

The local economy is entirely dependent on the Mont Wright and Fire Lake Mines owned by Québec Cartier Mining Company. In fact, Fermont is not a company town anymore – it has the same economy as other towns in Quebec (Sheppard, 2015). The facilities belong to the public, the

mine is private, and all private ownership pays taxes. The mining company owns so much that it needs to pay for everything.

Life in Fermont continues to revolve around iron mining, and majority of available jobs are directly linked to that industry. Most people move to Fermont after securing a job that gives them access to company housing, and non-company owned homes are very rare. The health centre, schools and business offering goods and services are also often looking for qualified and experienced workers to fill a variety of positions. The prices are on average 10-15% higher than in the rest of Quebec. The major employers are ArcelorMittal Mines Canada, Health and Social Services Centre (CSSS) of Hematite (Centre de santé et des services sociaux de l'Hématite). In health there are Agence de la santé et des services sociaux de la Côte-Nord and Centre de protection et de réadaptation de la Côte-Nord.

Spatial Objects Embedded With Meaning and Memory

Unlike Scandinavian mining towns full of memories and traditions, there are no special memories in Fermont (Sheppard, 2015). The town is relatively young; therefore, there is no significant elderly population as well as younger generation that was born in the town. The population is aged between 25 and 35, the average age of population is 34.7 and 79.6% of population is aged over 15 (Statistics Canada, 2012). Moreover, resident often cannot stay once they retire, because the mining company provides most of infrastructure. Nowadays, two different types of population live in the town – temporal "fly-in/fly-outs" workers and those who regularly live and work in Fermont. Besides, it is one of the few northern Quebec institutions that do not have significant indigenous population whose mother tongue is French.

Site

The territory portrays all features of the North – continuous permafrost due to very cold winters, and taiga forest vegetation. The city is situated on a flat area, bordered by Lake Daviault on the south. The landscapes consist of a sparse forest, numerous lakes and many hills bare summits. During the winter months, the temperature can reach to below - 40° C. The snowfall is abundant during winter whereas summers are short and cool. This location is an ideal city to erect a promontory adapted to the rigors of subarctic climate. Fermont is an isolated town. In reality, the

urban settlements of Labrador City and Wabush are located nearby on the other side of the provincial border, but cross-border trade is relatively limited due to the different languages (Simard & Brisson, 2013). Fermont can be reached by road along Highway 389. However, the winding road that runs through forest over 500 km is not completely paved. In addition, it is subject to winter conditions several months a year, there is no settlements on the way and refueling stations are rare. The nearest airport is 35 kilometres away in Wabush, Labrador. The train is usually reserved for the transportation of iron ore. By rail, passengers board in Sept-Îles and travel north to Emeril Junction, Labrador, located 90 kilometres east of Fermont (see Fig. 4.2).

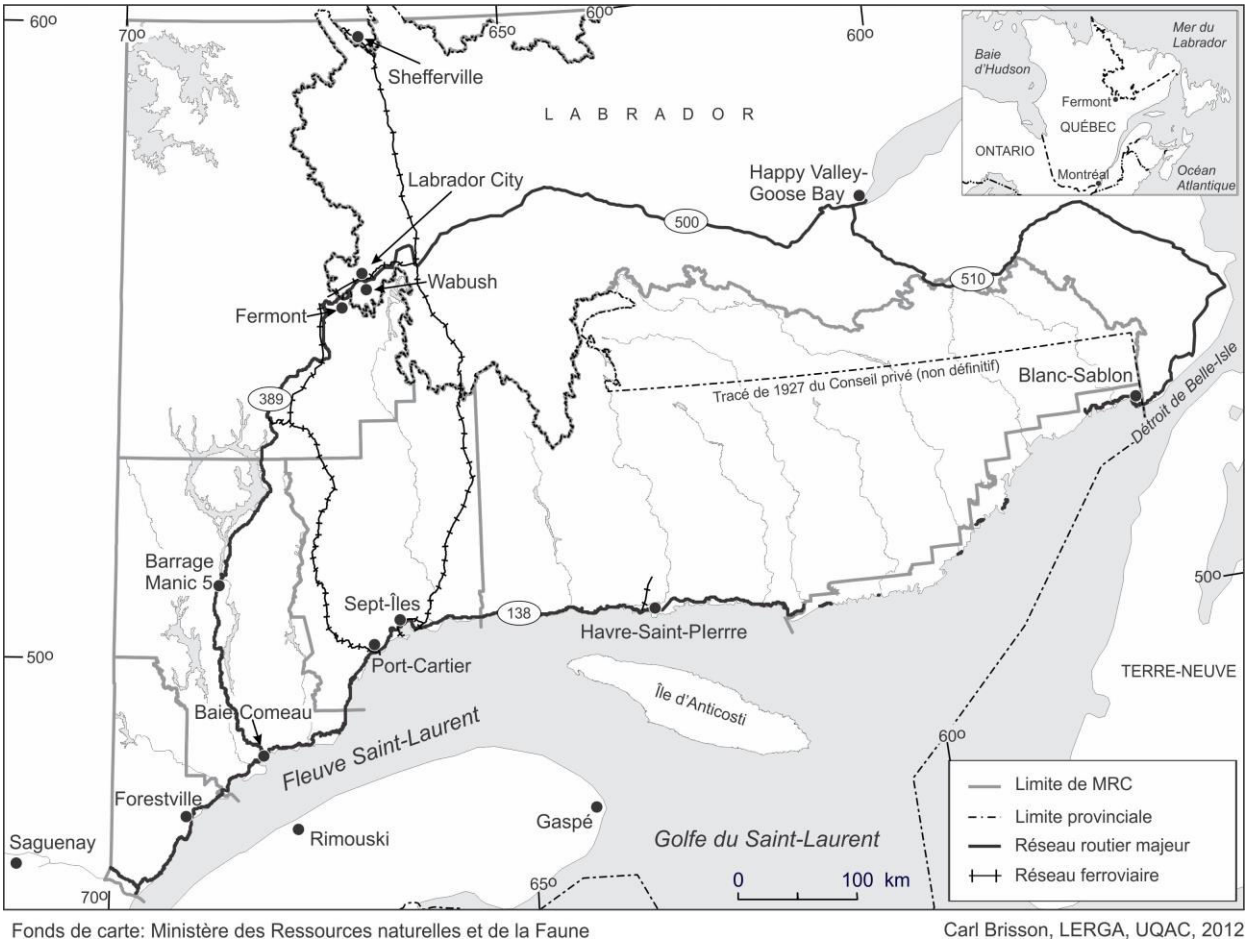


Fig. 4.2. Fermont au sein de la région administrative de la Côte-Nord (source: https://cybergeo.revues.org/docannexe/image/25817/img-1.jpg)

Layout

The city presents itself as an element of infrastructure for the exploitation of the ore, the other elements being the extraction site, the railroad, the processing plant and the port. Fermont was the first Canadian new town "specifically designed to respond to realities of the harsh climate conditions of the sub-arctic and to address the problem of living in isolation" (Sheppard, 2007). The construction of the settlement is based on planning concepts "entailing energy conservation in all its forms, the use of passive solar energy, and ecological common sense" (Sheppard, 2007). The idea of creating a microclimatic zone for the community by construction of the windscreen, the town was designed to be dense. The town is clustered and laid out in irregular geometrical pattern (see Fig. 4.3), the property parcels are small. It is a compact town – the length of the infrastructure is considerably reduced. The distances between the communal facilities and the houses is "abridged and makes human interaction easier, especially in winter" (Sheppard, 2007, p. 7) (see Fig. 4.4). The wall creates the sense of the community that was emphasized by Ralph Erskine. The location of the main street is not clear, but the town is developed around its commercial core.

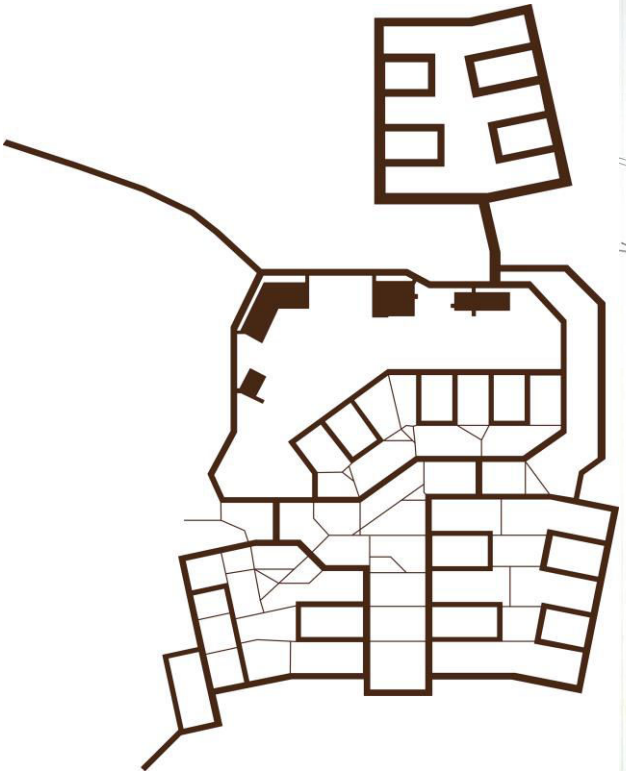


Fig. 4.3. Layout of streets

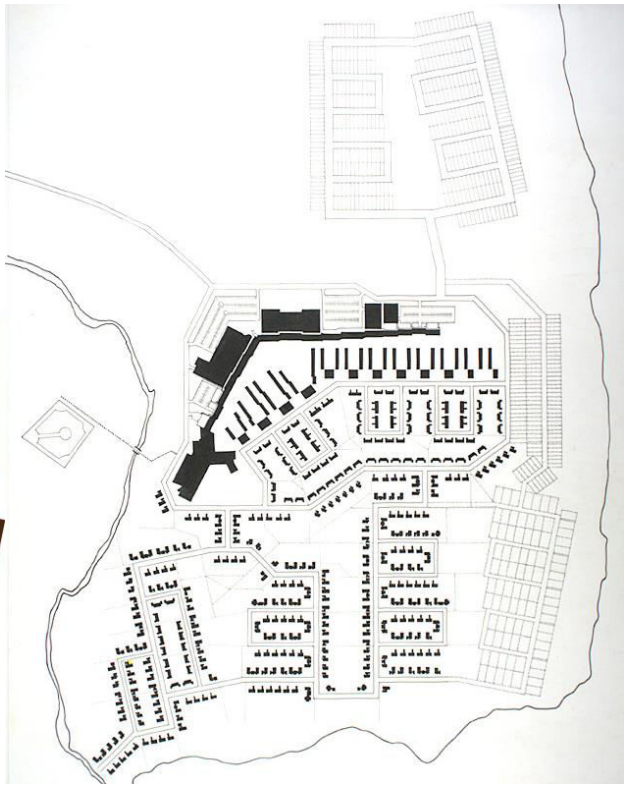


Fig. 4.4. Townsite of Fermont, Master Plan (Drawing by A. Sheppard, 1970)

The design parameters and the configuration of the road network in Fermont attempted to address problems of speed, security, configuration, width, snow accumulation, sidewalks, lighting, *etc.* The street network is based on optimum accessibility for active transport, hence the grid, but cars must travel around to minimise nuisance turning a neighbourhood into a fully connected pedestrian realm. There are four categories of roads in the network: "the access road, the primary distributor roads, the collector streets and the local streets" (Sheppard, 2007, p. 9). It also includes a sub-system of pedestrian pathways, which coincides with the street system. Only T-shaped junctions are used, in order to reduce the number of potential collision points in this environment where the road is often icy (Paquette, 1984). The major town promenade follows the south side of the Windscreen and connects all the significant facilities of the town. This system of roads optimizes infrastructure, assists district and regional traffic flow, and encourages walking by balancing the needs of pedestrians and drivers.

Architecture/Planning Response

Fermont was designed to provide shelter from an extremely harsh climate. Fermont's dominant feature is a windscreen structure. The overall strategy implementation and construction of this curtain wall designed to protect the city from the prevailing winds of 66% of its territory, to develop a microclimate control the accumulation of snowdrifts and optimize traffic. The firm of Desnoyers and Schoenauer was hired by the Quebec Cartier Mining Company in the late 1960s. The inspiration came from Swedish architect Ralph Erskine, who had designed a similar building in 1962 to provide housing for a mining town Svaapavaara in Swedish Arctic (see Fig. 4.5).

Ormen Lange is a residential building in Svappavaara designed by architect Ralph Erskine (see Fig. 4.6). The house was built in 1965 and is 200 metres long. The architect wanted to realise his ideas and studies on residential construction in an arctic climate. Erskine designed a housing opened to the south in an arc shape with balconies and large windows. Towards the north, the building was closed as a protective barrier against the cold winter storms. The internal street was designed with protection from weather, including gathering place for miners and executive group. Covered streets connected service facilities such as health centre, shops, schools and bus stops.

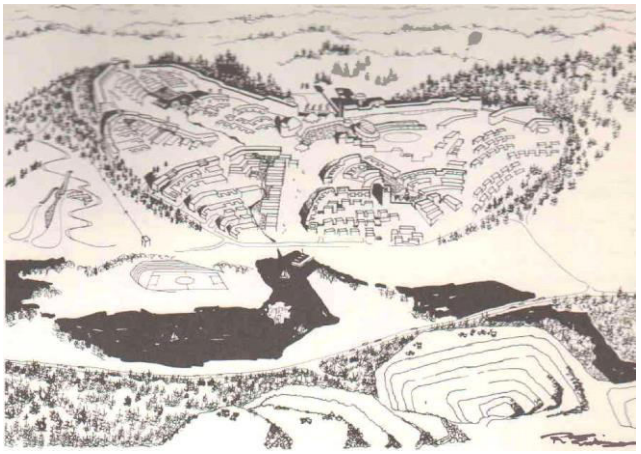


Fig. 4.5. Svappavaara (Egelius & Erskine, 1988, p. 77)

Fig. 4.6. Ormen Lange in Svappavaara (source: http://www.panoramio.com/photo/6123863)

The wall screen in Fermont is V-shaped and west-southwest – northeast north oriented that helps to create a microclimate by blocking a prevailing winds (see Figure 4.7 and 4.8). Standing 1.3 kilometres long and some 50 metres high, the building was inaugurated in 1974 and now is the symbol of Fermont. It is home to businesses, schools, a health centre, city hall and all other services, as well as 440 residences. The wall of Fermont will block the winds over a distance of 675 metres, which corresponds to 66% of the territory of the city (Paquette, 1984, p. 54), a compact land use through residential density to reduce the cost of infrastructure and encourage pedestrian movement. The structure was designed to mediate between the Fermont's sub-arctic climate and the desire of the residents to live like in the "south."

