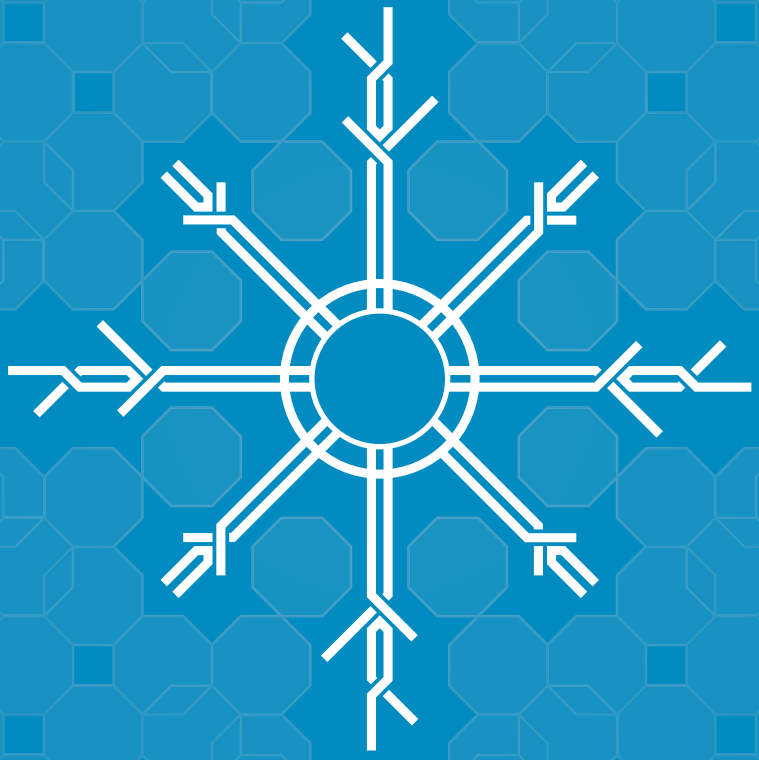
Snow Design from Lapland

Initiating Cooperation



Snow Design from Lapland – Initiating Cooperation

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Financier The European Regional Development Fund (ERDF)
Northern Finland subarea
Lapin Liitto

Printer Rovaniemen Painatuskeskus Oy
Rovaniemi, Finland

Publisher University of Lapland
Publications of the Faculty of Art and Design of
the University of Lapland
Series C. Overviews and Discussion 45. 2014
Snow Design from Lapland

ISBN 978-952-484-737-7
ISSN 1236-9616

Pdf ISBN 978-952-484-738-4

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Luminous Snow Design from Lapland

Snow, ice and winter are impressive phenomena. In Northern Finland we have always been able to enjoy the uniqueness and aesthetics of winter. We also know how to utilize the snow and ice in everyday life. Winter has been a good friend and an ally to us throughout the history. Changes in lifestyle have opened new opportunities to use winter elements in our favour and we have eagerly embraced them.

In the Lapland Snow Design project we have combined art and design expertise of the University of Lapland, Faculty of Art and Design with the Lapland University of Applied Sciences' cold climate engineering. We set a goal to develop a diverse application of snow and ice as art, design and architectural material. Together with the snow and ice construction and lighting design companies we developed technical and aesthetic visual innovations and production methods. We created competitive and innovative services based on design approach, which helps to utilize the Lapland's multi-disciplinary snow and ice expertise in various events and tourism services in the international forums.

In cooperation with the research and educational institutions, and the snow construction and design enterprises we have developed new, better quality and more efficient design and implementation methods for different types of snow and ice environments as well as marketing-related business concepts. We have utilized a wide range of user-centred design, service design, interactive ways of working with environmental and community art and the latest technical information. We use the research-based expertise of the higher educational institutions as well as the practical knowledge of the local businesses. Multidisciplinary data collection, integration, data sharing, application and further development have been the key factors of the project. This way we have created a combination of strength and expertise in the challenging snow and ice environmental design and implementation process. The European Regional Development Fund (ERDF) - funded Lapland Snow Design project has created an opportunity to perform cutting-edge product development in the particular field.

Currently we are able to provide services to those interested in ordering snow and ice architecture, design- and event-related planning, training and implementations through our websites. Our services include construction of massive snow structures as well as an execution of small winter art-related events. We have prepared the companies and educational institutions to bring about the customer-oriented design and the experiential and intercultural form of snow and ice environments. In the planning process we take into account the environment the customer is investing and its cultural, social and physical characteristics.

Our professional design improves ecological and economic aspects of snow and ice construction. Functional design, effective construction methods and material optimization lead to significantly lower energy costs during transportation of the constructions. We also believe that high-quality design can create a positive impact on the local businesses and even on the entire region's development. Snow designing can create unique and responsible cultural events and tourist attractions. A well-planned snow design will benefit i.e. the local event organisers, hotels, guesthouses and restaurants. This publication will provide information on the possibilities of snow design that derives from design thinking and it will present the various possibilities on what can be achieved by using winter elements in different contexts.

The book is divided into four sections. The first section Insights into Designing with Snow and Ice is started with a chapter where the Project

leader of the Lapland Snow Design, Professor Timo Jokela explains the challenges of winter art and the snow & ice constructions and describes the opportunities of the user-centred design. In his article Jokela also emphasizes the significance of cooperation between the customer, educational and business organisations in developing the snow design and its application. The project manager Antti-Jussi Yliharju continues by presenting the processes of developing skills and abilities to strive for high quality customer-oriented design and realization methods conducted in the Lapland Snow Design project. The following SkiDubai project description gives insight to snow and ice design concept development for the unusual surroundings in Dubai, the Arabic Emirates. The project was carried out by five master level design students from the University of Lapland. Antti Stöckell, the art education lecturer provides perspectives on participatory practices in content planning and practical implementation of building the winter art environments. Professor of Design, Satu Miettinen, in turn, presents the Arctic service design approaches and highlights the opportunities that service design offers to snow and ice environment planning. The first section is concluded with the chapter of Johan Edelheim, the Director of the Multidimensional Tourism Institute, who associates snow design with responsible development of tourism business.

The section two, Technical expertise of Snow Design provides technical information relevant to snow and ice construction processes. Kai Ryynänen, Senior lecturer in the Lapland University of Applied Sciences gives a thorough insight to safe design and use of snow and ice constructions. His article reviews the guidelines for constructing from the viewpoints of the customer, the builder and the authorities that supervise the operation and the use. Taavi Heikkilä, the regional Director of IP-Heikkilä / SnowKemi Corporation continues by describing the organization and realization of massive snow structure projects. He has a long-term experience as a head of the annual Kemi Snow Castle construction process. Lightning designer Jukka Laukkanen (VALOSA) shares his expertise in explaining the principles of light architecture and lighting methods used in snow and ice constructions. The second chapter is concluded with Juha Laakko's and Elina Männikkö's description of the development of the Lapland Snow Design Application software. The interactive Internet application is designed to enable customers to design snow and ice environments for their special purposes.

The third section of the book is a series of case studies of practical applications of snow design. The case projects have been carried out under the supervision of the University of Lapland. The book is concluded with the presentation of the Associates and their field of expertise involved in the Lapland Snow Design project.

This volume offers readers a rich variety of perspectives on snow and ice design and construction. The authors share their expertise, practical knowledge and insights of the field and thus help the customer to embrace the numerous possibilities of snow and ice as design and construction material.

Rovaniemi 22nd April 2014
Timo Jokela & Elina Härkönen

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Design

Insights into
Snow and Ice

Photographer – Topi Matikainen

Timo Jokela

Professor Timo Jokela worked as manager in charge of the Lapland Snow Design project. Jokela is the dean of the Faculty of Art and Design at University of Lapland and the director of the Institution for Northern Culture of Lapland University Consortium. Since 1995 he has worked as a professor of Art Education at the University of Lapland. His theoretical academic studies focus on phenomenological relationship between art and nature, environmental art, community art and art education. He is also responsible for several international cooperative and regional development projects in the field of applied visual arts, design and art education. Jokela works actively as an environmental artist, often using natural materials, wood, snow, ice, or the local cultural heritage as a starting point for his works. He has realized several exhibitions and environmental art projects and community projects in Finland and abroad.

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Snow and Ice Design Innovation in Lapland

This article presents the development of winter art and snow and ice construction that have been carried out in the Lapland Snow Design project years 2010-2014. The ESF-funded The Snow Show-winter art training programme (2002-2004) was acting as the background for this project. The Snow Show project was implemented by the Faculty of Art and Design at University of Lapland in collaboration with Rovaniemi University of Applied Sciences and Kemi-Tornio University of Applied Sciences. At that time, winter related multidisciplinary knowledge and technical skills were gathered together, training materials for winter art and snow and ice constructions were prepared and the field experts trained for the realization of major international art event The Snow Show, held in Rovaniemi and Kemi (2014). In connection with the event new areas for development were identified and they guided the objectives of the Lapland Snow Design project and within its framework, created new expertise, innovations and approaches.

The ERDF - funded Lapland Snow Design project's primary objective was developing snow and ice construction related innovative work. This was pursued by combining art, design, and construction technology. The project partners aimed to develop know-how for specific fields and products, related to these fields by their technical features, design and functionalism. The results were initially applied to companies' existing production

structures, and then the actors, involved in the project, worked on expanding cooperation and deepen their skills by planning snow and ice environment. This was pursued by promoting user-centred design, service design, and working methods for environmental and community art. Thus Lapland Snow Design project brought together professionals and experts in to a cluster, who are able to design, implement and market a more competitive winter art design, as well as snow and ice construction products and services.

From winter experience to design of winter art

First I will explain the winter art that is the basis for the Lapland Snow Design project. The concept of winter art was introduced in 2003 to describe its artistic features and phenomena related to winter aesthetics, which were the subjects of interest for review, research and development of The Snow Show winter art education project. At the time, I considered cultural changes and opportunities in Lapland in terms of winter: “One manifestation of this change is the brisk increase in winter festivals, winter theatres, snow and ice sculpting events and snow architecture. At their best these phenomena can be called winter art.” (Jokela 2003, 7.)

fig. a *Snow Installation, detail – Kuntshaus Nexus, Saaldfelden Austria*
Photographer – Timo Jokela

Originally, winter art is based on the Far Eastern tradition. The Japanese Zen-Shinto village ritual paid their respect to the moments of transition in winter with works of snow. Korean and Chinese celebration with ice sculptures have transformed into modern day snow and ice art festival that spread out around the Northern hemisphere. The winter events partly made the winter art well known, but at the same time freeze the snow and ice sculptures' into standardised competition. On one hand demonstration of decorative and technical proficiency, and on the other formalist language of form created a self-perpetuating feature. The events have isolated themselves from the original closeness to nature and community spirit. At its worst snow and ice events produce a winter Disneyland effect, which repeat the same theme in Japan, Canada, Russia, Finland and Dubai, without taking into account the cultural or geographical aspects.

fig. b *The faculty of Art and Design of the University of Lapland is training the Kirkenes tourism entrepreneurs in snow construction and winter arts Photographer – Timo Jokela*

An example of such a cliché activity in Northern Finland was the ICIUM – Wonderland of Ice, built by the Chinese snow and ice builders in Levi during the years 2010-2012. The Chinese buildings, figurines, and decorative motifs in ICIUM were displayed alongside the snow-miniature models of Helsinki signature buildings.

At their best, the winter art events are open and innovative happenings, which seek new ways of expression, content, and means of interaction. The winter art, rather than art of sculpture, can be viewed within the framework of environmental context. In environmental art the question is not about some sculptures placed in the open air, but to reflect the physical and cultural dimensions of environment as basis and content of the work. Thus environmental art is by its nature closer to design than fine art.

In the final seminar of the Snow Show art event, Professor of fine art Jyrki Siukonen (2004, 135) looks into the nature and relationship of contemporary art and characteristics of snow and ice art as follows: "Using snow and ice to build monuments creates many technical problems… Aiming for exact architectural forms denies the nature of a snow or ice sculpture as a slow mobile or a moving and changing work. Using the logic of making a pyramid creates serious and official works…The temporality of snow and ice suggests other kinds of possibilities, too, but perceivably they are too time-consuming when the experience has to be received within ten minutes."

Environmental artists have, however, used the 'flow' of winter elements such as lifecycle of ice, snow and frost in a way that they retain their characteristics as part of the natural cycle, and thus do not imitate marble or other materials that are used to create sculpture or architecture as well as its tradition with regard to language of form. Winter art as environmental art represents the natural process that takes into account place-specific art, and it could have a close connection with the inclusive community art activities.
A multidisciplinary approach would bring new content to the natural environment or to the winter art placed in the urban environment. Such art and science projects represent, for example, the global issue related event 'Burning Ice' (see Buckland 2006) or Lappish culture and identity related artistic activities with snow and ice created by Jokela (2008).

In urban surrounding and the tourism environment, implementation of place-specific art requires design skills from the artists and event organisers, and often the designs remind one, to certain extent, landscape architecture. Developing design skill in winter environment is a key challenge. The Lapland Snow Design project aims to develop interactive and collaborative design methods. They were found to be missing from the ICIUM event that supported Far Eastern handicraft tradition as well as the Snow Show event.

Winter art as an encounter for architecture and design thinking

In contrast to the traditional Chinese way in ICIUM, The Snow Show event offered creative dimension. Curator Lance Fung's goal to raise new creative dialogue between contemporary art and architecture was topical and challenging, and it continues to be so (see Fung, 2004). But the event was a disappointment to those waiting for innovative snow and ice architectures and new ways of expressions.

During interviews with a few artists and architects I found out that they had no prior information on existing winter art and snow and ice construction in Lapland, about its technical possibilities and applied solutions. This is why their planning process did not have a proper technical basis. In fact, the event produced only a few works which can be considered as architecture, in the sense that they had the available facilities. This was the case only with Tadeo Ando and Arata Isozaki's works, while several others, including snow and ice work of Zaha Hadid can be understood more as a massive sculpture (see Fung 2006; Jokela 2007c). Functionality and purpose of the work was clearly absent, it was not created to serve a purpose, but just for visual impact.

In the final seminar of The Snow Show project architect Matti K. Mäkinen (2004) evaluated architectural dimensions of the works as follows: "The next challenge winter art must face is becoming a part of real life and society, as the annual Kemi Snowcastles have partly succeed in doing. However, to ensure sufficient income from entrance fees they have had to incorporate a certain amount of kitsch. Most snow construction projects relied heavily on the power of nostalgia, for example, by turning snow and ice into knights' castles, churches, and wedding chapels with towers and turrets."

Mäkinen (2004, 143) continues discussion on architectural opportunities of snow and ice constructions: "The curators' question about the rebirth of collaboration of architects and artists is thought-provoking. Winter conditions in which matter circles from solid ice to melted waters and clouds disappear into the sky as well as a creative person's adaption to this journey of water forms a basis for ecological thinking and understanding product life cycle theories... The Snow Show shows how difficult it is to break free from these two archetypes in winter art: the idea of snowman is the apparent inspiration behind ice and snow sculptures; the snow castle, on the other hand, provides a model for winter architecture."

fig. c *Snow installation, detail – The installation construction process. Leongang, Austria*
Photographer – Timo Jokela

In the end, the problem of The Snow Show seems to be the same as the problem of Chinese built ICIUM event later. The art and architecture were seen as an institutional activity of top artists and architects, in which interactive design with other actors of the environment and the event played only a minor role, if at all. Creative aspects, that emphasizes interaction of contemporary art form or design thinking was absent or minimal. Assessment of Professor Jarkko Saarinen (2004, 157) on The Snow Show winter art event identifies shortcomings that can be overcome by service design: "In terms of touristic development of the events taking place in urban setting are given a specifically named, limited, and sacralised duration of time. Naturally, this requires greater investment than organizing short, one-time events. Furthermore, financial input might arouse local criticism — especially if the event perceived as serving only the non-local community — This was one of the weaknesses of The Snow Show. Locally, it was an international 'elite art' event aimed to serve non-local and mostly 'unknown' goals — Regardless of this, The Snow Show didn't succeed as a proper tourism event, either."

From touristic development perspectives the winter events and snow design should not be considered separately in relation to any other services or tourism profile and structure. Events should be connected to other tourism products of the area, as well as to the recreational environment and leisure time of the residents. This requires special focus on planning. Connection with tourism, research and design thinking has created a good foundation for the University of Lapland in the customer and user-centred design development of the winter art and design. Professor Satu Miettinen and Director of Tourism Research Institute (MTI) Johan Edelheim's articles in this publication offer more on these perspectives.

The Snow Show art event showed, however, that the world of art and architecture is interested in experimenting with snow and ice construction possibilities. The internationally well-known artists, designers and architects are available for planning designs together in the future as well. The University of Lapland, the European Union's northernmost university and the world's northernmost full size art and design faculty is profiling together with the city of Rovaniemi, the Arctic art and design excellence. Within the Arctic University the faculty of Art and Design also coordinates 28 networks of Northern art and design universities 'The Arctic Sustainable Art and Design'. The network provides an ideal forum to develop various aspects of winter art and design through research with the focus of design thinking. Design thinking emphasizes the traditional product design changing into increasingly complex objects, such as services, interaction, operational concepts and strategic design.

Safety and usable design

The winter festivals in Japan and China, including Sapporo and Harbin, the world's largest places for snow and ice construction, have been the sources of inspiration since Finland and Sweden noticed the possibilities for touristic development in the snow and ice constructions events. Nordic countries began to look for different possibilities to use snow and ice buildings. Tourists and visitors were invited to eat, sleep, drink, watch and pay for the experiences and services. Hotels made of snow were built including accommodation facilities; honeymoon suite, chapels, restaurants, bars, stages, grandstands, saunas and so on. In other words, they began to design and implement buildings for actual use.

The need for usable products led to the development of new methods for the snow construction and helped develop the vault and dome technologies. Structural analysis models were developed for the domes that are made of compressed air moulds and the vaults made of casting moulds that can be used to verify the structural safety. This development can be considered as a real technical innovation in the field of snow construction and it continued in the Lapland Snow Design project in cooperation with Lapland University of Applied Sciences and the companies. The construction technology and tools were modified and applied in construction by the companies in question, efficiency and safety for the constructions were found through product development. Lapland Snow Design project focused on the quality of snow construction, improvement of its safety and cost-efficiency, research on snow, ice and wet snow features and structure, safe and economic practices of snow and ice buildings, as well as introduction of new innovations in the snow building projects. Further information on this matter can be found in the article written by Kai Ryynänen in this publication.

The Lapland Snow Design project produced the safety guidelines for construction based on research and also developed training to implement these guidelines. Based on this research information the winter art and design can be used in a much more diverse and extensive way. With the help of design new diverse and usable structures can be created. The organisers of the Lapland Snow Design project believe that high quality, aesthetically and safely produced structures can increase the international interest and open new doors to export markets.

Agile user-centred design

In retrospect The Snow Show acted as a good pilot project, which also proved that the major international winter events are possible to organise in relatively small towns like Rovaniemi and Kemi. Similarly, many snow hotels, like the snow castle in Kemi, have been well-established in the tourism sector. The Lapland Snow Design project did not seek for mega-complexes like The Snow Show, or the Kemi Snow Castle. It is more topical to meet the growing complexity of art and design methods for future needs than planning castles and hotels. The project developed agile design patterns, operational concepts, and methods of implementing the targets. There is a great need for design experts as most of the actors in snow and ice building sector are self-taught or their background is in technical construction. The frame of reference is, however, an experience-oriented tourism. In this case, the winter environmental service related planning and visual and aesthetic design is more important in ensuring the quality factor than the technical know-how.

The project organisers already had encouraging experience from previous cooperation. Winter Conversation: in Rovaniemi - Harbin event (2007), the possibility of building a winter activity environment in Rovaniemi was presented in the view of supporting tourism in the city centre. The result was very successful in implementation as well as in its practicality and it encouraged further development of cooperation between companies and educational institutions. Another good example is winter art educational project The Ice and Snow organised for the tourism companies and vocational schools in the Northern Norway. The snow structures, made in the framework of this event combined design methods to the local place-specific winter art. It is worth mentioning that this cooperation opened export opportunities for the snow construction companies who were involved in the project. As a result of the training they have worked on snow structures initially in Norway and later in Canada, and Russia. Even in this case, education and training played a role in launching expertise and in successful marketing.

Lapland Snow Design project specifically developed user-centred design that was based on the customers' and users' often very diverse desires and needs, as well as developing them with the help of art and design into functional but also a visually successful end result. The context was defined and different design solutions were produced and presented in the design planning, as well as their evaluation and further development together with the actors. In Lapland Snow Design project, it was essential to find the right distribution of work between the educational institutions and companies that ensured effective and high quality in work.

Cooperation between the partners, the customer and user-centred design models in highly complex and challenging design applications were developed in the project. These included amongst others, World Design Capital 2012 Helsinki-Rovaniemi Snowroom, Design Week 2013, Arctic Design Week 2014, the Warsaw Central Market, Ski Dubai, Winter Swimming World Cup Championship etc.

fig. d *Snow installation, detail. Leongang, Austria*
Photographer – Timo Jokela

Lighting and audio-visual design

The development of technology in lighting and audio-visual media devices has opened up many new aspects in performance of experiential and informative winter environments. The objectives of the Lapland Snow Design -project was to improve the aesthetic-visual level of illumination of the constructions and at the same time to ensure a safe and cost-effective illumination for the exterior and interior of the winter art structures. Therefore a lighting design company was involved in the project. Thus a new kind of expertise was introduced in creating experience in the snow and ice construction. Expressive understanding of the change in natural light and artificial lighting must be identified by the winter experience providers. The development of illumination also increases ecological and economic sustainability.

fig. e Winter Conversation project in Rovaniemi 2009
Photographer – Timo Jokela

During the project planning it was also clear that the opportunities of new generation audio-visual media in winter art, snow and ice buildings, in creating an atmosphere as well as in communication are virtually unused and are hardly recognized. That is why we are aiming to combine digital audio-visual expressions to snow and ice constructions and to winter art, including film, audio- and video, motion detectors, and low-light sensors etc. We are also studying audiovisual media and lighting opportunities such as elements of space and time, reflecting surfaces and acoustic phenomena.

By bringing together the snow and ice constructors and the lighting and audio-visual media designers a new kind of skill has been introduced. The introduction of audio-visual media in the winter space expressive implementation also increases the ecological and economic sustainability, and various modes of projections allow diversification of narrative and use of the space.

fig. f *Snow installation Kirkeness, Norway – The faculty of Art and Design of the University of Lapland is training the Kirkenes tourism entrepreneurs in snow construction and winter arts*
Photographer – Timo Jokela

Training develops expertise; research contributes to the development of continuity

While Lapland Snow Design project has developed operational readiness of the entrepreneurs working on the field, the University of Lapland and Lapland University of Applied Sciences have developed their expertise in the field of educators and researchers not only in their own organisations, but provided education also to those schools that are working with professionals, artists or tourism, youth and social workers etc. We are now able to support the snow and ice construction and development work of winter art by research based training. We know how to promote the winter art and snow and ice constructions in different areas, such as educational institutions, cultural and social sector and particularly the tourism sector. The best way to achieve this is through action research & development projects. In this case, the research activities, alongside the winter art and design, may focus on areas such as reinforcing local identity, supporting psychosocial wellbeing, preventing social exclusion and participating in community empowerment activities.

In education projects we are able to create methods to bring forward the regional cultural heritage and visualise it with the help of winter art and design. Winter art should be seen as environmental, community, culture and education oriented activity, which seeks to strengthen its expertise in the field, regional competitiveness, as well as physical and psychological wellbeing. (see Jokela, 2007a, 2007b, Jokela 2007c.) Action research can be used to determine the effectiveness of the winter art in supporting well-being, as well as in social and cultural sustainability.

