Public Open Space Design based on People's Perception using Social Media in Winter Cities

PAUKAEVA Anastasiia

A thesis submitted in partial fulfilment of the requirements of Hokkaido University,
for the award of Doctor of Philosophy

2020.12

Abstract

Winter cities can take an active role in becoming more livable and appealing, primarily through greater use of the public open spaces, attempting to counter ‘indoor-living’ in winter. The enhanced activity on public open spaces can assist in rehabilitation of the negative perception of winter and winter cities. As a tool to enhance outdoor activity, temporary design as festivals presents a great opportunity by improving perception of winter. However, temporary design is considered as additional to permanent or traditional design and not implemented in the urban design process. To empathize the role of the temporary design in designing public open spaces in winter cities, we analyze the impact of the temporary design on people’s behavior and perception in relationship to permanent design. While spatial behavior analysis became widely used in urban design, evaluating perception of urban environment remains a challenging task, that reflect in collecting a lot of data from scratch. However, due to the rapid growing number of social media users and produced by them data on a daily basis, it becomes possible to fill that gap. Most of urban studies using social media focus on spatial use of cities, however few examines people’s perception. Thus, the primary aim is to develop new urban design approach for comprehensive analysis of people’s perception based on the social media, which is in line with the research purpose of exploring temporary design and its role in public open space design in winter cities.

The thesis consists of 7 chapters as following:

Chapter 1 defined winter cities as regions where the average temperature is below freezing with precipitation in the form of snow during a few months. Not only those factors are the main causes of reduction in outdoor activity in winter cities, but also negative perception of winter. The important role of the public open spaces as triggers for outdoor activity is emphasized in the chapter. Three major research topics in urban studies, focusing on the understanding of a greater use of public open spaces are defined in this chapter as follows: the

impact of the environment on urban design (microclimate), the relationship between urban design and people's behavior, and the relationship between urban design and people's perception. Considering academic studies in winter cities, after the first mentions of winter city concept by Pressman in 1987 the idea received little attention until around 2005, when it re-emerged as an object of academic attention, focusing on the development of the public open space design based on the impacts of environmental conditions. A few studies in winter explored the people's behavior and comfort and less considered perception. Moreover, despite that the temporary design as winter festivals was always proposed in winter cities to enhance necessary outdoor activity, there are still few studies that consider this design approach.

Chapter 2 defined that preserved in Russia Soviet-era public open spaces present great value for temporary design interventions, due to the intended temporary use of those public open spaces, with distinctive design approach from Western countries. The vision of the public open space in Western countries intents to serve individuals' comfort and social inclusion, while Soviet-era design aim to serve masses with different scenarios events. Great scale, central position in the city, attached wide venues for transportation, where central area is flat and empty of any kind of objects are the main physical features of soviet public open spaces. These features have a value for implementation of various temporary design strategies. Lenin Square in winter city Khabarovsk is well-preserved soviet public open space, while design of Kita 3-jo plaza in city Sapporo with similar climate introduces Western design approach in the chapter. In social media analysis the 'Illumination Festival' on Sapporo Station South Square and 'Ice Town' on Lenin Square were described in the chapter as the cases that can assist in understanding the impact of the different temporary design interventions on the people's perception and empathize the role of illumination in winter cities.

Chapter 3 described methods of examining relationship between environmental conditions, urban design, and people's behavior, based on the

field survey. Exploring relationship between urban design and people's perception is proposed in the chapter, using social media. Field survey in extreme cold climate at day and night on Lenin Square is described, including two situations 'event' and 'no event' that can assist in understanding of the relationship between temporary design and permanent design. The 'event' situation was defined in a chapter as period of festival 'Ice Town' on Lenin Square, that include such items as ice and snow sculptures, event illumination, and Main Tree. The 'no event' refers to those objects designed for everyday use, including flowerbeds, street furniture and light. Those situations were also proposed in social media analysis on the examples of the 'Ice Town' in Khabarovsk and 'Illumination Festival' in Sapporo. Photos shared in social media using geolocation can define the people's impression of the place, while captions attached to those photos – positivity or negativity of the impressions. The two kind of photo content analysis using Deep Learning were proposed in the chapter to faster overall process capable of scaling to the global scope of data. Deep Learning also was suggested in sentiment analysis of captions.

Chapter 4 explains the relationship between environmental conditions and people's behavior on Kita 3-jo plaza in Sapporo. It reveals the clear reduction in number of pedestrians' activities with lowering the air temperature in cooling period. The sitting time decreased with increasing of the wind speed. No sitting behavior was observed on public open space below 5 Celsius degrees. However, sunlight on public open space enhanced sitting behavior. Therefore, it is important to control the microclimates of the outdoor public open spaces and to create desirable outdoor environments to promote outdoor activity in cooling, especially, cold periods.

Chapter 5 revealed the relationship of the urban design and people's behavior based on the field survey on Lenin Square in winter. Temporary design interventions on public open space significantly enhances people's behavior even at extreme temperatures at night. Despite that some people used shortcut on the square, the rest 70\% walked around the square, slid the slopes,

took pictures and played with snow and ice. During permanent design only 10\% of pedestrians engaged in activities, while the rest simply passed through. The comparison of field surveys on Kita 3-jo plaza in cooling period and Lenin Square in winter month revealed similarities in spatial use of permanent design that reflect in a few outdoor activities on public open spaces. In cold climate people tend to use a public open space as a transit, a few people stop for a talk or playing with snow. The results defined that temporary design and permanent design should be considered as complementary to each other and each serves specific role for winter cities. Permanent design is described as an enduring and basic design for regular needs, with high accessibility, convenient routes through public open spaces with flat and vacant area in the center. It does not impose regular behavior but provides a basic framework and tools for it in the form of street furniture and shortcuts. Temporary design complements permanent design with enhancing supplementary activities as taking pictures, sliding, playing, and complexity of walking routes maintained by variety of urban items.

Chapter 6 revealed the relationship of the urban design and people's perception on the example of 'Ice Town' on Lenin Square and 'Illumination Festival' on Sapporo Station South Square. The results empathized that temporary design significantly improved people's perception of public open spaces in winter. Without temporary design pedestrians had a little impression of public open spaces and their attention draws to a few urban items. Noted, that during festivals the temporary items as well as permanent items draw people's attention at day and night, however, the well-lit urban items at night had a greatest impact on the people's impression, comparing two case studies. The people's impressions of urban items were analyzed mostly as a positive experience of two case studies. A few negative experiences were related to cold weather conditions. Temporary design items that enhanced people's perception the most are listed in the chapter.

Chapter 7 proposed comprehensive urban design approach for public open spaces in winter cities from 5 aspects as following: (a) The consideration of the environmental characteristic in urban design in winter cities is the first step in preventing the negative impacts of winter. (b) The features of permanent design as scale, accessibility, location, landscape, street furniture must be considered when planning the temporary design. (c) Temporary design is an effective tool to enhance supplementary physical and social activities in winter cities even in severe cold climates. (d) Temporary design is trigger that initiate interaction with the urban environment and improves the perception of the public open space. (e) The understanding of people's perception of different temporary and permanent items using social media is effective tool to develop temporary design guidelines for public open spaces.

The new urban design approach was developed to enhance activity on public open spaces in winter cities by temporary design interventions.

Table of contents

Chapter 1: Introduction

1.1 Research background

1.1.1. Definition of winter cities

Winter cities are typically located in the northern regions, where the average maximum daytime temperature is equal to or less than 0°C for a minimum of two months each winter[1]. The combination of long periods of cold, limited daylight hours and heavy snowfalls minimizes outdoor social and physical activity[2]. Especially at night when many urban elements are combined by snow, coverage and thaw, the night can be a dark scene without any distinctive hierarchy[3].

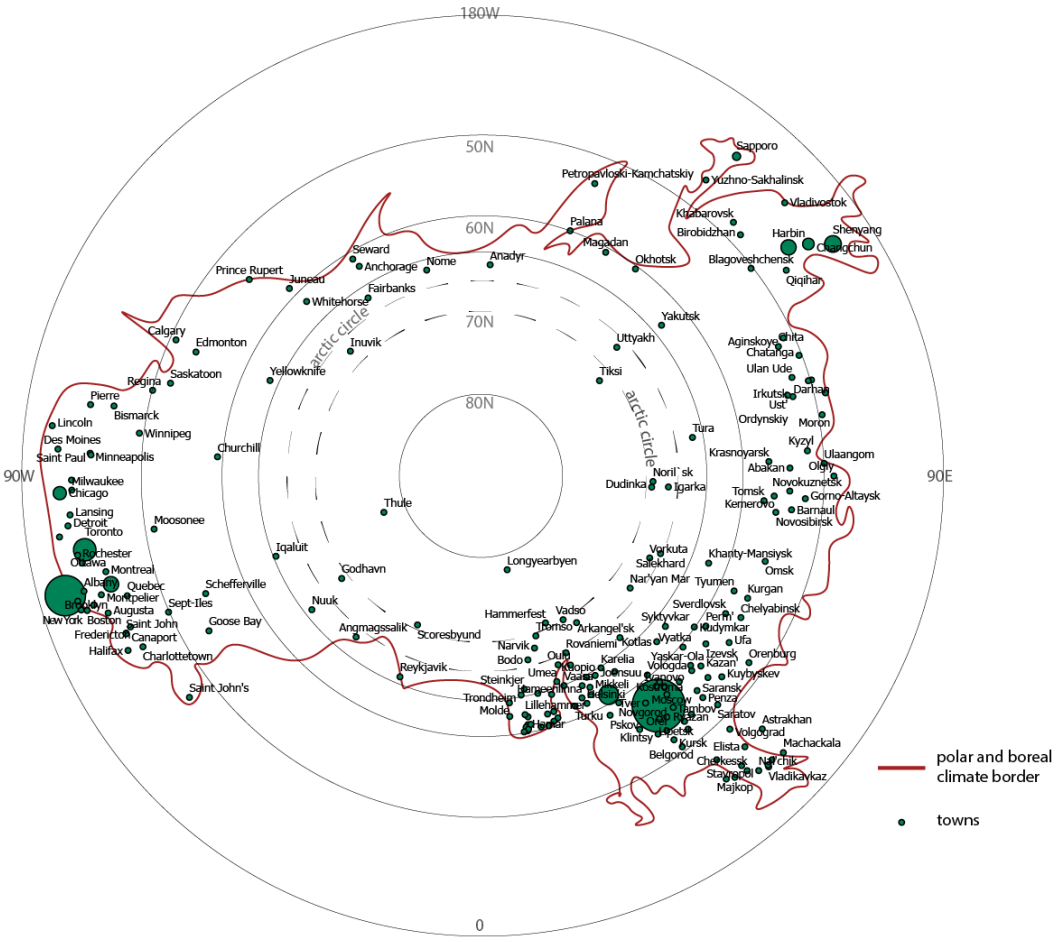


Figure 1-1. World winter cities based on the polar and boreal Köppen climate.

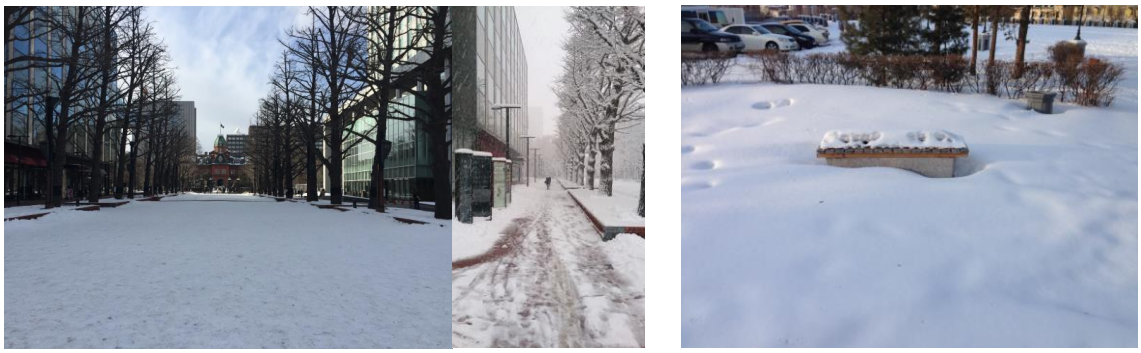
Approximately 200 cities with a population of more than 50 000 experience cold winters, among them high populated cities are New York, Toronto, Chicago, Moscow, Helsinki, Harbin, Shenyang, Changchun. These cities located in the boreal and continental climates of Köppen climate classification and can be defined as winter cities. The boreal climate characterized by long, usually very cold winters with 5–7 months, where the average temperature is below freezing in winter, can drop to below −50 °C (−58 °F). The definition of continental climate regarding temperature is as follows: the mean temperature of the coldest month below 0 °C (32.0 °F) and at least four months whose mean temperatures are at or above 10 °C (50 °F). Although the severity of winter in those winter cities is different, they experience a similar problem of decrease in outdoor activities in winter.

Enhancing outdoor activity and social inclusion in winter are the main purposes of winter cities design. The movement of winter cities implements in policy to promote liveability and sustainability in cities[4]. For example, the World Association of Mayors of Winter Cities (WWCAM) is a network that brings together the world's winter cities for promoting winter technologies and sharing experiences[5]. However, only 23 out of approx. 200 defined winter cities take part in that movement, such as Edmonton, Winnipeg (Canada), Changchun, Daqing, Harbin, Jiamusi, Jilin, Jixi, Mudanjiang, Qiqihar, Shenyang (China), Viimsi (Estonia), Rovaniemi (Finland), Matsumoto, Sapporo (Japan), Ulaanbaatar (Mongolia), Hwacheon, Inje, Taebaek (Republic of Korea), Magadan, Norilsk, Novosibirsk (Russia), Anchorage (U.S.A.). Yet winter city movement received little attention from municipalities located in the cold regions[4] (fig. 1-1).

1.1.2. Outdoor activity in winter cities

The outdoor activity of those living in cold cities is extremely important to maintain their mental health[6]. Low temperatures, limited daylight hours, snow cover and precipitation are the main factors that have been attributing to the reduction of total outdoor activity over the winter months[7]. The effect of the winter on the physical activity observed as a higher obesity level particularly in regions that experience cold and long winters, due to the decrease of outdoor recreational activities[8]. The steps per day decrease in winter however the walking speed per unit increased as a reaction to a reduction in body temperature[9]. Moreover, many snowy days and snow cover in winter would act to reduce total daily activity[10]. It is clearly important to recognize cold climate as a deterrent; therefore, researchers must consider the importance of the environmental factors in winter cities (fig. 1-2).

The amount of outdoor activity that people engage in has been shown to be directly related to the quality of public open space. Its architecture, equipment, design can either enhance or diminish levels of outdoor activities[11]. There is increasing interest in how public open space design can enhance outdoor activity, however, most of the design approaches focus on the hot and temperate climate. An innovative urban design approach is required to promote greater use of public open space in winter cities[8]. This paper attempt to develop an urban design approach that enhance outdoor activity in winter cities.



(**a**) (**b**)

Figure 1-2 Public open spaces in winter: (a) Kita 3-jo plaza in Sapporo, Japan (b) Komsomolskaya sqaure in Khabarovsk, Russia

1.2. Public open space studies (literature review)

The territory of the North is very heterogeneous in its natural and climatic characteristics, which are fundamentally different from the characteristics of more southern regions. This makes it impossible to use most of the techniques and technologies in construction and design of winter cities, which are widely used in temperate climates. It requires to develop the planning and design techniques for winter cities separately, however, a few studies are presented for developing winter cities and less studies conducted during cold period. In order to define the possible research gaps in studies, concerning the urban environment in winter cities, we compare the studies conducted in hot humid and cold climate.