Fig. 4.7. Plan of The Wall (Drawing by A. Sheppard, 1970)

Fig. 4.8. The Wall in Fermont (Photo by Maden Worries)

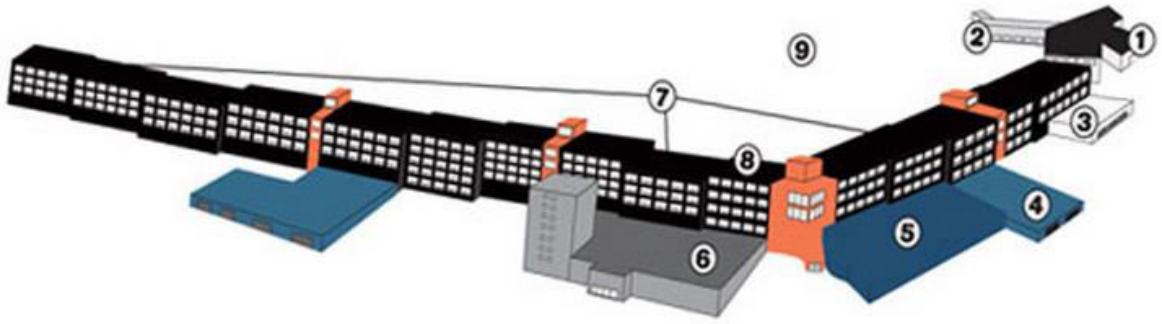


Figure 4.9. Scheme of the Wall in Fermont (source: http://www.jobboom.com/carriere/anatomie-du-mur-de-fermont/)

There are two dozen shops inside the wall: grocery, pharmacy, hardware store, liquor store, tobacco shop, clothing for adults and children, shoes, hair salons, tanning and beauty, eyewear, travel agencies *etc.* The Vagabond shop is the only adult clothing store. With its six floors, the hotel forms the highest section of the wall. The only one restaurant, Le Filon, was recently closed.

Residential architecture

Fermont has a variety of housing typologies. A sense of community is generated within the walls of the windscreen structure, le Mur Écran, and in the detached houses within its wingspan. This housing typology is not typical for mining settlements and not the most suitable for the climate, but providing these was instrumental in securing half of the town's initial population. The majority of housing units are located in the wind shadow of the windscreen. The wall comprises 440 housing: rooms for singles, studios, and 3 ½, 4 ½ to 5 ½. More snow accumulates on the town's buildings since they are not windswept. Homes can take advantage of this snow accumulation to prevent further heat loss and sun-damage. Provided this they can support the weight and safely drop snow loads, row-houses/buildings with flat roofs are the most energy-efficient design during the winter. The windscreen includes apartment housing, shops, school, and community centre. This allows for many residents to access services within short distance without driving long distances. The added density also produced many cost-savings in new infrastructure and a reduction in land footprint by 60% in comparison to other towns of similar size. The windscreen has colourful details to diversify the façade. The question of variety seemed important to the architect-planner (Wolfe, 2003). It offers a variety of housing types (see Fig. 4.10), despite the fact that the windscreen wall comprises the majority of housing and services, is a reflection.

The individual or semi-detached houses have a front facing south-east or south-west. This measure of energy conservation was part of what Schoenauer described as 5th generation of northern villages (Sheppard, 2007). Seven hundred fifty five houses extend beyond the wall. The town houses are located the closest to the Wall, after there are the semidetached units, and the detached bungalows are the most distant, all of them were prefabricated using a system of pre-engineered wood modules (Sheppard, 2007) (see Fig. 4.10). Houses have a variety of colours with the dominance of brown and grey.

Figure 4.10. Overlooking view on Fermont (source: http://spacing.ca/edmonton/wp-content/uploads /sites/9/2013/12/fermont_1.jpg)

Mining Landscape

Mont Wright is a mountain near Fermont, the site of major iron ore mining operations since the 1970s by Québec Cartier Mining Company (“Mont-Wright Mining Complex,” 2013). It is located in Caniapiscau Regional County Municipality. The mountain itself does not exist anymore – it is a 200 m deep pit now. Today's production of Québec Cartier ore comes from nearby Mont Survie and Paul's Peek Mountain.

The mine extends over 24 square kilometres and has resources of one billion tonnes of crude ore with an iron content (“Mont-Wright Mining Complex,” 2013). The pit forms a classic landscape of subtraction that consists of a deep scooped out depression surrounded by a series of benches. Railway lines run along these terraces, permitting the removal of ore and waste rock. The removed material forms a waste rock, and the material is leached so that water can be passed through it to remove further concentration of iron ore – it forms a huge leach dump. The water from a tailing pond is piped from the concentrator and dumped into a huge pond to evaporate.

Mont-Wright Mining Complex consists of an open-pit mine, an ore crusher and a concentrator, huge maintenance workshops, a large parts storage facility and a train loading system. The facilities are complemented by an extensive fleet of mining equipment, including drilling machines, electric shovels and large-capacity loaders, as well as some thirty 200-250 short-tonne production trucks (“Mont-Wright Mining Complex,” 2013).

Fig. 4.11. Mount-Wright mine (source: http://www.ledevoir.com/international/actualites-internationales/372312/des-exemples-a-suivre-pour-le-quebec)

Fig. 4.12. Mount-Wright mine (source: http://corporate. arcelormittal.com/news-and-media/multimedia-gallery/images/mining/64042?async=1)

Public life (Attractions/Festivals)

The activities in Fermont are separated on the basis of their permanent or temporal nature as it is in any modern city. One of the major tourist's attraction inherent to the region is the northern lights in winter (Appendix B). The ephemeral activity is the biggest festival in Fermont – Taïga Carnaval. The carnival symbolises the arrival of spring north of the 52nd parallel. Last winter event of the season, these four days of festival allow celebration of the equinox for the population. People enjoy outdoor, family and nightlife activities in an environment where the snow is in the spotlight. The largest dog sled race in eastern North America takes place and citizens enjoy different boisterous concerts ("Ville de Fermont," 2015). The festival takes place in the end of the week in March every year.

According to the official site of Fermont, the area is a place full of activities to enjoy both winter and summer. During the winter season, there are such outdoor activities as snowmobiling, snowshoeing, cross country skiing, the ice fishing, hunting and trapping, the para skiing *etc.* Furthermore, an outdoor skating rink is located next to the service cottage. In Labrador City (30 km from Fermont), the Smokey Mountain hosts downhill ski and snowboarding activities, the cross-country ski club Menihek is located nearby.

Indoor activities include hockey, figure skating and skating at the Arena Daniel-Demers. There is the municipal semi-sized Olympic swimming pool that also serves for underwater hockey and aerobics. Other activities, such as karate, spinning, badminton, fitness, crafts, among others, also take place in Fermont.

In summer, inhabitants and visitors can enjoy hiking in the mountains Severson, running or rollerblading on the athletics track, play tennis, participating in activities offered at the marina, such as beach volleyball, windsurfing, pedal boating, kayaking and small sailboat ("Ville de Fermont," 2015). There is a rent of boats and lessons at the marina, and mountain bike trails around the town. Public activities also include fishing at the lakes near Fermont. The municipal parks located in different areas of the city.

Kiruna

The little town of Kiruna, with approximately 18,000 inhabitants, is located in the north of Sweden. It is facing one of the greatest urban transformations of our time: the whole city needs to be moved 4 km to the east, because the iron ore mined from the mine Kiirunavaara in the city's western outskirts is causing structural changes in the ground below the present town. This is a big challenge, taking into account Kiruna's subarctic climate and location. Located 23 kilometres north of the Arctic Circle, the town is extremely remote and dark during most of winter. The Kiruna example provides a case that makes it interesting to "illustrate the reinvention of a town caused by great physical changes – a spectacular make-over" (Nilsson, 2009, p. 34). The mining industry in the Sweden is still growing and creating many jobs. The Kiruna mine is the world's largest and most modern underground iron ore mine – an ore body 4 km long, 80 m thick and reaching a depth of 2 km ("Kiruna Iron Ore Mine," 2010).

Fig. 4.13. Kiruna from Luossavaara mountain (Photo by Robin Ramstad)

The History Behind – The Dark Image of Kiruna

In the beginning, Kiruna was designed as a model town. It was recognised as a national cultural heritage site because of its unique grid plan and its collection of buildings of high architectural value – some buildings constructed since the establishment of the town remained and

the mining landscape itself embodies the history. The city was founded when an iron ore deposit was discovered on the Kiirunavaara Mountain during the mid-1880s, and grew with the establishment of the mining company LKAB (Luossavaara Kirunavaara AB) in 1890 and the inauguration of the Ofoten railway, which links Luleå via Gällivare and Kiruna to Narvik in Norway, in 1903 (Organisation for Economic Co-operation and Development, 2010). During the 1960s and 1970s, the industry went through ups and downs and together with it the population size. In the early 1970s, the town expanded significantly due the growing population. The conditions of living were not ideal and people associated the older town with crowding, and unmodernised dwellings. During this period, Kiruna gained an image of a deprived town. The mining company as well as the municipality required state support to survive (Nilsson, 2009). While social scientists as well as politicians in the Western world have been preoccupied with discussing the consequences of deindustrialization since the 1970s, the inhabitants of Kiruna have continued their cohabitation with LKAB (Granås, 2012, p. 125). Unlike many other places that were established during Scandinavia's early ascend into modernity, which were guided by an initial wave of industrialization and urbanization, Kiruna has always been exposed to large-scale industrial activities.

Despite this dark image of Kiruna, it is frequently known as Sweden's space capital due to its connection with space technology and satellite data (Ministry of Enterprise, 2008). The clear sky, northern lights, proximity to the North Pole and large empty territories made the city suitable to host space activities. Several space-related institutions are located there; the European Space and Sounding Rocket Range (ESRANGE), the Swedish Institute of Space Physics (IRF), the European Incoherent Scatter Scientific Association (EISCAT), Luleå University of Technology's (LTU), Division of Space Technology and Rymdgymnasiet (a secondary school with a space science focus). Kiruna also hosts a station for the European Space Tracking (ESTRACK) network. This global space town has 'activities that develop the national and international cooperation and attendance in the space town of Kiruna – within trade and industry, research and education' (Ministry of Enterprise, 2008).

The mining of iron ore in the town illustrates new and old industrialization processes, based on exploitation of natural resources, that still take place in different parts of Northern Europe today, similar examples include Kirkenes in Norway (Sejersen, 2010) or Greenland (Viken et al., 2008). In 2010, the nominal value of world mineral production was nearly four times higher than it had

been in 2002 – growth in value during this period has been significantly greater than growth in world gross domestic product. Between 2000 and 2010 the change in production value in Sweden constituted 275.5% (International Council of Mining and Metals, 2010). By the end of the 20th century, the rising global price of iron had driven the mining company to extend the mine underneath the existing town. Presently the ore is mined over one kilometre (1.365 km) below surface level. The process started in 2004, when the Kiruna municipality received an unassuming one-page letter from the state-controlled mining company LKAB that informed the municipality and the community about increased mine subsidence. This was allegedly caused by earlier mining activities; the same letter informed the municipality of LKAB's future plans for extensive mining activities which will mine the ore body extended underneath the town (Nilsson, 2009, p. 35). The ore body in Kiruna is about four km long and extends to an estimated depth of two km. Nearly one billion tons of iron has been mined so far and at current production volumes, existing ore reserves will ensure production until about 2016 (Organisation for Economic Co-operation and Development, 2010). A higher production rate would require a more rapid rate of vertical mining. The extent of the ore body is such that "future mining will affect part of the city of Kiruna due to the fissuring of the ground" (Organisation for Economic Co-operation and Development, 2010). In order to extract more iron ore, digging deeper into a nearby mountain was necessary. To avoid several unintended consequences like the fracturing and deformation of ground sitting beneath thousands of apartments, the City Hall, the main church and other vital buildings it was decided to relocate the city four km away.

Dependency in Company Towns

Some parts of the local community are excited about the new Kiruna, but also there was a lot of critique about the process. Some people envision a future of Kiruna without the mining company LKAB as the driving force. Other industries, such as the high-tech and tourism, have grown over decades, but town life is still noticeably affected by the presence of LKAB. The local economy and the municipality are dependent on the prosperous development of this mining company. "LKAB manages the mine, provides work opportunities, and some of Kiruna's inhabitants have become very wealthy from it," says anthropologist Viktoria Walldin. "The mine is the reason they are all there." ("Kiruna: How to Move a Town," 2014). About a quarter of the inhabitants in the

municipality are directly employed by LKAB – that gives the company a powerful position. The discovery of iron ore and the mining company are the main reasons Kiruna exists as a town.

Spatial Objects Embedded With Meaning and Memory

From an anthropological point of view, there is a major concern that people in Kiruna are dependent on old memories. It is hard to find a way to both respect the memories and take care of the people who have been living in limbo in this city for over a decade ("Kiruna: How to Move a Town," 2014). The past is visible everywhere, not only from formal commemorative or heritage sites, but also in spaces that have been repurposed for other use (Shanken, 2002; Wheeler, 2014). The town–inhabitant relationship is presented by explanations charged with rationality, connected to a positioning of the town within a network of locations where it becomes decentred. It does not mean a detachment from place, but a rationally based proximity that goes hand in hand with an openness to that of engaging in 'intimate' relationships with other places in the rural surroundings (Granås, 2012). The relationship is emphasized through an appreciation for town qualities that "nurtures a rural mindscape within an urban context"; moreover, "emotional relationship is constructed to rural places and areas that surround the town" (Granås, 2012, p. 136).

The dependency on the mining company does not allow the local community to have its own decision, it would prefer to leave the city grid and the town as it is now, but with some improvements. The case with New Orleans shows that even though the decision to move the city was obvious, the local authorities decided not to move it but to rebuild at the high risk that allowed avoiding many possible socio-economic problems, including those connected with memory.

Site

The area is flat treeless tundra formed by prehistoric glaciers and held frozen for nine months of the year by ground frost (Scieszka & Smith, 2012). The lower-lying east is dominated by boreal forest. Over 530,000 hectares of countryside are protected in the form of national parks, nature conservation areas and animal sanctuaries ("Kiruna kommun," 2014). In May, it becomes a landscape of lakes and ponds formed by the snow water. There are about 6,000 lakes within Kiruna municipal district, and six rivers: Torne, Kalix, Rautas, Vittangi, Lainio and Könkämä ("Kiruna kommun," 2014).