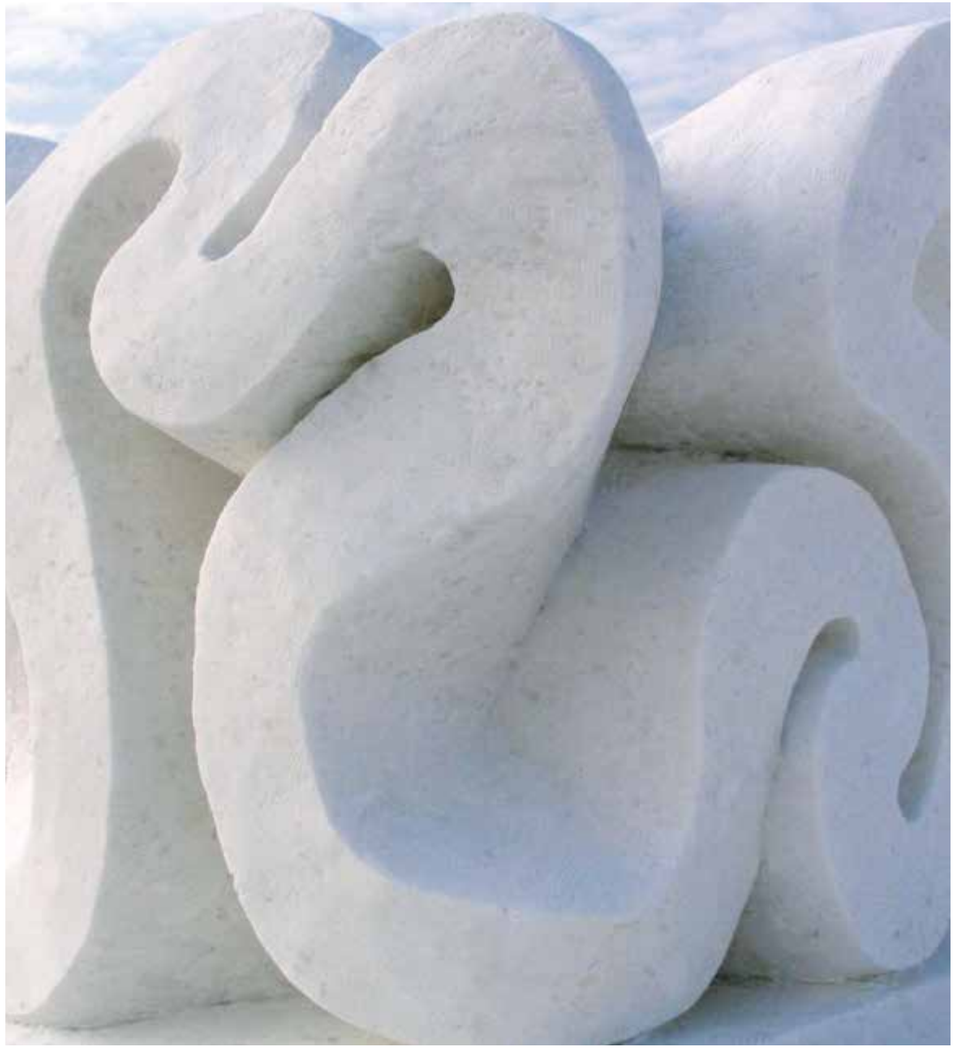

fig. g *Snow Installation, details – Shenyang, China*
Photographer – Timo Jokela & Risto Immonen

Conclusion

Lapland Snow Design project developed design and implementation methods for winter art and design, and related events. It united the user-centred design with the inclusive views of community and environmental art, lighting, and expressive aspects of the media, technical development of construction, marketing reflecting on the content and meanings of the humanistic tradition. Alongside technological innovations, construction safety and effective use of economy, possibilities of the winter, snow and ice became as important in ecologically, culturally, socially and economically responsible industries of experience and production of tourism.

We created a cluster-type network of experts that is able to apply the product, in domestic as well as in foreign locations. At the same time the project actors developed interaction and cooperation with the external parties. Practices were considered flexible, so that the project participants can apply them later in a variety of environments and tailor them to meet the needs of the customers for different kind of services. The project partners are jointly responsible for the product and it is sold as a service. There is also an educational dimension to the product. University of Lapland, Faculty of Art and the Lapland University of Applied Sciences educate the local institutions with multi-disciplinary snow and ice construction, operation, safety assurance, monitoring and maintenance.

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Lapland Snow Design Project

Exporting Snow Design Know-How From Lapland

Antti-Jussi Yliharju

Project manager of Lapland Snow Design Project. He is an Industrial Design graduate from Central St. Martin's College of Art & Design, London (2001) with Art Education studies at the University of Lapland (2007—). The author is an applied visual artist-designer and uses mainly snow, ice, wood and other natural materials in his site-specific works. He is also a natural builder with keen interest in sustainable living and permaculture.

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The cold and extreme conditions in the Arctic region has provided an unique design material that in the hands of a skilled designer yields itself from wonderful awe-inspiring artworks and winter venues to massive constructions and complete attractions. Ice can assume many different crystalline structures, more than any other material known. Snow is an accumulation of packed snow crystals. It can be piled up and by applying compression it can be shaped into sculptures, buildings or complete spatial environments. These temporary environments can be thought of as kind of ephemeral communities that rise up for the winter season and melt away when spring arrives. This temporary characteristic of snow and ice environments makes them a fascinating subject for design exploration (Yliharju 2010, 67—68). The materials of winter, snow and ice, are somewhat a synonym for the Arctic region and a part of cultures of the northern people. Therefore, one could argue that water in its solid state is the most characteristic Arctic Design material.

In Northern Scandinavian countries the tradition of building habitable structures out of snow and ice goes back a few decades. Snow construction business has utilised these construction techniques to create unique winter experiences for the use of the tourism industry (Huhmarniemi 2003, 14). Lapland has a multitude of attractions that have risen in the wake of the Kemi Snow Castle and Jukkasjärvi Ice Hotel. A few trials have also been made to export the snow know-how abroad through projects run by the University of Lapland (Jokela 2012, 41). However, a large-scale exportation of the business has not been

possible because of the small size of businesses and the lack of international connections. Snow and ice expertise has been imported to Finland from Central Europe and China. This is the situation that Lapland Snow Design Project was set up to respond to.

Lapland Snow Design is a cooperation of businesses, who work together with educational institutions on the design and implementation of different types of snow and ice environments. The working methods and latest technical data of user oriented design, service design, environmental & community art and the adventure activity industry are exploited to develop spatial concepts for marketing purposes as events, exhibitions, show rooms and for the leisure industry.

The Lapland Snow Design Project brought together experts from the field and aimed to develop high-quality and innovative products, environments and building techniques in snow and ice design. These targets included developing of new types of structures, lighting design solutions and interactive environments incorporating sound and new media to existing structures.

fig. a *Open-air snow cinema of the Arctic Snow Room (2012)*
Photographer – Teemu Lahtinen

Lapland‘s versatile expertise of cold-related technologies and applications in unique events offers the tourism industry and related industries great opportunities to give their customers memorable experiences of the Arctic winter.

Lapland Snow Design Project

Lappish snow and ice construction is a unique and important part of profiling Lapland as an expert in Arctic Design and culture. Previous projects and recent technical research and development in snow and ice construction safety together with building standardisation has allowed us to begin turning our focus past the products that we can currently produce to complete service environments that can be designed to meet the specific needs of users. For the past years there has been an increasing and diversifying demand for snow and ice expertise (Jokela 2012, 41) and there has been much interest in creative ways to utilize snow and ice for the purposes of tourism and experience industry (see Komu 2012). Lapland Snow Design Project was established to bring together local expertise and through collaboration create a way to meet the growing demand for Arctic Snow and Ice Design. Currently, there are only a handful of small businesses and educational institutions in Lapland that possesses sufficient know-how on snow and ice as design material. Therefore a real need existed to combine forces for carrying out larger national and international projects.

The aim of Lapland Snow Design Project was to combine Arctic design competence, Lapland's winter art and events, and snow and ice construction technologies in order to develop feasible export products for the global market. The objective was to develop an internationally competitive service innovation product to leverage Lapland's versatile expertise of snow-related technologies and applications in different events and offerings of the tourism industry.

The project was carried out in co-operation with educational institutions and companies located in Lapland. The project was based on collecting, combining, disseminating and applying multidisciplinary knowledge. The working methods and latest technical data of user-oriented design, service design, environmental & community art and the adventure activity industry were exploited and leveraged in project activities. Companies worked together with educational institutions on the design and implementation of different types of snow and ice environments and the development of marketing concepts throughout the project. The snow and ice constructing companies in Lapland are small in size. Therefore, Lapland Snow Design project aimed to set up a network which connects these small enterprises and the academic knowledge of educational institutions in order to produce high-quality products and execute large-scale projects both nationally and internationally. Businesses increased their know-how in the development of demanding snow and ice technology applications by using their combined resources and versatile expertise areas. Setting up a network also provided opportunities for ground-breaking product development and created inroads to new international markets.

fig. 1 *Organization of Snow Design Lapland*

Lapland Snow Design project was administered by the University of Lapland, Faculty of Art and Design and it was carried out during 2011—2014. The project was co-funded by the Regional Council of Lapland The European Regional Development Fund (ERDF), University of Lapland, Lapland University of Applied Sciences, Rovaniemi Regional Development Agency, Valosa Design, Arctic SnowHotel and SnowKemi. Project Execution Partners were Rovaniemi University of Applied Sciences, Rovaniemi Regional Development Agency, SnowKemi, Arctic SnowHotel, Valosa Design and Arctice.

Network Of Operators

Lapland Snow Design is a network of businesses and educational institutions that work in co-operation on the design and implementation of different types of snow and ice environments including spatial concepts for marketing purposes, events, exhibitions, show rooms and products for the leisure industry. The educational institutions and small local companies have a meaningful and purposeful role in carrying out the project. Role of the educational institutions is to offer specialised design expertise of the Faculty of Art and Design of the University of Lapland and facilities for product development and testing that the Lapland University of Applied Sciences can provide. These institutions are needed that new design solutions and methods of construction can be systematically developed.

The Faculty of Art and Design of the University of Lapland has a long expertise in content planning, organisation and designing new types of snow and ice environments from a user-centred point of view. Aim is to offer customers specifically tailored design solutions for various purposes such as product showrooms, children's playgrounds, events and cinemas. The University of Lapland also organises training for the future operators of snow and ice constructions - how they are maintained and how communities can utilise the new skills learned through the process (school ground projects etc.) The University of Lapland researches and develops Snow Design as one discipline within the collective Arctic Design label.

fig. b *Sámi Winter Art Project in Kautokeino – Collaboration with University of Lapland and Sámi University College (2009)*
Photographer – Maria Huhmarniemi

The Lapland University of Applied Sciences develops safer building practices and regulations and tests structures with specialised instruments and methods. This has provided vital data for assessing how structures behave throughout their life cycle. This information has been collected and assessed for a number of years and is crucial for safe building practices.

The participating snow and ice construction companies possess highly specialised expertise in constructing snow and ice structures. The companies' combined expertise is in the actual building process, project execution, financial planning and logistics. The project helps to develop the design know-how of participating companies. Safer building practises and marketing skills of companies were also developed throughout the project activities. The participation of the companies made it possible for the educational institutions to apply, test and put into practice the innovations they have developed in means of increasing the quality and competence of their products. The project supported the competitiveness of the companies not only internationally but also in Lapland as a large number of people working in the industry comes from outside of Lapland - the rest of Finland and abroad.

Developing The Know-How of the Companies

The project aimed to develop high-quality and innovative products, environments and building techniques for the participating companies' own specified targets. These targets included developing of new types of structures, lighting design solutions and interactive environments, incorporating sound and new media to existing structures.

Also the companies developed a general understanding how they could benefit from design-oriented thinking in their own businesses. This was accomplished by project collaboration and organised development meetings together with the multi-disciplinary design students and staff of the academic institutions. Each participating company had a direct access to a resource pool of creative thinking and could benefit from design expertise in the design and development of their products.

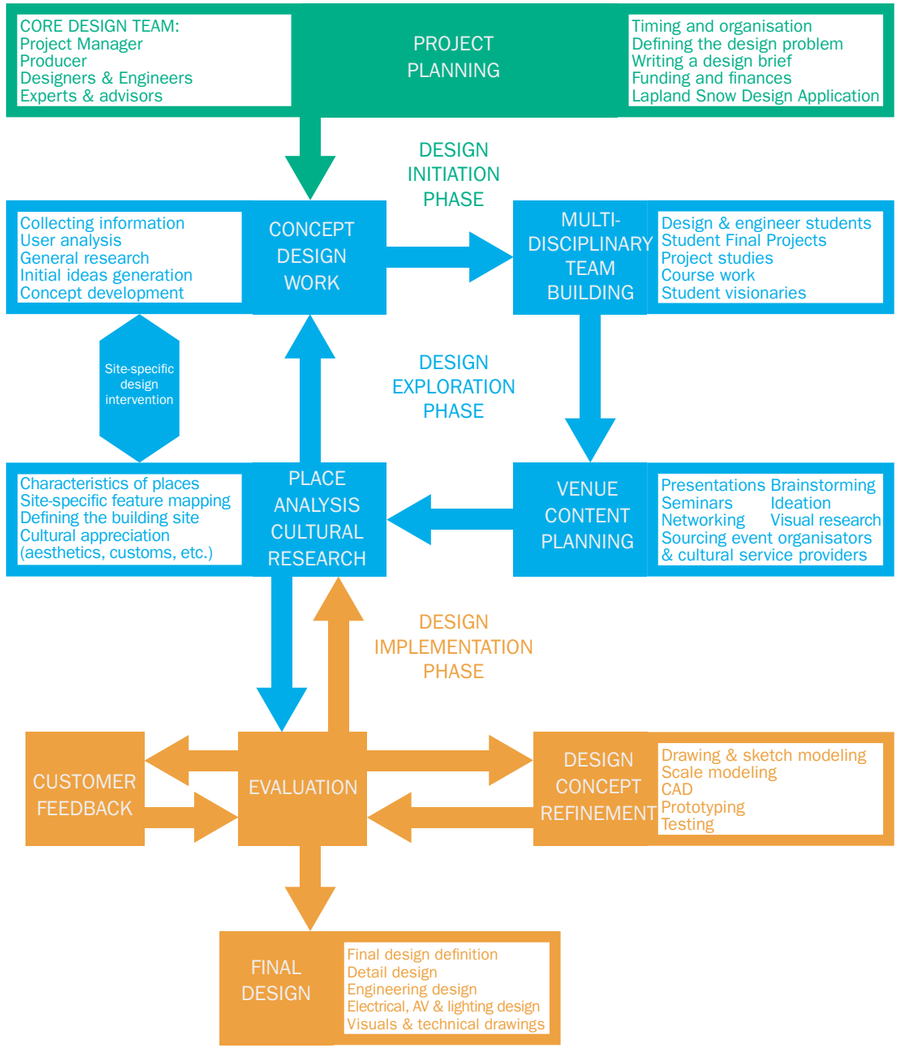
New design solutions were developed and these included innovations in construction techniques such as constructing with prefabricated modular building elements, designing adjustable and mobile snow moulds, building in challenging climates and developing new lighting design methods.

Safer construction practices were developed especially when building in urban areas. In the city centres the operative areas are limited and the builders have to take into consideration the pedestrians and live traffic conditions. Safety and security associated with lighting comprises construction period safety and ensures security after commissioning. These practises were developed and tested in several pilot projects during Lapland Snow Design project.

Better functioning service environments were also developed in conceptual design work. These included designs for snow and ice activity parks and service concepts for indoor skiing grounds.

Lapland Snow Design Model - The process of designing snow and ice environments

The aim of this chapter is to give the reader an overview of the design and production process of a typical snow and ice environment design project. This general model can be tailored to meet specific design requirements depending on the type and scale of the assignment. Naturally, a small-scale project requires a smaller set-up whereas large projects need perhaps a more detailed approach to the specific design problem. The assignments have to be planned case-by-case for them to be able to be executed in the most feasible manner. Snow and ice environments are in most if not in all cases ephemeral or temporary structures that will be in use from a period of only a couple of days to a maximum of few months. Theoretically at least, it would be possible to extend the environments' life-span but this would require them to be built in places where the climate is controllable, consistently cold and breeze-free or by using unsustainable cooling equipment with enormous utility costs. Therefore, we will consider the usual project to have a relatively short life-span and lead from project planning through different design phases to the inevitable destruction of the outcome. After all, snow and ice are purely natural materials - water in its solid state - susceptible to climate changes and other external factors.



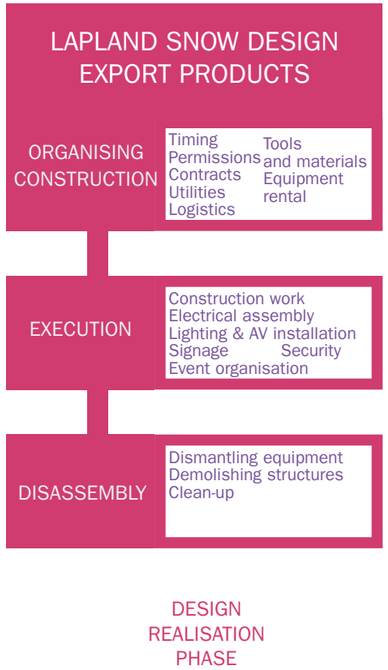


fig. 2 Snow And Ice Environments Design Model

Design Initiation Phase

A typical snow and ice environment design process consists of four phases. In the Design Initiation Phase the project is planned and the core design team is assembled. In this first stage the main design problems are identified and the aims and specifications are set in co-operation with the users or customers. Also the financial matters are negotiated and communication methods between project partners are decided.
Lapland Snow Design Application is utilized to give the user a basic understanding of designing snow and ice environments. Through the application the user can experiment with generation of the overall atmosphere or feel of the proposed environment. This will act as a starting point for the upcoming design phase. General scale of structures, lighting the exteriors and interiors, interior design, functions of different elements of the environment are few of the functionalities of the application that can be used to quickly draft initial design ideas that will be of assistance in planning the overall design project. Fundamentally, the Lapland Snow Design Application is designed for the user who has no first-hand experience of the nature of snow and ice environments or who is not proficient in computer design software. Accessibility has been the major defining requirement in developing the application so that it would be most beneficial to potential users and customers of Lapland Snow Design.

Design Exploration Phase

The Design Exploration Phase contains four cyclical stages of creative activities that are evaluated against project aims, specifications and customer's expectations. These cycles are repeated until new design innovations are identified and a number of potential design concepts are devised. These concepts are evaluated and the most potential concept is chosen for further development. The core design team is enforced with multi-disciplinary design and engineering students from educational institutions. The full design team can therefore be inclusive of designers in such fields as industrial design, fashion and textile design and audio-visual media culture together with construction and computer software engineers. The students will contribute their specialised fields of expertise for a diverse design team. These educational institutions can, in this model, be local partners in the location where the designed environment will be realised. These partners will be educated to understand the basics of Snow Design processes and execution of plans by the University of Lapland and the Lapland University of Applied Sciences who will be able to organise seminars and learning sessions concerning different aspects of Snow Design.

fig.c Multi-media installation at LUMOTION Design Show Venue (2013) Photographer – Dimitra Thanasia

Content planning for snow and ice environments is also carried out in the Design Exploration phase. The environments include not just the physical building exteriors, but the complete concepts are a combination of scenography, art and architecture, events, lighting, multi-media design and the like. The design concept is a complete surrounding with all content combined together creating a unique environment. This design model puts an emphasis on place analysis and cultural research that has a strong impact on conceptual design output (Jokela 2004, 47-54).

The concepts are always designed for a specific place allowing the characteristics of the place affect the design. This site-specific approach to Snow Design results in designs whose outcome is bound to its location and that can communicate meaningful messages (see Lippard 1997, 7-20). These messages can be merely an aesthetic layer on the structures or they can affect the whole design, services and additional content of the environments.

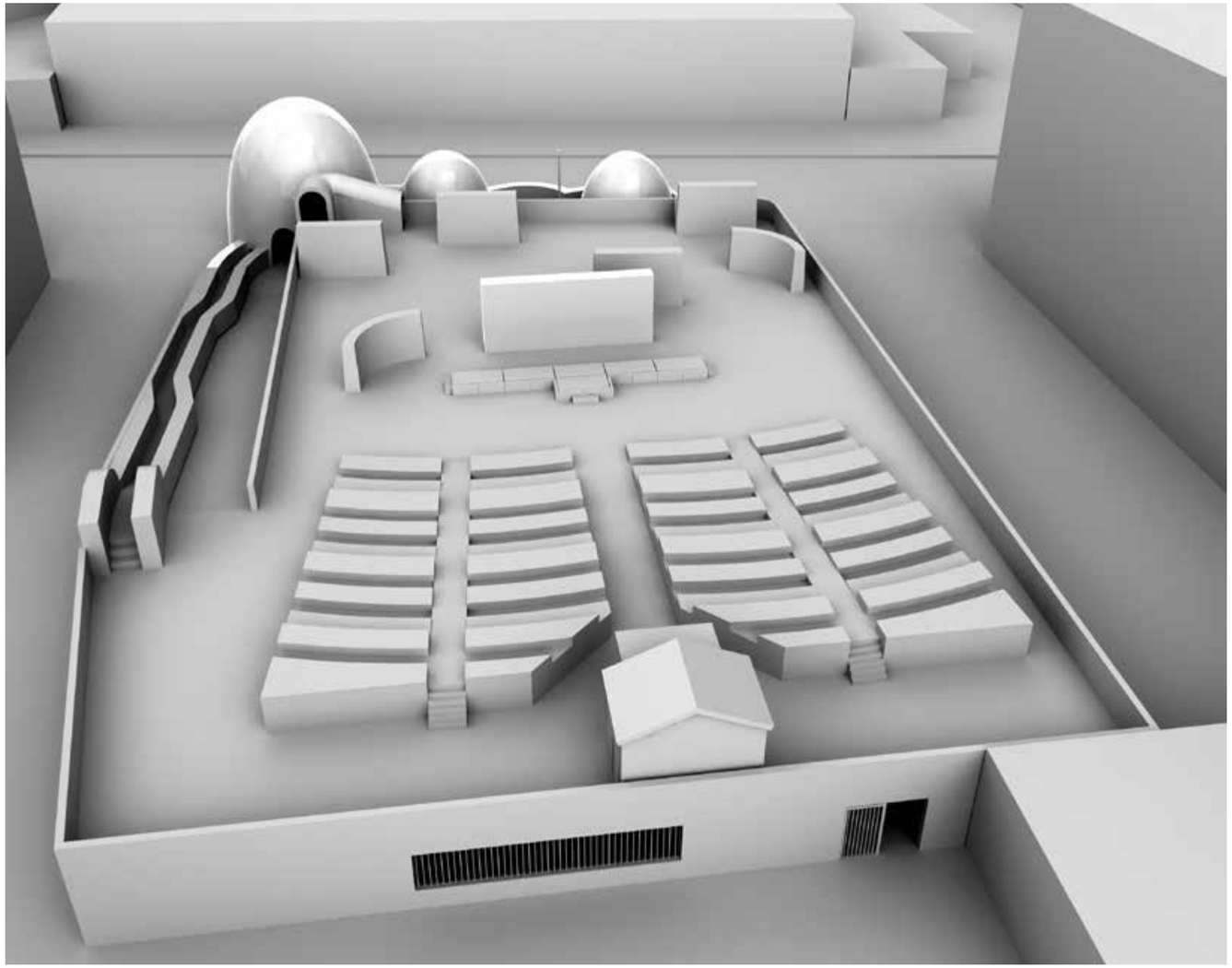
Lapland Snow Designs
Pilot projects and conceptual work

During the course of the Lapland Snow Design Project three pilot projects were designed and realized together with several conceptual designs. The purpose was to develop a design model that could be applied in designing concepts that meet the needs of customers. This model was to be as flexible as to allow for a high level of customization and creative design solutions. These pilot projects are described below.

fig. d *Arctic Snow Room (2012)*
Photographer – Annamari Manninen

Arctic Snow Room (2012)

During 2012 while Helsinki was the World Design Capital, Lapland represented itself with the Arctic Snow Room in the middle of the city of Rovaniemi. Arctic Snow Room (ASR) was a snow and ice constructed experiential venue built in a car park in the middle of the urban city center. ASR was designed to develop urban city design in winter season. ASR was built on, inside and in front of a concrete car parking in the city of Rovaniemi. ASR aimed for compilation of events for the local society and winter tourists. Events during the week-long Design Week included two KAAMOS ON/OFF Fashion Shows, a performance by the Nordic Dance and Media Art Network, feature films by Flatlight films and Sigur Rós both presented in an open air snow constructed cinema. The lower level of the car parking housed a snow sculpture park and a playground for children. This environment included media projections onto the snow structures. The snow domes housed a snow and ice design exhibition, a snowmobile design showroom for BRP Finland and multimedia installations.