Studies on understanding of greater use of public open spaces can be divided into three major categories as follows: the impact of the environment on urban design (microclimate), the relationship between urban design and people's behavior, and the relationship between urban design and people's perception. First category includes studies focusing on optimization of the microclimate of the urban design for people's comfort. Second category focus on exploring people's behavior in urban environment which also can consider microclimatic characteristics of the urban environment. Third category presents studies on exploring the relationship between urban design and people's perception to enhance visual understanding of the urban environment.

1.2.1. Environment and urban design

The assessment of the environment is crucial for the design of permanent constructions. The influence of the outdoor environment on the spatial composition of public open spaces has been investigated from many perspectives[1,12–14]. It is clear that the local climactic conditions should be taken into careful consideration in the urban design of every city since physical component of a place can be designed to influence the site-specific microclimate, and therefore affect the way people feel about the place and their likelihood to attend the place. The studies on microclimate of Ali-Toudert & Mayer[15] in 2006, Bourbia in 2010[16], Andreou et al. of 2012, 2013, 2014[17–19], Shahrestani, 2015[20] contributed to the development of comfortable microclimate at street level for pedestrians for hot and temperate climate.

Series of studies by Bosselmann et al. started in 1984 in San Francisco[21] and (fig. 1-3) in 1991 in Toronto's Central Area[12] exemined the effects of buildings on both sun and wind conditions at street level and evaluating the combined effects of these conditions on pedestrian comfort. Similarly, Baruch (1998)[22] explored the relationship among urban design and climate, proposing design principles for different climate regions, including cold regions.

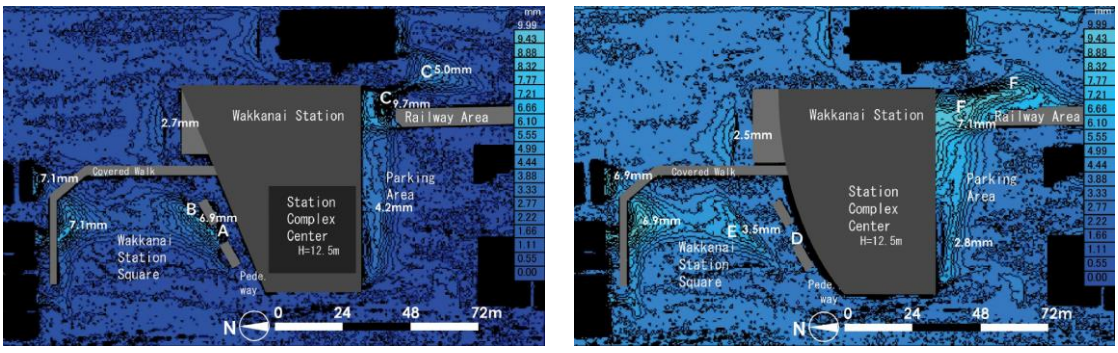
(a) (b)

Figure 1-3 Urban design approach based on the optimization of the wind flows, P. Bosselmann. Analysis of the windflows: (a) Current situation (b) Proposal for protection of the public open space from the northwest wind[21].

The research of the environmental impact of snow and wind on urban design using snow simulation with a wind tunnel was examined by Setoguchi et al.[23–25] (fig. 1-4) and Watanabe et al. (2016, 2017)[26,27]. They proposed urban design guidelines that can assist in preventing accumulation of the snow on public open spaces.

Meng (2010)[28] proposed several urban design principals to improve wind condition of the streets with various concepts of podium design which tested in a wind tunnel on the example of the downtown Shenyang. Erell et al. (2012)[29] have provided guidelines on interaction between microclimate and urban landscape for architects and urban designers. Although, this study examined impact of the environment on people's comfort in winter, it can be applied only for cities with temperate climate.

Other study on exploring the impact of the environmental conditions on urban design that should be mentioned is research of Hatakeyama et al.[3,30]. In the study was analysed the changing appearance of colour of surrounded architecture on public open spaces in winter cities Sapporo and Otaru, Japan. It demonstrated the clear difference between summer and winter seasons, that reflect in the brightness increases in winter due to daylight reflected on snow, it becomes more evident at night due to the lighting effect as white screen created by snow and artificial light.



(**a**) (**b**)

Figure 1-4 Urban design approach focused on reducing snow accumulations on public open space, T. Setoguchi. Analysis of the snow accumulation: (a) Current situation (b) Project development for protection of the public open space from the northwest wind[25]**.**

1.2.2. Urban design and people's behavior

Environment–behavior research which utilizes behavior mapping as a way of understanding the interaction between people and place has been undertaken for several decades. It was developed by Ittelson et al. (1970)[31] to record behavior in a design setting. Bechtel & Marans (1990)[32] note the value of observational methods in environment–behavior research to gain insight into research questions and problems and recognize the purpose of behavioral mapping in locating behavior on the map itself. This allows the kinds and frequencies of behavior to be determined and their association with particular sites to be demonstrated. In this study, it is necessary to determine the kinds of elements and urban design objects which have a critical impact on the behavior of the people, and the kind of activity which should be achieved by each urban design feature. Fig. 1-5 illustrates the example of analysing people's behavior on public open space using behavioral mapping.

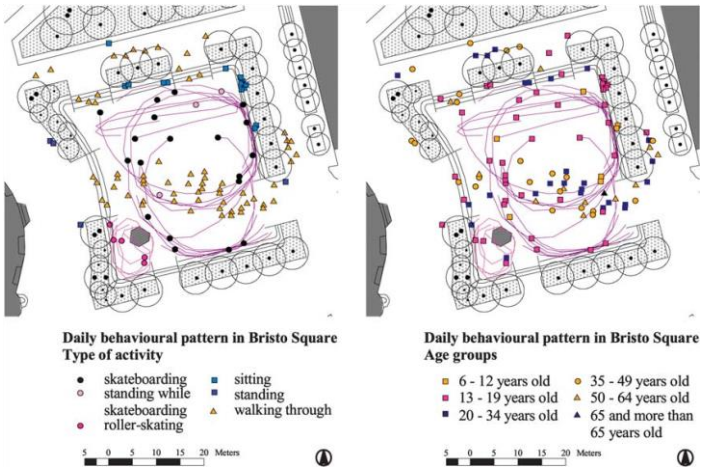


Figure 1-5 Urban design approach based on the people's behavior, B. Golicnik. Behavioral mapping analysis[33].

There are five main factors in the study of environment–behavior studies, such as: boundaries, connectivity of social nodes of space, social control / security level of space (the number of 'observers'); mobility/personal activity in an urban environment (types of environmental activity), distance/distance (distance between different groups of people, personal distance).

The first and most important spatial condition for social interaction is distance. The science dealing with the study of the geometry of human social ties on the physical level is 'proxemics'. Anthropologist E. Hall[34] introduced the term of 'proxemics' in the 1950s. Later, the American architect and urbanist O. Newman[35] in the 1970s and other researchers continued the further development of this science in the theory of urban space design. Lyman & Scott[36] gave a definition of territoriality depending on the types of control (presence of other people): public territory, home territory, interaction territory and personal space. Based on these academic studies, design practice was attempted with success by European scholars Juhani Pallasmaa, 1996[37], Jan Gehl[38,39], first edition 1971; Gehl & Gemzøe[40].

People's behavior and thermal comfort

First studies on exploring the relationship between outdoor thermal comfort and people's behavior were conducted by Carr, et al. (1993)[41] Marcus & Francis (1998) Gehl & Gemzøe (2004) [40], Maruani & Amit-Cohen (2007)[42]. Particularly, Nikolopoulou & Lykoudis, 2007[43] revealed the impact of microclimate on the people's place attendance. Air temperature and solar radiation were found to be the most dominant parameters in relation to the use of space, with relatively low wind speed. It stressed that overall presence is reduced when air temperature rises significantly.

Field survey on investigation of the relationship between microclimate comfort and use of public open spaces was conducted by many scholars as Thorsson, et al. (2007)[44] in Tokyo, Ahmed, K. S. (2003)[45] in Dhaka, Cheng, et al.(2006, 2012)[46,47] developed guidelines for urban Hong Kong. Andrade, et al. (2011)[48] conducted questionnaire surveys with weather measurements on public open spaces of Lisbon in Portugal.

Winter studies

Eliasson et al. (2007)[14] explored that such weather parameters as the solar radiation, air temperature and wind have a considerable impact on the weather

assessment of the people, and their perception of place: these parameters therefore influence the emotions of the locals, which determine their likelihood of attending an outdoor space during the cold season. By using microclimate monitoring and interviews, Lai (2014)[49] conducted a field survey at a park in northern China revealed the relationship between human comfort and each parameter of boreal climate. Guo (2017)[50] proposed optimized open space design guidelines for extreme temperature differences between summer and winter in northern China based on the observation of spatial behavior and wind simulation. Chapman et al.[51,52] explored the barriers to and enablers of soft mobility in winter to enhance the outdoor activity. Hou et al.[53] examines the impact of the microclimate perception of commercial streets.

1.2.3. Urban design and people's perception

The major influential works on the topic of people's perception of urban environment were done by Kevin Lynch (1960)[54], Gordon Cullen (1961)[55], that explore the visual recognition of the physical form of the city by observers. Other related important works that develop solid theoretical framework of visual perception of urban environment published in Berkeley school during the 1970-80s by Bosselmann (1998,[56]2008)[57], Craik & Zube (1976)[58] and American authors in general by Tuan (1977)[59], Stokols (1977)[60] and Altman et al (1980)[61].

Photography

Method of the studying perception via photography was first illustrated by John Collier in 1967[62]. The largest number of relevant studies has addressed the more limited question of representational validity of photographs used as actual perceptual assessments. Studies of the evaluation of the landscape perception confirmed that assessments based on colour-photographic representations have closely matched assessments based on direct experience[63–65]. In the studies of Scott & Canter of 1997[66] and Dakin (2003)[67], the action of taking photo is defined not only as a reaction to the environment but also the individual's preferences, opinion, memories.

Online questioner

Qualitative approaches in understanding of the people's perception of place as survey, interview, participant observation, and cognitive maps present challenging task, because it is particularly costly and the only way of collecting them is by asking people to assess a particular place (Clifton et al. 2008)[68]. The online survey systems to solve the cost-efficiency problem of collecting data were proposed in several studies as UrbanGems (http://urbangems.org/) (fig. 1-6) (Quercia et al., 2014)[69] and Street Score (Naik et al., 2014)[70] (http://streetscore.media.mit.edu/). These online surveys as a rule present respondent with a pair of images and ask them to choose which one adjusts best to a qualitative attribute as a 'happy', 'safe', depressing', 'dangerous'. Based on those set of data group of studies research the people's perception of urban environment by clustering perception attributes of respondents in different ways and use machine learning methods to quantify perceptions[70–74]. For example, Rossetti et al. (2019)[73] collected images of the urban environment, where the respondents are given with two images taken at non-specified place from within one of 56 predefined cities, and they are asked to evaluate which one adjusts better to a provided adjective. Adjectives represents the categories of public open spaces quality, such adjectives as 'beautiful', 'boring', 'depressing', 'lively', 'safe', and 'wealthy'.

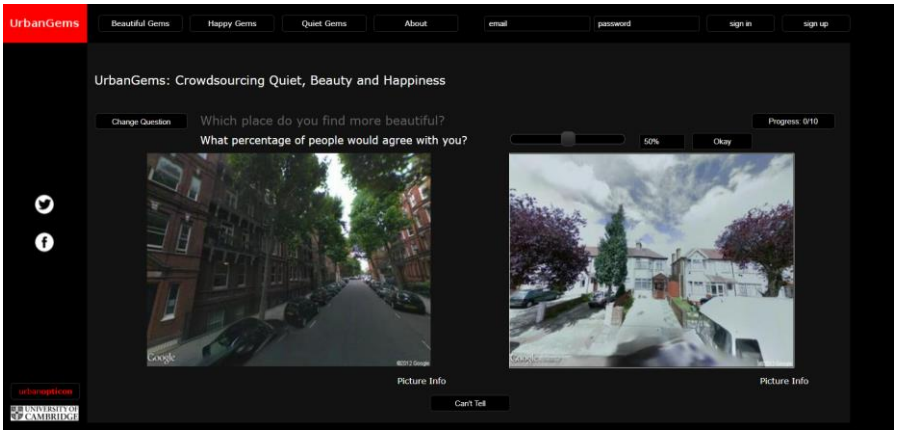


Figure 1-6 Urban design approach based on the people's perception, using online questioner, UrbanGems: Crowdsourcing Quiet, Beauty and Happiness[75].

Social Media

In contrast to evaluation of the presented images, where photos of cities taken by machines, photos from social media is first of all intention of the individuals. Another positive aspect of evaluation of people's perception via social media is the actual individual's experience of place. Many photo-sharing platforms as Flickr, Panoramio, Instagram, Facebook have already built up a huge database of photo collections covering most areas in the world. Social media analysis approved to be an effective tool in many urban studies. Dunkel[76] (2015) provided method of analysing tags attached to the photos from Flickr to visualize landscape perception, based on 12 study areas in US and Germany. Liu et al.[77] (2016) partially confirmed the five elements of Lynch[54] city image by interpreting the distribution and content analysis of geo-tagged photos from Flickr and Panoramio (fig. 1-7). This study clarified the 7 urban images perceived by users through a computational method. Martí et al.(2017)[78], using location-based social media network Foursquare clarified a strong spatial relationship between the most successful plazas.

(**a**) (**b**)

Figure 1-7 Urban design approach, using social media, city cognitive mapping through geo-tagged photos: (a) The distribution of the ''architecture perception'' photos on map of London (left), the distribution with kernel density map (right), and the sample photos of ''architecture perception'' in London (bottom) (b) The distribution of the ''high-rises perception'' photos on map of London (left), the distribution with kernel density map (right), and the sample photos of ''high-rises perception'' in London.[77].

The widespread use of various photo-sharing websites and location-based services has paved the way for the application of data in place-related research

projects. In particular, check-in locations and text data attached to the photos are the two most commonly used types of data in measuring and quantifying people's spatial perceptions. However, a few researches focus on the analysis of the content of the images to clarify visual perception of the urban environment.

One of them is study of Qian & Heath (2019)[79], that explored different forms of portals based on the people's perception using people-generated images. The approach was firstly based on analysing categories of captions attached to the photos, and later the content of the photo was analyzed. However, the explanation of techniques of analysing content of the photos was not described in detail, that leave the question on how to analyze the content of the photos open.

Winter studies

The studies related to urban environment in winter cities and people's perception quite few. Recent study of Stout et al. (2018)[4] discussed the people's perception of winter as an undesirable climate condition. Authors stressed that winter cities should be more appealing and liveable in winter suggesting events as Christmas markets to enhance the social inclusion and outdoor activity. Stout et al. emphasis that despite that the Christmas markets bring central role in creating positive image of winter experience, they are not specifically embedded in winter city strategies.

1.2.4. Results of the literature review

First the concept of winter cities was mentioned in academic literatures in the mid-1980s by N. Pressman et al.[1,6,80,81] due to the challenges that cold region cities faced about. The urban design and planning based on the hot and temperate design practices led seasonal use of the public open spaces and increased energy consumption in winter cities. Later the idea of winter city development received relatively little attention until around 2005[23], when it re-

emerged in policy field for developing northern cities, and in the academic field[4].

Particularly studies exploring the relationship of the people's perception and urban design in winter studies received few attentions by scholars. Pressman et al.[1] who introduce the winter cities movement discussed that people's perception of urban living in 'cold' is considered to be negative. Recent study of Stout et al. 2018[4] discussed the that the winter cities should be more appealing in winter. Authors stressed that winter cities should be more appealing and liveable in winter suggesting winter-oriented events to enhance the social inclusion and outdoor activity.