The city is built near the lake Luossajärvi with outflow to the Luossajoki. Kiirunavaara is an iron ore mine that is the town's primary economic resource. Luossavaara is a former mine and now used as a skiing slope. The land north of Kurravaara is roadless, uninhabited, partly barren and partly birch forest, up to the Norwegian and Finnish borders at Treriksröset. Around 15 kilometres east of Kiruna is a group of villages at the Torne River, the most famous is Jukkasjärvi because of an Ice Hotel built in winter, attracting tourists from all over the world. The city itself is located at the E10 road connecting Luleå with Norway. There is an airport – Kiruna flygplats. There are rail connections from Stockholm and Narvik – one of the Scandinavian freight-intensive lines.

Layout

The layout of Kiruna is fragmented and has low-density. The streets follow the contours of the topography in an irregular pattern to slow down cold winds. The main street concentrates commercial and public buildings – the city is developed around this commercial core. The layout of the territory is characterized by diversity. A variety of sites with individual identities is interconnected by main road that weave around the natural and manmade topography (see Fig. 4.14). Bicycle paths go along most of the streets. The town is small, but bigger than other company towns on the North. Kiruna is the biggest city in Kiruna municipality and the second largest municipality in the world after Australia (Persson, 2015).

Figure 4.14. The Layout of Streets

Architecture/ Planning Response

The architects Per Olof Hallman and Gustaf Wickman were appointed to design the city by Hjalmar Lundbohm. Hallman's plan was officially accepted on April 1900, and the construction of the city started (Scieszka & Smith, 2012). Kiruna was to be built near the iron ore mines with then innovative consideration of geographic and climatic factors. Being built on a hill, winter temperatures are milder in comparison with other winter towns. Norway, Russia and Finland also had a profound effect on architecture of Kiruna – public and private buildings feature different styles.

The city itself stands out as a "significant social experiment of the early 20th century" (Nuttall, 2005, p. 1095). Kiruna's planner engaged some of leading architects that time to build both private and public buildings, following English garden city movements. Transportation, housing, education and the city planning in general were adapted to harsh arctic climatic realities and needs of people.

> "Kiruna is largely a functionalist city, with many modernist building from the 1950s, 1960s, and 1970s, although a number of significant, prewar, wooden houses remain. […] There are also a considerable number of public buildings and domestic dwellings in Kiruna built in the classicizing style of the 1920s, as well as single family houses by the renowned Swedish architect Folke Zettervall (1862-1955)" (Nuttall, 2005, p. 1095).

Despite its small size, the sprawling and unfocused city is difficult to navigate, but the new Kiruna plan is supposed to foster community and activity (see p. 65). Many of the town's earliest structures, such as a clock tower and the Kiruna church, will be moved. Narrower streets to protect pedestrians from the wind will go around a core town square that will serve as the focal point for culture festivals. Residential units will be concentrated in apartments along streets situated on an east-west side. Mostly, the planners of the future town wanted to inject a new sense of culture into what has long been a cold, mining settlement that is not very successful to attract tourists with its gender imbalance as young women move away.

Fig. 4.15. The map of Kiruna (Made on the base of OpenMaps)

INSTITUTIONAL ARCHITECTURE

1 KIRUNA CHURCH (sw. KIRUNA KYRKA) (see Fig. 4.16 and p. 50)

2 CITY HALL (sw. STADSHUSET) (see Fig. 4.17 and p. 51)

3 HOTELS (see Fig. 4.18 and p. 52)

4 SPORT FACILITIES (see Fig. 4.19 and p. 53)

5 RESEARCH / EDUCATION (see Fig. 4.20 and p. 54)

Fig. 4.16. Kiruna Church

Fig. 4.17. City Hall

Fig. 4.18. Scandic Hotel

Fig. 4.20. Raketskolan (Photo by Robin Ramstad)

Fig. 4.19. Sport Hall

1 KIRUNA CHURCH (sw. KIRUNA KYRKA)

Fig. 4.21. Kiruna Church sketch

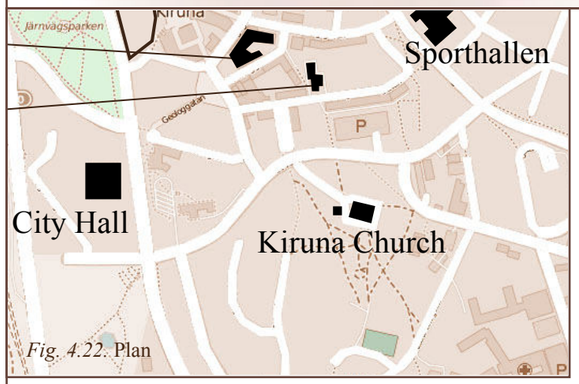


Fig. 4.22. Plan

Fig. 4.23. Kiruna Church

Fig. 4.24. Kiruna Chapel

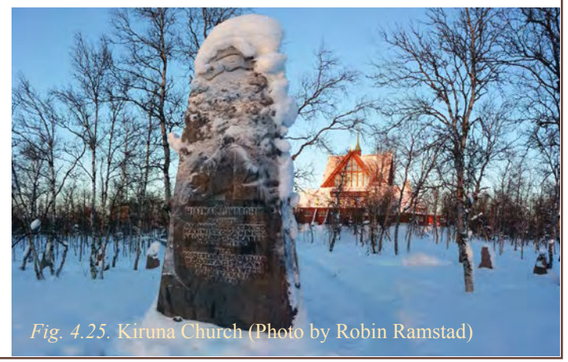


Fig. 4.25. Kiruna Church (Photo by Robin Ramstad)

Kiruna Church has a dominant position on the hill in a park, surrounded by Church Park with trees consisting mainly of birch and mountain ash. A low wall of granite, inside which a crematorium and associated memorial are located, also surrounds the park. The Church has a square shaped plan and built in Gothic Revival style (Scieszka & Smith, 2012). It is one of the largest wooden buildings, the roof structure consists of two prisms each end finishes with large stained glass window.

The complex consists of two buildings – the church building and the tower. The church (see Fig. 4.23) was built between 1909 and 1912 under the supervision of Bengt Lundren, LKAB's construction manager in Kiruna with active participation of architect Gustav Wickman and managing director Hjalmar Lundbohm ("Kiruna kirka," n.d.). The complex is built in neo-gothic style. Some of predecessors of this style in Kiruna date from the 13th century. In France, it was a dominated style for formal buildings and one of the earliest gothic cathedrals Archbishop of Bourges has five names. It was a realisation of the Gothic ideas about vast open space and it is the only one cathedral with five doorways on the west side (Kiruna Tindningen Nr. 4/94). The architect of the church also wanted to accentuate that the church has five names – he enlarged the triangular space above the portal similarly to the Gothic portals of the cathedral in Bourges. The sculptor Christer Eriksson created the guilded bronze sculptures on the slopes of the roof that remind of Dutch Cathedral St. Jan in Hertogenbosch. The sculptures represent people in different states of mind: inspiration, ecstasy, despair, shyness, pride, devotion, reliance, meditation, sadness, sorrow, love and humility ("Kiruna kirka," n.d.). Christian Eriksson has also made the carved relief over the church door that is a gift of Tuolluvaara Gruvaktiebolag. It created an unusual combination incorporated into facades of ancient architectural styles and decorative motives.

The bell tower was built first (see Fig. 4.24). It is made of a frame construction which time the chamber is supported by twelve nearly 20 metre high masts. The masts came via Narvik from Russian forests in the White Sea. The bell tower was inaugurated on Good Friday 1907. The complex includes the parish house that was built and designed by architect Istvan Porozlay in 1972, and the vicar home of 1913 located northwest of the church on the other side Gruvvägen.

The interior features national romanticism and the altar is in the Art Nouveau style. Flooring material of the church is wooden. Kiruna Church has had two organs since the inauguration. The current one was completed in 1957. The church was nominated the most beautiful building in Sweden in 2001. It will be affected by deformed ground, but going to be preserved and moved to a new location.

2 CITY HALL (sw. STADSHUSET)

Fig. 4.26. City Hall sketch

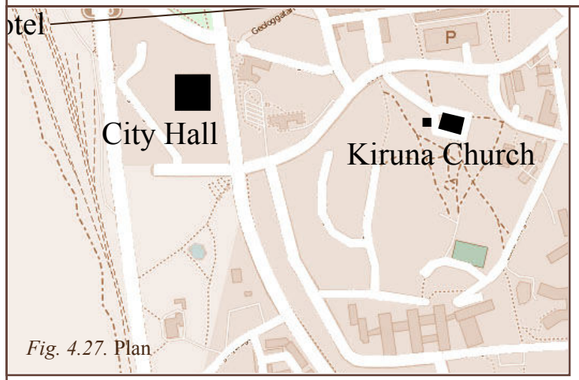


Fig. 4.27. Plan

Fig. 4.28. City Hall

Fig. 4.29. Sculpture "Sami Culture"

Fig. 4.30. City Hall Proposal (http://aasarchitecture.com/2013/09/henning-larsen-architects-wins-kiruna-city-hall-competition)

The city hall is outstanding example of a 1960's public building with its characteristic shape and bell tower. Its unique geographical location, atypical expression with simple shapes and scale and a balances asymmetry was built at the time that was characterized by "optimism and self-reliance". It has a gigantic proportions and always been a key building for inhabitants (Scieszka & Smith, 2012). City Hall's location contributes to the socio-historical value of the building – it is situated with a view at the open pit between LKAB's office towers and the main town centre of Kiruna (see Fig. 4.27).

Kiruna Town hall was designed by the architect Arturvon Schmalensee. It was referred as an "igloo" with its low entrance leading to a large open hall with windows placed on the top of this atrium. The construction of the City Hall begun in 1959 and it was ready for inauguration in 1963. It represents four floor above a full-sized excavated cellar. The walls of the open hall are made of hand-made Dutch brick, handrails are of American pine and the floor is an Italian stone mosaic.

The tower was made by sculptor Bror Marklund that was an openwork clock tower in cast-iron, bronze and decorated with figures, dials and bells. By placing the tower on the top of the building, the architect Schmalensee followed the old European traditions – both city halls in Stockholm and Västerås have bell-towers, but the tradition itself is much older than these 20th century buildings. The oldest remaining tower in Belgium is since 1187. Later, the towers on the buildings became the symbol of the wealth and freedom of the citizens – the market halls were often build with towers on the top and later clock-towers were added to town halls. Moreover, the material chosen for the tower were a symbol of industry in the town. The sculptures on the top symbolize the interplay between nature and culture – there is an anvil, an eagle, a wolf, a Sami, a miner, and a man walking in a storm. The building even won an architectural prize in 1964 being considered as Sweden's most beautiful building.

The architect meant the city hall to function as a meeting place for the townspeople, he was inspired by the city hall in Stockholm. Today the hall is used by the public mostly for the exhibitions and events. There is a big collection of art inside the building – sculptures, paintings, photos, the big physical model of Kiruna, and the permanent exhibition about the moving of the town including future projects and a touch screen with a 3d interactive model. One of the most noticeable sculptures is "Sami culture, tradition and everyday life" (see Fig. 4.29). The art craftsman Lars Levi Sunna created the artwork from curly-grained birch, a birch burr and reindeer horn in 1968. It shows a shaman drum between mountain tops that bears Sami symbols. There is the sun rhomboid with a holy white reindeer at the centre and four Sami deities – the wind god, the god of fertility, the frost man, and the god of hunting (Persson, 2015). The lower part symbolizes the everyday existence with a human in the middle.

Despite the significance of the building, unique structure and unusual design, due to the falling ground, the City Hall will not be preserved. It is also hard to move the whole structure that would require the demolition of several blocks of housing just to get it through. Instead, the parts of the building will be moved, for example, the clock-tower will be places next to the new city hall that will be built on the other side of the city in the new downtown by around 2018 (see Fig. 4.30). Known as Kristallen, it is designed to let in as much light as possible that will be appreciated during dark winter months ("Kiruna City Hall," 2014).

3 HOTELS

Fig. 4.31. Scandic Hotel sketch

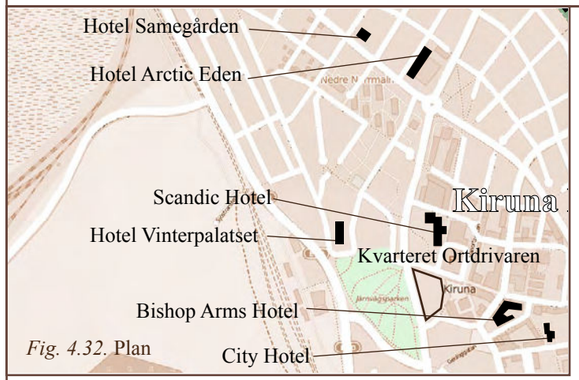


Fig. 4.32. Plan

Fig. 4.33. Scandic Hotel

Fig. 4.34. Vinterpalatset Hotel

Fig. 4.35. Arctic Eden Hotel

Kiruna has quite a few places to stay for visitors, although some of them will be pulled down due to transformations of the city (see Fig. 4.32). The rates are pretty high, as in other parts of Swedish Lapland.

The biggest hotel is Scandic Ferrum (see Fig. 4.33). It is located 8 kilometres from Kiruna Airport and 3 kilometres to the train station, 60 kilometres from Kebnekaise Mountain and 1.5 kilometres from the Kiruna ski slopes. The building is old, in a style of Swedish architecture, has 171 suits, garage and outdoor parking. The hotel is able to host conferences for up to 135 people.

Other hotels are smaller, Hotel Vinterpalatset (see Fig. 4.34), Arctic Eden (see Fig. 4.35), Hotel Samegården (see Fig. 4.36), Hotel City (see Fig. 4.37), Hotel Vinterpalatset And Stf Hostel Kiruna are located within city's borders. Máttaráhkká Northern Light Lodge is located away from the city but also serves to host tourists. There is also alternative type of accommodation – Camp Ripan (see Fig. 4.38). It has places to pitch a tent, plus more than 80 self-catering cabins that are arranged in rows and decorated like hotels rooms with interiors inspired by the local culture. There is a parking space, restaurant with local food, a building with spa and its own gym, saunas and pools. The "mid-night sun trail" goes a bit further from Camp Ripan. The main building was renovated and expanded by MAF Architects in 2008 (see Fig. 4.38). Its design was inspired by the image of the mining town. Material such as magnetite, steel and wood were used consistently throughout the building. There is a "northern lights" room designed with special attention to interior and exterior lighting in order not to interfere with the views of aurora during the winter season.