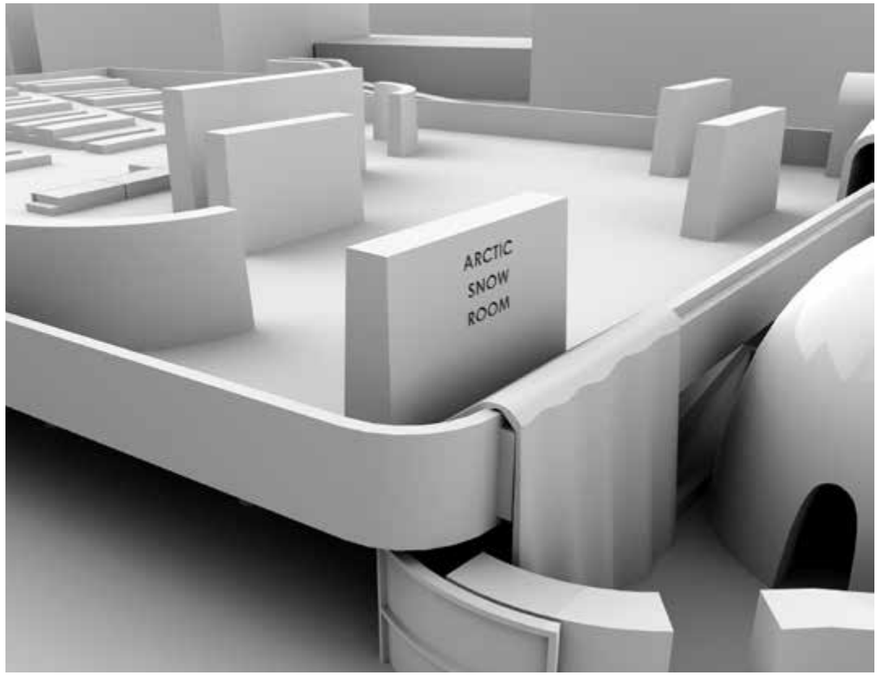


fig. e *Arctic Snow Room (2012)*
3-D – Model Antti-Jussi Yliharju

LUMOTION Design Show Venue (2013)

The world's northernmost design week was held for the fifth time in Rovaniemi, in the Arctic Circle in Finland from February 18-24, 2013, in the middle of the Scandinavian winter. The week's program covered dozens of events, such as exhibitions, shows, company presentations, audience participation activities, design processes and seminars. LUMOTION Design Show Venue was a joint-venture project with businesses and educational institutions. It combined fashion shows, multi-media installations, winter art, and cold testing lab: all in one Arctic Surrounding where visitors were able to interact with snow and ice installations and experience arctic climate in the wind tunnel built by Arctic Power of the Lapland University of Applied Sciences. The project tested co-operation between companies and educational institutions and developed collaboration between a multi-disciplinary design team. In the project the construction methods and logistics of an exported pre-fabricated modular snow construction system was tested in practice. Testing of more ecological building methods with building covered structures out of recycled natural snow that has been cleaned off the urban city streets.

fig. f

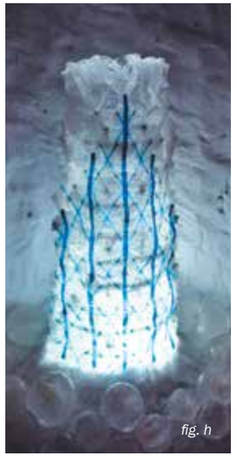


fig. h


fig. g


fig. i

fig. f *LUMOTION Design Show Venue (2013)*
Photographer – Antti-Jussi Yliharju

fig. g *Media projections at LUMOTION Design Show (2013)*
Photographer – Timo Jokela

fig. h *Multi-media installation at LUMOTION Design Show Venue (2013)*
Photographer – Dimitra Thanasia

fig. i *Ice installation at the LUMOTION Design Show Venue (2013)*
Photographer – Timo Jokela

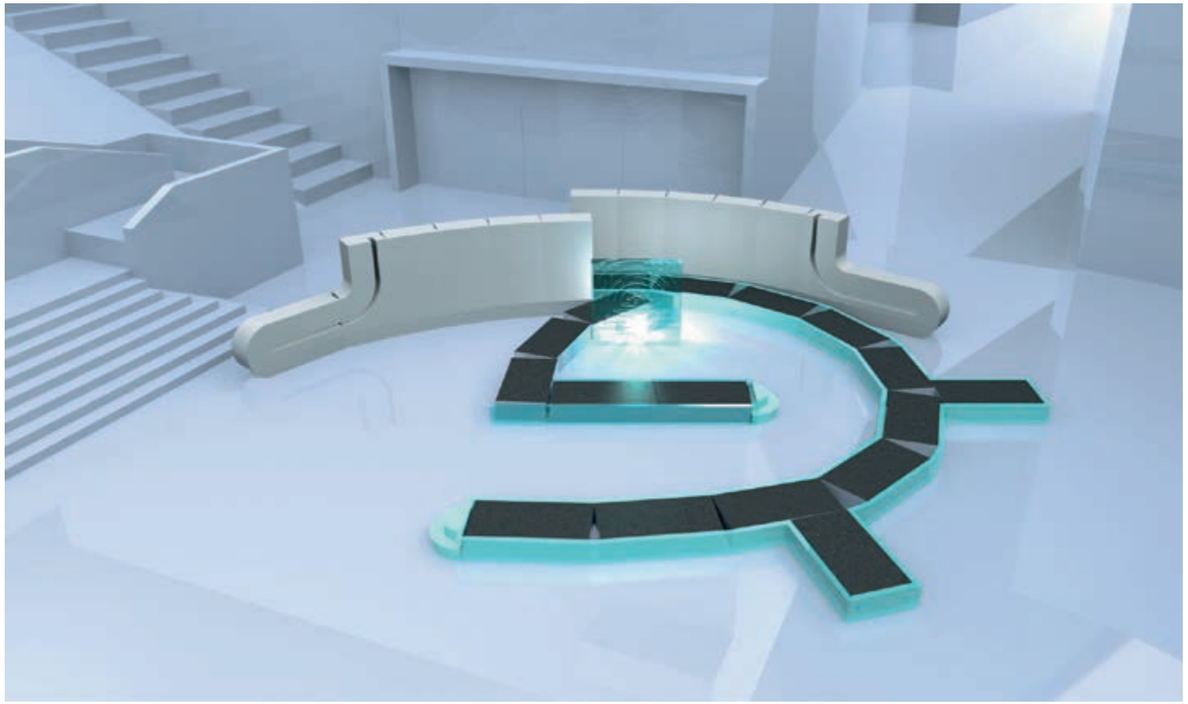


fig. j *Arctic Design Show Stage Plan 3D model (2014)*
Photographer – Antti-Jussi Yliharju

fig. k *Arctic Design Show stage (2014)*
Photographer – Antti-Jussi Yliharju

Arctic Design Show Stage (2014)

This project challenged the creativity of Lapland Snow Designers to adapt to the unpredictable arctic climate that allowed for developing building techniques in warm temperatures. The environment was functional only for one evening due to harsh weather conditions. Waste snow and harvested ice were used for constructing the environment. The environment included a snow and ice installation in form of a catenary curved arch where a new type of snow and ice combination structure was tested. The stage was a showcase of the skills and expertise of Lappish educational institutions and it was built by the staff and students of the Faculty of Art & Design of the University of Lapland, The Vocational College Lappia and the Lapland Vocational College. The project helped to develop and test the co-operation between educational institutions.

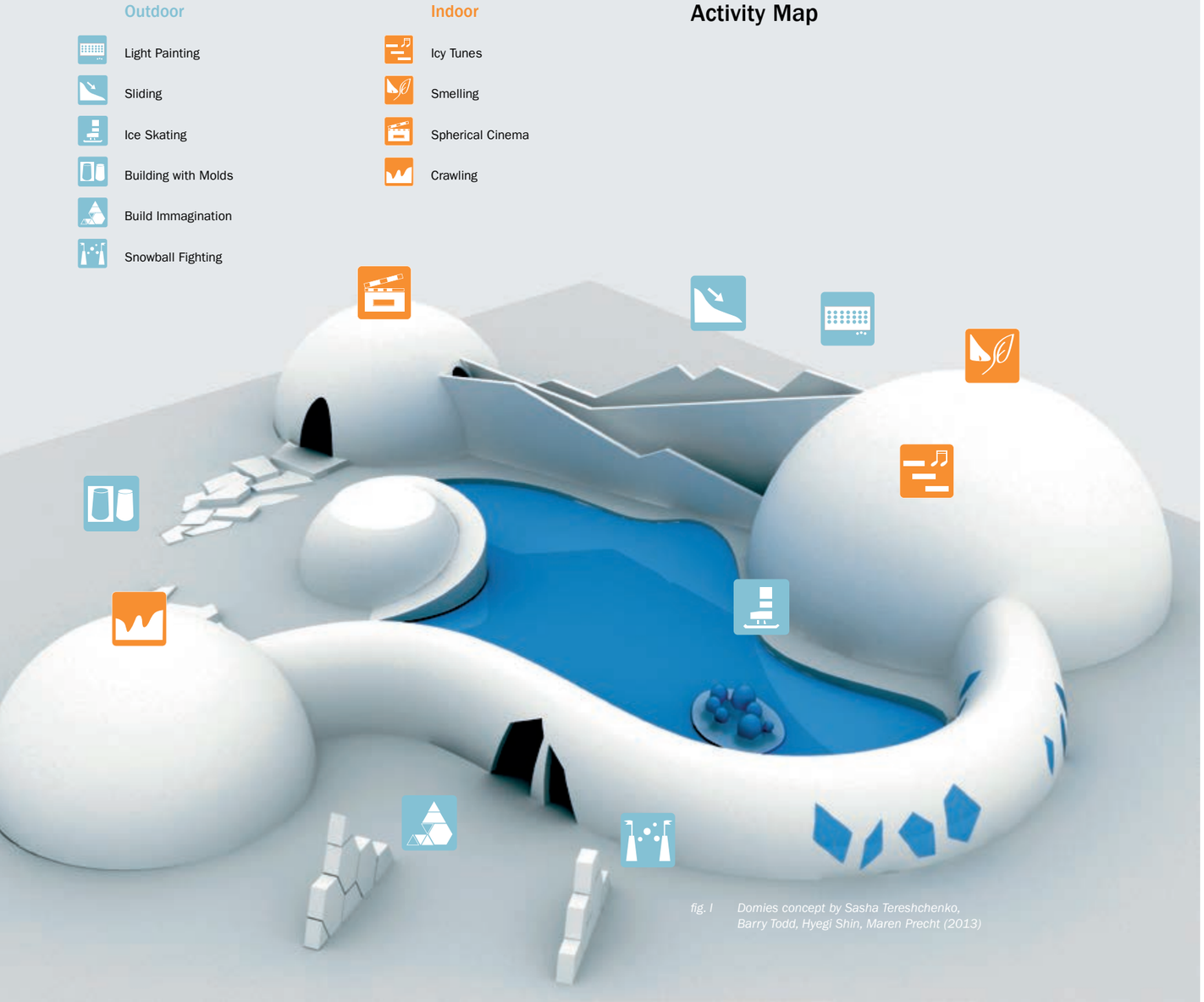


fig. I *Domies concept by Sasha Tereshchenko, Barry Todd, Hyegi Shin, Maren Precht (2013)*

Conceptual Designwork

In addition to realized pilot project designs work was also carried out in taught courses offered by the Faculty of Art and Design of the University of Lapland. This work was focused on new snow and ice construction techniques, interactive environments, lighting design and complete conceptual design work for an actual Lapland Snow Design export product in the Middle-East. The major design work carried out as part of Lapland Snow Design Project activities included the following concepts:

SkiDubai —
Design concept for an attraction in an indoor skiing ground. This design derived from research carried out on local Arabic culture that was interpreted through Lapland Snow Design. The project brief was obtained by visiting SkiDubai in the United Arab Emirates. The concept aimed for developing the indoor ski resort and looked for new products and services in a specific context.

Domies —
Flexible snow playgrounds is a modular and flexible system for designing interactive environments that provides various activities for children and adults. The design is based on different domes and connecting elements that create a mixture of inner and outer space.

Students also designed various concepts combining snow and ice and lighting design, and a design for a winter garden that aimed to develop the wintry urban city center by introducing an enclosed space with a dash of colour to brighten-up the atmosphere of a typical Finnish city square in winter.

Project Outcomes, Better Working Methods and Future Research

Through the project real collaboration between the project partners, the local educational institutions and businesses, was achieved through the application of many design activities and joint-venture pilot projects. The companies gained an understanding how they could benefit from a design focus in their individual product development process and in creating new export products and lighting design solutions. Real opportunities for exportation of Lappish snow and ice know-how were created and through this process the consort gained a basic understanding of the different factors that have to be taken into consideration in planning an export venture.

Throughout the project new technical and technological applications in different aspects of snow and ice environment design and construction were devised and tested. New ground was explored in the research of the possibilities of high-technology in the design process. There are great possibilities in developing computer software applications that can be used to design new types of snow and ice environments and to give customers and users a chance to experience and evaluate new designs prior their realisation. This will hopefully result in opening new areas of designing both the structures themselves and the content and services that are a crucial part of a complete design solution. Empty domes and galleries without purposefully designed content do seldom satisfy the customer's needs!

The expertise in snow and ice design of the educational institutions was greatly improved through project activities. The project allowed large-scale environments to be produced in collaboration with external partners and this required careful design of new kinds of working methods, strategies and design models. All project activities were based on the collaboration between degree and international exchange students of educational institutions and project partners. The educational models of producing actual snow and ice environment designs as student coursework and workshop-type of working methods were developed throughout the project. Orchestrating a large multi-disciplinary group of designers and artisans of different levels of expertise was one of the great challenges of the educational institutions and the experience gained through the process was an important outcome of the project.

The project aimed to develop better functioning, more ecological and economical methods of construction. These methods were devised and tested during the design and realisation phases of three concrete pilot projects together with conceptual and visionary design work. Some of the key areas that were developed through project activities were designing multi-functional buildings that can be adapted to accommodate different uses i.e. customisable and movable interiors, using waste snow for construction that suggests new usage for the towering piles of ploughed-away snow in urban areas.

fig. m *LUMOTION Design Show team*
Photographer – Miika J. Norvanto (2012)

Construction of snow designs currently requires certain weather conditions. For example the temperature should be somewhere between -10 and -20 °C for the construction process to succeed with minimum efforts and costs. Being able to building in difficult climates where temperatures are not optimal for snow and ice construction broadens the operational season thus potentially making snow and ice construction a year-round business. Research towards this goal was started in Lapland Snow Design Project activities.

Future investigation in snow and ice design should focus on venturing further in the possibilities of new design technologies, international collaboration and snow and ice material research. New forms of structures and new working methods together with developing new design strategies in place-specific design approach should be further carried out in future Snow Design research.

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The SkiDubai Project

Exporting Snow Design to the Middle-East

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The Lapland Snow Design's SkiDubai project was executed in cooperation with SnowKemi. The project aimed to develop new designs in the field of snow and ice design and find new and innovative design solutions to determine how the functioning service environments would look like when placed in different cultural settings. The international team consisted of the Master design students from Iran, Germany, Lebanon, Finland, and India, all part of the Faculty of Art and Design at the University of Lapland.

The brief for SkiDubai Skiing-centre in the United Arabic Emirates aimed for a concept, which would combine two cultures: The Northern and the Arabic Culture. Finding a common conceptual basis from the field of arctic winter design and applying it towards the oriental culture was a challenge to be taken. It had to include a strong visual appearance for both its exterior and interior architecture that would reflect the characteristics of Finnish design – functionality, clear and minimalist language of form and genuine materials but also demonstrate the elements of Arabic architecture and its arabesque style – decorative and iconic as can be seen for example in the construction of the mosques. Furthermore, the focus was on the needs and demands of the customer towards the given space. The design solutions should suit the spatial location and be modifiable to serve different purposes i.e. be adjustable for branding demands. Throughout the process the ideas got combined and formed into a suitable concept for the given purpose to create a unique experience for the visitors and an attractive return of invest for the customer.

Immerging into the user's and customer’s perspective

In an approach of user-centred design the needs and wants of the user and customer have to be localized. The aim is to offer new solution to any purpose that the customer may have and design them to be adjustable for the needs of the place. In the unique snow and ice surrounding the user wants most likely to be entertained and astonished. Triggers and touch points for the user have to be designed for the specific purposes. Snow and ice as a designing material give automatically a magical appearance - they stand for the aesthetics of winter, create experiences and deep emotions. The reflective characteristics of ice and snow in combination with light have an emphasizing, sparkling effect and create unique surroundings. This effect has even more impact when the user comes from a culture that is very different from the Northern.

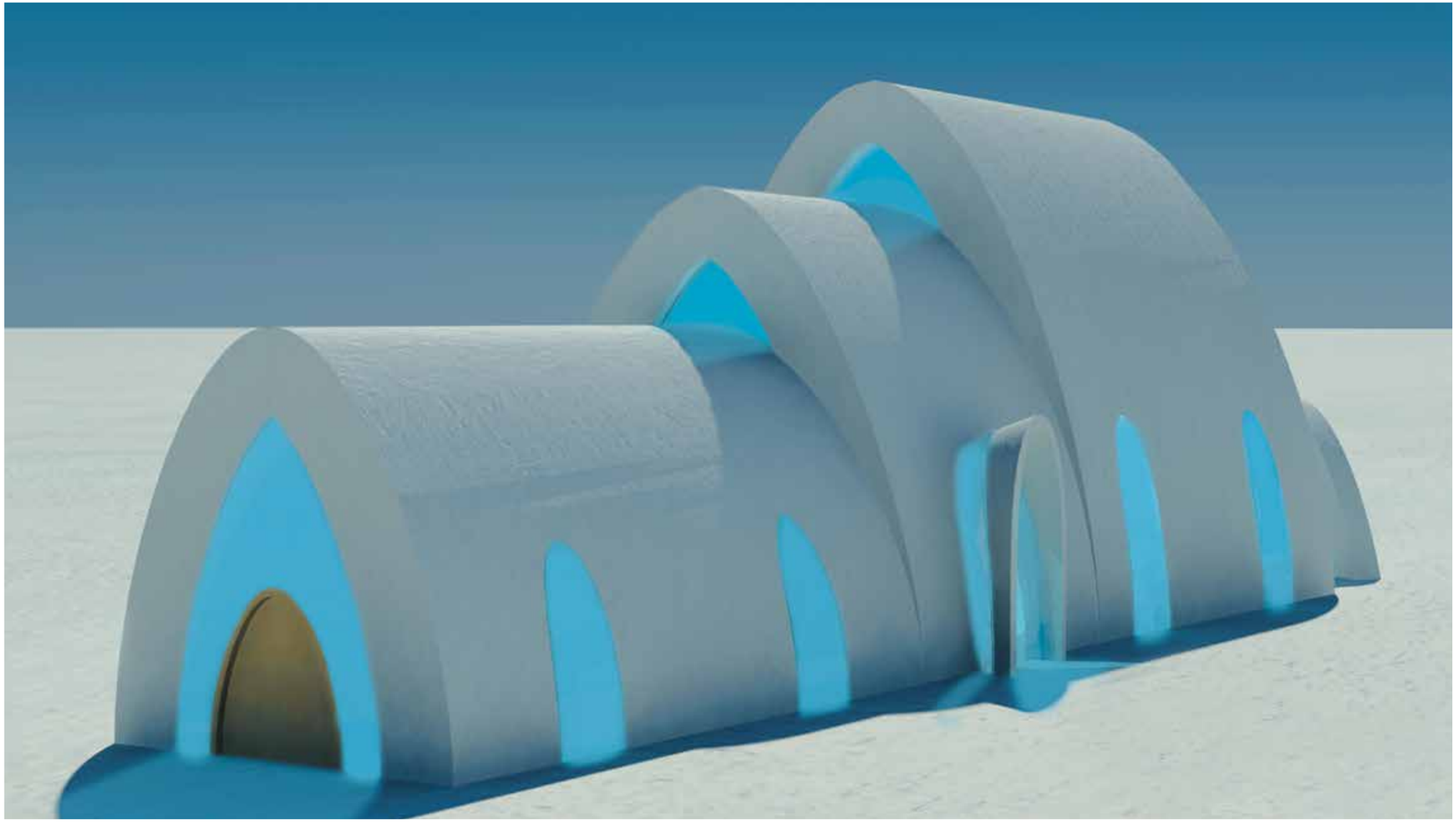


fig. a Architecture outside

The customer is focused on the business needs and how he is able to utilize the space for different purposes. The concept has to be adjusted to the needs of the users and it must operate as cost-efficient to generate profit. A great advantage of the SkiDubai design team was the diverse national backgrounds that gave the process different perspectives on ideas regarding the cultural issues and an in-house access to the specific characteristics of the Arabic culture. The design team had to consider the future business models, that could be applicable to the place in combination with the culture. It was difficult to determine just one model, knowing that the construction would be used for many purposes. The team had to turn this difficulty in a benefit to create a space what could be an adjustable and to a variety of purposes. This creative task was conducted by focusing onto the design features that the lights, projections and furniture could be quickly modified to different purposes of the building like a restaurant or a event space.

fig. b Front Projection

The Arctic meets the Orient

One of the challenges in branding the concept was to have an approach that bridges the two distinct cultures. Snow is a material that is as foreign to the average person living in United Arab Emirates, as is sand dune to a person from the North. We proceeded with cultural research of the location in order to understand the cultural context and be able to offer solution suitable for this specific environment. This was essential for generating a place-specific and a functional design for the place.

Along the process we realized a strong visual relationship between the shapes of snowflakes, the Islamic geometric pattern making, and Arabic Kufic calligraphy. We decided to focus on making the shapes more familiar for the user. We believed that a symbolic connection to a new inexperienced environment would help the visitor to relate to it and to establish emotional connections. A key design intervention was to realise that when new concepts are imported to new settings they have to be re-shaped for the local culture. Another link to the local culture was the catenary arch that is used in the local architecture. It seemed natural to adopt these intrinsic relationships as the basis of our design.

fig. c Snowflake, Pattern in Islamic Art, Kufic calligraphy

fig. d Arctic Gate

By using the catenary curve as a base, we wanted to create a structure that is visually interesting and invites the visitors to have a closer look and to step inside. The building represents the calm and clear design that gets its characteristics from the Finnish design.

To give an alternative to blank snow walls we integrated windows made of ice blocks. The light filtered through the ice would colour the interiors with a unique spectrum of cold light. The windows also provide additional surfaces for carving graphical entities. Ice windows as skylight windows in the roof of the structure are included to provide more light. An Arctic gate made from a combination of snow, ice and light is erected at the main entrance of the structure to invite visitors inside.

fig. e *Architecture inside*

fig. f Tea room setting

fig. g Refreshment bar & Arctic Mirror (interactive mirror)

Ideas form into solutions

The space was aimed to function as a mixture of a tea house and a restaurant. The centre of the building was established as a main attraction to create a unique experience and fulfil the demands of the visitor. This Arctic Tunnel was designed to give the visitors the opportunity to feel the arctic climate with its cold winds and snow.

Furthermore to entertain the visitors and especially the kids, an interactive Ice floor was designed where different themed games could be played. Also the sitting tables in the ice bar functioned as adjustable game tables for playing board games. The idea of an Ice sculpture photo booth was to attract the visitors in front of the main building. The ambient

fig. h Arctic Tunnel

light surrounding was to increase the atmosphere including the designed LED- Ice walls where animations or moving pictures could be displayed. This particular solution in combination with lighting, interactive projections and multimedia contributed to the atmosphere and extended the purposeful use of the space.