Based on the literature review, the development of the public open spaces design guidelines in winter cities focuses on enhancing the outdoor activity through preventing negative impacts of cold climate. Most of the urban design approaches and research works refer to design of the spatial composition of public open spaces in winter by optimizing the wind flows[12], minimizing the amount of precipitation[27,82] and maximizing access to sunlight[13]. Other approach, that should to be added, focus on ensuring protection from the negative impacts of the severe weather by designing heated and enclosed pedestrian spaces[83] (fig. 1-8). However, few design approaches consider the people's perception and see the winter from the positive view in design process. We consider more holistic design approach that can be sensitive not only to environmental characteristics of the place but responsive to people's behavior and especially perception of the urban environment. Winter-oriented events is a proposed as a new urban design approach assisting in the rehabilitation of the negative perception of the winter and winter cities.

(**a**) (**b**)

Figure 1-8 Urban design approach for winter cities based on the enclosed heated public spaces, Minneapolis skyway system: (a) Photo of the skyways by Star Tribune, Aaron Lavinsky (b) Minneapolis skyway map[84].

Table 1-1 Literature review

	Environment and urban design	**Urban design and people's behavior**	**Urban design and people's perception**
Hot & temperate climate cities	Ali-Toudert & Mayer, 2006; Bourbia, 2010; Andreou et al., 2012, 2013, 2014; Shahrestani, 2015.	Lyman & Scott, 1967 Gehl, 1971, 1987; Ittelson et al., 1970; Bechtel & Marans, 1990; Hall et al., 1950; Carr, et al., 1993; Marcus & Francis, 1998; Newman, 1996; Juhani Pallasmaa, 1996; Gehl & Gemzøe, 2004;	Bosselmann, 1998; Craik & Zube, 1976; Tuan, 1977; Stokols, 1977; Altman et al., 1980 Lynch, 1960; Cullen, 1961 **Photography** Collier, 1967; Scott & Canter, 1997; Dakin, 2003;
		Thermal comfort: Maruani & Amit-Cohen, 2007; Nikolopoulou & Lykoudis, 2006; Thorsson, et al., 2007; Ahmed, 2003; Cheng, et al., 2006, 2012; Andrade, et al., 2011;	**Online Questioner& Machine Learning:** Clifton et al., 2008; Quercia et al., 2014; Naik et al., 2014; Krizhevsky & Hinton, 2017; Rossetti et al., 2019. **Social Media:** Dunkel, 2015; Liu et al., 2016; Martí et al., 2017; Qian & Heath, 2019;
Cold climate cities	**Sun, Wind:** Peter Bosselmann et al., 1993, 1991; Baruch, 1998; **Wind and snow:** Setoguchi, 2003, 2009; Setoguchi & Tsutsumi, 2007; Watanabe et al., 2016, 2017; Meng, 2010; Erell et al., 2012; Other: Hatakeyama et al., 2005, 2008;	**Thermal comfort:** Eliasson et al., 2007; Lai, 2014; Guo, 2017; Hou et al. 2017; Chapman et al., 2018,2019;	Pressman, 1987; Stout et al., 2018;

1.3. Proposed urban design approach (originality of the research)

1.3.1. Temporary design

Festivals and a variety of events are always proposed in so-called winter cities[4,6,85,86] to enhance the aesthetic 'appreciation' of a winter, consequently, the activity in the public open spaces.

The emblematic festivals of the cold season tend to involve innovative uses of snow and ice, and are designed to rehabilitate the negative perception of winter[87]. Moreover, it is reported that art event can assist in strengthening social inclusion[88], creating or renovating local identity, consequently, fostering place-making processes[89]. Flagship events are considered as an urban strategy, playing role in reconstructing urban image and stimulating economic of a place or city itself[90]. The employing variety of multiple physical forms to urban space, including maps, plans, models and designs – is an important objective of these events[91]. Even minor design interventions such as benches, a changing cabin lead to a greater number of users than before these insertions were made[92].

In this paper, we consider events or festivals as a temporary design apart from the traditional or permanent design approach. Temporary design is defined as specifically and purposely time-limited[93] design interventions[92] in order to enhance social activity and inclusion. Temporary design interventions considered on the example of the winter-oriented events Christmas Market and Illumination Festival in Sapporo, Japan (2015-2016) and 'Ice Town' event in Khabarovsk, Russia (2017-2018) can be listed as follows:

- Interactive temporary urban elements (Illuminated frame for taking a photo) (fig. 1-9).
- New Year of Christmas Decoration as Main Tree (fig. 1-10).
- Temporary enclosed heated facilities on public open spaces (fig. 1-11).
- Tables and stops for rest designed for street food (fig. 1-12).
- Interactive guidelines of event (fig. 1-13a).
- Illuminated decorative constructions (fig. 1-13b).

- Temporary elements made of snow (ice and anow sculptures, slopes and labyrinth (fig. 1-14, 1-15).

Temporary design is viewed in the study as a sustainable new urban design approach that has impact on the people's behavior in winter cities and its interventions are minimal[94].

Figure 1-9 Interative designed frame for taking photos, Christmas market and Illumination Festival in Sapporo, 2015.

(**a**) (**b**)

Figure 1-10 New Year of Christmas Decoration: (a) Main Tree on Lenin Sqaure, Kahabrovsk, 2018 (b) Main Tree on Odori Park, Sapporo, Japan, 2015.

Figure 1-11 Temporary enclosed heated facilities on public open spaces Christmas Market at Odori Park, Sapporo, Japan, 2015.

Figure 1-12 Tables and stops for rest designed for street food Christmas Market at Odori Park, Sapporo, Japan, 2015.

(**a**) (**b**)

Figure 1-13 Temporary urban elements Christmas Market at Odori Park, Sapporo, Japan, 2015: (a) Interactive guidelines of event (b) Illuminated decorative constructions

(**a**) (**b**)

Figure 1-14: Temporary elements made of snow, 'Ice Town' event in Khabarovsk, Russia, 2018: (a) Patterned ice sculpture (b) Snow sculpture 'Bear'.

(**a**) (**b**)

Figure 1-15 Temporary elements made of snow, 'Ice Town' event in Khabarovsk, Russia, 2018: (a) Ice labirinth (b) Ice slope.

1.3.2. Implementation of the temporary design into urban design process

Many studies stressed that the temporary design present effective tool for developing vacant land and enhancing use of public open spaces. Németh et al. investigate in their study the vacant land and its potential temporary use perspectives from ecological, social, political and economic aspects. They consider temporary use has the potential for developing vacant land and become an important element of planning[95]. Madanipour combined political economical and cultural analysis of understanding of the urban process of temporary

urbanism to explore the different conceptions of temporality their cases and their effects. in the context of city[96]. Unt et al. emphasized that the abandoned post-soviet sites can be activated by so-called urban acupuncture which implies temporary design interventions. They analyzed the people's behavior before and after a few small-scale design interventions as benches, changing cabin, taming on fishing harbour site in Tallinn in summer. The study stressed that a few temporary design interventions can increases the number of users and their activities significantly[92].

Currently, there is a clear increase in the frequency of temporary design and published work that provides a solid framework and clear concepts[97]. The term 'temporary' is perceived in many different ways and has a large range of purposes according to applied field of urban studies[93]. Temporary design can be described with such terms as 'bottom-up'[89,98], 'tactical'[99], or 'pop-up'[100]. The pop- and bottom-up interventions almost always remain experimental, isolated and dependent on local initiatives[97]. In other words, temporary use is often unplanned[101].

Due to the unplanned and experimental action of temporary design, its rarely viewed as a tool of the design process and considered as either 'secondary' or 'provisional' in relation to traditional or permanent design[95]. However, despite the unplanned history of temporary practice, the reduction in open public space use makes it critical that temporary design is implemented in urban planning and design policy[95]. Temporary design has its own qualities use [102] and presents many opportunities as a tool for public space that triggers outdoor activities in underutilized urban areas[101,103,104]. More often temporary use is advocated as an opportunity for change and as a critique of fixed rules rigid master planning and long-term strategies. Many researchers seeking how to implement and make the temporary design more sustainable part of the city, implement it in long term for city development[92].

In this paper, we attempt to examine temporary design as a planned action of architects and urban planners. It is necessary to reconsider the notions of

'temporary' in relationship to 'permanent' design[105] when defining an urban design approach capable of enhancing outdoor activity in winter cities. Therefore, we analyse the impact of the temporary design on people's behavior and perception in relationship to permanent design to clarify the role of the temporary design and its qualities in the urban design process of winter cities.

1.3.3. Analysing people's perception using social media

There is a growing interest in landscape[106,107] and urban design[79] by employing social media to gather impressions of people's perception of urban and natural environments that implies people's reactions evoked[108] or emotional experience of urban objects. The individual's impression or emotional experience of an event, which is evoked from events themselves, can be captured in the photographs they take within spaces[79]. Therefore, to define the urban design that make a strong impression on the pedestrians[109], a large number of photos related to the urban environment posted on social media was analyzed. The focus was not only on the surrounded constructions but also on the small-scale urban design, since most people acquire knowledge of a place by a piecemeal 'bottom-up' process which is itself dependent on direct experience[54]. We believe that some urban forms can stimulate activity, create a positive or distinctive image[109] and therefore foster a strong impression. While many methods to extract information on human behavior from crowdsourced geodata already exist, most of the studies focus on the spatial use of the city and perception of the city landscape using geo-location data. Although the considerable number of urban studies based on social media, a few studies assist in understanding of the people's perceptions of public open spaces with identifying the importance of each urban elements.

1.4. Research framework

1.4.1. Purpose and hypothesis

In this study, we empathize the impact of the temporary design on public open space on people's behavior and perception in winter to clarify the role of temporary design in design process of winter cities. An understanding of role of temporary design and its significance in winter cities is expected to reveal design approach that can enhance people's activity on public open spaces and improves pedestrians' perception of winter and winter cities.

The primary aim is to develop new urban design approach for comprehensive analysis of people's perception based on the social media, which is in line with the research purpose of exploring temporary design and its role in public open space design in winter cities.

Several hypotheses are explored in the study as followed:

- Temporary design enhances people's behavior.
- Temporary design and permanent design complement each other in spatial use.
- Temporary design enhances people' perception.

1.4.2. Structure of the thesis

1st chapter proposed urban public open space design approach based on the people's perception using social media and temporary design as tool for enhancing people's behavior and perception of public open space.

2nd chapter explored the public open space design that can present value for temporary design interventions and defined the target areas in winter cities Khabarovsk and Sapporo.

3rd chapter proposed the methodology for analysing people's behavior through behavioral mapping and people's perception using social media.

4th chapter explored the impacts of the environmental characteristics as sun, wind and air temperature of the cooling period on people's behavior on the example of Kita 3-jo plaza in Sapporo.

5th chapter clarified the impact of the temporary design on people's behavior and explored the relationship between permanent design and temporary design on the example of the Lenin Square in Khabarovsk.

6th chapter defined the impact of the temporary design on the people's perception of the public open space using social media on the example of Lenin Square in Sapporo and Sapporo Station South Square in Sapporo.

7th chapter proposed urban design approach for public open spaces that improve people's perception by temporary design.

Chapter 2: Case study

In this chapter we attempt to address the question of: What are the permanent features of the public open space that can present a value for the various temporary design interventions? We review public open space design that distinctive from Western approach of public open spaces since it designed for permanent or daily use. In contrast with Soviet-era public open spaces design that have been used occasionally for temporary events[110] and in some degree were designed in opposed to Western ideas[111].

2.1 Public open space design approaches

In this subchapter we compare Western and Soviet-era design approaches of public open spaces in order to clarify the distinctive points of the permanent design. Later we consider the suitable permanent design features that can assist in the developing of temporary design interventions.

We consider the Western design approach of the public open spaces of 1900s that shaped today's vision of public open spaces design and design of Soviet-era public open spaces that Russia and other post-soviet countries inherited.

2.1.1 Comparing Western and Soviet-era public open space design

Synthesising the earlier traditions of such urbanists as F. Gibberd (1969)[112], J. Jacobs(1961)[90], P. Buchanan (1988)[113], K. Lynch[54] and J. Gehl[39], according to M. Carmona et al.[114] contemporary public open space design: '…is simultaneously concerned with the design of urban space as an aesthetic entity and as a behavioral setting. It focuses on the diversity and activity which help to create successful urban places, and, in particular, on how well the physical milieu supports the functions and activities taking place there'. Creating identity and control of the place, diversity of use, individual comfort[115] and circulation of the people's flows between buildings[116] can be defined as a main principals of the designing public open spaces in Western countries.

Movement

In Western countries the connection between buildings creating pedestrian flows through public space is critical factor in generating urban life and activity. This allows to stimulate consumption[117] making economically sustainable public open spaces[114]. In the book of Chicago plane, '...majority of vehicles and of pedestrians as well are lured out of the direct line to streets made attractive by the shops, the trees, or other embellishments....' (fig. 2-1).

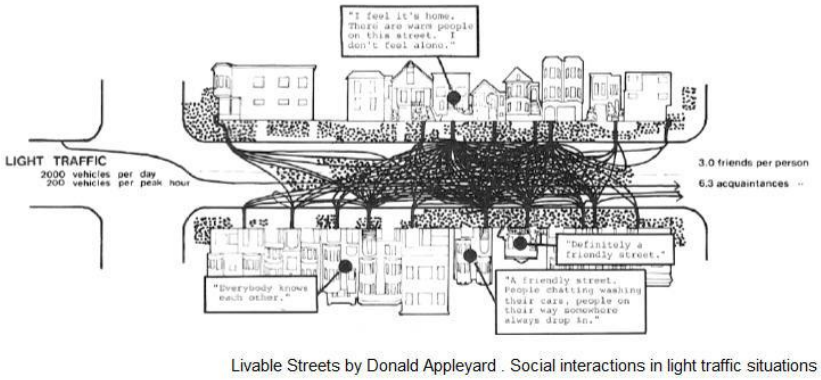


Figure 2-1 Appleyard's (1981) main study: level of pedestrian traffic and social interaction[118].

During Soviet-era commerce did not take a considerable role in designing public open spaces, and multi-story shopping complexes were anomalies. The usual association of central-city location and specialized shopping does not strictly obtain in Soviet cities[110]. Soviet-era public open space design focuses on the design on public open space, the design of the movements as a 'performance'. The Soviet-era public open spaces existed in political context, the center serves political and cultural functions. And square serves main public open space that provide the 'stage' for the performances and events. Soviet squares were symbolic tool for broadcasting the political regime and ideology[119], that were suitable for military parades and various demonstrations and rallies[119,120]. The public activity concentrated on producing parades and rallies, creatin the movements of the performances[121](fig. 2-2).