Fig. 4.36. Hotel Samegården

Fig. 4.37. Hotel City

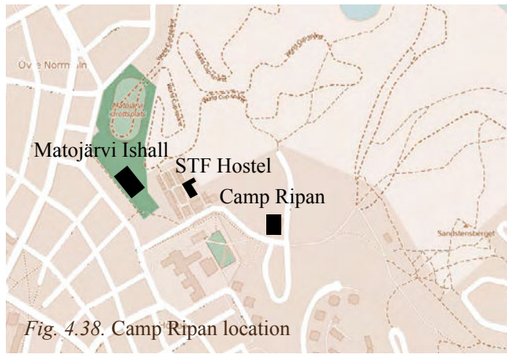


Fig. 4.38. Camp Ripan location

Fig. 4.39. Camp Ripan by MAF (source: http://www.maf-ark.se/en/Rita_Projekt.aspx?id=49#1)

4 SPORT FACILITIES

Fig. 4.40. Sporthallen - Sports Centre

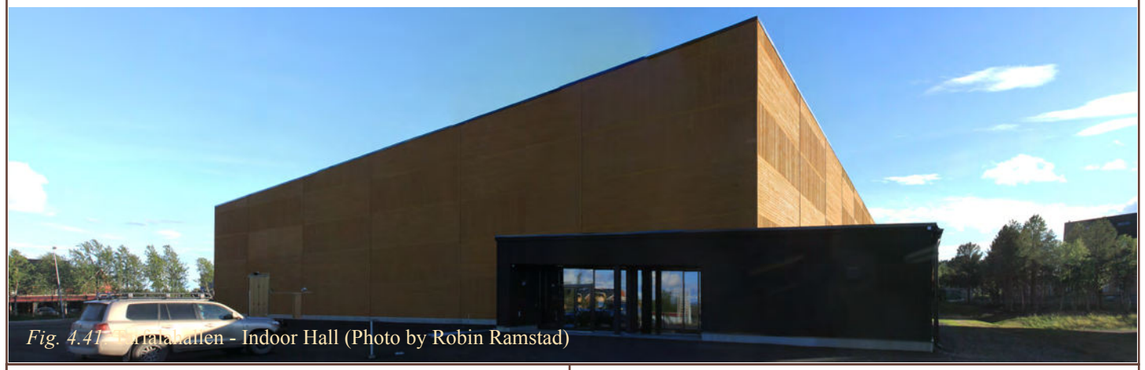


Fig. 4.41. Tarfalahallen - Indoor Hall (Photo by Robin Ramstad)

Fig. 4.42. Location of Matojärvi Ishall

Fig. 4.43. Matojärvi Ishall (Photo by Robin Ramstad)

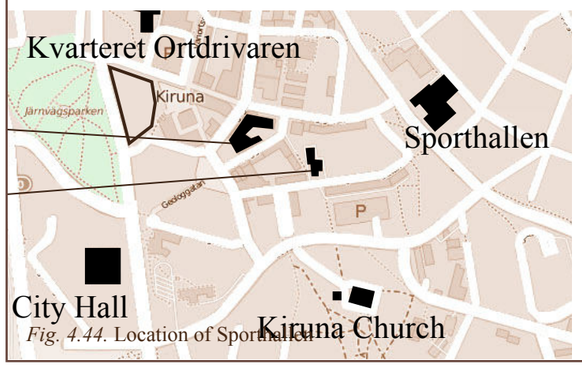


Fig. 4.44. Location of Sporthallen

Fig. 4.45. Sporthallen

Kiruna has a plenty of venues for playing sports. Sports are important in the Swedish way of life. Architecture was not a requirement for playing sports, it features functionalism and simplicity.

Matojärvi Ishall (see Fig. 4.43)

The hall is Sweden's oldest existing ice rink, it was built in 1957. It serves mainly for hockey. It has an ice storage bin, it is located in the Norrmalm neighbourhood next to Matojärvi sport stadium and Camp Ripan (see Fig. 4.42). Matojärvi also has a ski stadium, football pitch, athletic track, changing rooms and the secretariat.

Sporthallen (Sports Centre) (see Fig. 4.45)

This building is located in Kiruna city center, in the close proximity to main shopping area and Main Square (see Fig. 4.44). The sports hall provides opportunities for playing various sports (basketball, volleyball, tennis, football, curling, wrestling, boxing, powerlifting, athletics, archery, shooting etc.), games for education, workouts, competitions, fitness, recreation and sauna. Parking lots are located on the west side of the territory behind the building.

Tarfalahallen (Indoor hall) (see Fig. 4.47)

This indoor hall for football and athletics was built in December 2014 by the nearby newly built Raketskolan (Rocket school) in the southern part of Kiruna, the Lombolo neighbourhood (see Fig. 4.46). It houses field for seven-players teams in football, running track and spaces for various disciplines as indoor climbing, tennis, long jumps, etc. – there is a climbing wall, bleachers and serving. The gross area of the hall is 4,500 square meters. The hall will be inaugurated in autumn 2015.

Fig. 4.46. Location of Tarfalahallen

Fig. 4.47. Tarfalahallen (source: http://www.svt.se/nyheter/regionalt/norrbotten/kiruna-far-en-inomhushall)

Fig. 4.48. Tarfalahallen and Raketskolan (Photo by Robin Ramstad)

RESEARCH/EDUCATION

5a SWEDISH INSTITUTE OF SPACE PHYSICS (sw. IRF) (see Fig. 4.49 and p. 54)

5b ESRANGE (EUROPEAN SPACE AND SOUNDING ROCKET RANGE) (see Fg. 4.50 and p. 53)

Scientific research has always been a part of Kiruna, and began in the mountains with the Abisko Scientific Research Station (1903), and has since been complemented with the Institute of Space Physics (1957; see Fig. 4.49) and the Esrange Space Centre (1966; see Fig. 4.50) ("Kiruna kommun," 2014). Kiruna Practical Youth School (sw. Kiruna Praktiska Ungdomsskola) was one of the first vocational schools in Sweden started by Hjalmar Lundbohm in 1910. Kiruna is one of only five locations in Sweden offering the possibility to attend a Sami school – students are taught to read, write and speak Sami at the same time they learn about the Sami cultural heritage.

The area has unique features, including northern lights, an Arctic environment and the world's largest iron ore mine, so the research in Kiruna is concentrated around these. In addition to research, there are also programs and courses organized by Umeå University and Luleå University of Technology to pursue higher education ("Kiruna kommun," 2014). Luleå University of Technology has four campuses in the country. The space science campus is located in Kiruna, Luleå hosts the main campus, Skellefteå has wood technology and computer game engineering campus and Piteå has the Department of music and media campus.

New Rocket School (sw. Raketskolan) is one of Sweden's most modern schools (see Fig. 4.51). The school was inaugurated on January 11, 2013. The mine and space are the major sources of inspiration for the building. The building has the outline of a rocket. The architecture is based on five building blocks named by pedagogic, cultural, social, economic and ecological aspects. Premises and equipment supporting a modern pedagogy. The building's open spaces and large glass contributes to security and transparency. The large modern school building is a landmark for residential area and for the new Kiruna.

Fig. 4.49. Swedish Institute of Space Physics

Fig. 4.50. ESRANGE Space Centre (source: https://rexusscrapexperiment.wordpress.com/2014/06/15/esrange-space-center/)

Fig. 4.51. Raketskolan (Photo by Robin Ramstad)

5a SWEDISH INSTITUTE OF SPACE PHYSICS (sw. INSTITUTET FÖR RYMDFYSIK, IRF)

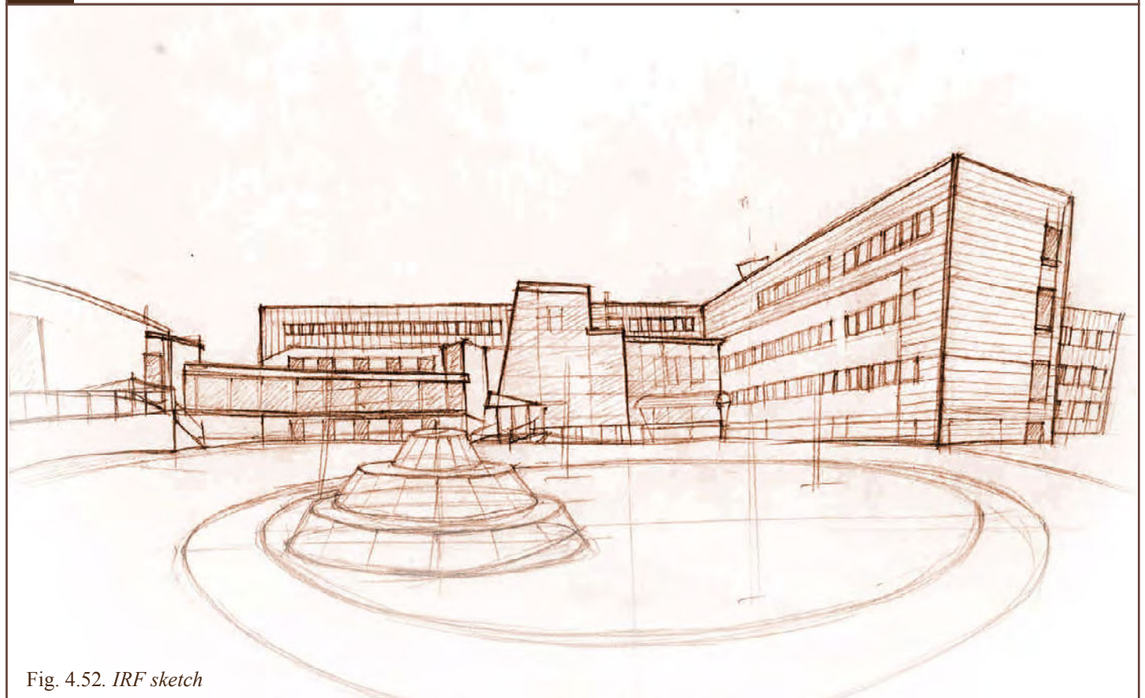


Fig. 4.52. *IRF sketch*

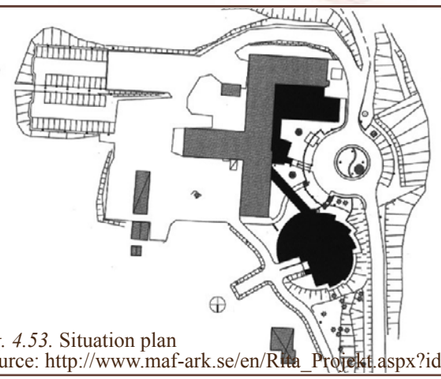


Fig. 4.53. Situation plan
(source: http://www.maf-ark.se/en/Rita_Projekt.aspx?id=44#1)

Fig. 4.54. IRF

Fig. 4.55. Courtyard of IRF

Fig. 4.56. Interior of IRF

The Swedish Institute of Space Physics (sw. Institutet för Rymdfysik/IRF) was founded by the Royal Swedish Academy of Science in 1957 to conduct experimental and theoretical basic research within space and atmospheric physics. In the beginning, it had another name – Kiruna Geophysical Observatory (KGO). IRF became a state agency in 1973. The head office is located in Kiruna, different activities of the institute take place also in Lund, Uppsala and Umeå. The building itself is modern, and located out of the city.

The research at IRF focuses on phenomena in the Earth's upper atmosphere, the ionosphere, and planetary magnetospheres ("Swedish Institute," 2012). The institute participates in several international satellite projects such as Cluster, Mars Express, SWARM, Bepi-Colombo, JUICE. Data from satellite instruments are analysed to understand the plasma-physical processes in the solar wind and around comets and planets.

Continuous measurements, such as of 'the geomagnetic field, optical aurora and ionospheric ionization (with ionosonde and riometers), atmospheric ozone content and infrasound waves of the magnetic field of the Earth, aurora, cosmic radio noise, ionospheric parameters', are made at IRF ("Swedish Institute," 2012). There are also special facilities to help with measurements and research, including library, mechanical workshops, laboratories, conference rooms, test facilities for space instruments and optical measurements, space simulation chambers, and observatory instruments.

The complex is located roughly 7 km east of the city (see Fig. 4.15). Four building extensions from the existing building were added to an existing building by MAF Architects in 2000. A new entrance building, classrooms and a new floor level was added to the existing structure, while the new satellite building including a cafeteria and library were constructed adjacent. The view to the west and Kiruna are significant in its ability to adapt to the terrain and the buildings structure ("IRF Kiruna," 2001). Taking into account Kiruna's lack of light most of the year, the facades are dominated by large glass windows allowing light to enter deep into the space of building.

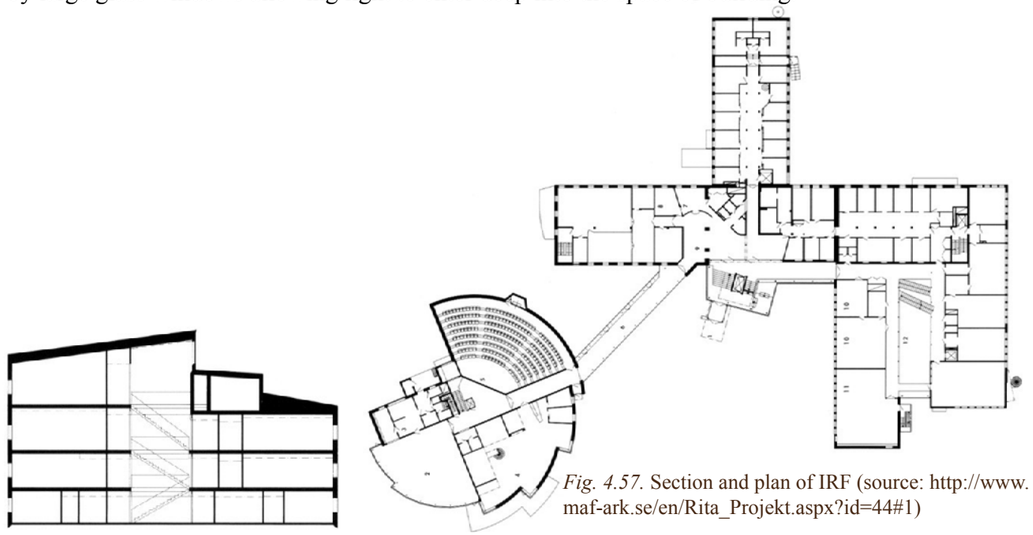


Fig. 4.57. Section and plan of IRF (source: http://www.maf-ark.se/en/Rita_Projekt.aspx?id=44#1)

5b ESRANGE SPACE CENTRE (EUROPEAN SPACE AND SOUNDING ROCKET RANGE)

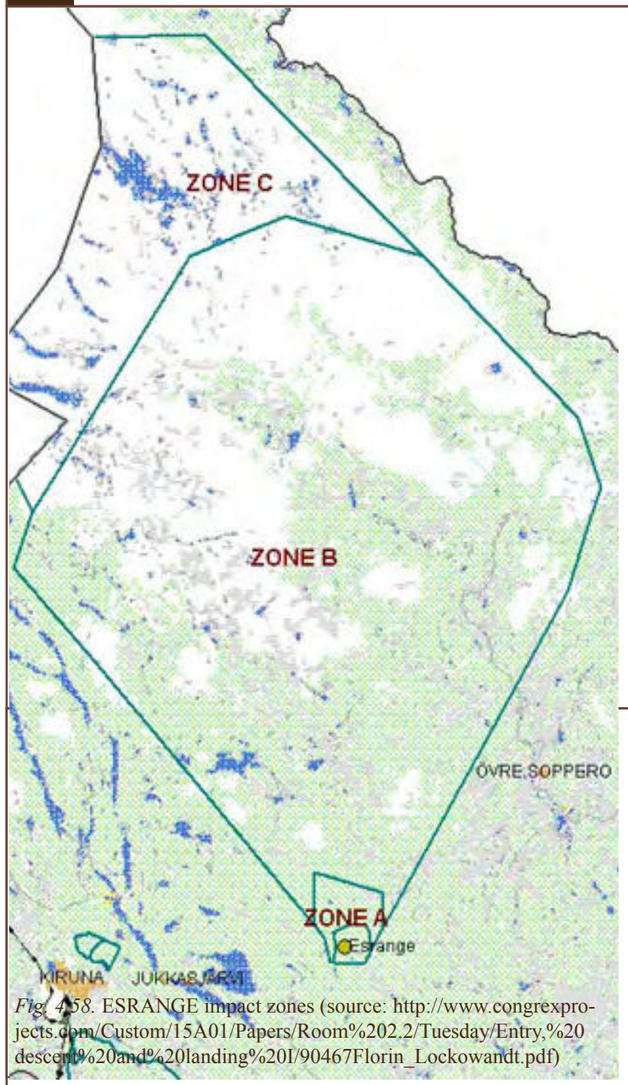


Fig. 4.58. ESRANGE impact zones (source: http://www.congrexprojects.com/Custom/15A01/Papers/Room%202.2/Tuesday/Entry,%20descent%20and%20landing%20I/90467Florin_Lockowandt.pdf)

Zone A, the impact area for boosters, can be extended when rockets with long-range boosters are launched.