The atmosphere was aimed to be adjustable according to the needs of the event and the customer. Meanwhile the solution of modular ice interior constructions was considered to be developed even further, the aim was to keep the basic maintenance of the fragile furniture and the space easily realizable. In this case the space could be used for private, corporate/ business or family events.

fig. i Customizable furniture

fig. j Interior setting customized for a corporate/business event

fig. k Interior setting customized for a private wedding event

The Arctic Gate was a great start for testing the visual appearance of the conceptual spatial design. It reflected the same features as the main building and with this we were able to test if the form and layout of line would be visually successful. The prototyping took place in the Arctic Design Week in Rovaniemi, Finland and the positive feedback from the visitors convinced us that the approach was right.

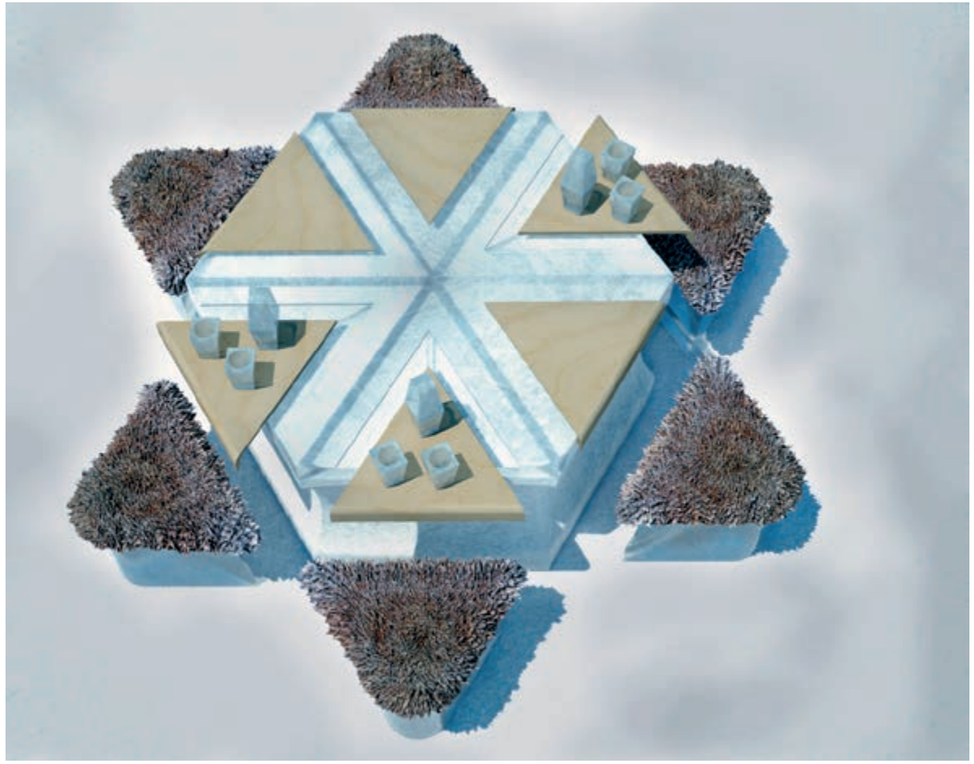
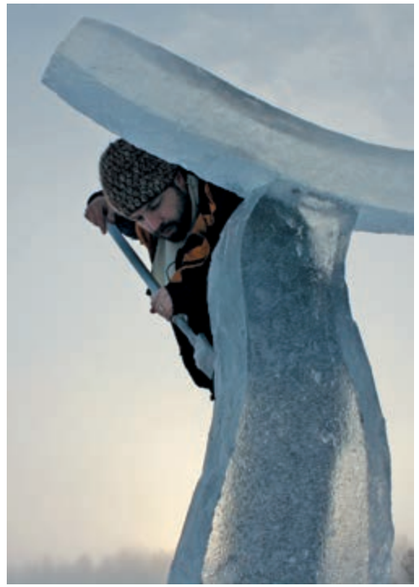


fig. I *Ergonomic furniture that reflects the identity of the space*

The Design has not yet been fully explored

Snow and ice are a set of natural materials each having their own unique properties and certain behaviour under different conditions. The prototyping provided us with the opportunity to experiment and develop an understanding towards the new set of approaches in shaping and carving structures out of snow and ice.

With this project we are looking forward to see the impact of our choices we made as the designers. The advantage of this project has been in its focus on spatial design from where the new designs can be established. This unique material gives lot of opportunities, and its design possibilities are not yet entirely explored – plenty of new designs are possible. Especially, when it comes to combining winter art with the fields of interactive installation, lighting, projections or multimedia in general, possibilities are unlimited to create something new.



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Perspectives on Winter Art and Snow Building Planning Process

Participatory practices with local communities and tourists

The article's pictures (except for fig. a) are from the Winter Swimming World Championships in Rovaniemi that took place in March of 2014. Students from the University of Lapland, and the Lapland Vocational College designed and carried out a gate construction leading to the competition area (long element separating office and public area) as well as prize-giving area. The theme was based on otters, who were swimming and fishing in a molten river close to the competition area some weeks before the event.

The article is based on the author's experiences of numerous winter art projects where he has been tutoring school and student groups and the local communities in both the content design as well as in the practical implementation of the projects. The presented ideas relating to tourism are the author's pondering on the unexplored possibilities of snow and ice construction in the artistic content planning.

The University of Lapland has wide variety of experience in implementing the community-based participatory practices on the winter events and environments. The snow and ice constructions and event environments provide opportunities for the range of participatory services - not only the finished product but also the environment where the local people as well as the visiting tourists are enabled to try out their ideas by taking part to the building and carving process. The concept is based on the community-art thinking where everyone is seen able to participate by using the skills they have.

This article reviews some aspects of the participatory planning and making. After the review of some practical solutions the theme is discussed with more substantive and thematic planning issues. The winter snow constructions can serve as a learning environment by providing an excellent framework for co-operative learning. The local identity as well as the facts derived from the content design are also taken into account. Place- and community-based activities also serve as authentic place-specific contents for tourism.

fig. a *Snow installation, Kirkeness, Norway – The faculty of Art and Design of the University of Lapland is training the Kirkenes tourism entrepreneurs in snow construction and winter art*
Photographer – Maria Huhmarniemi

Light plate molds offer opportunities for varying constructions

Besides the use of large molds based on the massive mechanized methods of construction, a very useful and light method is to use the sheets of plywood molds. By using them the individual plans of the sculptures, sculptural groups or the curved, wavy walls can be planned. These elements and structures can be either independent or as part of the dome and arch structures either inside or outside. By using the dome and arch molds same types of visual entities are often produced. Separate lightweight molds allow flexible use for breaking and fading the typical snow constructions' basic forms.

A collection of different sized mold plates is easily transported with a passenger car trailer. The molds can then be built together from four plates with two loading straps. The two loading straps are enough to keep the mold plates together. Smaller molds can be filled with shovels while the larger filling needs either a snow thrower or a tractor. The emerging physical exercise turns often out to be a nice time together for larger groups.
A good material for the largest single plate is the standard size (120x240cm) 6.5 mm thick film-faced plywood. In addition for the plates requiring the support of the wooden frame, the intermediate support for the biggest plate is also inevitable. By cutting the sheets to standard sizes, for example 120x120cm and 120x60cm, they can be easily built with many sized blanks and combinations.
The molds are mainly filled either with artificial or natural snow. Clean natural snow is usable when it has been piled up a day before the filling. The density of the piled snow is sufficient for the building of smaller elements. When filling the molds with shovels or a tractor, the snow has to be stamped down tightly in layers in order to reach the right density. At the same time the snow density shut with a snow thrower is sufficient for building and the molds can be opened immediately after the filling. The blanks are ready to be sculpted the next day.

fig. b *Photographer – Antti-Jussi Yliharju*

fig. c *Photographer – Antti-Jussi Yliharju*

Participatory practices in design: facilities, needs and goals

The experience of participation is greater and stronger when the participants have the opportunity to influence on the design at the early stage. Local communities can be involved with the process right from the beginning whereas the tourists' participation is shorter in nature. It needs to be bear in mind that the tourist groups consist both visitors from the surrounding areas as well as the domestic and foreign tourists. Their schedules differ to some extent but in most cases these groups take part in the specially programmed activities for only a shorter periods of time.

One option for participatory practice is to focus on making everything ready for the opening ceremony of the year. Another way is to provide a non-stop working area or workshop where the visiting groups and participants could participate on a longer period of time. For instance the simplest way for busy travelers to participate could be to enable them to work on their own small patterns with a piece of ice and connect them piece by piece to the growing wall.

The walls and the elements can be designed purely as architectural masses, spaces, shapes, rhythms, surfaces and the direction of movement. The area bounded by walls can build up with individual blanks or with group of blanks. Any architectural elements are the more interesting the better they are structured in the space both indoors and outdoors. Special attention must be paid to the internals and exteriors between the transitions. Meandering walls and elements leading to the building are great surfaces to allow different kind of participation. The structures can be shaped as three-dimensional elements or reliefs or a combination of these. They may provide an opportunity for snow sculpting the entire season.

Naturally, the design has to take into account all the participating groups, skills, resources and needs. The working area needs to be divided in a way that it provides a space and opportunity for people to participate with various skills and objectives in mind. The possibility to participate in the planning and building with local communities includes working with kindergarten children, pupils, working communities, elderly, clubs and associations. There should be no age limit for the participation.

Views and ideas for the thematic design

Snow buildings and environments can be built and designed with one overall theme or with separate smaller themes. It depends on the size of the construction and the methods of implementation what kind of importance the theme has for the final result. For instance, in the Kemi Snow Castle there is one overall theme that changes every year. It is a very spacious facility offering various ways to realize the annual theme. The Lehtojärvi Snow Hotel does not have a consistent theme, but even there one theme brings together most of the visual appearances of the individual premises. The transition from one space to another can be an experience of a great leap between two completely different worlds. In most cases the guests will still see the entity. When everything is built of snow and ice, not even the large differences in the contents of the reliefs and sculptures necessarily break the wholeness of the design. Perhaps more important than the figurative content is the quality of space planning, lighting, ways of expression and consistency in the finish. As important to the good-looking final results is — if not more — the participants' experience of the whole process.

School groups are interesting participators because of the possibility of integrating the working with the interdisciplinary learning contents. The themes for the design can be chosen straightly from the topics the pupils go through in schools. Another good starting point for choosing themes is to pick one current topic of the day that is relating to the local environment or the community life. Similarly, the global phenomena are worth searching for when they genuinely challenge the local people’s everyday life, reflecting on their values and their ways of life. One such theme could be the climate change, for instance.

One useful approach is a reflection on the theme trough narratives. Man is by nature a storyteller. Many like telling stories and stories are nice to listen to. A narrative can be portrayed in various ways on snow and ice. Narratives can be easy for the visitors to recognize due to their familiar characters. By integrating the characters and the snow elements together, the exciting spaces are created where the audience can easily relate to the event. Reliefs can also function as comics unfolding the narrative picture by picture. Reliefs can also function as comics unfolding the narrative picture by picture.

When searching the theme, the local or regional narrative traditions could help with the planning. When selecting the theme, it is often good to look back. Such an approach

may bestow a great opportunity for intergenerational encounters. Older people can tell stories and reminisce about the times in the past while carving figures related to their memories. Sometimes they might have the original objects to use as a model for the carving. The original objects can also be set inside to a bright piece of ice.

In addition to watching backwards, is always necessary to look to the future, particularly with children and young people. Building a future happens here and now. Places are often important to local people. Some of these places are very personal, while many of the places are also relevant to the wider local community. Such places, or even entire landscapes can be called communal identity symbols. People have multilayered relationship to places. The aspects of the past, present and also the future have presence in those places. When telling stories of places people are building a relationship to those places. Who would not like to see what affects they could have for the future of those places? This type of themes can touch the participants very deeply. This is especially so when the participants have handled feelings and experiences related to places which are lost, destroyed, or they are drastically changing. It is not necessary to avoid controversial subjects either, if the used working methods generate constructive and fruitful dialogue. Snow constructions and winter event environments can also be planned to be like a discussion and an operational forum to bring up this type of phenomenon. Citizens should have opportunities to influence on the changes of public spaces and places in their towns and villages, in their living environment.

Nature with rich species is always a useful starting point especially with children. For instance, some stories relating the local fishing culture with exaggeration can be rich theme storage. Humor should not be forgotten either.

fig. d Photographer – Antti Stöckell

Conclusion

Most of the travelers are looking for authentic local experiences, products, and phenomena. Many hope for authentic encounters with local people. There, where the winter and snow are a natural part of life and culture, it is natural to create meeting places, spaces and situations between the local and the tourists in the wintry snow environment.Thinking about the built snow environment, construction that involves groups and communities works actively on the people's relationship with their important local places and phenomena.

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Service design in the Arctic

Service design in the arctic has many purposes and development areas. Service design opens up new opportunities for Arctic wellbeing. It enables the discovery and development of new tourism products. It works as a living lab platform for service innovation and co-creation. Service design methodology and approach can be used in increasing innovation and competiveness of the Arctic region. Service design has been recognized as a method for regional development of the arctic. Newly published Finnish Arctic Strategy highlights service design as a method to respond to the challenges of the tourism and public service sector in the north.
Service design is a pathway to radical innovation, finding new solutions and introduction of new services is challenging. The use of innovative methods, creativity, and also intuition are included in service design thinking. In the Arctic distances between towns are long, land area is sparsely populated, natural living conditions are harsh and, in some places, population is rapidly ageing. Service design and radical innovation could create a balance between the lively tourism service sector and everyday living in the local context. We need both sides to sustain tourism and maintain the Arctic as a desirable place to live when securing the public service production. (Miettinen 2012)

[1] http://valtioneuvosto.fi/tiedostot/julkinen/arktinen_strategia/Suomen_arktinen_strategia_fi.pdf

New tools for creating services

Service design is establishing itself as both a practise and an academic discourse (Miettinen and Valtonen, 2012). Service design, as a multi-disciplinary field, has adopted working traditions from several fields. A variety of methods and tools derive from ethnographic research, marketing, industrial design, business and management (Tassi, 2009). At the heart of the service design approach lays the idea of interaction (Zeithaml et al., 2009). The interaction may take place at cultural, social and personal levels. It is typical to acknowledge the existence of several stakeholders to a service design process. The use of different design methods, design research, design thinking and different visualisation techniques connect different stakeholder views during the service development process. The idea of innovation is implicit, and it can use several methods for concretising new offerings or innovations even in the same development process. The process of service design enables concretising and understanding of the overview and the detail. The designer's role as a communicator and a facilitator of a process is evident. This is in line with the recent marketing notion that emphasises the role of the marketer as a facilitator of consumer experiences (Firat and Nikhlesh, 2006, Miettinen et al. 2013).

fig. a *Arctic Snow Room 2012*
Photographer – Linus Schaaf

Design thinking is an essential part of service design. Lockwood (2010) defined design thinking as a human-centred innovation process that emphasises observation, collaboration, fast learning, visualisation of ideas, rapid concept prototyping and concurrent business analysis, which ultimately influences innovation and business strategy. Design thinking also involves consumers, designers, and business people in an integrative process, which can be applied to products, services or even business design. Service design offers a tool to influence thinking, and service prototyping can also positively affect concepts and business strategy development. Service design process starts with exploratory or immersive research to lead to opportunities for innovation in strategy rather than starting from defining strategy (Holmlid and Evenson, 2008, Miettinen et. Al 2013).

Commonly, service designers employ methods that aim at empowering the user, and the users are invited to actively take part to the service design process. Co-design work is carried out on a regular basis, and new innovative methods are developed to allow inclusion, creativity and engagement (Prahalad and Ramaswamy, 2004; Miettinen et al. 2013, Miettinen and Valtonen 2012; Miettinen et al., 2012; Miettinen 2011; Miettinen and Koivisto 2009).

Service Design and snow

Service Design methods help in developing snow design and services related to production of snow architecture. Arnberg (2013) has studied how human-centred design approach can help in the development of snow design. Her study was contacted as an action research study in Lapland Snow design project during 2012-2013. She applied the methods and approach of human centred design in concept and service design process with local snow design entrepreneurs. Her study locates the snow design in the centre of arctic design discourse. Arnberg utilizes design methods when developing new concepts for snow constructions. She proposes user-centred approach, design management and prototyping methods to be used in snow design. This connects the areas of material design and more human-centred design. She testes her methods when designing Arctic Snow Room, which was connected with Lapland Snow Design –project[2]. Further when analyzing the design process of Arctic Snow Room, interviews and literature research, she concludes that design can add value in snow architecture in three different ways:

1. improve the service development
2. improve the design process
3. improve product development

Her findings support the idea of arctic design and how this approach can facilitate the development of Finnish snow architecture through different concept design and prototyping methods. Service design and concept design help in concretizing the process how service could be delivered and support the snow design concept. Further it describes the role and interaction of the user and proposed snow architecture.

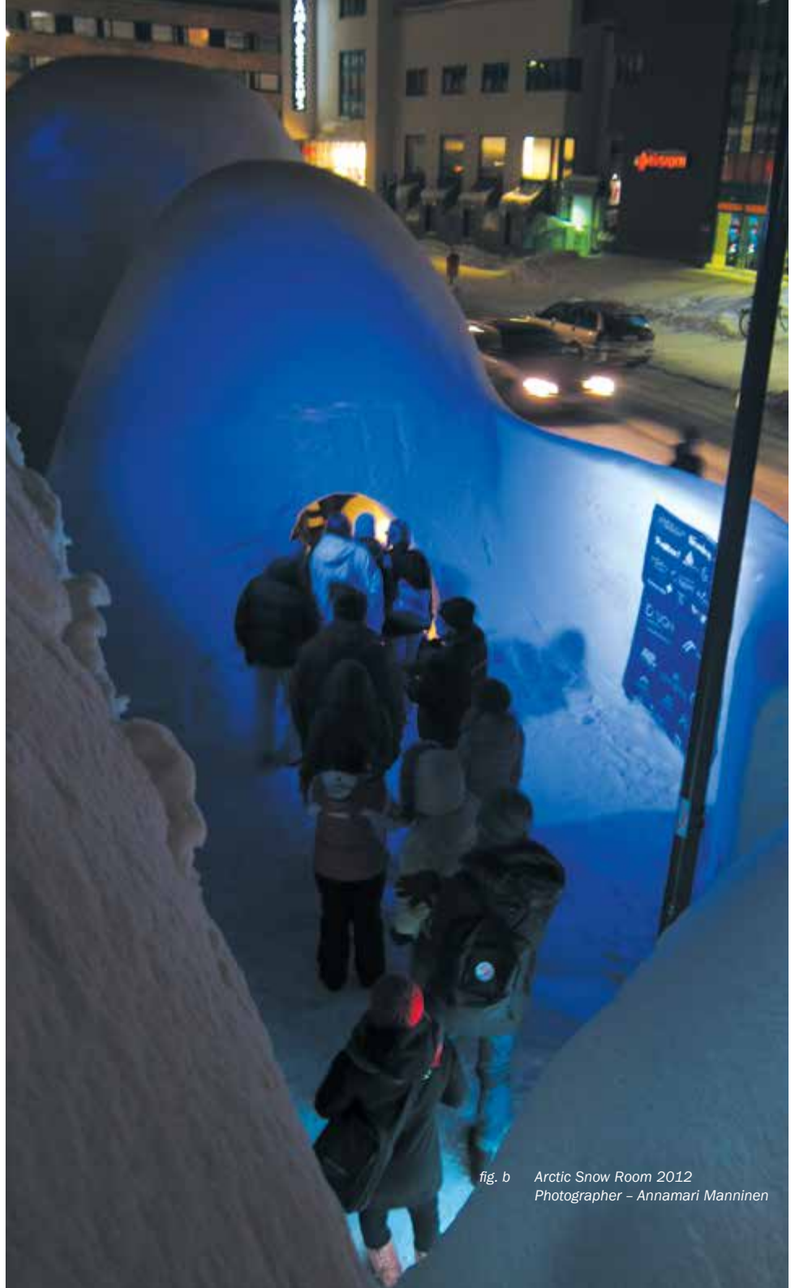

fig. b *Arctic Snow Room 2012*
Photographer – Annamari Manninen

[2] http://lapland-snow-design.blogspot.fi

Service design as a living lab platform

Service design tools and methods enable active user-participation in the service design process. University of Lapland and it's Faculty of Art and Design has a strategic role in regional service development from the perspective on research, community and stakeholder engagement as well as producing new solutions and information. Service design enables the involvement of designers, local entrepreneurs, actors and citizens, students and researchers to take part in rewarding and challenging development process that involves these stakeholders. Service design approach offers a living lab environment for this co-design work. Working in a multi-disciplinary community is a fairly recent development approach and requires new ways of working together. At its best service design and using it as a living lab platform can be a real life environment for different stakeholders where value can be co-created. (Miettinen 2012) Faculty of Art and Design has been involved in two living lab –projects where service design has had an essential role in integrating citizens in service development process. Living Lapland (Elävä Lappi) Living Lab –project[3] applied by two cities, Tornio and Rovaniemi in the county of Lapland during 2010-2013. The goal of the project was to develop shopping, sports and nature related tourism and local services with a living lab approach. A service design process can work as a framework that enables a designer to work in tourism service production. Miettinen (2007) discussed the creative tourism experience, the use of design tools and methods to reveal this creative tourism experience. Traditional and innovative research methods served to analyse the creative tourism experience and help to produce new knowledge on the process of service design. According to Miettinen (2007), a multiple set of research methods are needed in service design work related to tourism. The results clearly prove that people are ready and willing to take part in the development actions. Project functioned as a catapult for development and the development ideas come from all the parties involved. Further, the Ideal –project[4] conducted during 2012-2013 proposes integrating design for all methods into living lab approach. The project findings show that service design can easily work as a living lab platform and methodology that can be applied in the arctic service development context.

[3] http://some.lappia.fi/blogs/elavalappi/
[4] http://ami-communities.eu/wiki/IDeALL

Service design and the public service development

Service design has a growing role in public sector. It has been found out that the profession of design is changing as design moves towards experience based co-design (Szebeko 2011). Better public services are demanded by users and government as services are developing in general (Ministry of Employment and the Economy 2010). Co-design is a term that is often mentioned when talking about service design. According to Jäppinen (2011) co-design has increased in popularity - especially in public sector services. As a result of this development the traditional way of participating in decision making on services through representative or direct democracy is accompanied by and a new, more innovative way where residents participate in the planning and development of service provision through user-driven innovation activities.

fig. b *Arctic Snow Room 2012*
Photographer – Annamari Manninen

IKÄEHYT – Ikäihmisten elämänhallinnan ja hyvinvoinnin tukeminen (promoting older adult's wellbeing and coping in Northern Finland)[5] was a research and development project conducted by Lapland University Consortium during 2011-2013. The project was multidisciplinary, combining research interests of design, art and social sciences. Fourteen Northern Finnish municipalities, numerous 3rd sector actors and enterprises were involved in the project. One working methods was piloting service design methods with service providers and older adults in the context of assisted living and day care. Finding of the project show that service design can be used in the development of public sector services. Co-design workshops offer a new kind of discussion forum for the decision-makers, service users and local residents. Users' voice and needs are raised and listened to at the early planning phase of services. Co-design methods are in themselves inclusive in providing sense of community, community spirit and hearing of people's voices.

[5] http://some.lappia.fi/blogs/ikaehyt/

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Snow Design, Tourism, Hospitality and Events (TH&E) and Servicescape Thinking

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The article's pictures are related to tourism services provided in the Lapland's Snow businesses (Arctic SnowHotel & Snowkemi)

Snow is an almost magic element in many senses; the transformation of water into snow as a purely physical process is noteworthy on its own, the changes to landscapes that a cover of snow creates is equally dramatic, but even more so is the actual experience of snow for people who come in touch with it. The use of snow for leisure purposes has already a long history in Lapland in its many shapes, starting from snow related sports and more recently snow constructions. This chapter will investigate how the design of snow related environments is related to tourism, hospitality and events (TH&E) by taking in consideration '*servicescape*' as a theoretical framework that has the opportunity to enhance current practice.