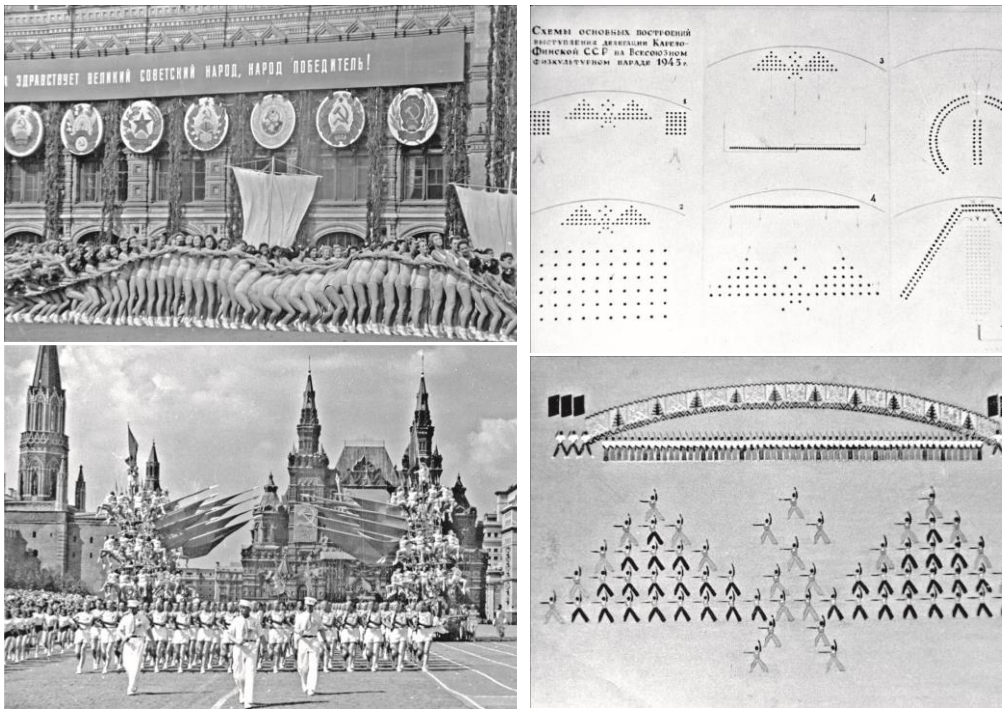


Figure 2-2 Soviet union cultural parades 1930-1940s, sketches of the people's movements on the Red Square[122].

The regular use of central squares and wide avenue for mass demonstrations was an important aspect of involving public participation in formal and informal events. Bater noted that 'the design problem was one of striking a reasonable balance between occasional public functions and the ordinary day-to-day purposes these same thoroughfares, squares and buildings had to serve. With the emphasis on the cultural and political uses of the central city, the usual central-city functions were downgraded…'. It led to intended decentralization of administrative and distributive services into developed secondary centres. Thus, cities structure was more sprawling. Unlike Western cities, the central core still had a substantial residential, as opposed to daytime, population[110].

Individuals and masses

The urban design strategies in Western cities focus on the individual's comfort, based on understanding of value of each individual and behavior of the people and groups concerned, and the environmental features crucial to their identity. In Soviet-era public spaces was determined by the public benefit and

by the number of people it could accommodate. The unification of public open spaces was the idea of the soviet ideology, that supported only occasionally massive events intended to facilitate the creation of a strong sense of community, while during the daily activities the places spaces were empty.

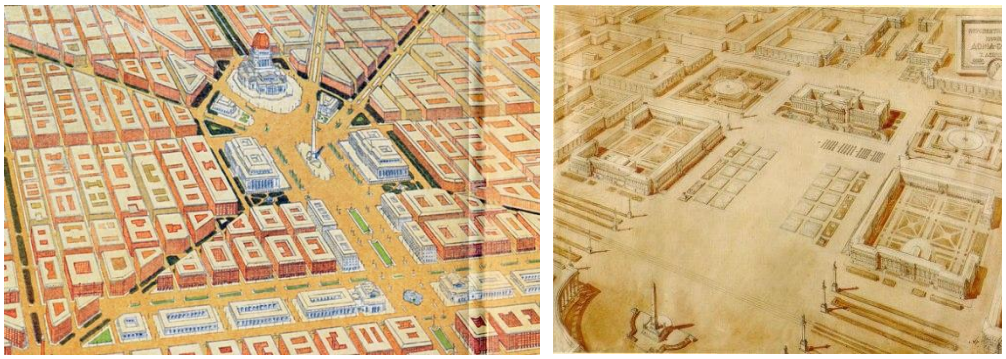
Private and public

Western public open spaces have a clear distinctive border between private and public space that reflected in designing semi-public spaces and semi-private spaces[36]. Unlike Soviet-era cities, where was no border between public and private, all the outside territory was public. 'Communists sum up their theory in the pithy phrase: the abolition of private property'[123].

Aesthetic

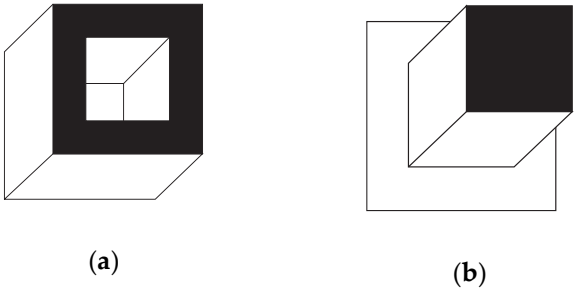
Considering similar design approach of the planning traditions that emphasized monumental architectural ensembles in Western countries and Soviet countries. In the case of the Western approach on the example, the 1909 Plan of Chicago the squares were equipped with the central objects as stelas, fountain, or lake. From the book of Plan of Chicago[124], '…The right of the people to assemble for discussion is fundamental. All these requirements must be met by the creation of open spaces, which appropriately may be adorned by the statues of men of achievement or may be ornamented with fountains and memorials of various kinds…' (fig. 1-3a).

In contrast to the soviet design most of the squares were equipped with the minimal objects and no central objects were proposed to allow people to gather in the central, to make a suitable stage for the events. According to the Soviet-era city design guidelines: 'When arranging squares and placing monuments they should be located on the square outside the main traffic flows of pedestrians and vehicles'[125]. The squares were equipped with minimal street furniture, such as monuments and benches, and the benches that can be found 'unfolded, most likely, towards the monument or other symbols of ideology and power'[126] (fig 1-3b).



(**a**) (**b**)

Figure 2-3 Comparison of the two public open space design visions during the 1900s in US and USSR; a) Plan of Chicago 1909, architects D. Burnham and E. Bennett b) Moscow Square in Leningrad (Sankt-Petersburg) 1936, architect N. A. Trotsky.



(**a**) (**b**)

Figure 2-4 Comparison of the two public open space design visions during the 1900s in US and USSR; a) Enclosed place design b) Open place design. Revised by author[127].

The other distinctive aspect of design that is that the borders of public open spaces was defined by the building, thus, the place looks more enclosed in case of the Western design (fig. 1-4a). While for Soviet-era public open spaces the public open spaces were defined by the adjoined wide-open venue, therefore, it created more open character of the place (fig. 1-4b).

2.1.2 Soviet-era 'Lenin Square' in Russian cities

Most of the public spaces in Russian cities have been inherited from the Soviet-era. All of these large -scale spaces were designed for a variety of functions and have distinct characteristics.

The existing Soviet-era public open spaces, particularly squares were analysed to define the common characteristics of the design inherited from the Soviet-era. We collected 28 central city squares from different cities around

Russia. The proportions of many public open spaces that are named after V. I. Lenin are monumental: a large square is adjoined to a wide and long avenue, allowing state events to be viewed from many angles, providing space for massive public gatherings and providing access for military transport[119,128]. Most of the squares have a regular rectangle shape. All of the squares located in the center of the city and adjoined to the main streets (fig. 2-5). Minimal number of the street furniture and various symbols of ideology as Lenin Statue are the objects that can typically be found in the post-soviet squares[126]. After the collapse of the USSR some other square were equipped with fountains and green zones with time. few squares cover by greens zone. The squares provide the 'voids' in the center of the city due to the proportion of the total area and vacant area. In addition, all of the squares surrounded by cultural and state public facilities as a theater, city or region administration building (Table 2-1). Other common features are the great scale flat areas, as a rule, coved by asphalt.

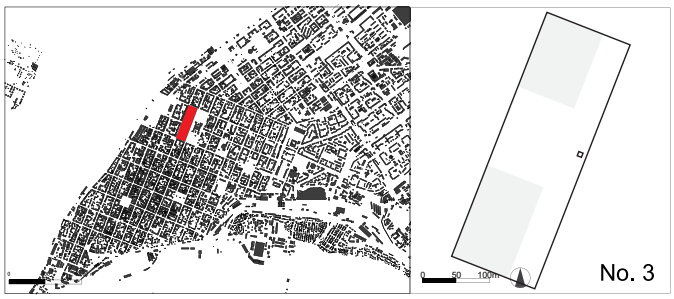
Overall, we can conclude the characteristics of the Soviet-era square as follows:

- Central position along the main street.
- 'Openness' provided by adjoined wide and long venue.
- Great size of the vacant area.
- Cultural and state function due to the surrounded buildings.
- Flat coved by asphalt area.
- Few green zones.

Shown characteristics considered to be useful for the various of the temporary events and consequently for temporary design interventions.


No. 1

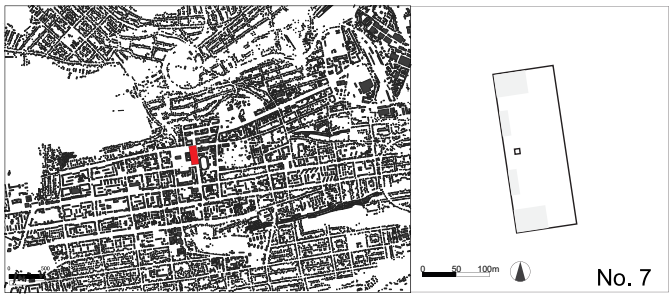

No. 2

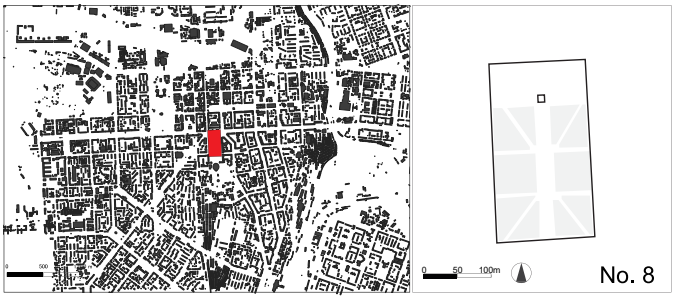

No. 3


No. 4


No. 5

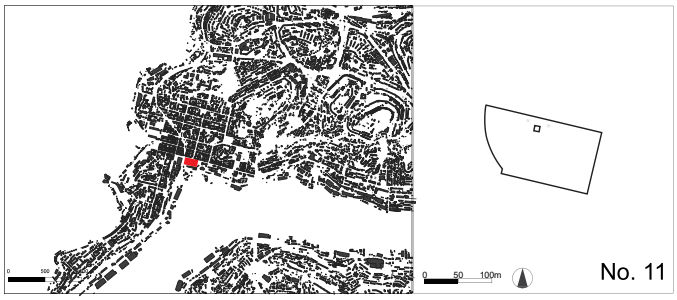

No. 6


No. 7

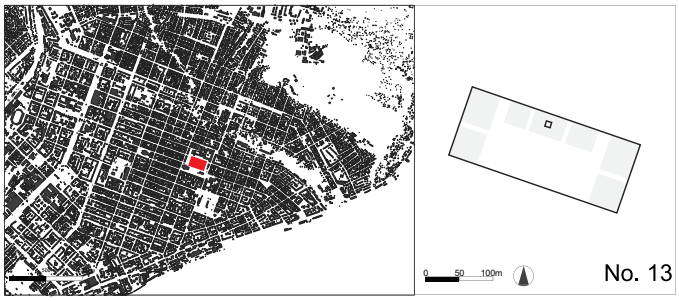

No. 8


No. 9


No. 10

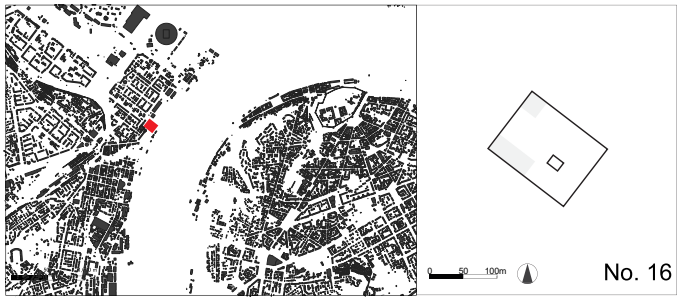

No. 11

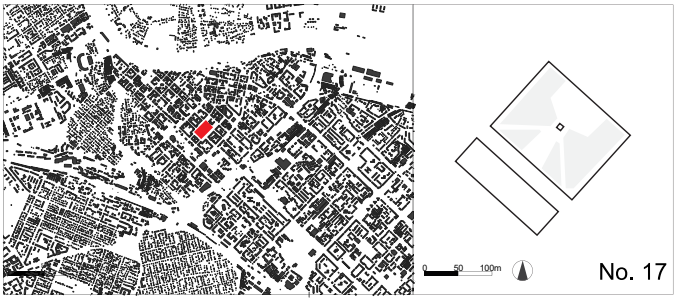

No. 12


No. 13

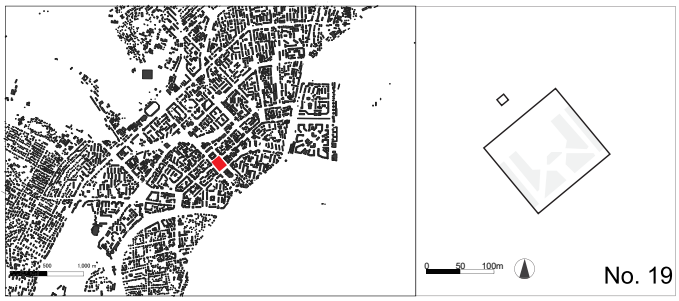

No. 14


No. 15


No. 16


No. 17


No. 18


No. 19


No. 20

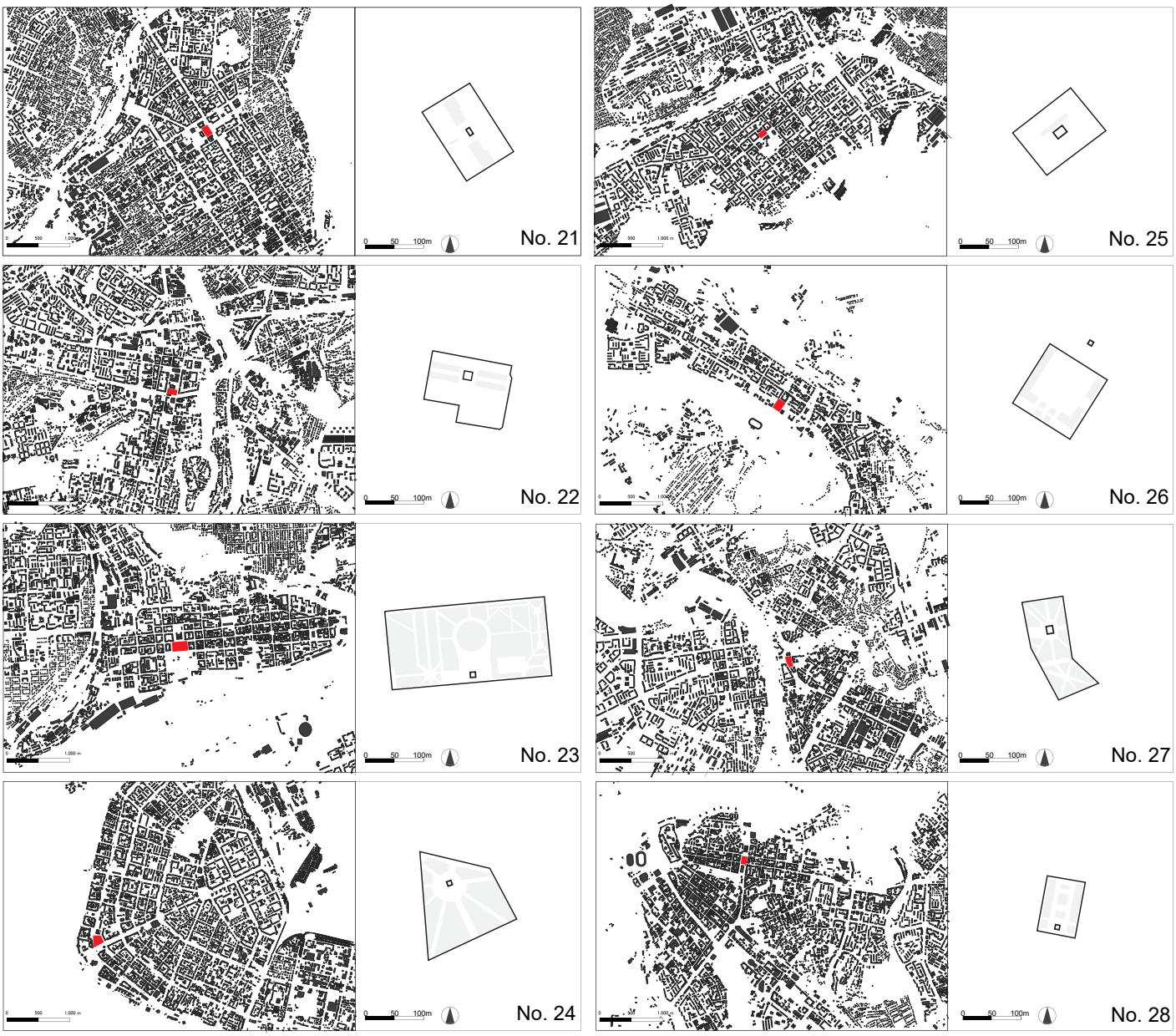


Figure 2-5 Schematic example of the central Soviet design squares in Russia.