Zones B and C are impact areas for second and third stages as well as payloads.

Zone C is not allowed for use during the period May 1 - September 15.

("Esrange Space Centre," 2015).

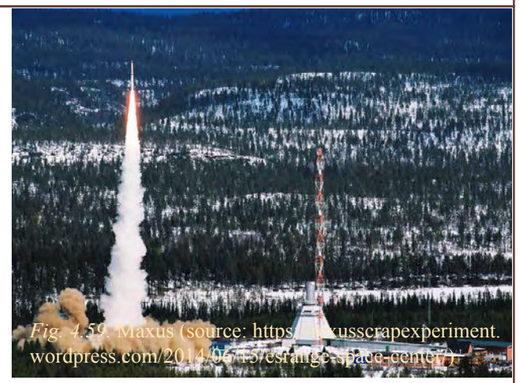


Fig. 4.59. Maxus (source: https://maxusscrapexperiment.wordpress.com/2014/06/15/esrange-space-center/)

Fig. 4.60. ESRANGE (source: http://www.swesecnews.se/esrange-space-center-valde-axis/)

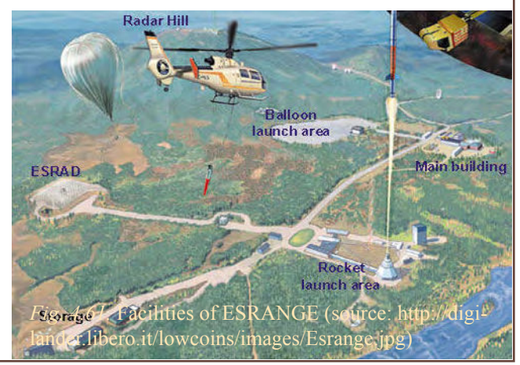


Fig. 4.61. Facilities of ESRANGE (source: http://digilander.libero.it/lowcoins/images/Esrange.jpg)

This rocket range and research centre is located 45km east of Kiruna. As the precursor to the modern European Space Agency (ESA), the ESRO (European Space Research Organisation) was founded by the European Space Research Organisation included Belgium, Denmark, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom in March 1964. ESRO was organised 'to establish a co-ordinated scientific programme for peaceful space research, combined with advanced research for technological development, and to support European industry in the member countries' ("Esrange Space Centre," 2015). Constructed by ESRO in 1964, the first launch of a rocket from ESRANGE took place on the 19th of November, 1966.

The location was caused by several factors – the area is sparsely populated and located under the nominal auroral oval, providing access for in-situ aeronomical experiments in a particularly interesting region. In addition, it has a minimal impact on the Sami people and the used areas for reindeer herding. The rocket impact area (A, see Figure 4.58) is located north of Esrange Space Centre in the Swedish tundra region ("Esrange Space Centre," 2015), covering 20 square km. This area is divided into three zones, A, B, and C, with a total area of 5,600 square km ("Esrange Space Centre," 2015).

Esrange is working with satellites and conduct space, atmospheric and weightless safety research through the launches of sounding rockets and stratospheric balloons, using radars and other terrestrial instruments. Since an agreement between the Swedish and Russian governments in 2010, its northern location makes ESRANGE a particularly suitable launch site for long-duration circumpolar balloon flights. More than 500 sounding rockets and 550 stratospheric balloons have been launched from Esrange Space Centre. This gives the Centre a leading position on the world map of launching facilities, moreover they provide the largest civilian ground station for satellites in the world ("Esrange Space Centre," 2015).

RESIDENTIAL ARCHITECTURE

1 ORTDRIVAREN BLOCK (sw. KVARTERET ORTDRIVAREN) (see Fig. 4.62 and p. 58)

As in any typical mining town, residential architecture consists of two different types of housing – individual dwellings and multi-family complexes such as apartment houses. The mining-related housing is different from housing found in non-mining communities within any particular region. One of the most common distinguished features is that it is usually standardized and is not highly ornamented – in Kiruna, it varies from small cottages to the largest and longest attached row houses.

Swedish functionalism emphasizes practical utility. Historically, it often involves standardization as a way to lower cost and ensue the high level of safety and hygiene that embodies in multi-family housing of the city (see Fig. 4.63). Individual dwellings feature larger variety, with the primary use of wood and other natural material (see Fig. 4.64). Colours also differ, that actually make the cityscape more diverse and works well for in-between seasons and winter – bright colours such as red, yellow, brown and green stand out housing from other buildings and grey environment (see Fig. 4.60). Newly built houses feature simplicity and practicality with the use of natural materials.

Despite these typical features, there are quite a few interesting examples that reflect Swedish culture in a more modern way. One of those examples is Kvarteret Ortdrivaren – renowned neighbourhood by Swedish architect Ralph Erskine (see Fig. 4.62).

Fig. 4.62. Ortdrivaren Block

Fig. 4.63. Multi-Family houses

Fig. 4.65. The view on the downtown from Luossavaara (Photo by Robin Ramstad)

Fig. 4.64. Individual dwellings

1 ORTDRIVAREN BLOCK (sw. KVARTERET ORTDRIVAREN)

Fig. 4.66. Ortdrivaren Block sketch

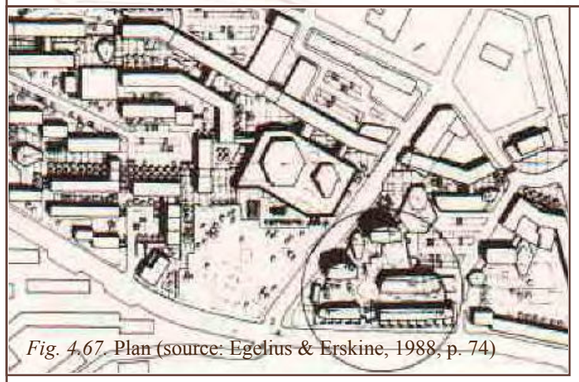


Fig. 4.67. Plan (source: Egelius & Erskine, 1988, p. 74)

Fig. 4.68. Ortdrivaren Towers

Fig. 4.69. Ortdrivaren Block

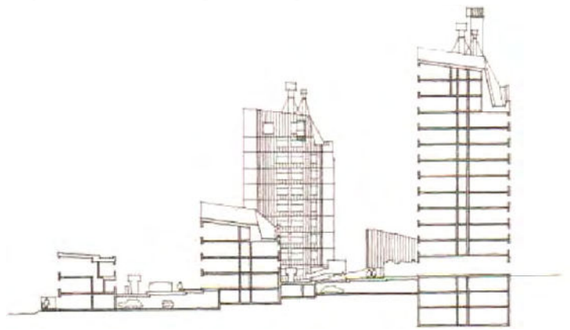
Fig. 4.70. Ortdrivaren Block

The earlier settlement of Kiruna consisted of wooden houses that were demolished in 1960s and higher concrete building were built on their places. One of the cites of this change was the Ortdrivaren neighbourhood. Ortdrivaren housing is an architecturally renowned neighbourhood with buildings designed by Ralph Erskine in 1961. The neighbourhood is located at the intersection of Lars Janssonsgatan, Hjalmar Lundbom Road and Victory Street Svanberg. Quarter Ortdrivaren is centrally located in the city and includes homes, offices, shops and a chapel. The neighbourhood was included in a proposal for a large part of the centre. The round ring shows the pad built (see Fig. 4.67). The block consists of several distinctive buildings – there are two tower blocks called snuffbox, spittoon and two residential longhouses called snuff and the Berlin Wall.

Erskine took into account both the functional and the aesthetic when he designed the neighbourhood. Climatic-responsive design is one of the main features of the housing complex – energy savings and less snow removal by short distances between buildings. Erskine managed to give a new shape for the modern architecture by functional analysis (Egelius & Erskine, 1988, p. 74). The tall buildings of ten and thirteen storeys has an angled roof shape sloped towards the north to reduce shadowing for buildings behind. Tall houses are advantageous at this latitude – during winter low sun latitude it is often shadowy and dark in apartments of conventionally constructed buildings. The buildings Årnäs streamlined to prevent unwanted turbulence and heat loss, pockets on the roof prevent snow to fall on the sidewalk below. The small balconies are detached from the housing body to reduce heat loss and were thought to act as natural freezers during winter (Egelius & Erskine, 1988, p. 74). The homes are built with concrete frame, concrete planks outside and insulated with polystyrene foam (Egelius & Erskine, 1988, p. 76). Under the houses and courtyards is a garage (see Fig. 4.71). The roof of garage are designed as a large play structure for winter and summer use. The buildings are coloured red, brown, terracotta, ochre and yellow.

Erskine saw the design of the house as “a game between the heated, soft rounded bodies in warm colors, with small balconies refrigerator, and the cold blocky concrete parts that are more articulate, whether they are of thermal” (Egelius & Erskine, 1988, p. 76).

The apartments in the neighbourhood still are the most expensive ones despite the upcoming changes, as project manager says. The houses are going to be demolished due the relocation of the city what, according to the opinion of local residents, means the big loss for the city.



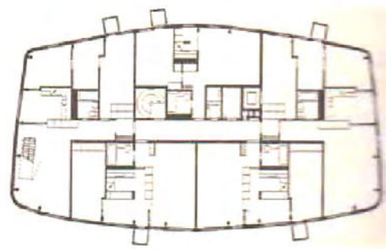


Fig. 4.71. Section and plan (source: Egelius & Erskine, 1988, p. 76).

MINING LANDSCAPE

1 MINE CITY PARK (sw. GRUVSTADSPARK) (see p. 60)

There are a few mountains in the city of Kiruna – Kiirunavaara, Luossavaara and Tuolluvaara. All of them have been a part in mining industry. The damaging effect of mining is clearly visible on all three.

The Kiirunavaara mine is located on the west of the city and together with the mountain forms the most noticeable topographic features of an area (see Fig. 4.72). Kiruna got its name due to the mountain Kiirunavaara that was named after Rock Ptarmigan. The mine of this mountain contains one of the largest and richest bodies of iron ore in the world. Norrbotten County is one of the first regions of heavy industry in Sweden due to the mining area in Kiruna and Malmberget, and the iron port and steel mill in Luleå. On the outside, the mine consists of an open pit area and benches on the side of the mountain, remains of the early open-pit mining techniques. The later underground mining is revealed by a line series of depressions, progressing in the direction of the town centre as the mining operations continue. Railway lines run along the benches, permitting the removal of ore and waste rock. Every level in the mine has been designed to increase capacity and efficiency. The rail haulage levels are the most efficient in the world. The ore body of Kiruna was formed around 1.6 billion years ago "following intense volcanic activity with the precipitation of iron-rich solutions on to a syenite porphyry footwall" ("Kiruna Iron Ore Mine," 2010). There are eight production areas in the mine with a group of ore passes and ventilation systems for each.

Luossavaara is another separate mountain and the site of a now-inactive iron ore mine formerly operated by LKAB. Today it has ski lifts and several slopes, as well as a hiking path called the Midnight Sun Trail (sw. Midnattsolstigen) (see Fig. 4.73).

Tuolluvaara mountain is located about four kilometres east of the centre of Kiruna, the district of the same name is located on the mountain's southeastern side (see Fig. 4.74). Several apartment buildings in Tuolluvaara were demolished in the early 1990s and replaced with new houses. Iron ore deposits in Tuolluvaara was discovered in 1897 by Hjalmar Lundbohm and open pit mining began in 1903 by the then newly formed Tuolluvaara mining limited liability company. Tuolluvaara mine was closed in the early 1980s due to high operating costs. The round head frame is Sweden's second highest existing headframe (highest head frame is in Aitik), together with the Garpenberg S, both of which are 76 metres high.

The Kiruna cemetery, inaugurated in summer 1901, is located 2.5 kilometres from the city centre in the direction of Tuolluvaara. A chapel was built in 1908 according to Gustaf Wickman drawings.