Introduction

It is generally taken as a self-evident feature in Lapland that snow, snow buildings, and snow design act as attractors in tourism industries. Snow is exotic for many visitors coming to regions with temperate climates where sub-zero temperatures are common in the winter, or around the year. Snow has long been linked to specific geographic extremes of the globe; the Arctic, the Antarctic, and on high mountains in other parts of the world. Some places, for example, the Finnish Lapland, are therefore promoting snow experiences as a main feature of the destination's offerings.

Snow is per se no more than frozen rain, and is thus simply a climatological feature like rain that falls as water or fog, neither of which feature as attractors in any major form. Snow is cold to the touch, wet to handle when in contact with human skin, cannot be stored indoors for extended times, makes transport difficult, and is generally a relatively hostile material when not managed well. Snow needs therefore a framing by which it is experienced in order for its distinctness and attraction to be appreciated. Snowy landscapes can act as arenas where sports and activities take place, but aside of these active leisure pursuits other more passive ways of experiencing snow are also needed. The close physical relation that snow structures create for visitors is therefore seen as a natural evolution and snow hotels, restaurants, castles, villages, stages, etc. have progressively been developed and offered to tourists.

Photographer – Pekka Huovinen

The pitfall of generalising tourists' desires, expectations and needs lies, however, also in the aforementioned factors; an

overarching expectation that geographic distinctness, exoticism, and passive leisure consumption are enough to satisfy travellers now, and in the future. A physical object is simply a physical object regardless of what material it is made of, and the experience of a snow structure is over time no more exciting than a brick structure. The whole rationale of TH&E is that they produce experiences that give services a value-added edge. By investigating the physical environment services that are offered in, such as in snow structures, it becomes evident why the whole servicescape need to be considered both from the customers' and the service providers' perspectives.

Photographer – Kaisa Sirén

Servicescape

Services are distinct because of their characteristics. They are *intangible*, i.e. cannot be seen, touched or smelled; they are *inseparable*, i.e. co-produced and consumed by customers and staff, they are *perishable*, i.e. have to be consumed at a specific time and cannot be stored, and; they are *variable*, i.e. can be performed in a multitude of ways depending on the staff member and the customer (Solomon et al, 2011). Services need therefore to be managed very differently from products. Mary Jo Bitner (1992) highlighted that services are offered in physical environments and much management and marketing effort and emphasis is placed on the physical appearance of these environments, but hardly any is placed on how the service is actually carried out in these environments, i.e. the interaction between customers and staff, and how the environments are enhancing or disadvantaging the service. The ultimate goal of service delivery is that customers are offered a quality experience that creates satisfaction. A servicescape include physical exteriors and interiors – Bitner (1992) divides these into:

a. Ambient conditions – noise, temperature, odour, air quality;

b. Space/Function – parking and landscaping, layout, equipment, furnishing; and,

c. Signs, Symbols and Artifacts – exterior and interior design, colours, signage, and styles of decor.

The combination of the different elements creates the perceived servicescape which is again viewed differently by customers and staff. All stakeholders carry with them their internal *cognitive*, *emotional* and *physiological* responses to the servicescape and attach therefore different meanings to the pain, comfort, mood, beliefs or physical fit that the servicescape creates for them (Bitner, 1992). A natural reaction when considering a snow structure for service provision is naturally temperature and the comfort, or lack thereof, the cold environment creates for service providers and consumers. Additional considerations need to be placed on other physiological features such as bathrooms and ventilation that both are necessary to function seamlessly for mutual comfort.

Tourism, hospitality and events (TH&E)

Photographer – Marko Junttila

In Finnish Lapland TH&E are commonly combined and referred to singularly as ***tourism***, but it is of importance to service providers to separate tourism, hospitality, and event services from one another – especially when designing servicescapes. The different activities involved in TH&E, the different temporal duration and geographical spread the services involve, and most importantly the different expectations customers have of the different services cannot be underemphasised when considering satisfaction and longevity of the enterprise. One-off customers do not exist anymore. Even customers that will never return to consume the same services again will potentially impact on future success through the word-of-mouth they are providing in person or on-line.

Commercial hospitality services, such as accommodation and restaurants are spatially relatively easy to define, as are also the temporal duration products are consumed in. Events are temporally the most demanding services as they take place during certain time-periods in specific settings, and cannot be altered easily regardless of external conditions. Tourist services range from program-organisers such as snowmobile safaris, through regionally specific attractions, to travel services.

TH&E is not an industry but a conglomerate of industries, and the services provided alter from one another in more ways than they resemble one another (Leiper, 2004). TH&E consumers are an equally heterogeneous group and services need to be designed carefully to be satisfying to the chosen target. A common misconception is that successful TH&E services are mainly consumed by non-locals, but research shows that most long-term enterprises involved in the industries receive a majority of their income from local multiple use customers (Hede & Hall, 2006). When considering the range of servicescapes needed to offer TH&E services one realises the need to apply this theoretical concept to snow design to enhance future enterprises in the field.

Photographer – Timo Laapotti

Snow design in Lapland and servicescapes

Snow structures are designed and erected for different purposes each winter all over the Finnish Lapland, as well as in other parts of the Arctic. Snow sculptures, snow sculpting competitions, accommodation spaces, restaurants, bars, and chapels are all examples of structures available for consumption. After an initial innovation in some location many 'me-too' services appear, and the provision of fairly similar services starts to be offered regardless of the location. Changes in design contribute to some differentiation, but seldom in terms of service provision. Locals and regular visitors to the region, who should be considered as a major source of long-term success through repeat patronage, will need to be enticed by well-designed servicescapes that satisfies their needs, whilst simultaneously offering memorable experiences for long-distance travellers.

TH&E services can be blueprinted from a management perspective where both consumers and producers are considered in the servicescape. Opportunities with this are that the needs and wants of consumers are better acknowledged, and experiences to satisfy these purposes are offered. The Kemi Snow Castle, as an example, is offering visitors a map when purchasing tickets to the area, and customers are thus given a visual overview of the services on offer, and a chance to plan how to spend the time allocated to the experience. Signage on-site and complementing services such as hospitality offerings, activities and the visual design that is guided by a yearly changing theme, are together forming the service experience. This can be put in contrast to some other snow structure installations in Lapland that charge a similar amount for entry to the Kemi Snow Castle but offer no overt themes, no pictorial overviews of the site, and limited additional services. It is at times clear that the snow structures, whilst potentially acting as artworks, have limited service functions, and can be quite disappointing experiences to visitors that are trying to satisfy wants and needs beyond aesthetic ones.

Conclusion

This paper as considered snow design from the perspective of TH&E services, and suggested that the concept of servicescape can act as a useful tool when designing snow structures. Customers consuming services as well as service providers offering the same services co-produce services in a specific setting. The overt and covert design of this servicescape will either enhance or disadvantage the service provision, and will thus have a large impact on customers satisfaction, and ultimately on the success and longevity of the enterprise.

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Photographer – Antti-Jussi Yliharju

Safe Design and Use of Snow and Ice Construction

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Snow and ice structures made in Finland are constructed and used according to uniform guidelines. This article reviews these guidelines from the viewpoints of the orderer, the builder and the authorities who supervise operation and use.

In Finland, professional snow and ice construction intended for use in the tourism industry belongs under official control. Official control of snow and ice construction means it must adhere to laws and directives. Authorities and builders in construction projects do not always have sufficient knowledge about snow and ice as building materials.

Design and construction of snow and ice structures in Finland are described in texts such as the Design and Construction Guidelines for Snow Construction, RIL – Finnish Association of Civil Engineers 218-2001, and the Snow and Ice Construction Guide, Rovaniemi University of Applied Sciences C 27.

Snow And Ice As Building Materials

Snow can be used a building material within certain boundary conditions. Due to its crystal structure, snow — especially artificial snow — is mainly suitable for compressive structures. The density, i.e., volumetric weight of snow in a structure changes during the entire service life of the structure. Because of the effects of changing density and temperature, density is expressed as:

$$\gamma = 600 \frac{kg}{m^3}, T = -10°C$$

where in this case the snow weighs 600 kg/m3 at a temperature of -10 °C.

Detailed information on the material properties of snow and utilisation of these properties is available in literature, e.g., RIL 218-2001 Design and Construction Guidelines for Snow Structures. The material property values used in designing snow structures are chosen case by case by the structural designer. The material values are affected by temperature, snow quality and the load of the snow and the built structure. Ice has a special property; its crystal structure does not remain constant under loading or thawing, for example. The properties of ice change according to the temperature of the ice. The structural properties of ice are weakest at 0 °C. As the temperature of ice rises, its strength decreases and its modulus of elasticity, shear modulus and creep strain grow. During the service phase, before the thawing process begins, the density value of ice used in calculations is 920 kg/m3.

Slush can also be used as a building material in snow and ice construction. Slush is a mixture of snow, ice and water. Snow and ice structures in which the amount of water added during the construction phase exceeds 5% of the amount of snow used can be called slush structures. The proportion of the different components in the mixture is unevenly distributed. For this reason it is not possible specify exact material values for slush. The material properties of slush are affected by, e.g., the properties of the snow and water used, the thickness of the layer of slush and the temperature of the produced slush and the environment.

Designing Snow And Ice Structures

General design principles

The basic principle in designing snow and ice structures is to ensure the safety of the people using the structure. These guidelines only deal with structures that are large enough or used in a way to require an official permit for their construction. A person using calculations done with the formulas presented here must be a professional in the field of construction with sufficient competence in structural design.

In Finland, structural design complies with the regulations and guidelines provided in Finland's National Building Code issued by the Ministry of the Environment and the Eurocode Standards ratified by Finland. National Building Code sections B1 Structural Safety and Loading and B2 Load-bearing Structures are applied when calculating load stresses on structures. In addition, guidelines published by RIL - Finnish Association of Civil Engineers—Structural Loading Guidelines RIL 144-2002 and RIL 201-1-2008 Design Principles and Structural Loads. Eurocode—are also applied (Ryynänen 2011, 28).

The instructions provided in the book RIL 218-2001 Design and Construction Guidelines for Snow Structures may be applied in designing snow and ice structures. The special properties of snow and ice materials must be taken into consideration. The following design parameters must be analysed when designing load-bearing structures:

Ultimate limit state calculations; indicate structural safety against breakage and falling over.

Serviceability limit state calculations; indicate structural safety against deformation.

The partial coefficient of safety method is used in the calculations. Using partial coefficients of safety in the calculations produces reliable limit values, so that structural deformation and changes in loading during the service life can be predicted.

In ultimate limit state calculations, structural design load Fd is calculated as follows (National Building Code B1 1997, 3):

$$F_d = \left.\begin{matrix}1{,}2\\0{,}9\end{matrix}\right\} g_k + 1{,}6 \cdot q_k + 1{,}6 \cdot q_{snow\ (wind)} + \sum 0{,}8 \cdot q_k$$

In serviceability limit state analyses, design load qd is obtained as follows (National Building Code B1 1997, 4):

$$q_d = g + q_k + q_{k\ snow\ (wind)} + \Sigma\, 0{,}5 q_k$$

where,

g and g_k dead load (not snow or wind load)
$q_{k\ snow\ (wind)}$ snow or wind load
q_k other variable loads

The impact of weather conditions on snow and slush structures must be assessed. The RIL 218-2001 guidelines can be used to assess weather conditions. If the construction site and structures are the same every year, weather condition information from previous years which is based on sufficiently reliable measurements can be used to assess structural behaviour.

In serviceability limit state analysis, limit values are set for the structure. If these values are reached or exceeded, use of the snow and ice structure must be suspended or terminated.

Limit values in the serviceability limit state are:

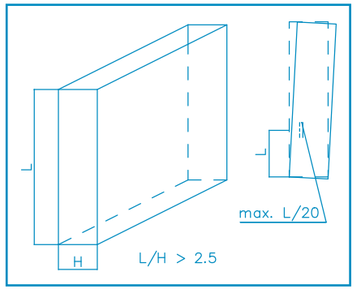

fig. 1 Limit values for structural tilt in snow, ice and slush structures (RIL 218-2001, 36)

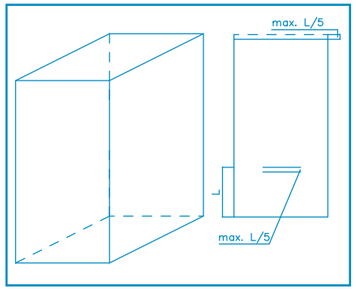

fig. 2 Limit values for structural tilt in snow, ice and slush structures (RIL 218-2001, 36)

Tilt

For free-standing structures when the ratio between the height of the structure L and the cross-sectional dimension of the structure's base H in the direction of tilt is greater than 2.5 (fig. 1) (RIL 218-2001, 39).

The limit value is L/20, where L is the reference point's horizontal distance from the bottom edge of the structure (fig. 3) (RIL 218-2001, 40).

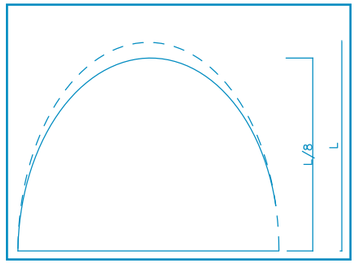

fig. 3 Limit values for structural tilt in snow, ice and slush structures (RIL 218-2001, 36)

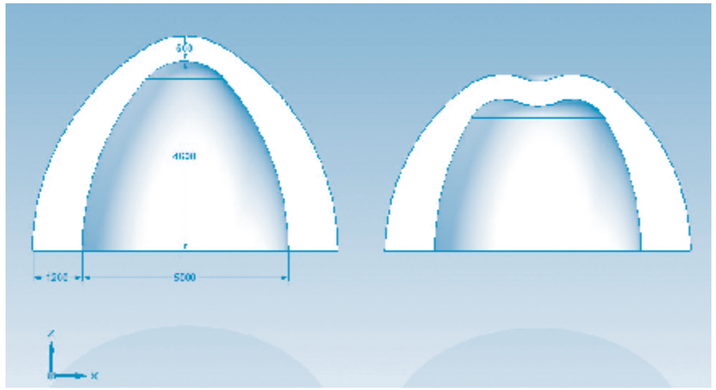

fig. 4 Retention of the original structural shape in snow, ice and slush structures (RAMK 2010)

Sag

The limit value for a free-standing structure is L/5 (RIL 218-2001, 40), where L is the reference point's vertical distance from the bottom edge of the structure (fig. 2).

The limit value for vault, arch and dome structures is L/8 (RIL 218-2001, 40), where L is the vertical distance from the bottom edge of the structure to the highest point (fig. 3).

The reliability and permanency of the reference point at the bottom edge must be verified

Window and door opening functionality

Retention of the original structural shape must be verified particularly in vault, arch and dome structures (fig. 4).

If a structure loses its original shape, its use must be suspended until the prerequisites for further use of the structure are verified.

For example, a vaulted arch that sags to a horizontal shape always means use of the structure must be suspended.

Designing snow structures

In Finland, snow structures are designed according to the guidelines published by RIL - Finnish Association of Civil Engineers in 2001: Design and Construction Guidelines for Snow Structures, RIL 218-2001.

The Design and Construction Guidelines for Snow Structures are used when:

Load-bearing structures are constructed from snow

The density of snow in a load-bearing structure is 400–800 kg/m3

The minimum density of snow is 400 kg/m3

Construction requires a permit

Short-term seasonal structures (service life less than 6 mo.) (RIL 218-2001, 7).

In designing snow structures, particular attention must be paid to the following:

- Balance, i.e., stability
- Falling over, if the structure is thin or over 4 m high
- Breakthrough, usually shearing in the upper part of a dome structure.

Tensions and deformation are calculated with the help of a structural model. The structural model is made using the structure's nominal dimensions. Calculations are done according to the RIL 218-2001 guidelines, taking into consideration changes in the structure's geometry caused by sagging and the impact of weather. In these calculations the service life of the snow structure is divided into load periods.

Designing ice structures

The loads of ice structures are calculated as described above. The density of ice used in calculations is 920 kg/m3 regardless of whether natural or artificial ice is used. The thawing effect of the sun and the eroding effect of wind must be taken into consideration in specifying structural thicknesses. Certain parts of the RIL 218-2001 Design and Construction Guidelines for Snow Structures can also be applied when designing ice structures.

A special property of ice is its weak impact resistance at low temperatures. The impact resistance or so-called toughness of ice increases as its temperature rises. This must be taken into consideration during design, construction and use of the structure. Ice structures are designed at a temperature of 0 °C, where various studies have indicated that the material properties of ice are most reliable and adequate safety during the service life is achieved.

The size and shape of the crystals in ice and the relative alignment of their axes have a major impact on strength and deformation properties. Therefore, ice structures must be designed so there is minimal variance in the crystal structures in different parts of the structure. The design should ensure that when pieces of ice are used, they must be installed so the direction of freezing is towards the force of compression.

The load exerted on ice should be designed to be as small and constant as possible during the service life of the structure. When the load is kept constant, three different phases can be observed in ice during time-dependent deformation (fig. 5) (Kilpeläinen, Mäkinen 2003, 52).

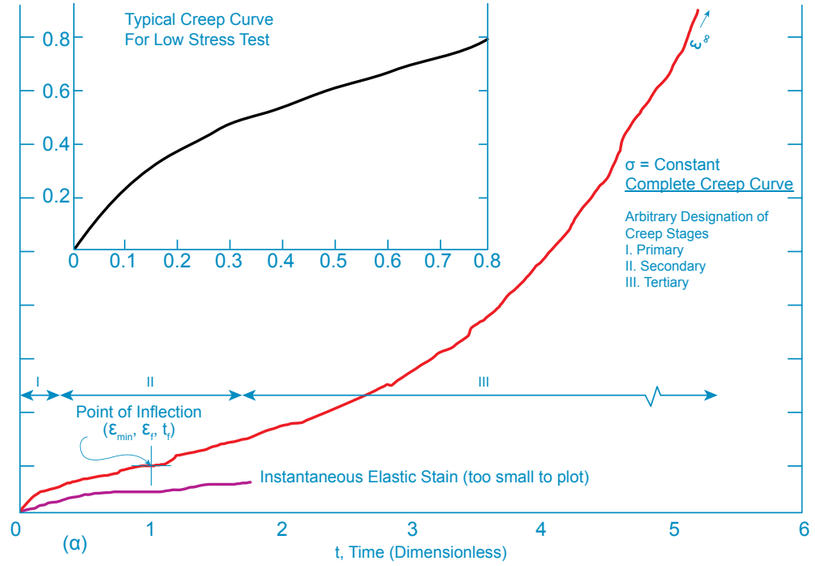

fig. 5 Time-dependent change in ice load (Kilpeläinen, Mäkinen 2003).

Time-dependent deformation in ice consists of:

Primary deformation, which takes place at the beginning of the graph.

Secondary deformation, where deformation increases at a nearly constant rate.

Tertiary deformation, if loading is heavy enough. A breakage state is reached.

The following condition must be verified in designing an ice structure: compression strength σ in the serviceability state in relation to the temperature of the ice T must satisfy the equation (Kilpeläinen, Mäkinen 2003, 62.)

$\sigma \leq -0{,}1 \cdot T + 0{,}2$ MPa

For example, if the temperature of the ice is -10 °C, compression strength must be **$\sigma \leq 1.2$ MPa.**

In designing structures made from pieces of ice, the following principles are recommended in addition to the general design principles:

- The structure should be mainly a compressive structure.
- The thinness and height of the structure should be as follows:

  Maximum unsupported height when using pieces of ice up to 200 mm thick and wide (b x L) is 2 m.

  Maximum height when supported by another structure should not exceed the height of the supporting structure.
- Joints in successive layers of ice should be staggered at least.

  One-half a block when using blocks of ice or other similar formed pieces

  One-third a piece when using long pieces of ice (fig. 6).

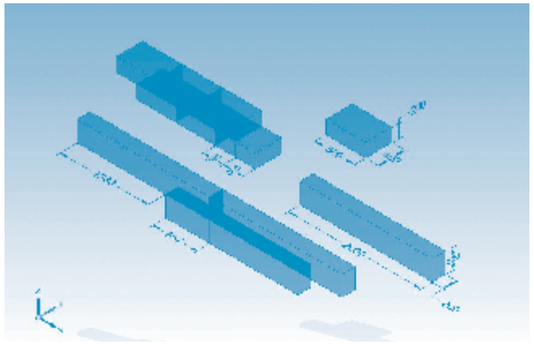

fig. 6 Recommended length of staggering of pieces of ice in ice structures (RAMK 2010).

- If so-called tensile structures, such as straight beams of door openings, are used:

  Maximum width of the opening is 1500 mm

  A tensile structure is allowed only with long pieces of ice

  The support of the tensile structure must be verified.
- Connections between ice and other structures must be verified.

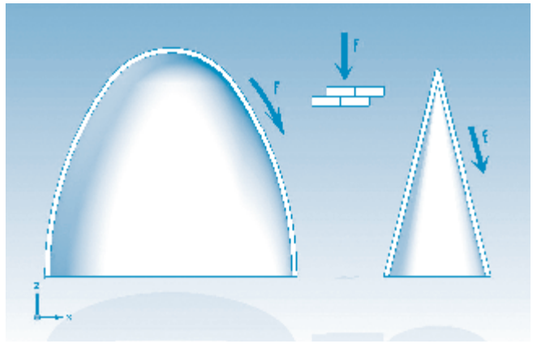

fig. 7 Compressive structures made by freezing (RAMK 2010).

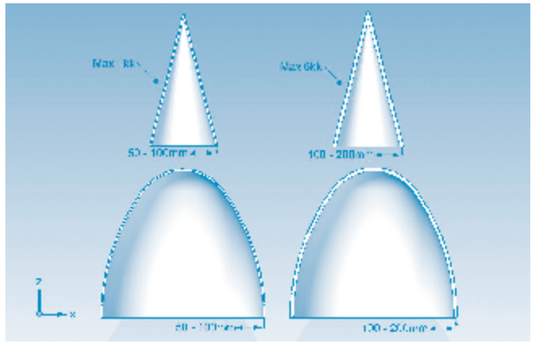

fig. 8 Minimum thickness of a layer of ice in a structure made from ice (RAMK 2010).

In designing structures made by freezing, the following principles are recommended in addition to the general design principles:

- The shape of the structure should be compressive (fig. 7).
- The thickness of a structural layer should be at least (fig. 8)

  50–100 mm in short-term structures (maximum service life 1 mo.)

  100–200 mm in long-term structures; maximum 6 mo, thickness must be verified with calculations, e.g., by applying the RIL 218-2001 guidelines, taking the impact of thawing into account.
- Connections to other structures must be verified.

If air pressure moulds are used, the mould pressure should be specified in the design phase. Mould pressure is sufficient if the pressure carries the mould's own weight and wind load does not move the mould in the initial phase (Kurtakko 2011).

Designing slush structures

Loads in slush structures are calculated as described above. Changes in tensions and deformation which occur during the service life can be calculated according to the RIL 218-2001 guidelines. Slush structures are designed to be constructed so that the slush is allowed to freeze completely as the work progresses. If the slush freezes throughout the thickness of the material, it will be nearly equivalent to ice during the service life. In such a case the guidelines provided for ice can be applied to slush. Then deformation and sagging during the service life of a slush structure are minimal.

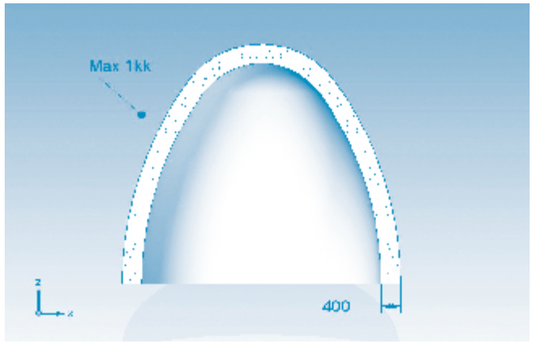

fig. 9 Minimum thickness of slush in a short-term structure (RAMK 2010).

In designing structures made from slush, the following principles are recommended in addition to the general design principles:

- The structures should be compressive.
- The structural thickness should be

  At least 400 mm at the base of the structure in short-term structures; maximum service life 1 mo.