Table 2-1 Rank of the Soviet design central squares in Russia based on the size of the open area.

№	Square	City	Total area, m^2	Vacant area, m^2	Surrounding attraction/public facilities	Main Monument
1	Red Square	Moscow	35 200	**35 200**	Memorial hall; St. Basil's Cathedral; State Historical Museum; GUM.	-
2	Palace Square	Sankt-Petersburg	34 000	**34 000**	General Staff Building; State Hermitage Museum;	Aleksandrovskaya Kolonna
3	Kuybyshev Square	Samara	70 000	**30 000**	Concert Hall; Samara State Academy.	V.V.Kuybushev
4	Moskovskaya Square	Sankt-Petersburg	37 300	**20 000**	Business Center.	V. I. Lenin
5	Lenin Square	Chita	47 000	**19 000**	Theater; History Museum.	V. I. Lenin
6	Lenin Square	Khabarovsk	25 600	**17 000**	Khabarovsk Krai Government bld.; University of Management; Medical University.	V. I. Lenin
7	Lenin Square	Stavropol	21 000	**16 000**	Duma of Stavropol Territory; Stavropol Academic Library; Stavropol State Museum.	V. I. Lenin
8	Square of Revolution	Chelyabinsk	40 000	**15 000**	Art Museum; Theater; The Legislative Assembly of the Chelyabinsk region.	V. I. Lenin
9	Lenin Square	Novosibirsk	27 600	**15 000**	City Hall of Novosibirsk; Novosibirsk State Academic Theatre; Museum of History.	V. I. Lenin
10	Theatre Square	Rostov-on-Don	21 000	**15 000**	Rostov Academic Theatre.	Stele "Liberators of Rostov"
11	Central Square	Vladivostok	14 600	**14 000**	Administration of Primorsky Territory; Station coastal Posts.	Fighters for Soviet Power
12	Lenin Square	Ufa	26 000	**13 400**	Ufa City District Council; Academic Drama Theater of Bashkortostan.	V. I. Lenin
13	Theatre Square	Saratov	29 000	**13 000**	Saratov Academic Opera and Ballet Theater; Saratov Regional Duma; Art Museum.	V. I. Lenin
14	Lenin Square	Tula	15 000	**13 000**	Administration of Tula; Uspenskiy Cathedral; Tula Regional Duma.	V. I. Lenin
15	Lenin Square	Voronezh	12 500	**12 500**	The Government of the Voronezh region; State Theatre; Administration of Voronezh.	V. I. Lenin
16	Lenin Square	Nizhny Novgorod	14 000	**12 000**	Riverfront of Oka river; Hotel.	V. I. Lenin
17	Central Square	Tyumen	22 600	**10 000**	Government of the Tyumen Region; Tyumen Regional Duma.	V. I. Lenin
18	Lenin Square	Yuzhno-Sakhalinsk	20 000	**10 000**	Administration of Yuzhno-Sakhalinsk; Yuzhno-Sakhalinsk Station;	V. I. Lenin
19	Lenin Square	Yakutsk	16 000	**10 000**	The Government of the Republic of Sakha; National Art Museum.	V. I. Lenin
20	Lenin Square	Sankt-Petersburg	17 400	**8000**	Finland Station; Concert Hall.	V. I. Lenin
21	Soviets Square	Barnaul	15 400	**8000**	Administration of Altai Territory; Altai Regional Drama Theatre	V. I. Lenin
22	Lenin Square	Penza	12 400	**8000**	The Government of the Penza region; Central Bank of Russia; shopping mall.	V. I. Lenin
23	Square of Revolution	Krasnoyarsk	33 000	**7000**	State Academic Library.	V. I. Lenin
24	Lenin Square	Arkhangelsk	20 000	**7000**	Administration of Arkhangelsk; Central City Library; State Philharmonic of Arkhangelsk.	V. I. Lenin
25	Lenin Square	Kurgan	9000	**7000**	Administration of the city of Kurgan; Kurgan Regional Drama Theater.	V. I. Lenin
26	Lenin Square	Birobidzhan	11 000	**6300**	The Government authorized the EAO; Jewish Autonomous Region Court	V. I. Lenin
27	Lenin Square	Pskov	11 400	**4000**	Pskov State University.	V. I. Lenin
28	Freedom Square	Kazan	6000	**2500**	Cabinet of Ministers of the Republic of Tatarstan; Tatar State Academic Theater.	V. I. Lenin

2.1.3 Temporary use of the Soviet-era squares

Besides the parades and rallies various events were held on the Soviet squares, starting from cultural event and promoting radio finishing with the protest against the law.

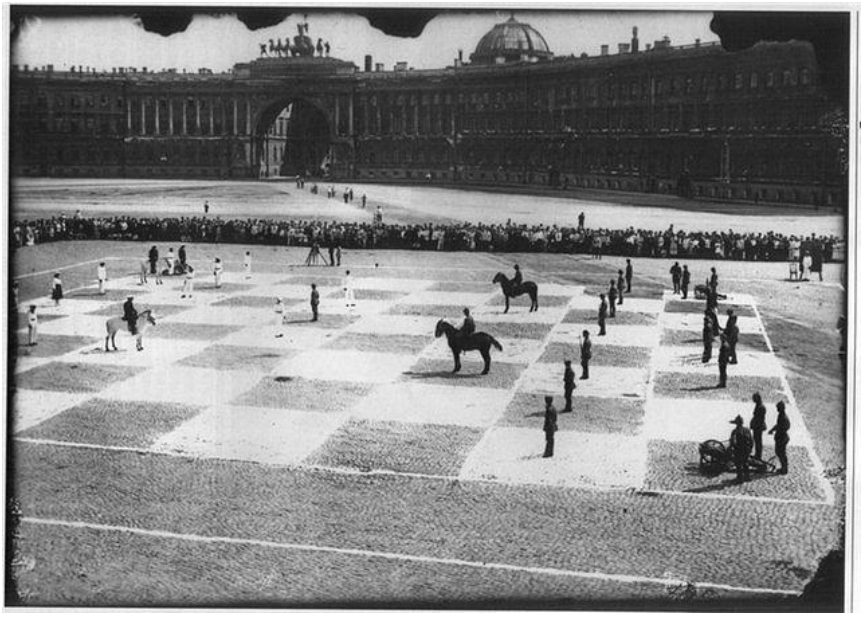


Figure 2-6 "Live chess" on Palace Square in Sankt-Petersburg, July 20, 1924[129]**.**

This ‘Live Chess’ spectacle hold on July 20, 1924, lasted 5 hours and attracted an audience of 8,000. Two masters of that time played the game, Peter Romanovsky and Ilya Rabinovich with the moves transmitted by telephone. The Black pieces were represented by members of the Red Army. The White pieces were represented by members of the Red Fleet. This was an annual event, designed to promote chess in the USSR, that had taken place since 1921 at different venues: 1921 in Smolensk, 1922 in Kerch, 1923 in Omsk and 1924 in :Leningrad (Sankt-Petersburg) (fig. 2-6).

Figure 2-7 Pioneer bonfire, Lenin Square, Khabarovsk, 1948 [130]**.**

Pioneer bonfire was hold on Lenin Square in 1948 in Khabarovsk (fig. 2-7). Moreover, on the main central square people gathered to listen a reading of the newspapers since most of the followers of the ideology of Soviet-era were illiterate.

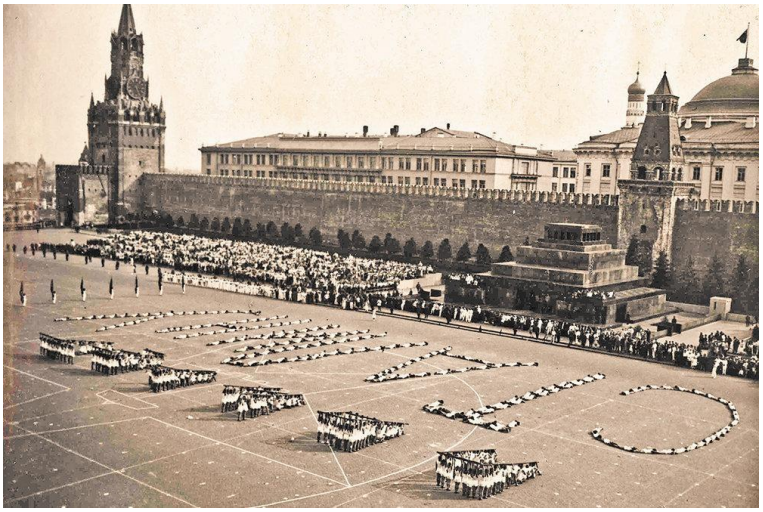


Figure 2-8 Greetings to Stalin. Moscow Red Square. May 1, 1937[131]

The picture above was taken on the Red Square in Moscow in the 1937; the inscription says, ‘Greetings to Stalin’ (fig.2-8). A half-century later, right after the collapse of the Soviet Union, Moscow artists decided to use the same place, and the same technique. ‘The action was timed to coincide with the "Law on Morality", with which we at that time did not agree at all. It was released on

April 15, 1991, it was forbidden to swear on public places '[132]. April 18, 1991[132]. Photo: MK correspondent. Courtesy Anatoly Osmolovsky (fig. 2-9).

Figure 2-9 Movement "E.T.I." Action "E.T.I.-text". Moscow Red Square.

2.1.4 Transformation of the 'Lenin Square'

In 1992, serious changes occurred in the functional equipment of squares when trade was allowed. Many areas were used as a source of income[119,133], and the squares filled almost immediately with the chaotic character of markets; there were commercial pavilions and advertisements combined with a great increase in traffic and parking issues[121]. Public spaces in Russian cities underwent a transition from the 'overwhelming' political regime of Soviet period to the space of consumption[134]. The huge open space/'voids' in the center of the many post-soviet cities is happened to be occupied by commercial pavilions, advertisements, parking and car traffic[121].

With the demise of Communist ideology, these days, such spaces are open and accessible, but unpopular. 'In modern cities, many spaces that are impeccable in terms of composition and aesthetics of modernism turn out to be 'empty' [126] regarding the potential of their social activity. Ladogina noted, however, that such 'voids' [135] provide great potential for implementing a variety of behavioral strategies [136]. Many squares are being reconstructed and the process of restructuring is still ongoing' [137,138]. According to Kuba Snopek, all post-communist city squares are in the process of 'transformation'[121,138], with

some places being developed a final model of urban space, and others in a state of ‘deep chaos’[121]. Clearly, there is no unit solution for developing these spaces. This study suggests Temporary design intervention as a unified model for developing such spaces as social and cultural attraction places. Plans to restructure Soviet-era cities, where public open spaces tend to be unutilized nowadays, need to be flexible and to serve alternative scenes. That is, the role for temporary activities and interim phases of development should be considered at the design stage [93].

2.2 Khabarovsk, Russia

Most of the Russian cities can be listed as a winter city, following Pressman definition, that winter cities are cities where the average maximum daytime temperature is equal to or less than 0 °C for a minimum of two months each winter. However, we focus on cities in Far North or cities equated to Far North with more severe climate. The first climatic region has subareas: IA, IB, IB, IG, ID, of which subareas IA and IB are especially severe for living defined by Construction Climatology (Table 2-2). Although the set of rules considering climatic parameters are used in the design of buildings and structures, heating, ventilation, air conditioning, water supply systems, the design of the public open spaces remains the similar in all climatic zones (fig. 2-10).

Climate comfort was not considered during the design process of public spaces and building spacing, street orientation came to be similar despite cities drastically different climates. Public spaces were aggressively redesigned by the Soviet State for mass-political agitation into wide-open areas with monumental architecture. Although the low-rise building of the Russian cities contributes to a better comfortable climate in the northern regions, the orientation of the street grid is wide and does not meet the standards of a comfortable northern city. As wide spans create vortex flows in public spaces and snow drifts with a wind of 5 meters per second, creating an uncomfortable environment. In already established development, it is important to develop and search for alternative design approach to enhance the outdoor activity. There is potential[139] for a range of temporary design interventions[140] in public spaces designed for parades and rallies,[119,120,135] such as events and festivals intended to promote greater use[86,140,141]. Besides, the development of the culture of the north and the unique northern cities by means of temporary design, that is, holidays and events can contribute to better adaptation of citizens to the harsh climate.

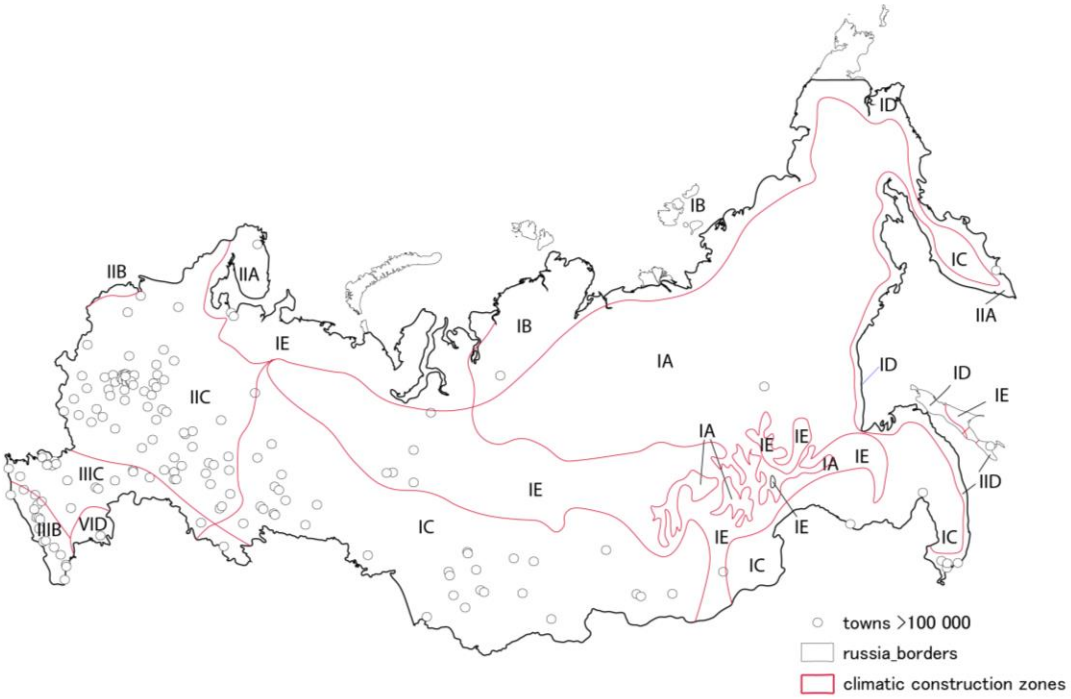


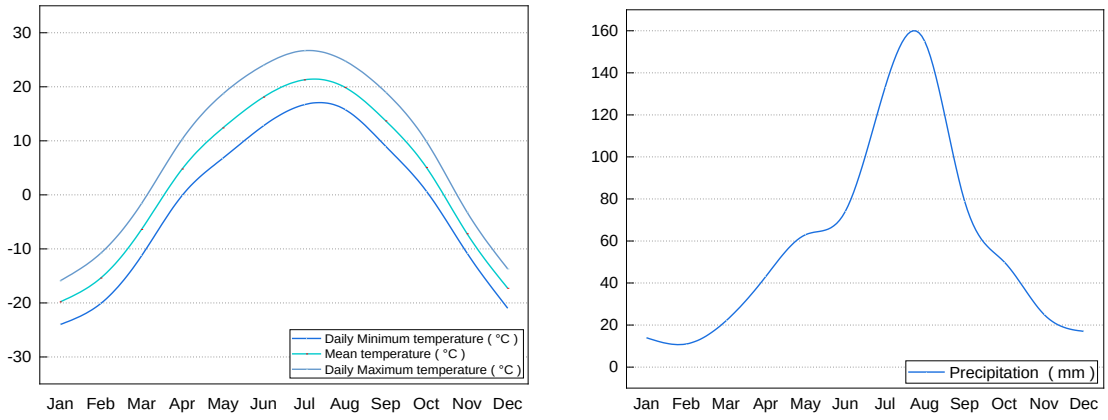
Figure 2-10 Climatic construction zones in Russia. Construction climatology[142] (revised by author).