Fig. 4.72. Kiirunavaara

Fig. 4.73. Luossavaara

Fig. 4.74. Tuolluvaara mining towers (Photo by Robin Ramstad)

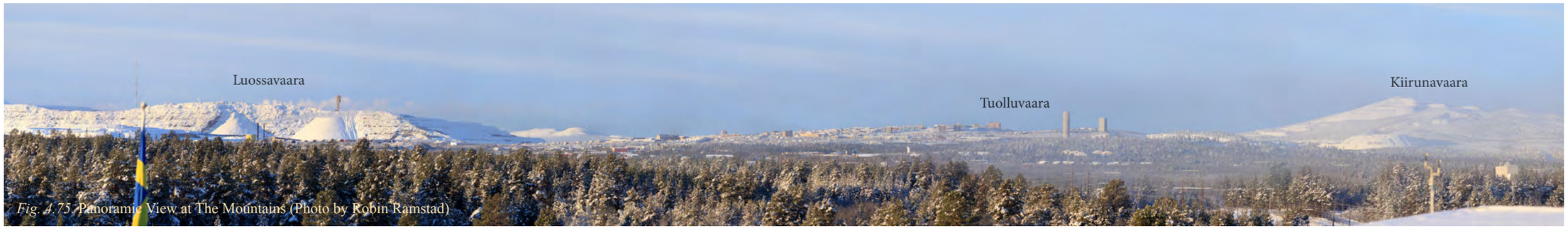


Fig. 4.75. Panoramic View at The Mountains (Photo by Robin Ramstad)

1 MINE CITY PARK (sw. GRUVSTADSPARK)

Fig. 4.76. Mine City Park Transformations (source: http://www.kiruna.se/stadsomvandling/City-in-transformation/Mine-City-Park/)

Fig. 4.77. Mine City Park

Fig. 4.78. Mine City Park

Fig. 4.79. Mine City Park

Once you approach the current beginning of the park, you see the metal structure with a few signs with the same meaning in different languages. The English one says (see Fig. 4.79):

> "Welcome to Gruvstadsparken – a moving oasis between the mine and the community. The park is being developed by LKAB and Kiruna Municipality and will grow gradually towards the town as ground deformation due to mining progresses."

It is a joint project between the mining company and the city municipality. The main idea that inhabitants will still have access to the area even after the houses and buildings that are affected by deforming ground will be gone. The whole area includes about 3000 residential units, and a total 450 000 square metres of public and commercial premises, about 6000 people will be affected and must gradually move ("Kiruna Stadsomvandling," 2015). The Mine City Park is starting on the border between the city and the mine Kiirunavaara that allows creating a buffer zone in between so nobody can live next to the industrial site. As the production of the mine will grow and mining resources will be explored further, the park will move closer towards the city.

The first part of the Mine City Park opened in February 2011. The area around Iggesundsparken next to Hjalmar Lundbohmsvägen between the company hotel and the town hall was the first to become park area. This section was inaugurated during the autumn of 2011 ("Mine City Park," n.d.). An agreement regarding the second part of the Mine City Park was signed by Kiruna municipality and LKAB on June 14, 2014 ("Kiruna Stadsomvandling," 2015). The park is supposed to be a year-round recreational area with playgrounds and some memorials. Mayor of Kiruna Kristina Zakrisson and LKAB president Lars-Eric Aaro unveiled the park's new work of art with motifs of Borg Mesch Photographs from the early 1900s ("Kiruna Stadsomvandling," 2015). The two works of art on slices of graphic concrete picture "Söderberg family" from 1899 with a first child in Kiruna and "On Annual Hotel Staircase" from 1902 with Hjalmar Lundbohmsvägen in the centre ("Kiruna Stadsomvandling," 2015).

The first phase of the new park will affect 313 apartments, hotels, several Inkwell, Engineering villa, Sheriff Accommodation, Kiruna's oldest residential B5, Railway Station, Kiruna City Hall (Bläckhorn, Ingenjörsvillan, Länsmansbostaden, Kirunas äldsta bostadshus B5, Järnvägstationen, Kiruna Stadshus) and part of the road E10. The first homes affected are in the area of Ullspiran.

> "Buildings, roads and street lighting will be removed while existing vegetation such as lawns and trees are going to be preserved. […] Even if the first fractures to appear are small, the fracture zone is fenced off. Even this demarcation can be arranged in different ways to create new value, e.g. with overlook points where people can look in toward the deformations and mining area. The land inside the demarcation zone is thus former parkland and the way land is affected and reclaimed by natural vegetation can be observed." ("Mine City Park," n.d.)

Benches, barbecue and wood storage are adjacent. The winter ski trails and a BMX track are planned for the coming years, playground and ice rink in winter are on the stage of consideration.

ATTRACTIONS/FESTIVALS

1 SEASONAL ACTIVITIES

PUBLIC SPACES **(see p. 62)**

ICE HOTEL IN JUKKASJÄRVI (SW. ISHOTELLET I JUKKASJÄRVI) **(see p. 63)**

WINTER ACTIVITIES

2 EPHEMERAL CULTURAL PROGRAMS

KIRUNA SUMMER FESTIVAL (sw. KIRUNAFESTIVALEN)

KIRUNA SNOW FESTIVAL (sw. SNÖFESTIVALEN)

Permanent and temporal nature is inherent to different activities of Kiruna and the municipality. One of the major tourist's attraction related to the arctic region is the northern lights in winter and midnight sun in summer (Appendix A, Appendix B). Kiruna is one of the main directions for tourists who want to explore rural Swedish Lapland and the city "that needs to be moved". The tourists also fly to Kiruna to visit the Icehotel in Jukkasjärvi about 17 km east. It is easy to arrange many types of outdoor activities including hiking, boat trips on the lakes, canoeing and fishing in summer, and dogsledding, Sami tours, ice fishing, skiing, snowmobiling and snowshoeing during winter. There are also organized tours to the Kiirunavaara mine during summer in both English and Swedish. It is an experience about mining environment where exhibitions, slide shows and videos showing mining and urban transformation of the city. The mining museum showcases the mine's 100-year old history.

There are two annual festivals in the city – Kirunafestivalen in June and Snöfestivalen in January. Kiruna Summer Festival takes place in Camp Ripan during the weekend in the end of June to celebrate the midnight sun with music, entertainments and activities for every age. Kiruna Snow Festival is held over in the last week of January. The festival started in 1985, since then, it is an annual event with such activities as reindeer dancing, snowmobiling jumping and the Swedish Snow Sculpting Championship attracting both tourists and artists.

About 95 km northwest of Kiruna there is Abisko National park on the border with Norway. This is a destination for hiking with its protected wilderness, big skies and shimmering lakes. In addition, it is a place for downhill skiing in winter both backcountry and the resort. Abisko also is claimed as the best place to see the northern lights in Sweden – due to high latitude, remoting location from city's light pollution and mountains around that drag clouds away at night to clear up the sky to spot aurora.

Fig. 4.80. View from Luosavaara mountain on the City and Midnight Sun

Fig. 4.81. Ice Hotel and Northern Lights (source: http://www.amalgame.co.uk/en/lhotel-de-glace-a-jukkasjarv/)

Fig. 4.82. Abisko National Park (Photo by Mate Kerenyi)

1a PUBLIC SPACES

Fig. 4.83. Central City Square

Fig. 4.84. Public Square

Fig. 4.85. Playground

Fig. 4.86. Central City Square

Fig. 4.87. Public Space in front of houses

Truly public spaces in the city are hard to find, there are enough squares, parks and spaces that appear public but not very well organised and, more importantly, not filled with people. The main city square (see Fig. 4.83) is located behind Scandic Hotel and Kvarteret Ortdrivaren. It is surrounded by multi-family houses and such commercial buildings as tourist offices, souvenir shops, cafes. The filling of the square is traditional – there are benches, some flower containers, garbage bins and trees. Right behind Ortdrivaren neighbourhood there is a space used for little outdoor markets. The little shopping street starts on the south side of the main square where the clocks-sculpture is located. The street leads up to the south-east towards to other hotels, popular cafes and bars of the city. There are ones of biggest grocery and beverage stores located nearby. A diffident respect for other people's privacy is typical in public spaces of Kiruna.

"The right to walk" inherent for Scandinavia makes every space and territory public. Forested land is held largely by individuals and corporations; the state owns less than 5 percent. Access to nature is assured by allemansrätten, the freedom to roam. This is a right granted by the Constitution of Sweden that makes it permissible to access almost all private property and certain public land for recreation and exercise (Mortazavi, 1997). It is also permitted to pick the wild berries, flowers, mushrooms but not to hunt. Landowners are not permitted to barricade their lands. Strict building codes protect the quality of accessible spaces by public. Possibly, the right to roam attracts people to go outside of the city.

1b ICE HOTEL (Jukkasjärvi) (sw. ISHOTELLET I JUKKASJÄRVI)

Fig. 4.88. Ice Hotel (source: http://marianacertan1995.blogspot.ca/2013/01/top-10-constructii-de-gheata-din-lume.html)

Fig. 4.89. Torne River and the storage

Fig. 4.90. Ice Hotel inside (Photo by Robin Ramstad)

Fig. 4.91. Jukkasjärvi

Fig. 4.92. Sami Camp

Ice Hotel is located in Jukkasjärvi, a locality situated in Kiruna Municipality over two miles east of Kiruna. The village got its first permanent inhabitants in the 1600s, now consisting of 548 inhabitants in 2010. The wooden church is the oldest building in Jukkasjärvi with the famous wooden carved altarpiece, a triptych by Bror Hjorth. The outdoor Sami Camp located next to the church hosts grazing reindeers, exhibitions, handicraft shop, Café Sàmpi and some information about Sàmi culture and traditions (see Fig. 4.92). The village is a popular tourist accommodation during the winter months due the Ice Hotel. Icehotel is the world's first ice hotel and one of the biggest tourist attractions in Northern Europe. In 1989, visiting Japanese ice artists created an exhibition of ice art. The artist Jannot Derid, inspired by the Japanese artists, constructed igloo named Artic Hall in 1990. Since then, a structure has been rebuilt on the shore of the Torne River every year and the concept has expanded gradually to the present day hotel.

The Ice Hotel is famous for its size. It changes its architecture every year because it needs to be built from scratch – the hotel exists only between December and April, everything melts away and returns to the Torne River once spring comes. The complex includes the bar, church, rooms and suites for over 100 guests. Each spring, around March, Icehotel harvests tons of ice from the frozen Torne River and stores it in a nearby production hall with room for over 10,000 short tons of ice and 30,000 short tons of snow ("Ice Hotel," n.d.). The ice is used for creating Icebar designs and ice glasses, while the snow is used for construction of a strong structure for the building. About 1,000 short tons of what is left is used to build the next Icehotel ("Ice Hotel," n.d.).

The Icehotel in Jukkasjärvi opens in steps. The first step opens in the beginning of December. For each week, another section of the hotel opens up for visitors and guests until the beginning of January. At this time, the entire construction is completed.

The area features various activities during the year according to a cycle of the Torne River. In winter, the ice from the river becomes a subject of art, design and architecture. During summer, the landscape becomes a lush river valley due the midnight sun and water. There are opportunities to do whitewater rafting, hiking, fishing and surfing the whole day since the sun glows for approximately one hundred days and nights.

Fig. 4.93. Sami Camp

Fig. 4.94. Church in Jukkasjärvi

Relocation of the City

Since the idea of relocation of the city centre was published in 2004, Kiruna got widespread media attention. The relocation would be made gradually over the next decade. A new location was proposed on January 2007 – northwest to the foot of the Luossavaara Mountain, by the lake of Luossajärvi ("Framtida placeringen av Kiruna klar," 2010). In 2006, as part of the comprehensive municipal planning process, a questionnaire survey was conducted to collect views from the inhabitants about the Kiruna's urban environment. In the participatory process, people were asked to comment on future developments and protection of existing architectural heritage (Nilsson, 2009). According to the surveys, the most important components were the church, the city hall and the view of the surroundings. The mining company LKAB hired architecture and infrastructure consultants to elaborate a spatial planning proposal called "The New Kiruna," in the same week, first sketches for the layout of the new part of the town became available. The proposal pictured 'a townscape with winding streets along the mountain slopes, a tropical garden and an indoor skiing hill under a glass roof' that was attractive to both locals and potential tourists (Nilsson, 2009, p. 43). In 2008, more precise and official sketches were posted.

A number of meetings were held by authorities to manage the difficult conditions of the city's relocation. Several published documents, with an emphasis of the national interests in the resources and heritage that can potentially be affected by the ground deformation, were produced and widely circulated. The number of people involved in a project of this scale exceeds the thousands and includes interdisciplinary teams of city planners, architects, landscape designers, biologists, urban designers, civil engineers, demolition and construction experts, builders, and even social anthropologists. The Municipal Counsel and LKAB are the biggest actors in the city, but there was an opposition between them as well – the local planning administration suggested that the parts of the town should be relocated to the east of the present location, but LKAB wanted it to be on the north-west (Nilsson, 2009, p. 47).

In June 2010, the municipal council eventually decided that the town is going to be moved on the east, towards Tuolluvaara, instead of the proposed northwestern location ("Framtida placeringen av Kiruna klar," 2010). White Arkitekter AB based in Stockholm won the contract to design the new city, which envisages a denser city centre with a greater focus on sustainability, pedestrians and public transport than automobiles ("Kiruna: How to move a town," 2014). Most

of the buildings in Kiruna will be torn down and rebuilt at the target site. However, the Kiruna city hall, and the Kiruna Church as architecturally highly significant buildings will be physically moved. The move will require an extremely flat and level road tens of metres wide and will be extremely slow.

> "The first phase of the masterplan is a new civic square, which will be home to Kiruna's historic clock tower as well as a new travel centre (2018), facilitating connections between old and new, and a new city hall, The Crystal, designed by Henning Larsen Architects (2016). Phase 1 will also comprise a new library (2019) and swimming pool (2016) and by 2021 the Kiruna Church will be carefully demounted and reconstructed on the new site." ("Kiruna," 2015)

Fig. 4.95. The relocation plan (Image Courtesy of White. Retrieved August 14, 2015 from http://www.archdaily.com/433499/architects-to-relocate-entire-city-s-downtown-two-miles-over)

The article on BBC news of March 2014 published the collected interviews from local planners and authorities that reveal the concerns and scepticism about the present situation, especially the issue with housing. "It's a new situation and no-one really knows how to handle it," says Yvel Sievertsson, urban transformation officer at LKAB. "We have hundreds of people working on the issue alone, including researchers at the University of Stockholm. The goal is to have the new city centre ready before we start to move everyone over, and then to move everyone

at once in one or two stages, to impact people's businesses as little as possible." ("Kiruna: How to Move a Town," 2014). It is interesting that new housing has to be built in the existing town, before the construction of the new city will start, as Kiruna needs up to 800 more living spaces for the workers coming to build the new city.

The scale of the plans rises anxiety over whether the project will be completed on schedule. "The municipality and LKAB think we can build this entire city in four or five years, but it's impossible," says construction manager Peter Johansson. "It's more of a vision than a truth that the building will begin this spring. We should have started building in 2009 or 2010." ("Kiruna: How to Move a Town," 2014). LKAB has already spent about $612 million on the project to March 2014 and has earmarked two times more money for the remaining transformation, though it says it is impossible to estimate the total cost of the project.