  In long-term structures — maximum service life 6 mo. — structural thickness is specified with calculations according to the purpose of use (fig. 9).
- Connections to other structures must be verified.
- If air pressure moulds are used, the mould pressure should be specified in the design phase.

Type Structures

Type structures are structural moulds which have been used in Finnish snow and ice construction at various construction sites for over twenty years. Type structures are examples of safe, reliable snow and ice structures. The following structures can be used as type structures in snow and ice construction:

1. **Walls, breastworks and towers** (p. 1)

   When constructing from snow and slush or when structures are built from pieces of ice.

   Structures are vertical, usually free-standing structures.

   The shape may be of even thickness or thinning upwards gradually or in steps.

   The design should take into account falling over, tilting and sagging of the structure.

p. 1 Free-standing snow breastwork of even thickness (Ryynänen 2011).

p. 3 *Dome structure (RAMK 2010).*

p. 2 *Arch-shaped snow tunnel (RAMK 2010).*

p. 4 *Elliptical structure in the Kemi Snow Castle in 2009 (RAMK 2010).*

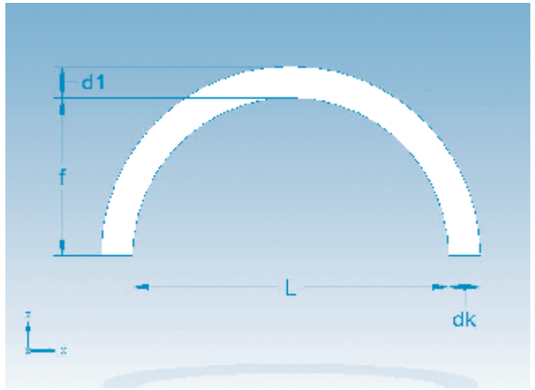

fig. 10 *Proportions and components of an arch structure (RIL 218-2001).*

2. Arch and vault structures

Constructed from snow and slush or by freezing (fig. 10) and (p. 2).

The main structural tensions are compressive; the best shape for the structure is a catenarian curve.

The ratio between the pitch of an arch or vault f and the interior span L when the structure is taken into use must be at least f/L > 0.5 (RIL 218-2001, 44).

The ratio between the thickness of the base of the structure dk and the span L must be at least dk/L > 0.2 (RIL 218-2001, 44).

The ratio between the thickness of the peak of the structure dl and the span L must be at least dl/L > 0.1 (RIL 218-2001, 44).

3. Dome structures

(p. 3) and (p. 4)

When constructing from snow and slush or by freezing.

The ratio between the pitch f and the interior diameter L when the structure is taken into use must be at least f/L > 0.5 (fig. 15) (RIL 218-2001, 44).

The ratio of the pitch f/L of an elliptical structure is not constant in all directions. Elliptical structures always require a layer of ice as a load-bearing layer. An elliptical structure must be constructed as a three-layered structure with ice, slush and snow layers.

Construction moulds suitable for snow and ice construction

Construction moulds give snow and ice structures the correct shape during the construction phase. The mould material can be almost any available mould material, such as, construction sheets, sheet metal, plastic or wood.

The mould should be designed to withstand mould pressure caused by construction so that the mould does not move or collapse due to the weight of the material. The mould should be designed by a professional. The design procedure depends on the shape of the structure and the mould material (Ryynänen 2011, 39).

In Finland, the calculation procedures for wall, arch and dome moulds presented in the RIL 218-2001 guidelines are used for snow structures.

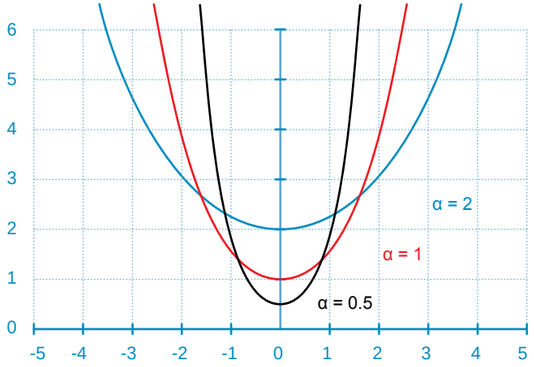

fig. 11 Graph of a catenarian curve (according to Ryynänen 2011, 41).

When arch-shaped moulds are used to build from snow and slush, an arch shaped like a catenarian curve works best. A catenarian curve — the graph of a hyperbolic cosine — is formed by suspending a flexible chain or rope between two supports; (fig. 11) and (p. 5) (Ryynänen 2011, 40).

The mathematical equation of a catenarian curve is:

$$y = a \cosh\left(\frac{x}{a}\right) = \frac{a}{2}\left(e^{x/a} + e^{-x/a}\right),\ a > 0$$

p. 5 Steel vault mould shaped like a catenarian curve (Ryynänen 2011, 41).

p. 6 Catenarian curve-shaped air pressure mould (RAMK 2010).

Studies conducted in Finland have determined that when constructing from snow and slush, a catenarian curve functions also with domes in which the shape of the curve appears in the cross-section of the dome in all directions; (p. 6)

It has been observed that there are limitless possibilities to use air pressure moulds which take the shape of a catenarian curve in snow and ice construction. However, the dimensions of the snow and ice layers in the structure must be verified. Future research should focus on finding new structural shapes.

Safe Construction Process

Official guidelines and supervision of snow and ice construction

In Finland, construction of buildings or structures intended for professional use — such as in the tourism industry — from snow and ice requires a planning or building permit. This especially applies to cases where structures are constructed from snow or ice and people will be underneath or inside said structures during their service life. In Finland the building supervision authority specifies the necessity and type of permit. The objective always is to ensure the safety of the users of the structure (Ryynänen 2011, 48).

In Finland, a building permit may be granted for a fixed-term or temporary building. A building permit may be granted for one time or for a five-year period, for example. A building permit granted for several years must include yearly inspections of the plans if the same structural moulds are used to construct an entity from snow and ice, but the layout of the components changes each year.

The designer of a snow and ice building in Finland must be a sufficiently competent person with necessary training in the sector and experience in similar design jobs. According to the Finnish guidelines, the construction phase of snow and ice construction work must be supervised by a sufficiently competent, trained person (National Building Code A2, 2002).

Finland's authorities who supervise construction and use have specified that the following guidelines must be observed in snow and ice structures:

Building fire safety:

In case of a fire or other emergency, it must be possible to exit from the building safely.

The building must have an adequate number of suitably situated, sufficiently wide and easily navigable exits. The functioning and usability of the exits must be verified during the building's service life, taking into consideration structural sagging.

Every evacuation area in the building that is occupied by employees or other persons more than temporarily usually must have at least two separate appropriately situated exits.

Suitable and sufficient means for extracting smoke must be designed and constructed in all the rooms in the building.

Structures used as lodging or meeting rooms must be equipped with exit signs with a battery backup. Small structures with no lodging rooms may be equipped with phosphorescent exit signs. Lodging rooms must be equipped with fire detectors designed for cold climate conditions.

If necessary, the building must be equipped with adequate and appropriate fire extinguishing equipment.

Maps of exit routes must be situated in visible places in the building (e.g., lodging and meeting rooms).

Sufficient routes must be provided for emergency vehicles. They must always be in navigable condition, unobstructed and properly marked (Leiviskä, Pitkänen 2003).

F1 Accessible construction:

Snow and ice buildings usually are places to which everyone must have access. The rooms must be designed so they can be used by disabled persons (National Building Code F1 2001).
Thus, attention must be paid to travel routes, ramps and WC facilities.

F2 Safe use of buildings:

Attention must be paid to at least the following items in connection with snow and ice construction: stairs, handrails, guardrails, adequate lighting and anti-slipping measures (National Building Code F2 2001 and Pitkänen 2003).

Permits required for snow and ice construction

In Finland the municipality's building supervision authority specifies in each case whether a snow and ice structure requires a planning or building permit or if the structure can be constructed without a permit by following a declaration procedure. The person engaging in a construction project must determine the need for a permit together with the building supervision authority.

According to the guidelines used in Finland, a construction permit procedure is necessary in at least the following cases:

A snow and ice structure in which professional lodging or restaurant operations are practiced (a building permit is always required)

Rooms intended for overnight stays

Rooms used as cafeterias, where meals, beverages, etc., are served

A chapel or other similar meeting room.

The shape and size of the snow and ice structure are such that users go inside the structure or underneath load-bearing structures.

The snow and ice structure is built in a public place like a square or other similar area and it is open to the public.

In Finland, depending on the purpose of use of the snow and ice structure, compliance with other official permits and guidelines may be required during its construction and use. In Finland, this includes, for example, a license to dispense alcohol, a rescue plan or an operational safety plan.

Monitoring Structures During Their Service Life

Snow and ice structures must be monitored during their service life. Monitoring includes daily maintenance inspections and long-term monitoring, such as measurement of deformation. Responsibility for monitoring structures during their service life must be assigned to specific persons who monitor the structure's operational safety and assume responsibility for its use during its life cycle. In Finland, a separate operating and safety plan is compiled for each snow and ice building site as a part of its construction (Ryynänen 2011, 56).

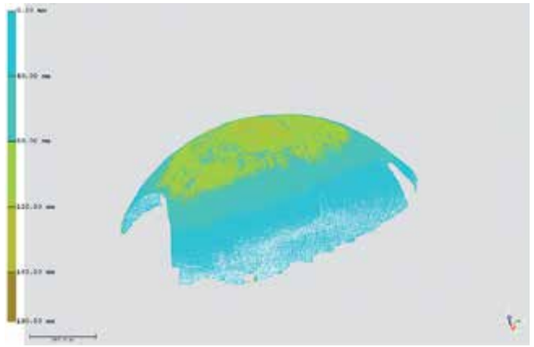

fig 13 Laser scan measurement result as a sag map (RAMK 2010).

Structural deformation

Deformation of snow and ice structures must be monitored during the structure's entire service life. The deformation measurement points and measurement intervals for each load-bearing structure must be specified in the building plans.

Monitoring of deformation must employ sufficiently reliable measurement procedures that depend on the size and shape of the structure. The deformation measurement data must be recorded in a measurement log and appended to the structure's operating and safety plan.

Deformation measurements may be done manually or electronically. Manual methods include measuring rods and plates with which sagging can be observed. Electronic methods include tachymeters and laser scanning. Both methods have been used in Finnish snow and ice building sites. Electronic measurement methods, in particular, provide reliable measurement results; (fig. 12) and (fig. 13) (RAMK 2010).

Reference points that are critical from the standpoint of the functioning of the ice and snow structure are chosen as measurement points. The measurement points are marked in the relevant drawings. Critical points include:

The highest point in the structure

Boundaries between different materials

Door and window openings and other weak points in load-bearing structures

In arched structures, the highest point, halfway points and base of the arch

In free-standing structures, the highest point and halfway point of the structure (Ryynänen 2011, 56).

fig 12 Sag of a snow structure as a laser scan drawing (RAMK 2010).

Hardness and density of the structure

The hardness of the structure must be monitored during its service life by measuring it at regular intervals. Hardness is monitored with measurements and visual observations. Hardness can be measured with a steel bar, for example; the amount of penetration of the bar indicates the hardness of the structure.

The density of the snow and slush must be verified during the construction phase. The density of ice structures changes minimally during the normal service life of the structure.

With reliable monitoring of deformation and hardness it is possible to verify changes in the strength of the structure during its service life. Density should be measured if a specific reason for doing so becomes apparent. Such a reason could be a sudden period of warm weather during the structure's service life, for example.

The density of snow and ice can be determined with a weighing-immersion method, for example. Instructions for using the method are given in the RIL 281-2001 guidelines and the Snow and Ice Construction Guide (Ryynänen 2011, 133).

When thawing begins, the crystal structure of snow, ice and slush material changes both internally and externally. Snow and wind cause the structure to soften at the surface, and the material changes from a solid to water and water vapour. During the thawing process, melting occurs during the day and partial freezing takes place at night when the temperature drops. This phase of thawing and freezing partly improves the durability of the snow and ice structure (Ryynänen 2011, 65).

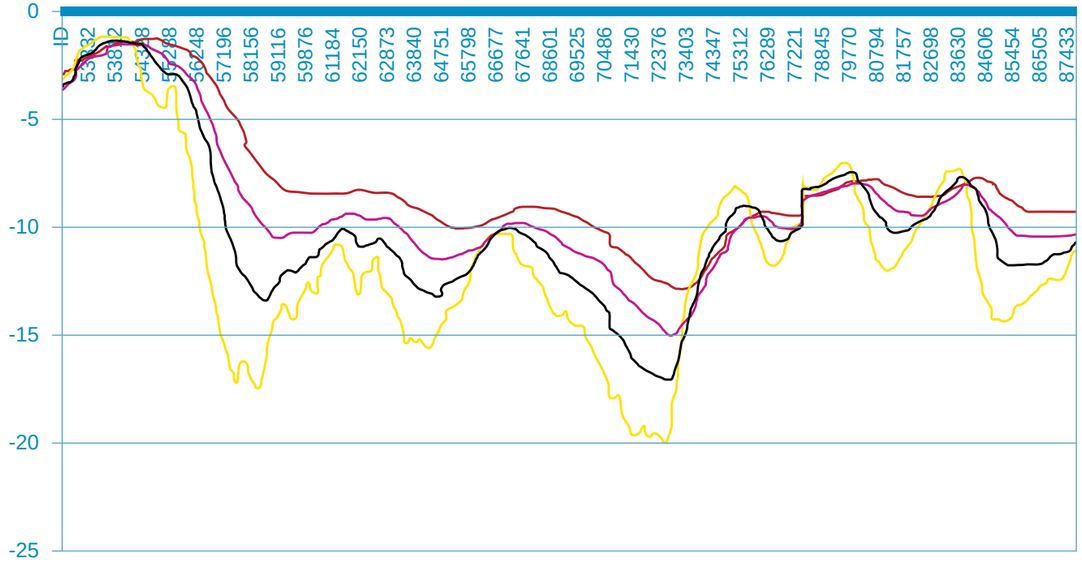

fig. 14 Change in the internal temperature of an experimental snow structure (RAMK 2010).

Temperature of the structure

The internal temperature of the snow, ice and slush structure must be sufficiently low during the structure's service life to ensure the functionality of the material. According to the RIL 218-2001 guidelines:

"The temperature of snow structures must be measured if the indoor and outdoor temperature has been above zero continuously for over 48 hours. The structure must be measured at a depth of at least 20 cm from the surface. The measurements must be made in structures with a snow roof." (RIL 218-2001, 67).

The measurements must be monitored to verify warming and thawing of the structures. When the internal temperature of the structure rises above -1.0 °C, the density of the structure has to be monitored (RIL 218-2001, 67).

Prior studies have indicated that there is no need to monitor the internal temperature of thin structures. Usually, by the time the internal temperature of a thin structure rises above -1.0 °C, the structure has nearly always already lost its load-bearing capacity (Ryynänen 2001, 62).

The internal temperature of a snow structure is not constant during its service life. Prior studies have indicated that the internal temperature of a snow structure follows changes in the outdoor temperature with a certain delay; (fig. 14) (Ryynänen 2011, 62).

Ending The Use Of And Dismantling A Snow And Ice Structure

If one of the following limit values is reached during the service life of a snow and ice structure, use of the structure must be suspended. If the suspension lasts long or the cause cannot be eliminated, dismantling of the structure should be considered (Ryynänen 2011, 67).

The following situations can be used as limit values for dismantling:

1. A load-bearing structure has sagged or tilted beyond the allowed limit value.
2. A load-bearing structure has fractured/collapsed.
3. The internal temperature of the material has risen above the specified limit value.
4. The material's properties have changed so that they no longer fulfil the properties of slush, for example.

The user and the party responsible for maintaining the snow and ice structure specify the time point when the structure must be dismantled. The authorities may also appoint an external party who specifies the conditions for dismantling the structure; for example, sites that involve special procedures. When a snow and ice structure is dismantled, it must be broken up sufficiently to prevent its further use for its original purpose. Load-bearing structures must be dismantled completely.

The dismantling process must be documented with photos, and a written notice of the end of the service life and the dismantling of the structure must be submitted to the authorities.

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Massive Snow Structure Projects

From design to construction and destruction

Taavi Heikkilä

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Translated from Finnish by ABC käännöstomisto

The article's pictures are from Snowkemi's Snow Castle construction and the ready facades Photographer – Timo Laapotti

The implementation of massive snow and ice structures is project management at its best. In the planning phase, actors from many different fields come together and the plans are created in cooperation. Creating massive snow structures is a subject to several permits in many countries. The starting point of the design includes, in addition to the desired end result, complying with the legal requirements that apply to building with snow and ice. The placement of the construction sets its own demands on the building phase and the structure to last and remain safe the required time. Building with snow has reached a strong basic knowhow in Finland, next follows accepting the new challenges.

The implemented large snow structure projects mainly associate with tourism. In the future, snow and ice structures will also be utilized in larger scale for other lines of business from the general use to marketing and promotion.

The starting point for a massive snow structure project begins from an idea or a need that creates the basis for launching the construction. The massive snow structure projects usually require the development of a solid infrastructure. It usually means that the projects are developed with several years keeping the activity in mind from the start. An on-going project can also be developed further each year. In most cases the structures melt during the summer and need to be rebuilt in the following season. The implementation of a project is divided into five stages:

1. Planning,
2. Building,
3. Maintenance
4. Dismantling
5. Development.

If the project is intended to last for several years, the stages will repeat and the project develop in this way.

The planning stage will begin by defining the needs. A spatial planning program can be created as a tool for planning, where the required spaces and functions are defined and the questions ‘for who’ and ‘what’ answered. Choosing a location is an important part of the basic definitions, which will impact on the overall cost. Creating snow requires water. It can be supplied from natural reservoirs that fulfil the criteria or utilized from the solid water supply network. Despite the popular conceptions, massive snow structures are not created from natural but from artificial snow.

The ice used in the construction is taken from natural water systems. Artificial ice is mainly used in smaller structures due to its high costs. Important criteria in choosing the location includes water, sewage and electricity networks and the necessary connections for transportation with heavy duty equipment. The location needs to be flat and functional in terms of maintenance. In the spring the run off water often creates larger problems at the site than the melting of the structures.

The planning of the snow structure can commence on the basis of the spatial planning program and the chosen location. Planning management has an important role in a project where professionals from many fields are participating in the build in order to reach the required end result for the customer. The person functioning as the main planner, usually the architect, must know the possibilities and limitations of snow and ice building when defining the layout and the visual look. For the customer a cost effective model includes leaving the design responsibility to the implementing organization where the main planner / architect will do the planning in cooperation with the implementer. The planning team will include, in addition to the implementing organization, representatives of the customer, electricity/lighting designer and the (artistic) leader of the carving team. The project will proceed on the basis of the plans created. More exact plans are created for the possible spaces and facades included in the structure, from where the carving team will plan detailed spaces without forgetting artistic licence. The last step in planning is the electricity and the lighting schemes. They are defined besides the planning of the ice structures and sculptures to be created. Large projects usually require temporary building or operation permits from the local building supervision agency, which means that the rules will vary from country to country and area to area.

Before the building starts, the construction equipment is serviced and prepared for the build. Old, existing molds are developed and improved every year and new ones added according to needs on the building site. Each year points of improvement are noted and written down during the construction process. The financial impacts of the development ideas are estimated and based on the estimation the saved costs and improved quality will be taken into production. Over the years there has been significant development of the snow and ice equipment allowing the implementation of different kinds of structures. The implementation techniques between snow and ice and the mold structures to be used are chosen based on the demands of the site. The implementing organization must have efficient and safe equipment available in order to produce the quality defined by the needs of the site.

When the weather permits, the building begins by creating snow. The starting date is planned based on long-term weather predictions and by comparing different predictions together. Depending on the size of the project and the equipment in use, the required amount of snow is created about a week to the manufacture. It is challenging to judge the right starting time as creating snow requires a steady freeze of about – 10 °C continuously during the operation whereas the actual building can be done with warmer weather. A tight building schedule of large projects puts pressure to start the snow creation as early as possible. If the weather warms above the critical levels, too early start can bring challenges in creating the snow and with the melting of the already created snow. The snow used in the building must be dry enough to ensure tight and lasting structures.

The ice used in the structures and sculptures is usually taken from the immediate vicinity. A mild winter can create challenges when there is not enough time for suitable solid ice formed by the required date. The formation of ice can be accelerated but in the worst situations it may have to be transported from colder areas or use the manufactured ice. It is critical to time the harvesting right as ice is needed at an early stage of the building. If the ice isn't available on time, it will impact negatively on the time schedule. Also harvesting ice during very cold weather is challenging and uneconomical.

Even with large projects the actual building schedule is only a few weeks each year, as the time used for building is time away from the productive season of the project. All the preparations must be done before the building. The tight schedule and varying weather conditions create challenges for project management. It needs to be made sure that all parties involved in the building from sculptors to electricians can start to work as efficiently and continuously as possible.

For the most part the building will progress as follows:

1. Snow structures
2. Ice structures
3. Electric work
4. Sculpting
5. Lighting
6. Complementary structures (doors and gates)
7. Customers equipment (such as restaurants and hotels).

The biggest challenge is to finish the large snow structures and spaces in time so that all teams can begin implementing their tasks in different areas in time. The project and schedule management have an important role. Each team must have its own leader responsible for the work of the team. The team leaders on site need to be in constant communication and have meetings with the other teams involved in the process.

In most cases the finishing schedule of the sites have been defined beforehand. Even if there are delays due to the weather, all work must still be finished by the opening date. Challenging conditions, cold and windy weather, the damages of the machinery, and especially the fatigue of the workers require special anticipation and maintenance of a safe working environment in order the project to be finished. Work may have to go on in shifts and for long periods. Estimating the risk present at the site has a large role in the action and quality planning. Risk management ensures first and foremost a safe site but also fast and efficient working methods. Challenging conditions are met with the right clothing made of wind and water resistant materials, which can keep the body temperature up but will also evaporate moisture.

Before the opening an inspection is carried out where the safety and compliancy with the original plans is verified by several official agencies. The customer will receive the construction after the inspection is completed. The inspection is usually run by building control, emergency and health officials. The targets of the inspection include the structural elements, safe use and actions during emergency and accident situations. The structures must comply with the plan and be implemented using the defined building methods, which ensure safe structures in use. Passages, slides and other functional structures must be safe to use. The access to the area by fire and rescue personnel must be planned and unhindered in case of accidents. Emergency exits inside the structure must be marked.

A massive structure will have no more than 3-5 months of use during a season. Large numbers of visitors mean that the structure requires continuous maintenance and service. Snow structures settle which is why entrances will need to be lifted during the season. Visitors bring snow from the outside and this will freeze onto the pathways in uneven patches. Removing these is absolutely necessary to prevent customers from slipping. In addition, the snow work outside must be done at the sites just as at other buildings. The actual structures do not need maintenance, but any changes are continuously monitored by measuring the inside temperature and using temperature sensors installed in the structures. When the temperature inside is close to 0°C, the use of the structure is monitored closely, and when the temperature is above 0°C, the structure will be closed from use.

Massive snow and ice structures are dismantled once the season is over depending on the location, if safety requires it. The dismantling is implemented by removing the solid structures and furniture, such as doors, gates and the beds of a snow hotel. An electricity contractor will remove lighting and cabling, after which the structure is destroyed using machinery and transported to a location to melt, if necessary. Yearly stress tests are done on the structures during dismantling where structures that have been in use for a season are stressed and weakened to induce collapses. According to the tests structures that have been closed and weakened by rain have fulfilled the requirements placed on them.

The lessons learned during the season are collected and handed over to the development department for evaluation. This way the projects evolve from year to year into better functioning and more experiential sites. Development work itself is continuous and new techniques are tested in order to implement snow and ice building in even larger sites and more challenging conditions.

Lighting Design Technology

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The article's pictures are from the Arctic Snow Room 2012 and the Arctic Design Show Stage 2014

What is light architecture?

All existing construction forms and structures require light in one form or another to become visible. Therefore, light architecture is a subject that is applied to every design site. What is light architecture? Architecture is generally regarded as being much more than just the sum of the realisation of functional, economic or otherwise practical objectives. It is something more than just a regular building. It is a multisensory experience on many levels, where the true spirit of the place is recognisable, making it a memorable sight.