Table 2-2 Climatic construction zones in Russia. SP 131.13330.2012 Construction climatology[142].

Climatic zones		Av. Air Tem. in January, ℃	Av. Wind speed, m/c
I	IA	-32 and <	-
	IB	-28 and <	>5
	IC	-14 to -28	-
	ID	-14 to -28	>5
	IE	-14 to -32	-
II	IIA	-4 to -14	>5
	IIB	-3 to -5	>5
	IIC	-4 to -14	-
	IID	-5 to -14	>5
III	IIIA	**-14 to -20**	**-**
	IIIB	**-5 to +2**	**-**
	IIIC	**-5 to -14**	**-**
IV	IVA	**-10 to +2**	**-**
	IVB	**+2 to +6**	**-**
	IVC	**0 to +2**	**-**
	IVD	**-15 to 0**	**-**

2.2.1 General Introduction of Khabarovsk

One of the largest political, educational and cultural centers of the Russian Far East. The largest city in the Far East with a population of 616,372 people (2020). The area of the city is 386 km². Khabarovsk one of coldest regions – the Far East Russia. Khabarovsk experiences a monsoonal dry-winter humid continental climate. Winters are extremely cold, with an average temperature in January of −19.8 °C (figure 2-11). The temperature hit a record low of −40 °C in January 2011. The average annual precipitation is 682 mm, mainly concentrated in the summer. Snowfall is common, with an average maximum snow height of 16 cm. The air temperature between summer and winter is extremely ranged from −40 °C (−40 °F) in January 2011 to +36.4 °C (97.5 °F) in June 2010[143].



(**a**) (**b**)

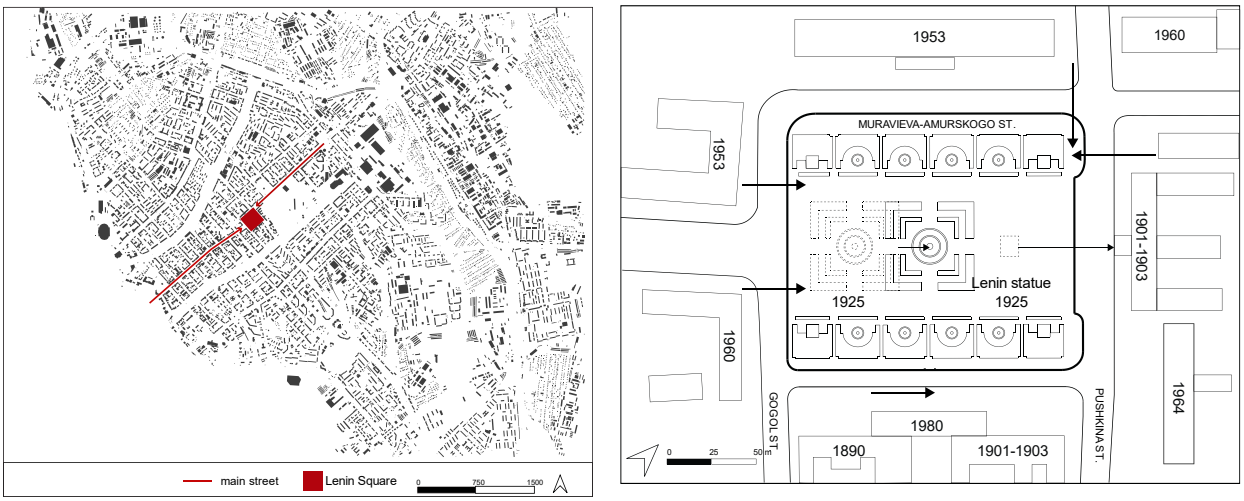
Figure 2-11 Climatic characteristics: (a) Annual temperature (b) Annual percepetation[143].

2.2.2 Target area, Lenin Square

The target area Lenin Square, a classic example of Soviet-era design, has been well- preserved with no dramatic changes over the last 30 –40 years[144]. Because Lenin Square is located in the downtown area and positioned at the intersection of two main streets with numerous public facilities, pedestrian traffic is guaranteed (fig. 2-12a). The square is enclosed on 3 sides by historical buildings, and the south-west side is partly open to the main road designed for parades and rallies. Its scale and composition remain the largely same as during

the Soviet era. Only the central fountain and Statue of Lenin have been relocated from their original places (fig. 2-12b). Thus, we believe, that the square is an appropriate example for considering the urban design approach of unutilized soviet design public spaces. Throughout its history, Lenin Square has been a place of temporary use. Many parades, rallies and events have been held in Lenin Square, which, 24 750 м^2, is one of the ten largest squares of Russia. However, daily it turns out to be empty and few activities happens (fig. 2-13).

Historically, the central square was a natural meeting place, and served to promote the concept of democracy: it is a space in which people can deliberate, make policies and decide their course of action. While the function of the most squares in Russia defined by key building at the square, for example, cathedral squares or railway station squares, this was not the case in Lenin Square. The 'void'[135] used for temporary activities became its dominant feature. This 'incompleteness'[144] in the spatial composition of the square designed for temporary activities allows various design strategies to be implemented. Thus, we view Lenin Square as a suitable example of a permanent design to consider a variety of temporary design implementations.



(**a**) (**b**)

Figure 2-12 (a) Central area of Khabarovsk, location of Lenin Square. (b) Historical transformation of the Lenin Square, Khabarovsk, Russia.

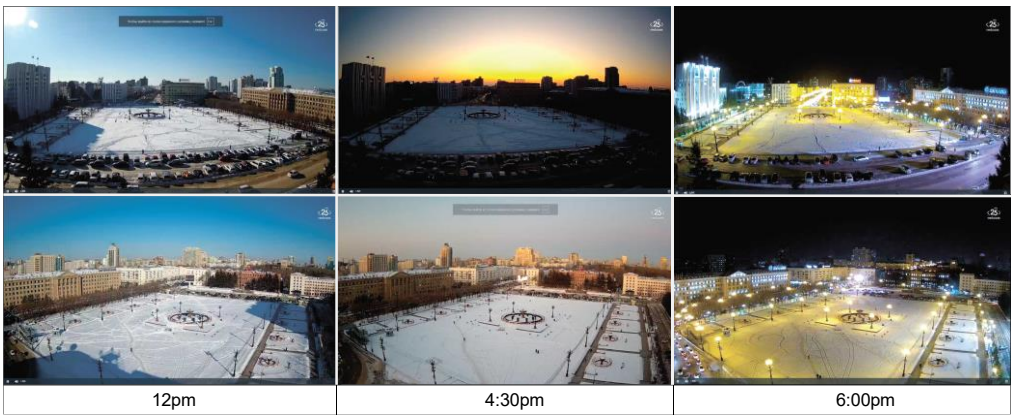


Figure 2-13 Lenin Square, scenes during the day (21.11.2019). Data from live cameras[145].

2.2.3 'Ice Town'

Lenin Square was selected as the target area due to the annually held 'Ice Town' ('Ledyanoy gorodok') event. A unique element of winter celebrations in many winter cities, records indicate that structures have been built for similar 'Ice Town' events from as early as the 18th century most notably in Montreal in Canada[1]. In Russia, this winter-oriented event has been held since 1903 and remains a part of the culture in many winter cities. The basic elements of the event include a massive scale Main Tree and a slide. During 'Ice Town' in Lenin Square, there are different patterned ice sculptures, snow sculptures, ice slides and labyrinths, as well as a Main Tree.

Figure 2-14 'Katushku', winter festival in Yekaterinburg, XIX century[146].

People arranged street festivities even in severe frosts. Right on the frozen city pond, they skated, sledges and ride horses with music. They sold food and drinks, and organized a theater. They also built a large wooden hill, the ‘katushku’ (fig. 2-14). Since 1935 large spruce or Main Tree become a main decoration of winter festivals around the fair trade[147] (fig. 2-15a). Since 1947, a ‘Ice Town’ with snow figures and wooden slides has been annually built on the square. Over time, sculpture design became more symbolic related to specific event of the country, such as flight into space, Olympic games[148].

(**a**) (**b**)

Figure 2-15 (a)The ‘Ice Town’ in the 80s Yekaterinburg[149]. (b)The massive scale slide "Russian winter, and the New Year flying on a satellite", Theatre Square, Kirov, 1950s - 1960s[150,151].

Many of ice sculptures or slides with high of 10 - 12 meters were notable for their massive scale, an interesting idea and expressiveness. For example, massive scale slide with idea of "Russian winter, and the New Year flying on a satellite" (fig. 2-15b) or the monumental "Noblewoman" (fig. 2-16).

Figure 2-16 The massive scale sculpture, Theatre Square, Kirov, 1950s - 1960s[150,151].

It is different from other winter-oriented events, such as contemporary Christmas markets, in that it does not aim to contribute to economic and social vibrancy[4]. Instead, the aim of the 'Ice Town' is to exploit the opportunities provided by the of ice and snow for the sole purpose of enjoyment and to promote acceptance of the climate as an integral part of the cultural framework[1]. It should be stressed that while these cultural events do not facilitate economic vibrancy in the city, they certainly contribute by successfully addressing the ecological challenge to hold zero-waste events.

2.3 Sapporo, Japan

2.3.1 General Introduction of Sapporo, Japan

Sapporo is the central city of Hokkaido, with a population of about 2 million. Sapporo is the fifth-largest city in Japan with 1121.25 km^2 city area. Hokkaido is northern prefecture of Japan, which is a cold and heavy snowfall region. Sapporo has a humid continental climate, with a wide range of temperature between the summer and winter, similarly to that in Khabarovsk (fig. 2-17a). Winters are cold and very snowy, with an average snowfall of 5.96 m. per year (fig. 2-17b).

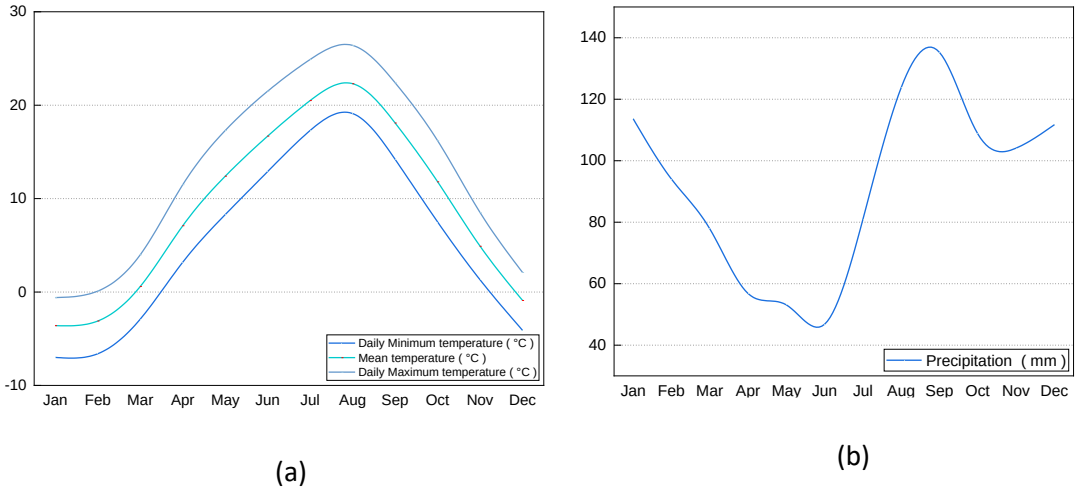


Figure 2-17 Climate of Sapporo, Japan Meteorological Agency(a) Annual temperature (b) Annual percepetation [152].

Winter lasting in Sapporo from December to March. Snowy winter makes the four seasons of Sapporo more distinctive and impressive attract many tourists in winter. Snowfalls as an important source of enjoying skiing, skating and other winter sports, and enabling to hold winter-oriented events such as snow festivals with great scale snow and ice sculptures[153]. Most winter-oriented events concentrated in February during the coldest period to allow residents and visitors enjoy winter and adapt the cold.

2.3.2 Target areas, Kita 3-jo plaza, Sapporo Station South Square

The chosen target areas for analysing impact of the environmental condition in cooling period is Kita 3-jo plaza. Kita 3-jo plaza surrounded by hight-rise buildings is recognized as an important public open space in downtown Sapporo.

Figure 2-18 Target area of Kita 3-jo plaza (20.01.2018) in Sapporo.

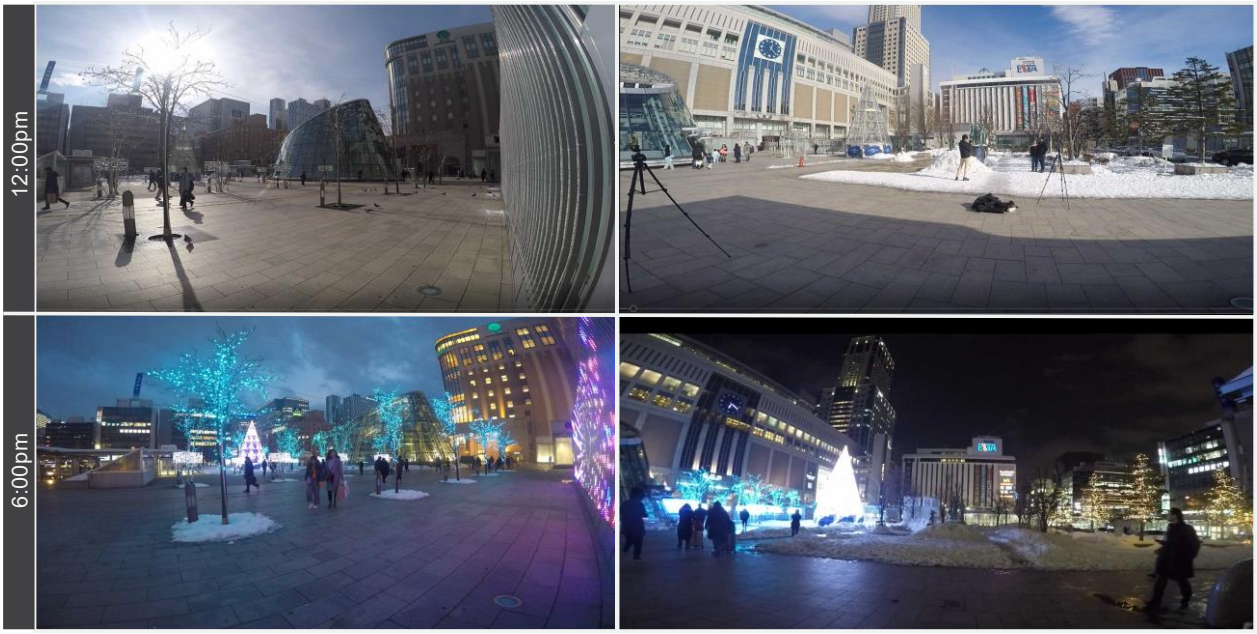


Figure 2-19 Target area Sapporo Station South Square, 'Illumination Festival' (20.01.2018).