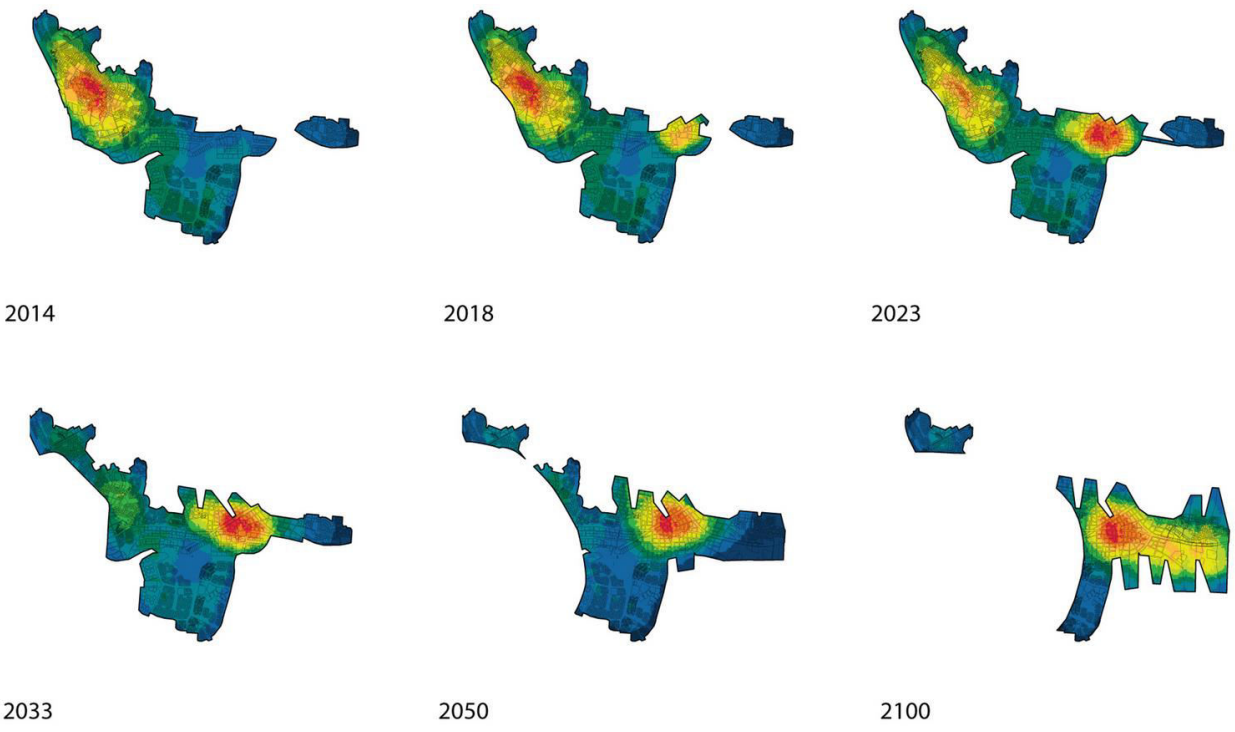


Fig. 4.96. Relocation of Kiruna (Image Courtesy of White. Retrieved August 14, 2015 from http://www.white.se/en/project/268-kiruna/slideshow?slide=6)

On March 26, 2013 was a historic decision – the City Council approved the continuation of the work for the winning proposal “Kiruna 4-ever” in Kiruna Municipality. A new detailed comprehensive plan for Kiruna of future land use was adopted by the City Council in September 01, 2014 and it became final in October 01, 2014 (“Fördjupad översiktsplan Kiruna c 2014,” 2015).

> “White Arkitekter have monitored all the housing lettings in nearby cities over a period of years, and then "tagged" the Kiruna houses with each asset they possess, such as space, gardens, and proximity to the city centre.” (“Kiruna: How to move a town,” 2014).

According to the description of future Kiruna by White Arkitekter vision,

> “A denser more intelligent plan, equipped with meeting places and cultural amenities, will promote public life, broadening the male dominated demographic of Kiruna’s past, allowing a more diverse community to settle and thrive. Kiruna has the fastest-growing rate of small businesses in Sweden and after years of population decline it now has a huge demand for new housing. New housing developments will be built in addition to the 3000 homes that will be relocated.” (“Kiruna,” 2015)

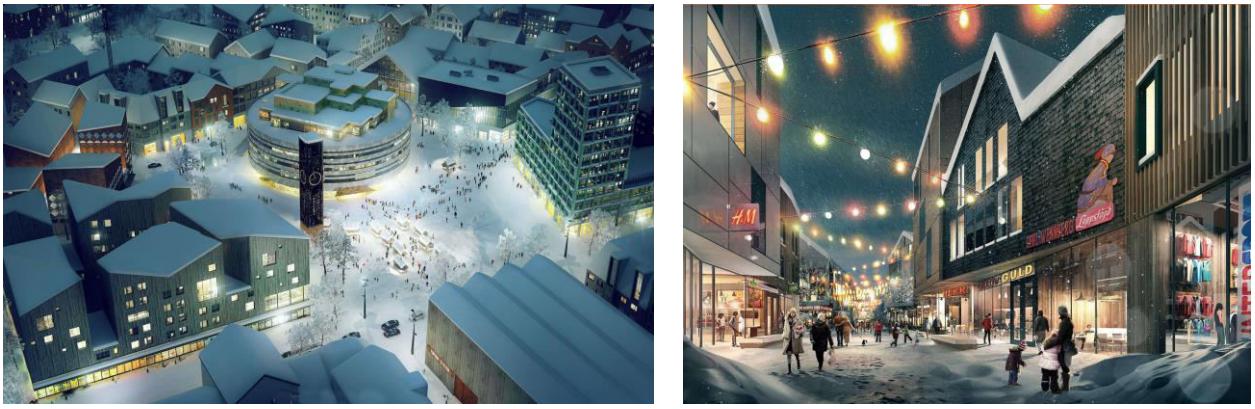


Fig. 4.97. Proposed city centre and shopping street (Image Courtesy of White. Retrieved August 14, 2015 from http://www.white.se/en/project/268-kiruna)

Chapter 5: Final Thoughts

The key objective of this research was to articulate principles and strategies that can be implemented in specific contexts to promote the livability of single-industry towns and to enable people to enjoy winter in harsh climate conditions. The project investigated two towns built to address the problems deriving from their harsh climatic conditions. Despite the fact that Fermont and Kiruna are located in different countries and even continents, they do share certain features typical for both mining towns and settlements located on the North. The towns vary a lot in terms of population and the territory they occupy; they are both considered small – although Kiruna's population is eight times bigger than Fermont. The mining industry is the reason why these towns exist, and they are noticeably affected by the presence of mining companies.

The research project report comprises five chapters. Introductory material was presented in the first chapter. The wide range of approaches was discussed in the second chapter. The third chapter showed the methodology used for the work. Case studies were presented and discussed in the fourth chapter. This last chapter presents final thoughts and conclusions that were drawn following analysis of Fermont and Kiruna. The work answers such questions, as "What concepts and methods have been developed to optimize the connection between people and nature in cold climate? How can they be applied in any context? What can be done to increase and diversify activity in "winter cities" to both retain and attract people? How can one transform existing perceptions and activities to celebrate winter life?"

Mining towns seem temporary, artificial or ephemeral, but even though they were built instantly, they often have rich histories (Francaviglia, Sheppard, Robertson). There are "basic" issues that need to be taken into account in the planning of mining towns on the North. Most important is the relation of the town form to the local climate. In both case studies, the concept of climatic responsive design was the driving force. In case of Fermont, it was about both planning and architecture, where the windscreen itself is a structure that protects people from harsh realities of the climate, namely the north winds. In Kiruna, the climatic-responsive design is related principally to the architecture – the Ortdrivaren neighbourhood designed by Ralph Erskine envisioned and included many principles for protection. Here the form of the town responds to climate in both winter and summer seasons as emphasized by Pressman.

The density of housing differs in both towns, although they are both low-density settlements (vertically as well as horizontally) in comparison with more conventional big towns. In Fermont, most of the houses have two levels, and the height does not exceed five and half floors in the Wall. The vertical density in Kiruna is higher, there is a lot of multi-family housing. Most of the houses have four levels above the ground; the highest being the Ortdrivaren towers, which have eleven floors. The horizontal layout of Fermont is denser than in Kiruna; this is largely due the idea of concentration the housing in the leeward side of the Wall, whereas Kiruna's planning did not pursue the same principle. The situation with housing is difficult in Kiruna where an apartment is hard to find, either to rent or to purchase. The project manager, Maria Persson, stated that there are not enough places in hotels either – they cannot host all tourists coming in winter to see the northern lights, and in summer for hiking tours and midnight sun.

The population is currently declining because LKAB does not provide enough jobs – the price of iron ore is falling and the company has to lay off a number of the workers. Nevertheless, the new city plan considers this condition and is going to provide more housing for 1000 people as well as more hotels. Other solutions include the creation of temporal housing, flexible organisation of apartments, long-stay hotels or condo-hotels that are getting popular nowadays. By buying an apartment in such a hotel, the owner can live there for a certain number of days during the year; on other days it works as a hotel depending on the occupancy rate that also gives an extra income.

The width of the streets in Kiruna is larger than in Fermont, which indicates that the settlements were planned according to different principles. The amenities offered to inhabitants in Fermont are concentrated in the one windscreen structure, contrary to Kiruna, where commercial architecture and facilities are scattered all other the city and most of shops are located within one street in the city centre. This is partly due to the different size of the two towns– Kiruna is bigger than Fermont in both the population and density. Both towns needed all the usual services, including religious. Another story is about quality of culture and recreation amenities – they are certainly not developed and promoted.

Both cities provide a poor public life. The public space in both towns lack proper definition and not enough importance has been given to the design of the public domain in most of mining towns, including those of Fermont and Kiruna. It might be connected with the cultural specifics of

the regions. There is a lack of programming and no collective culture in the city of Kiruna. In case with Fermont, an attempt was made to create a public space in the form of the long promenade both inside the Wall, and along its south side. It works perfectly during winter, providing the shelter from harsh climate and community space, but the same concept cannot be applied in summer season. Moreover, the inhabitants are not encouraged to leave the Wall that does not promote the public life and interaction with outdoor activities. As emphasized by Norman Pressman and other researchers, overprotection from nature is not desirable, but this is how it feels in case of Fermont – people are overprotected from harsh climatic conditions instead of highlighting the areas with unique natural characteristics. In Kiruna, the inhabitants are not obviously engaged in public life and interaction with the city. The lack of public spaces is noticeable – only a few parks and a small city centre. The streets are empty most time of the day; the bicycle paths are not in use most of the time and it seems that there is almost nothing to do in the city. The street life is non-existent. Although houses are full of people, they are not encouraged to leave them. The same situation happens with parks – there are no visitors in the Mine City Park. The park simply consists of a green space and a few benches that do not invite people to sit on them. The attempt to create memorials by installing concrete blocks with photos is not a fully developed idea – the memorials look lonely in this empty context. The main square does not have a distinctive identity, the borders are not clear thus the feeling of the public place is lost.

Both mining towns need more festivals and/or organized public events. Festivals should aim to appeal tourists that can attract additional funds outside of the capital, enabling more festivals without spending public funds. Taking into account that these regions are dark for most of winter they need more interaction with different states of light. The size of Kiruna and Fermont limits financial options – they are small towns, but still there is a lot to learn from, for example, Montreal in Quebec – a sprawling metropolis of three million people. One of good examples is festival *Montréal en Lumière*, an installation on the Place-Des-Arts site that involves lights and colours, and people can engage with those shapes. Another festival *Nuit Blanche* also allows inhabitants to enjoy winter. It is a music festival with different events and installations to interact, which is a great reason for people to leave the house and have fun even in harsh climatic conditions. Good collective spaces need to be truly public, to belong to everybody, have no social status, should include housing and have a vibration. The public space must be multifunctional. To reach this goal, it needs to have a great variety of activities. A good example is *Place Jacques-Cartier* in Montreal,

Quebec. The place provides many activities around the square, as well as the square itself is a vibrant place filled with people at all times of the day all year round.

The case of Kiruna addresses the idea of place-promotion and place-branding. There is a need for government and for private sector to maintain competitiveness globally. Kiruna needs other industries and opportunities for the future development in order to be at least partially independent from the mining company LKAB. The situation of moving the town has already resulted in widespread attention in the media, and by scientists and researchers. The further strategy for promotion can learn from examples of aspiring science and technology parks, such as Cyberjaya in Malaysia. The place-making strategies there was situated as 'a new 'global hub' for information communication technology and multimedia industries, framed as an extremely 'sticky place'' (Brooker, 2013, p. 1). There is a need to create a place within a global economic system where local skills, infrastructure and capital attract new visitors and make research and development. Such field as space physics can also be an important part of economy and attract investors and visitors.

Some socio-cultural issues should be addressed to improve the general quality of life. The industry and transitional workers affect indigenous people and the local population. In case with Fermont, the problem of security has vanished due to the big flow in and out of transitional workers. The people in Kiruna are also affected by upcoming change of the relocation of the city. The protected natural areas, such as reindeer pastures, are affected by the relocation and the sound of mining as well as deformed ground and waste material affect those areas and Sami people. Another question is about privacy in such small cities. A problem is that there is little privacy in small places. There is no place to hide for the person who stands out with some vision of life that others do not support. In contrast, it enhances the psychological sense of community in such places – the sense of similarity to others, interdependence with others, and the feeling that inhabitants are the part of one large stable structure.

A major issue is the lack of identity in Kiruna – some houses that have the same physical appearance have a sign on the wall in order to distinguish one from another. There should be other methods to express the diversity of the neighbourhood, the samples can be taken even from the town itself – using special colours, more diverse architectural forms and decor, or, providing interesting landscape design around houses. In some areas of the city, plain facades and residential

houses oppress the area. It may seem normal for any city to have such districts, but it is more noticeable in smaller towns.

The mining industry has been having a profound effect on the landscape of both towns. Kiruna is located exactly on a deposit of iron ore and the extraction of this has changed surrounding mountains forever leaving the big scars after the industrial processes. The open pit in Fermont is located slightly out of city, but the changes are visible from the town – instead of existing Mont Wright mountain there is a big open pit and excessive material creating another hill nearby. Although the mining landscape in those towns looks depressing, it defines the image of the towns. This manmade topography is a powerful tool for the perception. The modern expression of landscape architecture simply does not exist in those towns. Nonetheless, there is no thoughtful extraction or creation that envision some design of outdoor public spaces, landmarks or structures to achieve aesthetic, environmental or social-behavioral qualities. It is pure functionality for the most convenient extraction of resources to increase the amount and speed of production. Those 'scars' can be played around. Opening the old mine for different events will attract people and diversify activities in the towns. An inspiration can be an abandoned Louisville limestone mine that was turned into an underground Bike Park.