Form, colour, distance, space, size, pattern and perspective are incomprehensible without light. Light facilitates shaping and changing the visible architecture. The character of a structure is never the same in artificial light as it is in daylight. Using artificial lighting, desired characteristics can be enhanced, and new characteristics added. Lighting design not only conveys the desired message, but also totally new experiences. Providing lifetime experiences is the most important factor for snow and ice constructions.

Lighting methods and direction in snow and ice structures

A snowy environment is always different to a snow-free environment when it comes to illumination, as the site and surroundings to be illuminated are made from the same wintry material; snow and ice. Nevertheless, the same basic elements apply to lighting methods: highlighting and silhouette lighting. With highlighting, the object has a lighter shade than its background and is easily distinguishable. Lights are installed between the viewer and site, which makes the lighting impression static and permanent. With silhouette lighting, the object is lit from behind or illuminated against a larger surface behind, thereby detaching the object from the rest of the surroundings. Ice as a material provides new possibilities for silhouette lighting. Lights can be placed inside ice, which enhances the light penetrating characteristics of ice. Angled lighting brings out the surface texture and increases the dramatic impact.

Photographer – Antti-Jussi Yliharju

The purpose of dynamic direction of lighting is to emphasise attention on the desired object. In addition to ready-programmed lighting, assistance can also be sought by using motion detectors, heat detectors or other devices that measure the surroundings. In this way, the person visiting the site can become an active participant as the person's presence affects the lighting of the surroundings. Lighting direction can also mean much more. Lighting that changes slowly to the rhythm of the week or day are changes that cannot even be noticed during brief periods. In fact, any information containing variables can be turned into an aesthetic lighting piece. In lighting direction, your imagination is the only limit.

LED

The development of LED technology as an energy-efficient source of light has revolutionised the lighting sector and particularly lighting of snow and ice. Here are six facts associated with the use of LED lighting in snow and ice structures:

Photographer – Antti-Jussi Yliharju

1. LED lights do not radiate heat away from the light as more conventional light sources; rather the heat is transferred to the frame and from there into the surroundings. This facilitates the placement of the light source close to the object to be illuminated, without having to worry about melting.

2. LED lights are energy efficient and consume very little power. This facilitates the illumination of large object with much smaller energy consumption than before.

3. LED lighting is especially good for producing coloured lighting. The LED light generation is based on a process that produces almost monochromatic light. The generating of coloured light is powerful, as no separate colour filters are required. By combining the colours of RGB LED lights, all the necessary colours are achieved. The best light efficiency is achieved by using so-called cold white light.

Photographer – Anni Heinilä

4. LED lighting is a long-term investment as a lighting source. Temperature significantly shortens the LED lifetime. In cold snow and ice environments, the lifecycle of high quality LED lights is usually in excess of 50,000 hours. A LED light is said to have reached the end of its lifecycle when only 70% of its light is left.

5. The lighting efficiency of LED lights does not yet quite achieve that of public lighting in conventional habitats, but in the winter environment the white colour of the snow multiplies the amount of light, making it possible to provide sufficient lighting using even a small source of light.

6. Comparing LED products with one another is challenging, because there is no comprehensive standardisation for the testing of LED characteristics. Getting the right LED lights and utilising all the benefits provided is achieved with expert designs.

Safety & Security

Safety and security associated with lighting comprises construction period safety and ensures security after commissioning. During the construction stage, all normal safety regulations concerning construction employees are adhered to. Furthermore, safety has to take into consideration some special characteristics of snow and ice construction, such as slipperiness, coldness, etc.

Prior to taking the site into use, it must be verified that the safety of visitors is assured.
In respect to lighting, this means the following:

1. Manufacturing instructions have been followed for the installation of lighting.

2. Receiving electric shocks from the lights or cable surfaces is not possible.

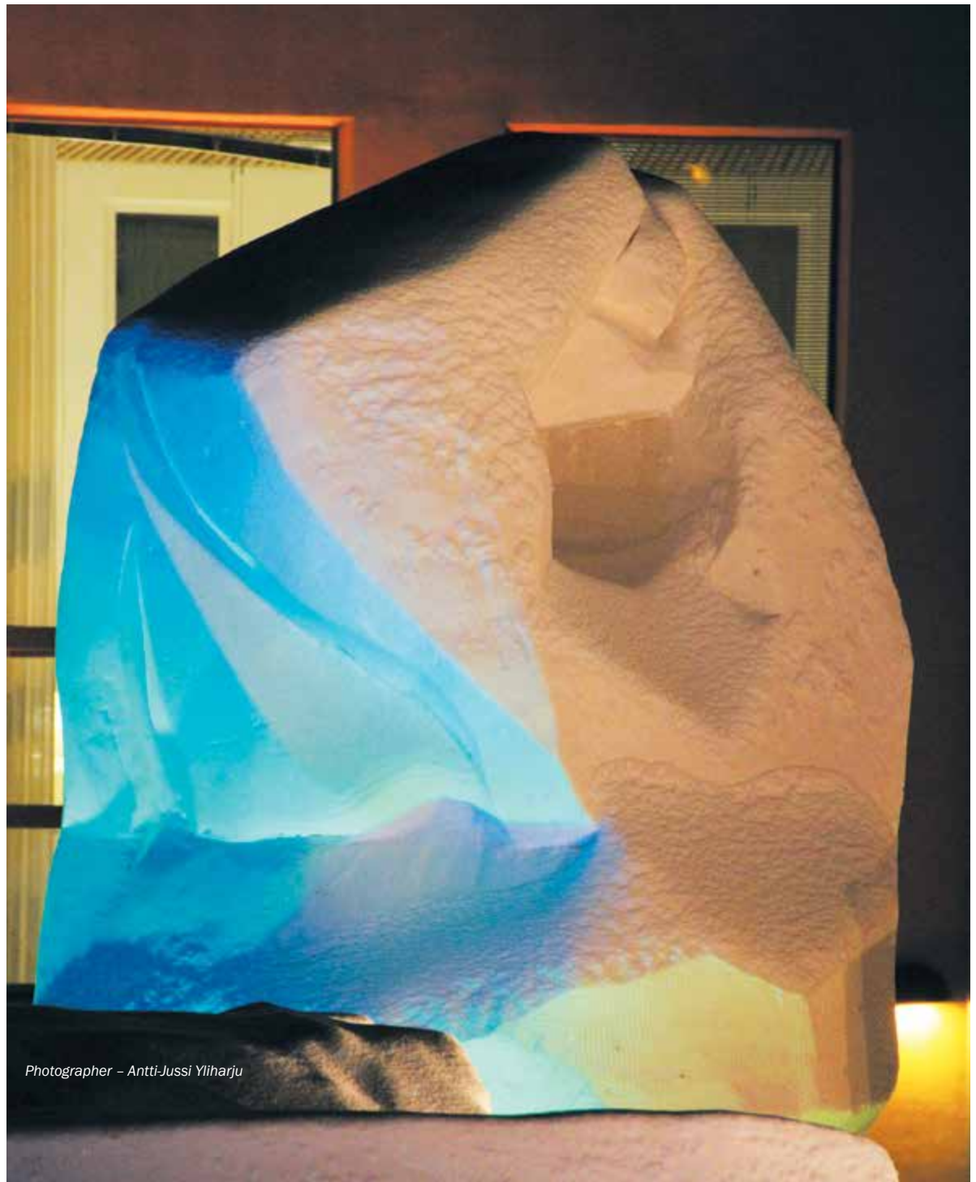
3. Lights are not within the reach of children.

4. Prevention of glare, especially when slippery or on a gradient.

5. Tripping over lights, lighting supplies or cables has been prevented. Lighting power cables warm when used. Uninsulated cables thaw the surrounding snow and ice and may become visible.

6. Heat-producing lights shall not cause risks to humans or structures.

7. Emergency exit lighting is always in order.



Photographer – Antti-Jussi Yliharju

Approval is required for public lighting

In principle, the illumination of the façade of a snow structure must always be suited for its environment, and it cannot disturb those living and using the area. Illumination of snow and ice is, however, usually associated with commercial activity and is seasonal, so exceptional permits are granted and plenty of façade lighting that is unsuitable for the environment can be found. Depending on the site, approval should be sought for the lighting designs. The place to seek approval could be:

Neighbour
Building authorities
Façade Board
Property proprietor
Aviation and marine traffic authorities
Other external bodies

The important role of planning in advance

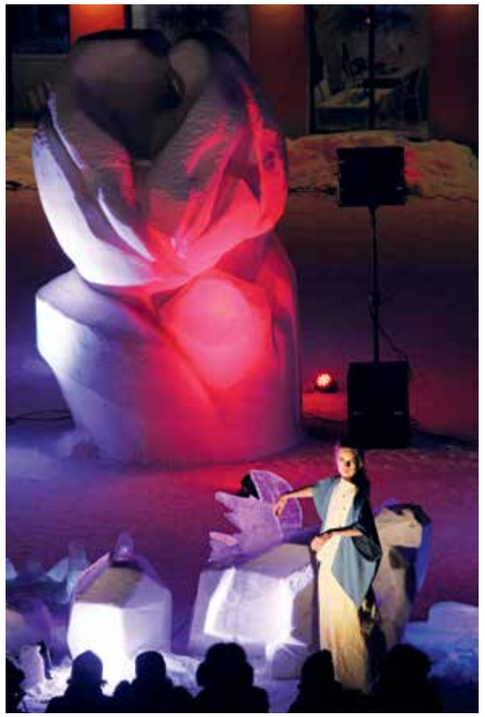
Advance planning plays a vital role in designing lighting for snowy and icy environments, as it will allow for problems and delays to be minimised during the actual construction stage. A quick construction period is typical for snow and ice constructions. When the conditions are right, construction is commenced quickly and depending on the site, can take from a single day to a few weeks. Lighting usually has to be completed at the same time as the construction. More important factors in the advance designs for the lighting of snow and ice environments are:

1. Electricity supply to the area and within the area between sites, e.g. crossing access ways and taking cables through walls and the roof.

2. The location of the electricity board should be such that it allows easy access without disturbing other operations. In addition, access to the electricity board needs to be quick in closed spaces, e.g. for electricity faults, especially if no reserve system for lighting is available.

3. Advance planning for hanging lights. If the lighting designs include lighting that needs to be suspended, the location of the fixing point should be known in advance, in order for these to be taken into account in the strength of the structures.

4. Organising experimental lighting at the site. Only then are all the factors in the environment verified. The modelling of the entirety into a 3D environment can often replace the need for test lighting.



Photographer – Antti-Jussi Yliharju

Advance planning is conducted in cooperation with the client, structural designer and contractor. Electrical planning is also required for larger sites. Other bodies that can participate in the planning can include, e.g. snow and ice sculptors, audio designers, the entrepreneur working at the site or the local council representative. Advance planning commenced in sufficient time serves everyone involved in the project.
The modelling of lighting ever increasingly utilises computerised 3D modelling software, using which it is possible to model almost everything associated with the site to be illuminated. Visual modelling helps in visualising the end result of lighting in advance. In addition, technical data is received concerning, for instance, the energy consumption of the lighting for the site during the winter months, or the calculation of the actual amount of light produced with the lighting. The making of cost calculations is also much easier once the requirement for equipment and energy is already known in advance.

> “The purpose of lighting designs is not to add light, but to add planning”

Juha Laakko
Elina Männikkö

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Elina is a fourth year student of engineering at the Lapland University of Applied Sciences. She studies Information Technology and is oriented to Software Engineering. She is doing her thesis on the development of the Lapland Snow Design application and making an interior design tool to the application. She is also working as a project trainee in Software Engineering Laboratory pLAB.

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Development of Application Software for Designing Snow and Ice Structures and Interiors

http://laplandsnowdesign.fi/snow-design-application.html

Snow and ice are useful materials for modelling and designing the experience, sensation and tourism environments in Lapland. These materials are nowadays used in several ways for tourism and marketing purposes. Arctic conditions are desired to be exported abroad, and thus different companies in Lapland constantly develop new ways and ideas to be exported anywhere.

One of the export concepts is so called Lapland Snow Design Application, which enables designing and building snow and ice environments on the Internet. It is an interactive design tool for constructing example snow constructions from available pre made snow models. The application was developed by a group of Lapland University of Applied Sciences (Lapland UAS) students in cooperation with the Lapland Snow Design project. The tool was initially prototyped in summer 2012 and majority of the implementation work occurred during 2013. This paper is intended to give the reader an overview of the tool and the used technologies. It highlights some of the solutions provided and discusses the design choices made during the construction.

The Software Engineering Laboratory pLAB

The developer behind the application is the Software Engineering Laboratory, pLAB that locates in Rovaniemi, Finland. pLAB is specialized for real-time interactive 3D environments and using modern game technology for visualizations, simulations and serious gaming solutions. pLAB also realizes lots of different kinds of solutions from web-pages, mobile solutions to desktop software. pLAB offers developing services for different interest groups and supports functions for companies. The goal of pLAB is to support the R&D actions of Lapland UAS and also to help the integration of education to these functions. pLAB's strong points are the comprehensive knowledge of different areas of software engineering and experience of national and international R&D -projects. It also provides students with the opportunity to further their skill in real working life environment and R&D -projects. pLAB is a widely networked, international software engineering laboratory that has a comprehensive knowledge of R&D functions. It co-operates with other laboratories of Lapland UAS and supports them with the high quality software services.

Overview of the system and specification of the Application

The concept behind the Snow Design Application software is that it enables anyone to design snow and ice environments by using the pre-defined models of the application. The models are based on the tested real-life models that have been applied in various snow environments in Lapland over a number of years.

The outline and framework for the tool was set in a series of discussions within the Lapland Snow Design project group and the discussion's set of 'rules' were drawn and refined in form shown below to serve as guidance for the requirements of the environment. The base definition for the tool and environment was to allow people regardless of their backgrounds to design their own 'snow environments' in an easy and playful manner.

fig. a Designing the structural layout

Rule 1. The platform must allow users without specialized training or experience to construct and experiment their own snow environment constructions from the set of available premade real-life constructions. The platform must be easy to use and engage user experimentation in game-like, playful manner.

Rule 2. Serve as communication platform between potential customers and snow construction companies who could implement the potential customer's construction. This would make the tool usable for companies and customers as a sketchpad to quickly visualize ideas and gain mutual understanding. Potential customers could design their construction, save the scheme for themselves and take contact transparently to the actual companies who would then go trough bidding and further design discussions with the customer using this scheme as basis.

Rule 3. Promote snow construction, knowledge and design know-how of the Lapland Snow Design project consortium. Majority of the models for the 3D environment should be available from the constructs local companies offer. As such, the constructs and designs used inside the tool should be physically sound, sized and look & feel like their counterparts in real life.

These rules led the design of the tool to be divided to three distinct components:

1. a design view where the users can proceed the actual construction process

2. the visualization view where the users are able to view their constructions in 3D format and would be able to walk through and possibly interact with the construction and

3. finally the communication layer where the database and contacting platform would reside.

Unity3D is one of the most popular modern game engines of date. Selection of unity3D as the base platform for the design tool was simple for several reasons:

1. Easy and streamlined development on multiple platforms, most importantly the unity3D web plugin.

2. Simple and easy licensing model

3. Easy to use and understand for students, accompanied by large active community and asset store.

Voxel vs. polygon

Two quite different approaches describe the snow and ice structures in 3D world, voxel based and a polygonal based. A voxel described simply is a three-dimensional 'pixel' representing a volume of material in 3D space. The voxel can be used to represent surfaces and structures in 3D lattice similarly as pixels describe image surface in two-dimensional lattice.

One of the most well-known game type applications of current date utilizing voxel's is Mojang studios game Minecraft, where users can construct anything they can imagine from 'metre' sized blocks made of single material. Minecraft has allowed millions of users around the world to unleash their creativity without prior knowledge of 3D modeling or texturing experience.

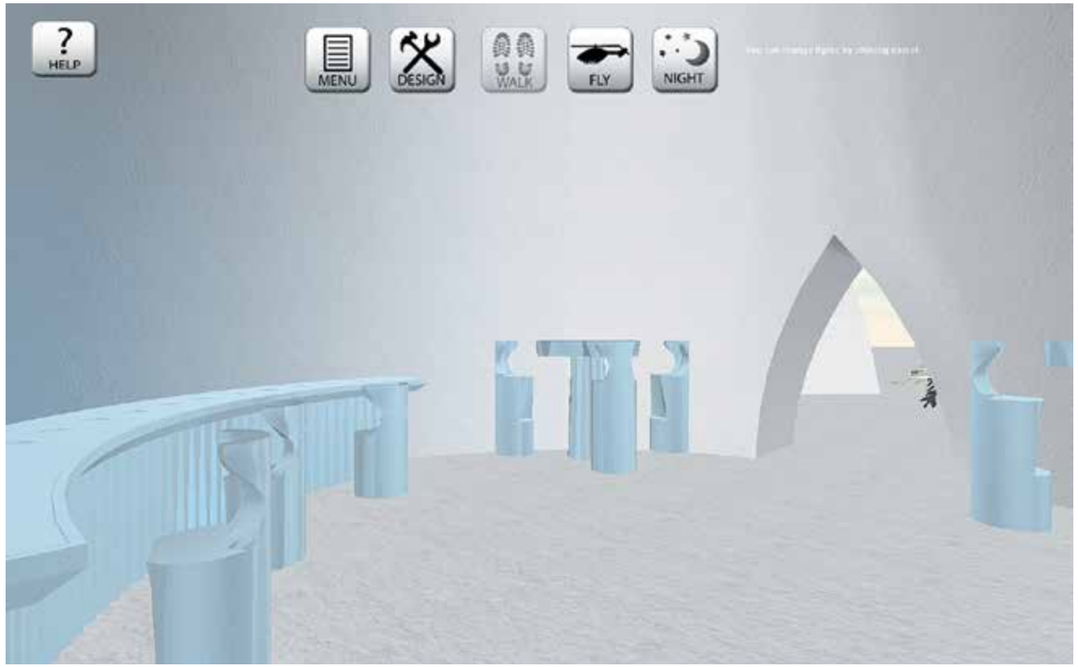

fig. b Designing the interiors

Pure voxel based solution benefits from user's ability to construct anything via simple method of inserting or removing blocks from the world, this simple approach is also the greatest weakness of voxel approach as the users can easily violate the previously set rule of 'constructs as real and physically sound as possible'. Second problem is that the voxel construction can be tedious and frustrating especially when the users are new to the approach. Although premade constructions are easy to implement in voxel-based solution as well in the polygon-based approach this restriction combined with the relatively slow construction time defeats the meaningful use of voxel-based solution.

From construction mode to a viewing mode

The Application has two sides, firstly concentrating on building snow and ice structures and secondly exploring them from different angles of view. The application offers a platform where the user is able to add objects and create structures according to his visions, plans and demands. There are several different objects where to choose the amount of different structures that can be built. Different sorts of objects can be joined together, which enables the user to combine different spaces and create wider areas. The objects can be moved from different points by dragging or rotating. If the user is not satisfied with his creation, he can delete the used objects one by one or go back again to the empty drawing board.

The constructing mode can be changed to so-called viewing mode. In this mode the user can move around in the area of construction and explore the buildings both inside and outside. The application offers multiple perspectives to the whole area of construction, which makes the perceiving of dimensions easier. Buildings can be viewed from above by changing the camera view. To outline the actual

fig. c Different viewing modes: the bird's-eye view

area of construction, the user can add i.e. houses and tree models on the scene. The atmosphere in the buildings can also be changed by using the light tool and by shifting the day mode to a night vision.

When visualizing structures in an environment one key factor of generating realistic feeling and immersion is lighting the scene correctly. Lighting is also an important factor from the sales

viewpoint in snow constructions, and to generate correct feeling each construct need to be individually lit.

For the environment one important limitation regarding the lighting was set through requirement of it working well also on low performance computers such as laptops. This lead the group to select a hybrid lighting model where generic lighting of the environment was set by single dynamic light acting as sun (or moon/starlight in night time) and the actual constructions used pre-calculated intensity light maps (ie. static lighting) which could be then on runtime mixed with color selected by the user.

Currently the Application software allows mainly the creation of the basic snow and ice buildings. The software development is in process and the new decorating add-on to application will be released in the near future. The new addition will enable the user also to furnish the buildings created. The user gets a list of items that can be added and placed inside the building. For instance room can be designed to look like a theater. The user needs only to add the wished items like furniture and a stage. The use of the room can be changed easily by replacing items: i.e. shifting stage to a screen changes the space from a theater to the movies. Every model has its own list of object choices. The bigger the model is, the more the user can decorate it and the size of the furniture chances automatically according to the size of the construction.

fig. d Adding lighting and props to the interiors to create functional spaces.

The interior design tool brings meaningful content to the snow structures and more visualization and garnish to the application. The tool also helps to perceive the areas and dimensions of the buildings better. The user can see the added decorations right away. By changing it back to the building view the user can continue creating/editing his buildings. The used decorating will be automatically saved to

the memory of the program to prevent it from disappearing while changing the operating views. This makes the usage more safe and flexible.

Constructing 3D environments in actual 3D view is generally not viewed as good option for non-computer savvy individuals. One of the major issues within 3D view based construction is exact placement and orientation of the 3D constructions. The placement of 3D objects in 3D view is usually implemented via using various transform Gizmos that allow the user to control the object.

Conclusion

The application is created for serving the customers' needs. The user interface is designed to be easy and user-friendly where the user himself is the designer of the desired product. The application is made to help the visualization of the product easier. It enables to create and test ideas. There is no ready-made product to sell, the user designs it according to his needs and visions.

There is a lot of decorating and designing applications on the Internet but this kind of product can be rarely found. Snow and ice materials make this product unique. The concept of the application is innovative in enabling the user to design the product the way he desires. This application is very useful and is constantly developed further. The aim is to serve large number of customers and help them to test and design the products they wish to accomplish.

http://laplandsnowdesign.fi/snow-design-application.html

Photographer – Topi Matikainen

Place-Specific Snow Design Projects

In collaboration with the educational institutions and the snow construction company

Timo Jokela

Professor Timo Jokela worked asthe manager in charge of the Lapland Snow Design project.

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fig. a *Bone harpoon used as inspiration for the design. Kirkeness, Norway*

Photographer – Timo Jokela

University of Lapland has produced several educational snow design project in Scandinavia. One successful example of innovative educational collaboration with small-scale nature tourism companies and vocational school students took place in northern Norway, in the small multi-ethnic towns of Kirkenes and Vadsø. The aim of the education project was to make winter art and snow design known in the region and to develop activities that were suitable for multicultural societies in northern Norway. The educational snow design project combined the goals of vocational education and the needs of growing nature tourism companies of the region. The main funding body for the project was the Innovation Norge.

Education project was undertaken by nature tourism entrepreneurs and other actors of tourism field and by vocational school teachers and students. The aim was to focus on place-specific winter art and user-centred snow design methods. The collaborative education project started with distant learning activities and culminated in two-day seminar about the basis of place-specific winter art, snow design and construction in Kirkenes. Tutors were the teachers and professors of University of Lapland and experts from the snow construction company from Finland who already had collaborated with the University. The educational project was completed with impressive place-specific snow and ice design complex in Kirkenes and Vadsø in the winter 2006.