To clarify to what extend the illumination design interventions in winter cities impact on the people's perception the 'Illumination Festival' on Sapporo Station South Square was chosen as a target area. Sapporo Station South Square adjoins to Railway Station and providing the transition place as well as place or events. Similarly, with the Lenin Square it adjoins to the wide avenue, thus,present 'openness character' of the place.

Chapter 3: Methodology

3.1 Impact of the temporary design on people's behavior, Lenin Square

3.1.1 Hypothesis

In most of the literature focused on temporary design[139,154,155], it is considered separately from the traditional or permanent design concept. We suggest that the two design approaches should be seen as complementary rather than exclusive, both serving specific purposes in cities. We believe that design paradigms can be defined by the way the users inhabit the design space. The concept of permanent design is a fundamental, sustainable design either for people's basic activities, like walking, sitting, resting and gathering, or space for a wide range of activities, like processions and parades. The concept of temporary design, on the other hand, is to stimulate interest in the urban environment and to support extra activities, such as walking around, playing, taking photos, talking, and enjoying the urban environment.

Therefore, the purpose of this study is to examine the impact of permanent and temporary design approaches on user behavior in order to understand their paradigms for developing guidelines for the design of open public spaces in winter cities. These guidelines should be suitable for use even in places with a severe climate. In this study, we consider one example in the square in the winter city of Khabarovsk, where the average low temperature in the coldest month is −19.8 °C. Spatial use after and during the winter event 'Ice Town' ('Ledyanoy Gorodok') is compared in detail. The spatial use of the square during the event helps is to define the paradigm of the temporary design, and also the use after the event, the permanent design. We define the situation after the event as the 'no event' and the situation during the event as the 'event'. Moreover, we compare the spatial use during the day and in the evening. Note that we consider temporary design elements as objects designed for an event and used for a short period of time. In the case of a winter-oriented event these include ice and snow sculptures, slides, and New Year decorations. Elements of permanent design refer to those objects designed for everyday use, including buildings, benches, decorative pots and flowerbeds. Based on the results of the

observation of the square during and after the event, the paradigms of permanent and temporary design were clarified. Various guidance emerged for the design of open public space appropriate for temporary design in winter cities (fig. 3-1).

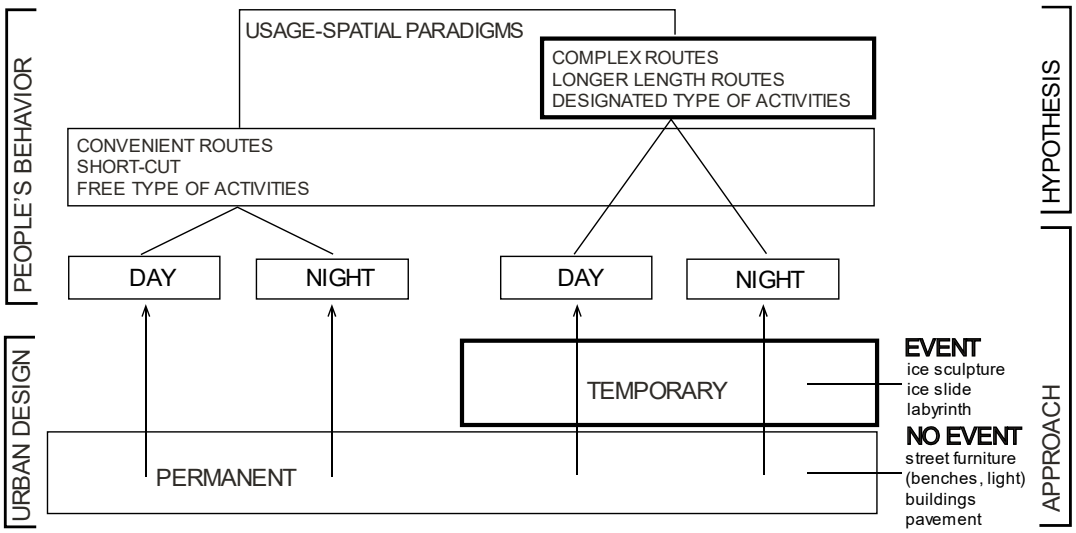


Figure 3-1 The research framework based on the analysis of the spatial use of the permanent and temporary design.

3.1.2 Methodology

Background data was collected and a site survey was designed to allow for scanning the space, and mapping the behavioral data. This data was used in a subsequent comparative analysis the 'event' and the 'no event' pattern of use. Note, that the 'no event'/'event' are used for outlining a particular time and situation. On the other hand, the terms 'permanent' and 'temporary' are used to describe the design.

Behavior mapping was used to clarify the extent to which the event affect the users' physical activity. Many scholars [11,31] have cited activity mapping as the principal comprehensive method to investigate the relationship between the physical environment and people's behavior. This allows the kinds and frequencies of behavior to be determined and their association with particular sites to be demonstrated[32]. The walking distance and type of activity of the users

were observed on the square during the ‘no event’ and the ‘event’ situations. The walking distance was used to assist in understanding to what extend the physical activity change. The quantitative analysis of the activity types and their patterns reveal which activity is preferable in winter and also the distribution of this activity. The behavior mapping method was carried out during the winter event ‘Ice Town’ held in 2017–2018 and afterwards. Photographs of the ‘event’ elements were collected at an initial site survey (fig. 3-2). The square on the map was divided into 5 subareas. Subareas are created for scanning of the space to clarify the most usable elements and sites as well as their effect on the type of activity. There were five subareas: subarea A is the main fountain area, subareas B and C are two side-open areas, and subareas D and E are two side walking areas. Subarea A includes such elements as event lighting, a central fountain and 31 ice art sculptures with a scale of 2 square meters, placed along the borders of the fountain area. Subarea B includes an ice maze, 5 snow sculptures related to the New Year and Olympic Games Symbolism: these include ‘Happy New Year’, ‘Year of 2018’, ‘Bear’, ‘Cup’ and ‘Heart’. Subarea C includes ‘New Year Tree’, 7 identical snow sculptures, 11 symbolic snow sculptures, with the themes of ‘Merry Christmas’, ‘Santa Claus’, ‘Snegurochka’, ‘Stars’, and ‘Frame’. In subareas, C and D, along both walking paths, 2 ice slopes and 5 identical ice sculptures were positioned (fig. 3-2).

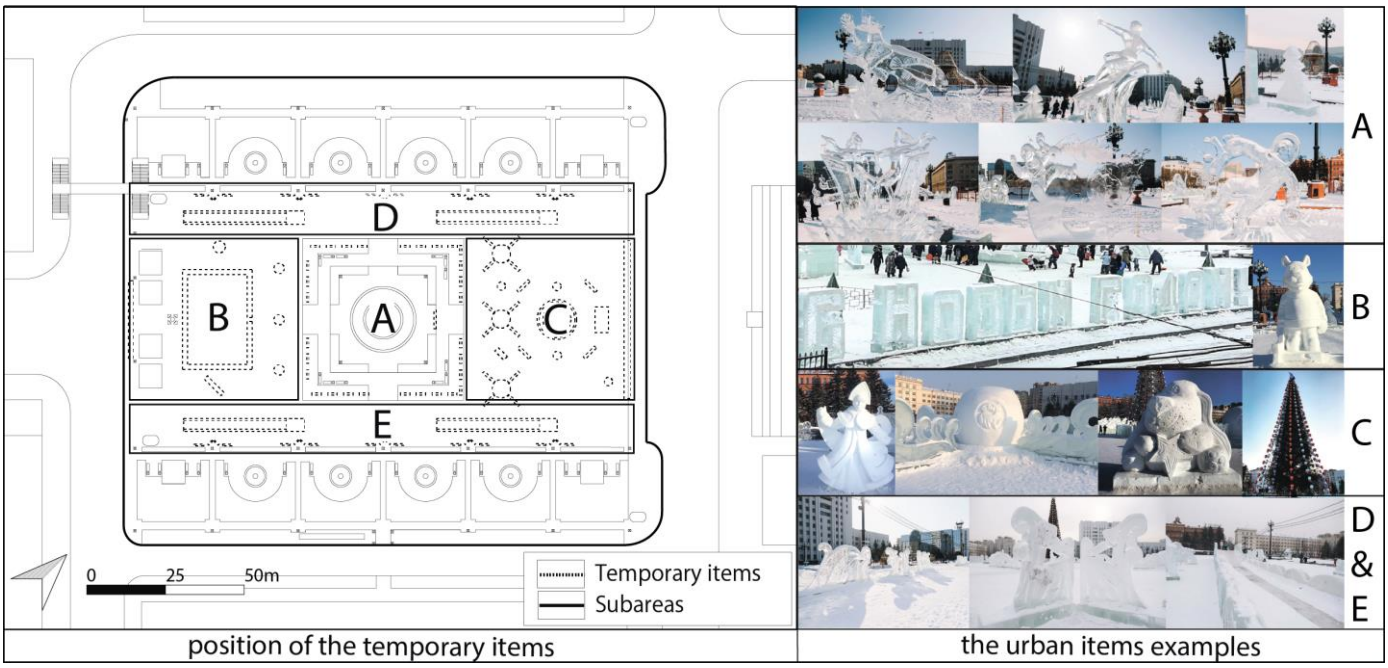


Figure 3-2 Elements of the 'Ledyanoy Gorodok' ('Ice Town') event of 2017-2018 on the Lenin Square, Khabarovsk, Russia.

3.1.3 Field observation in winter cities

Most studies in terms of the interrelationship of the urban environment and people's behavior have been conducted only above 0 Celsius degrees [44,49,156,157], and only a few have focused on extreme situations in cold seasons[50]. Field observations in winter cities, however, have their own peculiarities due to the low temperature and wind speed that can create further discomfort. As an example, the mapping of the location and type of activities are compounded by extreme cold temperature: every 15-30 minutes the one by another observer has to be replaced because of limits to cold tolerance. Thus, to document the observations a time-lapse video was taken to be visually processed at a later time. Additionally, the observation requires appropriate equipment since the battery runs out quickly at extreme low temperatures. A time-lapse-camera Brinno (fig. 3-3b) offers months of battery life that works well in severe weather conditions, such as heavy precipitation and extremely low temperatures. To evaluate the weather conditions, we used the Pocket Weather Station (Kestler 4000) on the square. Meteoritical station Kestrel 4000 (fig. 3-3b) measured the

wind speed, relative humidity, and operated with an ambient air temperature of –30 °C.

Figure 3-3 Two-days survey of the 'no event' and the 'event' situations at day and night of the Lenin Square: (a) positions of the equipment (b) equipment (c) scene view of camera 1

The observation of the people's behavior at night is also required in the winter cities. It is well-known that the white covering from precipitation can turn the nights into a dark scene with no distinctive hierarchies [3]. Street lighting adds to the outdoor activity and provides a feeling of safety[158]. Thus, we try to clarify to what extent the well-lit urban elements during the event can promoted outdoor activity. Moreover, we assumed that people would exhibit different distinct behaviors on weekends and during weekdays. We chose the weekday for the 'event' to highlight its significance for pedestrians, even on workdays,

when people utilize the public spaces less than on weekends[159]. The observation period selected was the period with the lowest average temperatures, ranging between –10 °C to –30°C (fig. 3-4). There was a midday observation and an evening observation period[160]: the midday observation was from 12:00 till 13:30 and the evening observation was from 18:00 till 20:00 The hour of the day was set according to the type of public space use, when the public space was used (midday) and the street lights are turn on (evening).

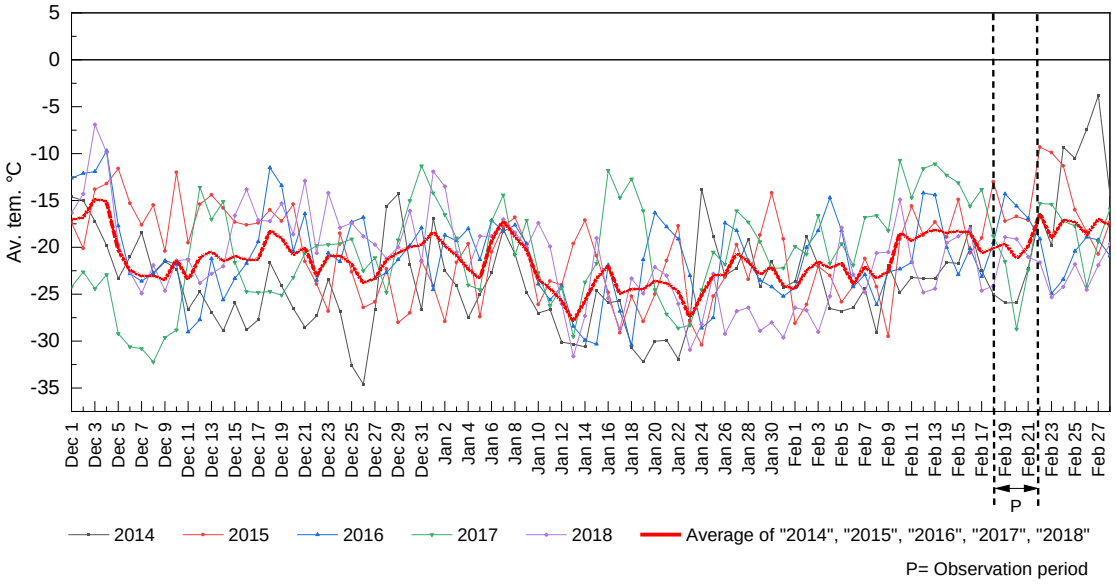


Figure 3-4 History average min. temp. in dec.-feb. (2014-2018). Data from National Meteorological Information Center.

3.1.4 Preparation for the fieldwork and scan analysis

At the initial stage, observations were carried out to clarify the ideal placing of the cameras. The cameras at a remote distance on the east and west sides of the square (fig. 3-3a), with the lowest possible degree of distraction and minimal interaction with users. The measurement point for the meteorological parameters (Kestler 4000) was were taken at increments of 5 minutes. It was critical to choose days when the meteorological parameters did not include precipitation and when the wind speed was average for the relative comfort of the users and for visibility for conducting the survey.

A single scan observation of the movements and activity was produced. During the scan, each individual movement flow in the area is indicated by a red line and each type of activity was coded. A digital map was created that summarized the fieldwork data, using Adobe Illustrator. The types of activities were differentiated by colour. These data were later input into the GIS Map (ArcGIS) to analyze the length of the pedestrian routes and the distribution of the activities. Firstly, the routes were scanned from the left to the right side and were placed on the digital map in relation to the location of urban elements. In the case where the route is repeated, the route line was simply copied. Secondly, to scan the type of activity, the square area was divided into the 5 subareas shown in Fig. 3-2. Subarea A is the main fountain area, subareas B and C are two side-open areas, and subareas D and E are the two side walking areas. Using this approach, it is possible to determine changes in the behavior of the pedestrians in each subarea during the ‘event’ and to what extent elements influenced this behavior.