Kiruna's transformations may help to solve issues arising. But if there was no such "problem" of iron ore that should be extracted underneath the town, would the city ever developed its new "plan, equipped with meeting places and cultural amenities" to "promote public life, broadening the male dominated demographic of Kiruna's past, allowing a more diverse community to settle and thrive"? ("Kiruna," 2015). Hopefully, the relocation of the city and the new plan will eventually be implied to provide the city of Kiruna with truly public spaces. It makes think about Fermont and what can be a trigger that will help to solve the problems mentioned above.

This study of two northern towns, one in Canada and one in Sweden, points to some basic questions about the making of a new settlement in harsh climatic conditions. What makes a town in the sub-arctic/arctic different from one built in the south? How does one address the social circumstances of a society that is finite and isolated from the rest of the nation? What are the tools necessary to make such places lively and inspiring for the youth? In fact, can a planner really deal with these issues in a constructive way?

Only some minor aspects of the design of the town can be controlled by planners. The form of the town and the housing types are certainly controllable by the planners and the architects. The social make-up of the town is beyond the jurisdiction of the professionals. So are the economic realities of governing the town. The mining company inevitably acts as the "big brother". It controls, directly or indirectly most aspects of the life of the citizens who are the company's workers. Good cities grow organically and democratically so that they can respond to the desiderata of the people. The isolated mining town is an urban aberration. It is often an instant creation of a corporate body rather than a collectivity. Architecture and urban design cannot fix problems that are economic, structural, social, *etc.*, but can help to mitigate negative conditions.

The first question, namely that of their relationship between the form of the town and the harsh environment in which it sits is the within the domain of the planners. The morphology of the town can conceivably be determined independently of the social circumstances. Both towns demonstrated that the formal premise of the town could be defined in terms of the environment, of the topography, and of the climate, although Kiruna does not addresses these issues to such extent as Fermont, mostly resembling a model of a suburban environment. The lesson from Kiruna is very limited in terms of urban planning, but more extensive from attractions the region offers, while Fermont more noticeably demonstrates that the planning solution for a town "on high latitudes" can and must be different from the towns in the south. It remains a compelling lesson in urban design.

References

Bloom, N. D. (2001). *Suburban alchemy: 1960s new towns and the transformation of the American dream*. Columbus: Ohio State University Press.

Clay, G. R., & Daniel, T. C. (2000). Scenic landscape assessment: the effects of land management jurisdiction on public perception of scenic beauty. *Landscape and Urban Planning, 49*(1-2), 1-13.

Coates, K., & Morrison, W. R. (1992). *The forgotten North: A history of Canada's provincial Norths*. Toronto: J. Lorimer.

Egelius, M., & Erskine, R. (1988). *Ralph Erskine, arkitekt*. Stockholm: Byggförlaget.

Environmental impact of mining. (n.d.). *In Wikipedia.* Retrieved April 2, 2015 from https://en.wikipedia.org/wiki/Environmental_impact_of_mining

Erell, E., Pearlmutter, D., & Williamson, T. J. (2011). *Urban microclimate: Designing the spaces between buildings*. London: Earthscan.

Fermont. (2012). Commission de toponymie Quebec. Retrieved April 28, 2015 from http://www.toponymie.gouv.qc.ca/ct/ToposWeb/fiche.aspx?no_seq=22297

Fishman, R. (1977). *Urban utopias in the twentieth century: Ebenezer Howard, Frank Lloyd Wright, and Le Corbusier*. New York: Basic Books.

Fördjupad översiktsplan Kiruna c 2014. (June 16, 2015). Kiruna kommun. Retrieved August 17, 2015 from http://www.kiruna.se/Kommun/Bygga-bo-miljo/Oversiktsplaner/Fordjupad-oversiktsplan-KirunaC-2013/

Framtida placeringen av Kiruna klar. (June 21, 2010). *Dagens Nyheter.* Retrieved April 19, 2015 from http://www.dn.se/nyheter/sverige/framtida-placeringen-av-kiruna-klar/ 19.04.2015.

Francaviglia, R. V. (1997). *Hard places: Reading the landscape of America's historic mining districts*. Iowa City: University of Iowa Press.

Gouvernement du Québec. (2011a). *Rapport sur les activités minières au Québec – 2011*.

Gouvernement du Quebec. (2011b). *Plan Nord, Faire le nord ensemble, Le chantier d'une generation*. Québec: Ministère des Ressources naturelles et de la Faune.

Granås, B. (June 01, 2012). Ambiguous place meanings: living with the industrially marked town in Kiruna, Sweden. *Geografiska Annaler: Series B, Human Geography, 94,* 2, 125-139.

Hall, P. G., & Ward, C. (1998). *Sociable cities: the legacy of Ebenezer Howard.* New York: Wiley.

Hough, M. (1995). *Cities and natural process*. London: Routledge.

Holston, J. (1989). *The modernist city: an anthropological critique of Brasilia*. Chicago: University of Chicago Press.

Ice Hotel (Jukkasjärvi). (n.d.). *In Wikipedia.* Retrieved August 2, 2015 from https://en.wikipedia.org/wiki/Icehotel_(Jukkasjärvi)

International Council of Mining and Metals. (October 2012). The role of mining in national economies. Retrieved March 17, 2015 from http://www.icmm.com/document/4440

IRF Kiruna. (2001). MAF Arkitektkontor. Retrieved August 07, 2015 from http://www.maf-ark.se/Projects_information.aspx?id=49

Jakle, J. A. (1987). *The visual elements of landscape*. Amherst: University of Massachusetts Press.

Kiruna. (2015). White Arkitekter. Retrieved August 18, 2015 from http://www.white.se/en/project/268-kiruna

Kiruna City Hall. (December 15, 2014). Routes North. Independent travel guide to Sweden. Retrieved July 06, 2015 from http://www.routesnorth.com/kiruna/kiruna-see-and-do/kiruna-city-hall/

Kiruna in Swedish Lapland. (n.d.). Retrieved July 22, 2015 from http://www.kirunalapland.se/en/

Kiruna Iron Ore Mine, Sweden (2010). Retrieved March 10, 2015 from http://www.mining-technology.com/projects/kiruna/

Kiruna: How to Move a Town Two Miles East. (March 06, 2014). *BBC News*. Retrieved April 18, 2015 from http://www.bbc.com/news/magazine-26447507

Kiruna kirka. (n.d.). Retrieved July 7, 2015 from http://www.jukkasjarviforsamling.se/page.asp?SiteID=15&lang=1&PageID=01379

Kiruna kommun. (2015). Retrieved July 22, 2015 from http://www.kiruna.se/Kommun/

Lang, J. T. (2005). *Urban design: A typology of procedures and products*. Oxford: Elsevier/Architectural Press

Mine City Park. (n.d.). LKAB. Retrieved July 28, 2015 from http://www.lkab.com/en/Future/Urban-Transformations/How/Mine-City-Park/

Mining Facts. How can mining become more environmentally sustainable? Retrieved March 20, 2015 from http://www.miningfacts.org/Environment/How-can-mining-become-more-environmentally-sustainable/

Mortazavi, R. (January 01, 1997). The right of public access in Sweden. *Annals of Tourism Research, 24,* 3, 609-623.

Mont-Wright Mining Complex. ArcelorMittal Mines Canada (2013). Retrieved April 28, 2015 from http://www.arcelormittal.com/minescanada/en/about/operations/Mont_Wright.aspx

Manty, J., & Pressman, N. (1988). *Cities designed for winter.* Helsinki: Building Book Ltd.

Marsh, W. M. (2010). *Landscape planning: environmental applications* (5th ed.). New York: Wiley.

Ministry of Enterprise (2008). Press release. Retrieved January 18, 2015 from http://www.regeringen.se/sb/d/

Nilsson, B. (January 01, 2010). Ideology, environment and forced relocation: Kiruna - a town on the move. *European Urban and Regional Studies, 17,* 4, 433-442.

Nilsson, K. L. (2009). Place reinvention by real changed image: the case of Kiruna's spectacular make-over. In Nyseth, T., & Viken, A. (Eds.), *Place reinvention: Northern perspectives*. (pp. 33-51). Farnham, Surrey: Ashgate.

Norberg-Schulz, C. (1996). *Nightlands: Nordic building*. Cambridge, Mass: MIT Press.

Nuttall, M. (2005). *Encyclopedia of the Arctic*. New York: Routledge.

Official site of the town of Fermont. Retrieved July 28, 2015 from http://www.villedefermont.qc.ca/

Organisation for Economic Co-operation and Development. (2010). *OECD territorial reviews*. Paris: OECD.

Osborn, F. J., & Whittick, A. (1969). *The new towns: The answer to megalopolis*. London: Leonard Hill Books.

Paquette, L. (1984). *Fermont: Évaluation de la planification*. MA thesis, McGill University, Montreal.

Persson, M. Interview conducted on June 10, 2015.

Pressman, N. (2004). *Shaping cities for winter: climatic comfort and sustainable design.* Prince George, B.C.: Winter Cities Association.

Pressman, N. (1995). *Northern cityscape: Linking design to climate*. Yellowknife, NT: Winter Cities Association.

In Ratcliffe, J. A. (1960). *Physics of the upper atmosphere*. New York: Academic Press.

Resource towns. The Canadian Encyclopedia. Published 02.07.2006. Retrieved March 18, 2015 from http://www.thecanadianencyclopedia.ca/en/article/resource-towns/

Rice, E. (2008). *Building in the North*. Fairbanks: University of Alaska Press.

Robertson, D. (2010). *Hard as the rock itself: Place and identity in the American mining town*. Boulder, Colo: University Press of Colorado.

Scieszka, M. & Smith, D. (2012). *Nordic Exodus: Moving Kiruna.* Studio E.A.R.T.H.: University Strathclyde.

Sejersen, F. (December 01, 2010). Urbanization, Landscape Appropriation and Climate Change in Greenland. *Acta Borealia, 27,* 2, 167-188.

Shanken, A. M. (March 01, 2002). Planning Memory: Living Memorials in the United States during World War II. *The Art Bulletin, 84,* 1, 130-147.

Sheppard, A. (2007). Fermont: the making of a new town in the Canadian sub-arctic. Paper presented at the Architecture Symposium at the Ion Mincu School of Architecture and Urbanism, Bucharest.

Sheppard, A. Personal communication June - August 2015.

Simard, M., & Brisson, C. (January 25, 2013). L'industrie minière et le développement urbain en milieu nordique: l'exemple de Fermont au Québec. *Cybergeo.*

SSR Group official site. Esrange Space Centre. Retrieved July 26, 2015 from http://www.sscspace.com/launch-services-esrange-space-center

Statistics Canada (2012). Fermont, Quebec. Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. Retrieved July 25, 2015 from http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E

Statistics Sweden (February 19, 2015). *Population in the country, counties and municipalities on 31/12/2014 and Population Change in 2014.* Retrieved July 28, 2015 from http://www.scb.se/en_/Finding-statistics/Statistics-by-subject-area/Population/Population-composition/Population-statistics/Aktuell-Pong/25795/Yearly-statistics--Municipalities-Counties-and-the-whole-country/385423/

Stein, C. S. (1957). *Toward new towns for America.* Cambridge MA: MIT Press.

Swedish Institute of Space Physics. (May 31, 2012). Overview. Head Office, Kiruna. Retrieved July 29, 2015 from http://www.irf.se/Overview/?dbfile=About_Kiruna&dbsec=Administration&chosen=overview

Van, R. S., & Calthorpe, P. Ed. (2008). *Sustainable communities: A new design synthesis for cities, suburbs and towns*. Gabriola Island, BC, Canada: New Catalyst Books.

Van Der Ryn, S., & Cowan, S. (1996). *Ecological design*. Washington, D.C.: Island Press.

Viken, A., Granås, B., & Nyseth, T. (June 01, 2008). Kirkenes: An Industrial Site Reinvented as a Border Town. *Acta Borealia, 25,* 1, 22-44.

Welcoming winter. (February 10-12, 2005). Conference proceedings. Dalhousie Faculty of Architecture and Planning. Halifax, Nova Scotia, Canada. Retrieved May 2, 2015 from http://architectureandplanning.dal.ca/planning/research/conference/downloads/wc.pdf

Wheeler, R. (October 01, 2014). Mining memories in a rural community: Landscape, temporality and place identity. *Journal of Rural Studies, 36,* 22-32.

Wonders, W. C. (2003). *Canada's changing North*. Montreal, Que: McGill-Queen's University Press.

Zacharias, J. (2005). Generating urban lifestyle: the case of Hong Kong new-town design and local travel behaviour. *Journal of Urban Design*, 10(3), 371-386.

Appendix A. Midnight Sun

The midnight sun from Luossavaara Mountain in Kiruna, Sweden

The midnight sun is a natural phenomenon when there is no sunset during the day. Around the time of summer solstice, the sun stays up for 24 hours. During summer the Earth turns so that the North Pole becomes opposite of the sun and despite the fact that the planed is in constant move it stays lightened for a while. Due to the permanent sun, the local flora and fauna get a powerful boost of energy. The further north the longer is the period of the midnight sun. In Kiruna, the time of this sun is from the end of May until mid-July.

Polar night is an opposite experience during winter – a day does not have a sunrise. In the Southern Hemisphere it is opposite, there are Polar Nights when the Northern Hemisphere has Polar Days.

Appendix A. Northern Lights

Northern light above Kiruna, Sweden (Photo by Robin Ramstad)

Northern Lights is a common name for the Aurora Borealis in the Northern Hemisphere.

Atoms and molecules of gases included in its composition get excited in the collision of energetic particles from the plasma layer upper atmosphere. The emission of excited atoms in the visible range is observed as the aurora borealis. Since the ionization of charged particles is most effective at the end of the path of the particle and the density of the atmosphere decreases with height in accordance with the barometric formula, the height of the northern lights strongly depends on the parameters of a planet's atmosphere. The Earth with its complicated composition of the atmosphere red glow of oxygen observed at altitudes of 200-400 kilometres, and a joint glow of nitrogen and oxygen – at an altitude of about 110 kilometres (Ratcliffe, 1960). In addition, these factors contribute to a shape of auroras – fuzzy upper and abrupt lower boundaries.

Auroras occur in spring and autumn are much more likely than in the winter and summer. The peak incidence of falls in the period closest to the vernal and autumnal equinoxes. The Aurora releases massive amounts of energy during a short time. When viewed from Earth aurora appears as a general glow of the sky rapidly changing or moving rays, bands, crowns, and curtains. Duration of auroras is from tens of minutes to several days.