Winter art complexes were utilised in late winter in several small-scale local and regional happenings such as husky safaris, skiing competitions and kite skiing in Northern Norway. Winter art was also part of the Barents Triennial cultural events coordinated by Kirkenes and so became a subject of study in the art world as well.
The education project produced a number of follow-up projects during the following years for both the Norwegian participants and the snow construction company from Finland, who worked as a partner with the University. Since those days one of the local Norwegian tourism entrepreneurs has built a snow hotel in Kirkenes with the help of this particular Finnish company. Later on the Finnish company has annually built a snow hotel in Southern Norway and widened their snow construction enterprise to Canada and Russia.

fig. a

Artistic Concept and Art Pedagogical Implementation of the Arctic SnowHotel

A Site-specific Design Approach to Snow buildings

Antti-Jussi Yliharju

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fig. a *Wooden Elk head sculpture from Lehtojärvi, Rovaniemi 5790 B.C. Natural History Museum, Helsinki*

Photographer – Antti-Jussi Yliharju

fig. a

This is a brief description of a product development project where art pedagogy and design process are combined to produce a visual concept for a new snow hotel at Lehtojärvi, Rovaniemi. Aim was to develop a visual concept for the customer, Snowflake Oy/Arctic SnowHotel and also to provide a series of design-based winter art workshops for the Art Education Program of the Faculty of Art and Design.
This project-based study was carried out during two consecutive winters. I took the roles of a project leader, instructor and active artist-designer. The focus was on developing an aesthetically cohesive whole from the perspective of site-specific art. This was partly in response to the apparent visual incoherence and kitsch visible in established winter attractions in Lapland. International exchange students from the Faculty of Art & Design had a key role throughout the project. As learners of winter art and assistant designers they made a vibrant international working team. The work was divided into five different workshops that all worked along the same design brief.
The combination of workshop outcomes and my own design work created the visual concept for the Arctic SnowHotel. This concept had its starting point in an ancient wooden elk head sculpture found on site. The action model created through the project was realised for the sixth time in the winter of 2013–2014.

Overall design concept of Arctic SnowHotel was inspired by the local cultural history of Lehtojärvi in Rovaniemi. Arctic SnowHotel was to be built next to the finding spot of an 8000 years old wooden elk head sculpture that was probably a headpiece of an ancient seal hunting vessel. Hotel ground plan resembled a fallen elk antler as the sculpture had markings that it used to have antlers fixed onto it. Workshops were held to help to visualise the concept. International art and design students contributed a broad range of new ideas and approaches to interior design.
Outline of outcomes: With site-specific design approach it can be possible to create snow constructions and interior designs that communicate a meaningful message. This in turn benefits the visitor who can experience an Arctic attraction and at the same time learn cultural messages about the speciality of a certain place. Proper design concept where all the elements serve a purpose and the content is designed to communicate the speciality of a place creates visual coherency for artwork. The layout of snow hotel buildings was based on an open ground plan removing anxiety some visitors experience in closed-up mazes of snow tunnels. On the down side open ground plan reduces crucial space for construction and this is not beneficial for the business owner who requires a certain number of customers to be able to fit in the allocated area.
A starting small business benefits from the collaboration with the University through which it can have access to affordable specialised expertise. Overseas students bring in global perspective on local issues and for these students a project like this is an opportunity to be able to get first-hand experience in snow and ice design and also it gives them a chance to partake in a concrete project from idea initiation to final production.

Firefox

A cooperative project involving winter art, science and education in Utsjoki (2004, 2005, 2006)

Mirja Hiltunen

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Photographer – Mirja Hiltunen

The Firefox project was an educational art event carried out by several people and organizations in Utsjoki. It was funded by the European Social Fund (ESF), and consisted of science and art events, of which the common theme was the Northern Lights and research into that phenomenon. The winter art project was carried out by the University of Lapland's art teacher training attempting to influence people through art; the aim was to strive for social change, environmental responsibility, participatory thinking and enhanced communality.
The main goal of the Firefox project was to educate people to produce events that would touch and unite all of the villagers, from the Finnish to the Sámi, and from the children to the elderly. The project aim was to increase people's skills and knowledge of winter arts, and develop ways in which science and art could support each other. This was done through community-based art education and community art approach. The activities brought together different age groups, sectors, and actors to develop their artistic learning and working culture.
In the project, winter art acts as an open space that invites people into action. The winter art works which were created were an indication of the many kinds of skills the villagers possess, and they also spoke of a desire to cooperate. When working together as a group, and when observing the work of others, unique opportunities for learning open up.

The emphasis in the Firefox project was on cross-sector collaboration. Art makes things visible, and gives a voice to groups of people – such as the elderly or the children – who might ordinarily not be heard.
In Utsjoki – the northernmost municipality of Finland, and the only municipality in which the Sámi are the majority – it is of special importance to be sensitive and open to dialogue. Art offers an open space for conversation and collaboration. It helps participants to understand values and appreciate differences. The community can use art to introduce and distribute meaningful, topical themes to itself and its surroundings.
Through the winter art activity the villagers observed their community's sociocultural environment and traditions with the art students and visiting professors. Participation in multidisciplinary and multicultural activities through winter art facilitated meetings between different kinds of people in their every day life, made the importance of cooperation visible, and offered models for the further development of activities. In addition, the project has strengthened not only the locals, but also the participating art education students' and other visitor's agency.

Arctic Art Camp

Jari Rinne

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fig. b

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fig. a *Various interaction scenarios are being explored, including interaction with virtual skiers and virtual obstacles, annotation (competition scores, motion trails, speed display, etc), demarcation of safety perimeters and tracks for novices and skilled skiers, as well as real-time networked experiences (e.g. projection of skiers silhouettes from a ski slope in a different continent, etc).*

Concept imager – Jussi Ängeslevä

fig. b *The goal of the project is to transform a whole ski slope into an interactive display, where (laser) graphics are drawn in response to the skiers' motion. Using laser projection, common in large scale audio visual shows, the graphics can be drawn from a single location onto an uneven surface in varying distance (something impossible to attain with standard projectors). Moreover, snow provides an excellent projection surface, giving high contrast imagery.*

fig. c *All this facilitates numerous possible interaction scenarios ranging from informative to playful, to new forms of competitions and experiences on the slopes and eventually on all kind of playgrounds regardless of the scale and shape.*

Photographer – Alvaro Cassinelli

Arctic Art Camp was an international art and tourism co-pilot, in which innovation was put into practice in northern tourist centres in Finland. AAC's goal was to apply the working models of community art into regional innovation activities. Another objective was to develop art-based tourism products, from which the implementation of the pilot of interactive slope projection system can be seen as an example. The project developed media expression tools necessary for the use of interactive real-time camera tracking for laser projection environments. The built expression instrument can be well utilized for new application development in the future.
It was also essential to develop the University of Lapland laboratory network cooperation and regional influence. The primary target groups were the Lapland tourism centres and companies and the visiting tourists. The pilot phase was carried out in cooperation with the ski resort companies located in different parts of Lapland. In addition to the business life the Lapland University Consortium for arts, culture and tourism sectors were one target through the development of the innovative environments. AAC succeeded in the use of the existing resources. New know-how was brought to the educational sector and to the region by the involvement of the international University Network.

The idea of the project was to bring the creative potential of tourism physically into everyday life. The organized pilot laboratories in the Ski resorts utilised audio-visual and artistic environments. That helped to reduce the time lag between the innovation and the actual application. At the same time new art and technology service products and service innovations for the travel industry were created. A good example was the integration of the snow and ice construction know-how with new media applications.

fig. a

The project workshops were held in the Levi Ski Resort. According to the principles of community art the needs of the culture education community and the Levi Ski Resort were taken into account. In developing the ski slopes for maximum versatility, the project applied the existing working methods of the Consortium and looked for suitable community art solutions to support the technology-focused expression. The themes of the workshops were related to the needs of the actors in the region and implemented directly to the region's everyday life.

fig. c

Arctic Design Show in Snow Environment

Päivi Rautajoki

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Translated from Finnish by ABC käännöstomisto

fig. a *Designer – Pirita Norvanto*
Photographer – Riikka Oikarainen

fig. b *Photographer – Linus Schaaf*

fig. c *Projection planning by Johanna Luusua*
Photographer – Riikka Oikarainen 2013

The students of clothing design of the Faculty of Art and Design at the University of Lapland arrange a show every year to present the designs and their course. In recent years the show has become a large, joint event by all of the study fields of the faculty, showcasing widely the know-how, community spirit and vision of the university. The latest shows, KAAMOS ON/OFF 2012 and LUMOTION DESIGN SHOW 2013 were outdoor events done in cooperation with the Lapland Snow Design (LSD) project. The shows were presented to sellout audiences at the Rovaniemi Design Week (now Arctic Design Week) in midwinter, February 2012 and 2013.

fig. a

The cooperation that culminated in the shows took five months. The Lapland Snow Design project was responsible for the snow environment and was the main planner and implementation organizer 2012. In 2013, the main responsibility for the planning and implementation was handed to the students of industry design, interior and textile design and art education. The graphic design students were responsible for the visual look and students in audiovisual media culture for projecting and documentation. The students in clothing design were responsible for producing the contents. In addition, many students from different fields of study and other faculties were included in various tasks. Local professionals and partner companies also gave their input.

An outdoor show in midwinter includes a great many factors that can be anticipated but not necessarily removed. The elements of the outdoors must be taken as experiences, not as problems. Windy weather can help the motion of clothing, but if the temperature falls even a little under zero degrees, the wind will make the weather freezing cold for the models and the audience alike. The cooperation with the Lapland Snow Design made it possible to present the clothing lines in a unique snow environment. This is something that can and should be presented beyond Rovaniemi as well.

fig. b

fig. c

Prototyping Snow and Ice

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fig. a *Prototyping with ice and fire*
Photographer – Hanna Viitasaari 2013

The first year Industrial Design students from the University of Lapland had a chance to cooperate with Lapland Snow Design project and Valosa as part of a concept design project in the spring term 2013. The aim of the cooperation was with improving approach to create future concepts of combining light with snow and ice. The students had no significant previous experience about snow and ice as materials which allowed a very open minded approach to the task. Concepting as a research and development action gives an excellent platform for improving creativity since there is no productional pressure. It also enables totally new solutions to appear and may in long term effect on the expectations of the public. (Keinonen, Andersson, Bergman, Piira and Sääskilahti 2004, 29-35).

Snow and ice are organic materials that are characterized by not having a fixed state. Also the light as an element may have different characteristics depending on whether it is a natural or artificial light. This gives the prototyping an essential role in the process. During the prototyping the students made several tests with the constructions and lights. Prototyping was done both during the daylight and in the dark. It was carried out in smaller scale or as a part of the construction, which made it an extremely useful method for testing the functionality of the ideas quickly.

Careful documentation is very important when prototyping snow and ice since it is quite impossible to preserve the prototypes. Good documentation may also act as a source for further development. Especially visual materials are very inspiring for creativity. Prototyping was very useful both for testing the ideas and for getting information. We noticed it is important to take the natural light into consideration. Also the possibilities of combining fire and ice would have been theoretical without the prototypes.

fig. a

References

Keinonen Turkka, Andersso Janne, Bergman Jukka-Pekka, Piira Sampsa ja Sääskilahti Mikko. 2004. Tuotekonseptointi. Toim. Keinonen Turkka ja Jääskö Vesa. Helsinki: Teknologiainfo Teknova Oy. 29-35.

Snow, Ice and Media Expression

Tomi Knuutila

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fig. a *Dama 8 workshop – Making live music with ice bubbles and icicles – embedding sensors, microphones and led's in ice worked out well*

fig. b *Aurora Borealis workshop, Pyhätunturi 2007 – A long exposure photo of a video projection on falling snow reveals something which the eye can't see*

fig. c *Dama 8 workshop, Rovaniemi 2012 – curtains and tablecloths frozen, dancers inside these tubes.*

Photographer – Tomi Knuutila (cc–by–2.0)

As a lecturer in Digital Media working in the high north, I became interested in combining new media to snow and ice design and art, which I saw a lot in Rovaniemi. The process involved altering a

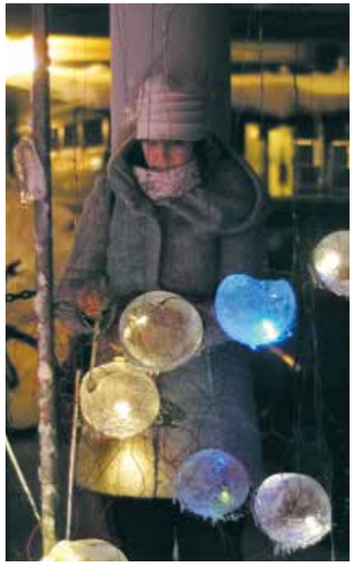

fig. a

faculty-wide interdisciplinary course 'Media Expression' to 'Snow, Ice and Media expression' in 2009. This course has been organized nearly annually in the University of Lapland, and it has included teaching not only in snow construction and ice carving, but also mini-workshops and tutoring on electronics, sensor technologies, projections, video, light and sound design. I have also taken part as a tutor-teacher to some other workshops including one with 3D projections on snow sculptures lead by Nimrod Weis from Eness, one with video and sensor tracking and laser projections on downhill-ski slope lead by Jari Rinne and partners from Japan and Germany. I also coordinated (and taught in) a aurora borealis-inpired workshop for a group of international media students and a Dama VIII workshop, where a group of interdisciplinary students in the fields of dance, media and fine arts from Nordic and Baltic countries created a 45 minute live sound-, light-, and movement performance outdoors in February in Rovaniemi. Experiences from these courses and workshops are twofold: on the other hand, it is interesting and inspiring to bring new technologies, playfulness and interaction possibilities to a cold winter landscape. On the other hand, technology is fragile and hard to set up in this kind of environment. Computers and projectors and sound equipment need heating boxes, and electronics used for sensor technologies behave unrealibly in cold environments. It takes some time to do testing, and by acquiring products, which are cold and moisture tolerant many problems can be avoided. We have learned something: in 2012 a group of students created interactive projections, which were controlled with 4 different types of physical interface objects enclosed in snow and ice blocks, with sensors which communicated wirelessly to a computer inside during the Rovaniemi Design Week Fashion show.

fig. b

fig. c

Associates

Snow Design
from Lapland

Photographer – Topi Matikainen

Snowkemi

Consulting for creation of experiences via snow and ice construction, along with comprehensive construction services.

Snowkemi offers all kinds of services for snow and ice projects from design to construction and destruction. We have been a partner and contractor of the worlds most famous and finest snow construction the SnowCastle of Kemi since 1998 and in the future, the story continues. Our expertise of snow and ice building techniques have progressed quality, that is the most finest in the business worldwide.

We reply our customers needs internationally. We have been improved our construction technology to build structures also in challenging conditions and environments. Cold weather is not a needed factor anymore. New system is based on production in our facilities. This way we can offer more cost-effective solutions to our customers for example in the city area and in different weather conditions where snow hasn't been an option for constructing material before our innovations.

With our wide network of subcontractors and partners we can offer everything related to snow and ice construction and events all in turnkey solution or separately in elements. All our services are high quality and the goal is to create frameworks to our customers where they are enabled to fulfill their customers dreams and offer life-time experiences.

"Imagination is the only limit when it comes to snow and ice construction"

With our wide network of subcontractors and partners we can offer everything related to snow and ice construction

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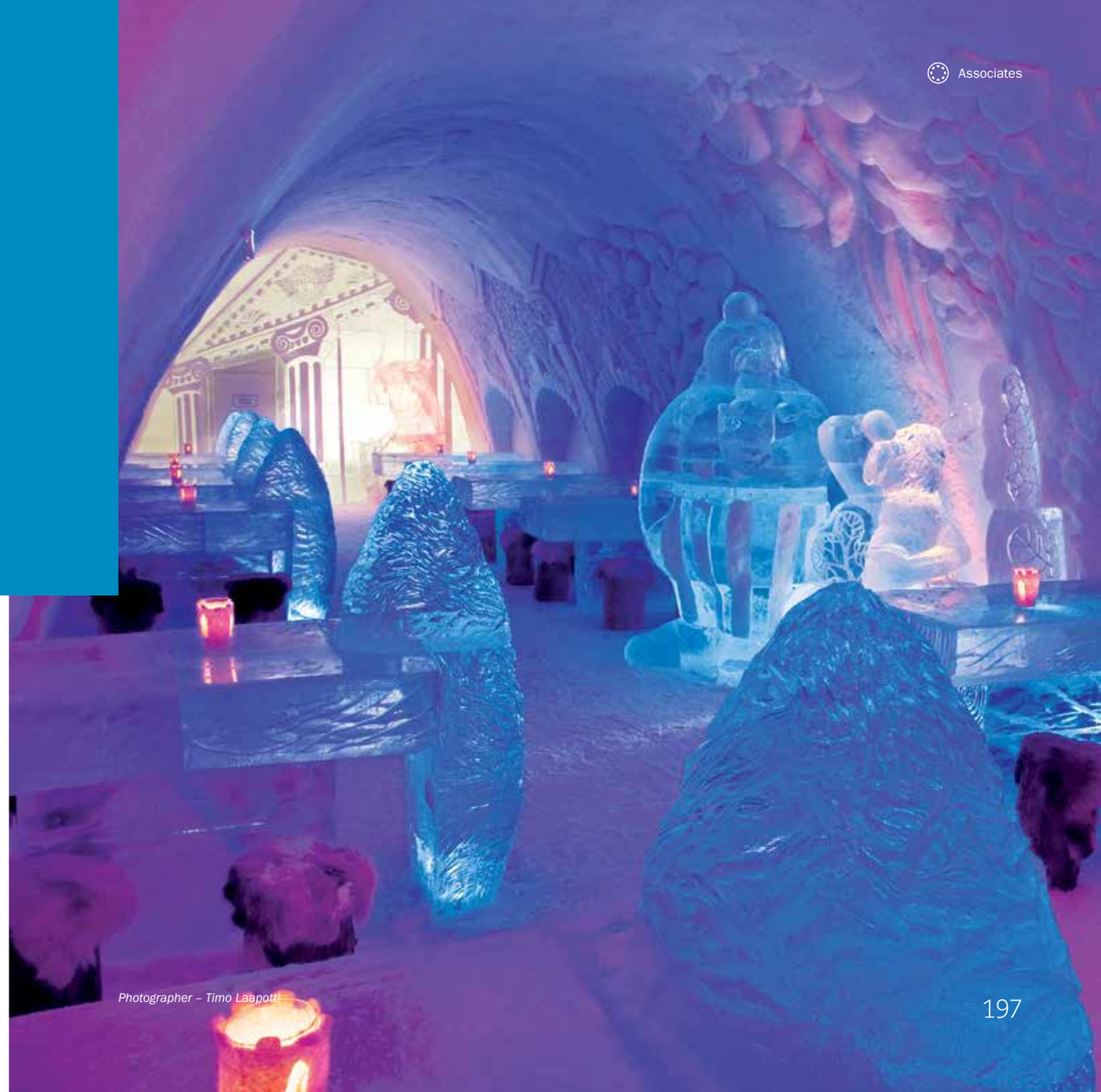

Photographer – Timo Laapotti

VALOSA

VALOSA is a lighting design office from Lapland that provides services in all matters related to lighting. In addition to lighting design, VALOSA also designs visual structures for various purposes. Our office has over 20 years of experience of design in theatres, all kinds of indoor and outdoor space, and snow and ice construction. VALOSA also designs innovative special lighting for demanding sites, utilising the most modern lighting techniques available.

Light makes the space visible. It creates ambiance and gives the space shape. Lighting helps us to perform work tasks, chores at home and when we leave the home.

One of the main duties of lighting is also bringing added value. This added values can be:

Aesthetics	**Ambient home lighting**
Sales Promotion	**Appealing illumination of products in the shop**
Safety & Security	**Park, persons with sight disabilities, urban area without cycle routes**
Image	**Lighting the company's façade**
Ecological	**Changing conventional bulbs into low consuming light sources**

Lighting design combines multidisciplinary design work. In addition to competence inartistic and aesthetic design work, designers are also expected to have commercial and technical expertise from various fields. Design utilises the newest computer-based 3D modelling software, which means that plenty of information about the object to be lit is achieved in advance, such as the number of lights required, combined energy consumption and service frequency. Energy efficient and visually successful lighting can be implemented for any site in question using professional lighting design.

We design innovative special lighting for demanding sites, utilising the most modern lighting techniques available

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Photographer – Antti-Jussi Yliharju

Arctic SnowHotel

Arctic SnowHotel is a Rovaniemi based company, which provides tourism and event services as well as snow and ice construction services. The core of the business' success lies in its excellent know-how about snow and ice design and construction.
The company's specialised area of expertise is planning and implementation of warm spaces in snow and ice buildings.

Arctic SnowHotel's mission is to create customer experiences. Sustainable development is a strong guiding principle for the hotel and the construction is carried out by local professionals. Arctic SnowHotel consists of several ice and snow structures that make a memorable environment for both family and business events and for tourists seeking extreme experiences. It is an entire world of snow, an experience destination that provides an exotic possibility to spend the night sheltered by snow and surrounded by picturesque and placid Lappish nature and to experience Arctic specialities, including the Ice restaurant and a sauna completely built from snow and ice as well as the surrounding fields of snow. For owners and visitors alike, the Arctic SnowHotel is a way of life.

The company designs technical details as well as moulds for snow and ice construction. This type of expertise has been elementary to the company's progress from the very start and the development work continues. The Faculty of Art and Design at the University of Lapland has been of invaluable support in terms of design expertise, and design students have worked for the company on many occasions. Design services have included graphic, product, service and strategic design together with art education projects.

The company's specialised area of expertise is planning and implementation of warm spaces in snow and ice buildings

Arctic SnowHotel

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Photographer – Marko Junttila

University of Lapland

The University of Lapland is the northernmost university in Finland and in the European Union. The University is located in the city of Rovaniemi on the Arctic Circle. The faculty of Art and Design, the northernmost multidisciplinary art and design unit in the world is a pliant academic partner focusing on the Northern and Arctic art and design. In the Arctic art and design the international perspective joins forces with the northern dimension and its cultural heritage. The faculty collaborates actively with small and medium-sized enterprises and other communities via education, research, development, and innovation projects. It has a long expertise in content planning, organisation and designing new types of snow and ice environments from a user-centred point of view. Aim is to offer customers specifically tailored design solutions for various purposes such as product showrooms, children's playgrounds, events and cinemas.

Research projects in the Faculty of Art and Design have particularly contributed to the development of methods and practices in the field's education, environment and community. It opens up new opportunities to increase wellbeing and to boost the economy on the Arctic. Developed art and design tools and methods enable active user participation in the design process. The use of innovative methods helps the implementation of design approaches in the North and the Arctic. Arctic art and design at the faculty have been recognized as an approach that supports innovation and development and is applicable in any parts of the world.

We have a long expertise in content planning, organisation and designing new types of user-centered snow and ice environments

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Photographer – Arne Van Balen

Lapland University of Applied Sciences

Lapland University of Applied Sciences is the northernmost educational institute of its kind in the European Union.

One of our Campuses is situated on the Arctic Circle in the town of Rovaniemi, Finland. One of our core competences are cold and winter technologies.

Our location makes it possible to offer a unique learning environment. The surrounding natural environment, facilities equipment and expertise offer a unique opportunity to test and develop snow and ice construction together with companies.

With our areas of emphasis, we are pioneers in arctic expertise and an internationally recognised educator, developer and partner

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Rovaniemen Kehitys

Rovaniemi Regional Development Agency

Rovaniemi, the capital of Lapland Province and Santa Claus's home town is situated on the Arctic Circle, 800 km north of Helsinki. It has about 60,000 inhabitants and a land area of 8 016 km² making it the largest city in the EU. By virtue of being preceded in Finland only by Helsinki as the most visited city by foreigners, Rovaniemi is very international.

Rovaniemi is a well-connected business hub and University City in the fast-growing area of northern Europe. Multibillion projects in Lapland as well as in nearby regions of Sweden, Norway and Russia offer excellent opportunities for companies based in Rovaniemi. Thanks to its international airport, railway and E75 highway, Rovaniemi is very easy to reach. Not only is Rovaniemi is the commercial centre to a wide region in the north but it also constitutes a veritable shop window for visitors from around the world.

Abuzz with energy Rovaniemi provides an ideal setting for both for traditional manufacturing - not least when cold technologies are concerned - as well as the creative industries. Santa's Technology Park, located right next to the airport, is the centre for film, game, content production, and design companies.

Abuzz with energy Rovaniemi provides an ideal setting for traditional manufacturing, cold technologies and creative industries

Rovaniemen Kehitys

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photo retrieved from VisitRovaniemi website


UNIVERSITY OF LAPLAND
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Rovaniemen Kehitys


SNOW
KEMI


VALISA
DESIGN


Arctic SnowHotel


Rovaniemi
THE OFFICIAL HOMETOWN
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Leverage from
the EU
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REGIONAL COUNCIL
OF LAPLAND