3.2 Impact of the temporary design on people's perception

3.2.1 Hypothesis

One of the assumptions in this study is that the combination of the permanent design with temporary design has significantly greater impact on the pedestrians' perception, than permanent design. The primary aim is to emphasize the impact of the temporary design on the pedestrians' impression in relation to traditional or permanent design. On the example of winter-oriented event 'Ice Town' ('Ledyanoy gorodok') at the Lenin Square we consider permanent design as a 'no event' situation of the square and the combination of the permanent design and temporary design is considered as 'the event' (fig. 3-5).

There is a growing interest in landscape[106,107] and urban design[79] to employ social media as means to gather impressions of people's perception of urban and natural environments that implies people's reactions evoked[108] or emotional experience of urban objects. The individual's impression or emotional experience of an event, which is evoked from events themselves, can be captured in the photographs they take within spaces[79]. Therefore, to define the urban design that make a strong impression on the pedestrians[109], a large number of photos related to the urban environment posted on social media was analyzed. The focus was not only on the surrounded constructions but also on the small-scale urban design, since most people acquire knowledge of a place by a piecemeal 'bottom-up' process which is itself dependent on direct experience[54]. Such elements as street furniture, fountains, statue, buildings, and pavements were considered as Permanent design, while an ice, snow sculptures, maze, and New Year decorations and illumination – as temporary design. Moreover, the perception of the public open space during day and night were analyzed, considering their different impacts on the appearance of the urban environment. We believe that some urban forms can stimulate activity, create a positive or distinctive image[109] and therefore foster a strong impression (fig. 3-5).

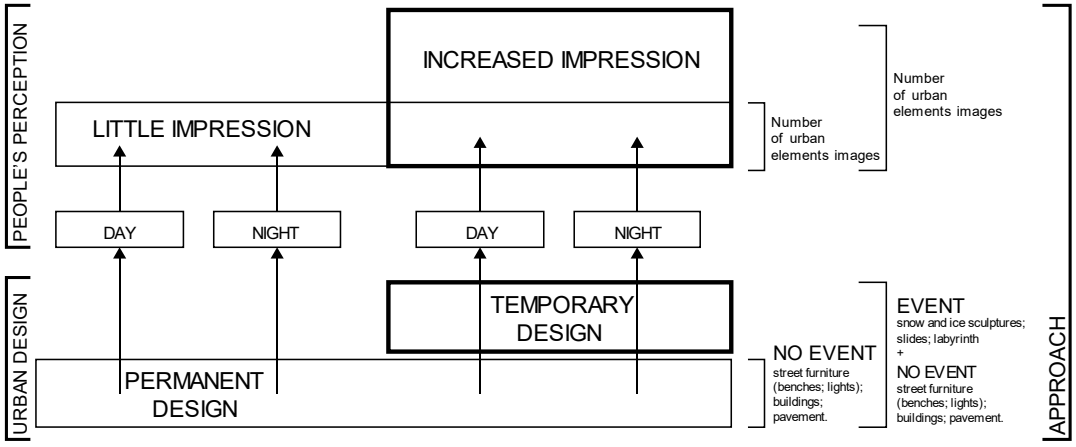
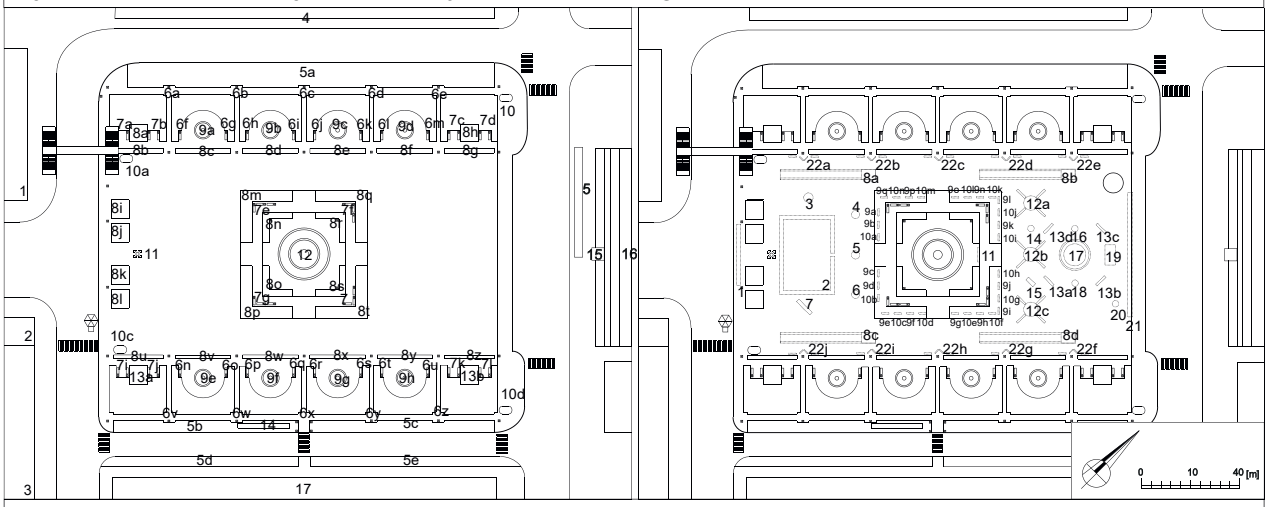


Figure 3-5 Hypothesis and theoretical framework.

At the initial stage, the digital map of the urban elements was prepared for the 'no event' and the 'event' for both the day and night situations on Lenin Square. All the urban elements were labeled with numbers according to their position. Four scenes in Lenin Square were observed, for the 'no event' on 24th February of 2018, and for the 'event' on 19th of February during the daytime and at night when the urban elements were well-lit (fig. 3-6).

(a)NO EVENT DAY (b)NO EVENT NIGHT

«No event» elements :
1. Management University bld. 2. General Hospital bld. 3. Gogol St. bld. 4. Medical University bld.
5. Alley of Trees 6. Single bench 7. Set of benches 8. Flower bed 9. Small fountain 10. Kiosk 11. Memorial 12. Central Fountain
13. Flower bed 14. Memorial 15. Lenin Statue 16. Pushkina St. bld. 17. Government bld.



«Ledyanoy gorodok» (25.11.2017 - 20.02.2018) event elements:
1. Snow sculpture «Happy New Year» 2. Ice children's labyrinth 3. Snow sculpture «Heart» 4. Snow sculpture «Bear»
5. Snow sculpture «Weave» 6. Snow sculpture «Bear» 7. Snow sculpture «2018» 8. Ice slope 9. Ice sculpture competition
10. Ice sculpture «Tree» 11. Ice sculpture «Pattern» 12. Ice sculpture «Pattern 1» 13. Ice sculpture «Pattern 2» 14. Ice sculpture «Dog»
15. Ice sculpture «Frame» 16. Snow sculpture «Ded Moroz» (Santa Claus) 17. Christmas Tree 18. Ice sculpture «Snegurochka»
19. Snow sculpture «Stars» 20. Snow sculpture «Snowman» 21. Snow sculpture «Merry Christmas» 22. Ice sculpture «Pattern 3»

(c)EVENT DAY (d)EVENT NIGHT

Figure 3-6 Four scenes of the Lenin Square: (a) 'no event' during the day (24.02.2018; 11:50); (b) 'no event' at night (24.02.2018; 19:00). (c) 'event' during the day; (19.02.2018; 12:30) (d) 'event' at night (19.02.2018; 19:00).

3.2.2 Studies of urban environment using social media

Many studies have explored important aspects of landscapes using social media sources: these include the evaluation of attractive areas[161], places of interest[162], landmarks and cityscape[76], and user travel preferences[163]. One study utilized Foursquare geo-location to reveal the degree of social relevance and livability of plazas[161]. In many studies, the scale of the urban environment has been explored, with a particular focus on the impression that public open spaces make on visitors. The focus of the case study is demonstrating the impact of temporary architectural and design interventions on pedestrians' perception. The methodology is similar to that used by X. Qian (2019), who explored transition spaces between streets and squares using people-generated image analysis based on the similarities of the features and by clustering them by text analysis of the caption[79]. However, this method of this study focuses on clustering the images into the groups of urban elements and their number.

3.2.3 Collecting dataset

Instagram was selected as the platform for data collection in this study. As the fastest growing social network, with a seemingly ever-increasing number of users, Instagram was the obvious choice. Since the launch of Instagram in October 2010, the number of users today exceeds one hundred million. At the end of 2012, Instagram passed Twitter with 7.3 million daily mobile users in one month[164], and in 2020 it reached 500 million[165]. Instagram is a photo-sharing web platform that allow users to instantly upload photographs on a daily basis. It is reported that the primary motivations for Instagram users are self-expression[166], and to signal identity[167]. When individuals post on Instagram, they try to present the best or distinctive version of themselves and their lives, because they place their identities on public display for others to evaluate. Researches and journalists have agreed that this image-driven feature of Instagram encourages representation of only a desirable and polished narrative of one's life[168–170]. Thus, as a rule, Instagram users are selective about the content of their personal images[171], and tend to take photos because they think a subject is visually

interesting, pleasing, or distinctive in order to represent themselves in specific manner for followers[171,172] This implies that it is as if photo of an urban element is a 'vote' for a special experience or impression[173]. Therefore, we assume that a higher number of images related to specific urban elements indicates stronger impression and, consequently, greater impact on the people's perception.

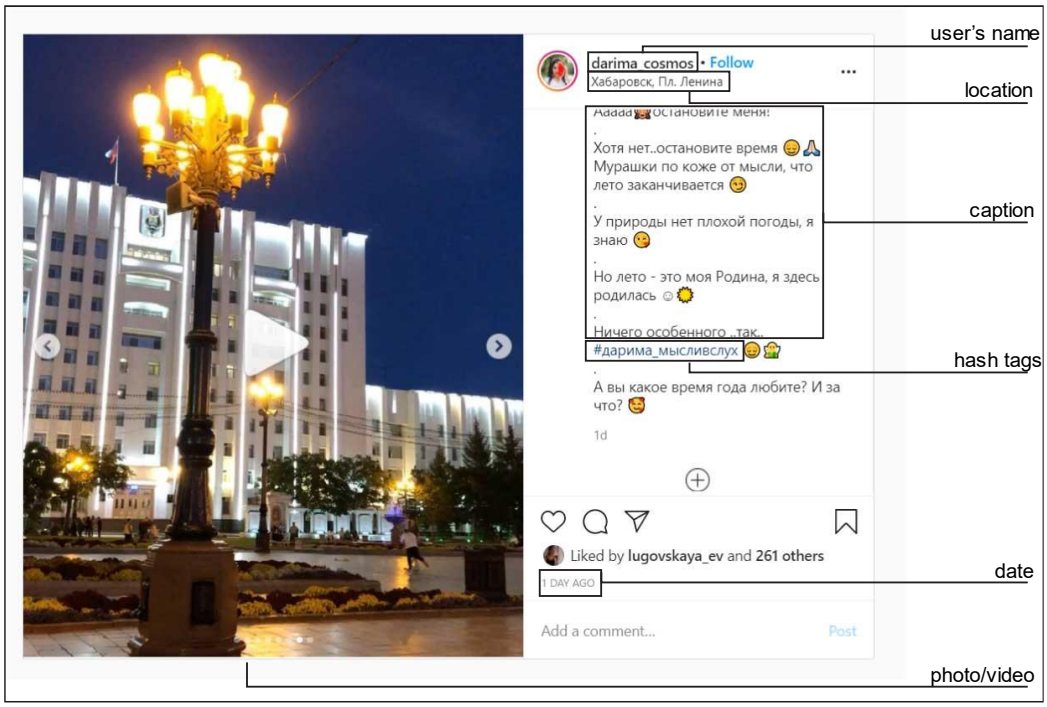


Figure 3-7 The sample of the Instagram data posts, photograph of Government building on Lenin square, Khabarovsk.

Each photo in Instagram has identification metadata through which users can search, navigate and order according to their interests and priorities. For exporting datasets, online analytics service Picodash[174] was used. Picodash is a web-based paid service that complies with the Instagram Platform policy to allow users to export Instagram data of followers, hashtag posts, location posts, comments (fig. 3-7). Datasets include the URL of the image, captions hashtags, the date, the time, the geographic location of the location IDs, and the location name. Text data as a caption is an optional function for users: it allows them to express the intention of taking the photograph[79] and make reference to the place using hashtags. The amount and correctness of the dataset of the place can be distinct due to the exporting options. We collected data generated from within

100 meters of the physical location of Lenin Square that captured all related to the place location-ids. The export of the data using a one location-id will limit the amount of actual data, and in the case of exporting data by designated hashtags, not all data will correspond to the image or actual location.

3.2.4 Analysing content of the images

A total of 10 200 datasets related to Lenin Square were downloaded for the period of 1.11.2017 to 15.03.2018. The dataset was prepared for analysis by considering the content of the images and automatically excluding data that has no value for the urban design issues. For instance, the data that relate to commercial issues and promoting of the products was excluded. In the case of Lenin Square, captions of the images that contain such hashtags as 'cost', 'discount', 'client', 'sell', 'rent', 'buy', 'order', 'customer', 'delivery', 'bank', and 'massage' were excluded from the dataset. This reduced the size of the dataset by 50% before analyzing the content of the images.

The analysis of the content of the images involved three main steps: selecting the images related to the urban design issue, defining the clusters of the urban elements and labeling the summary clusters. We collected data for two equal periods on a number of days. For the 'no event' periods (1.11.2017 – 24.11.2017 and 20.02.2018 – 15.03.2018) we collected 1600 datasets, while for event period (25.11.2017 – 19.02.2018), 8600 data sets were collected. Later, the data was classified according the whether the image represented indoor or outdoor content– "not urban" and "urban", respectively. This is a critical stage since only 10% [175] of the content data relates to the urban design issues as a rule.

Our second task was to consider the question of what was being photographed in each given image, by selecting the targeted object of the photography. By clarifying the target, more subtle precision issues can arise for the personal photographs that are shared online. For example, while some users more interested in the urban elements, other prefer to take a photograph of themselves or their family members standing in front of a visited place or urban

element. If the shape of the target object can be easily traced on those images, they were included into the summary clusters that present captured urban elements on the square. However, selfies or portraits that represent more 70% of people's image of the total photo, blurry photos, and the images that show a discarded view of the urban elements, where the object in question was hardly recognizable, were not included in the analysis. Similarly, many users take an artistic approach to personal photography; for example, some photos were extreme close-ups of the urban element or were so far away that it was difficult to clarify the targeted object of the photo. For example, the bird view photos were disregarded, since the target object, as a rule, is the square or the cityscape. The target object of the other taken photos from a distance was decided by its centrality.

The third step was to label the photos that present clusters related to specific urban element. Many landmarks and locations can be frequently captured from a number of distinct viewpoints. Because most of the images are photographs of the urban elements taken from similar angles, it is easy to cluster the images into groups for the different urban elements. Thus, we find representative images of the different urban elements, such as the Christmas Tree, the central fountain, and the ice sculptures, by visually distinguishing the clusters from among the most salient subset (fig. 3-8). Next, we labeled the clusters with the number allocated to the urban element positions; for example, "Christmas Tree" was labeled with number 'T17' where 'T' refers to the temporary urban element and '17' is the number of position (fig. 3-6). The same process was followed for the permanent elements; "central fountain" was labeled with "P12", for example. This was a more lightweight, faster overall process, capable of scaling the global scope of our data with deep learning, and also producing significantly better results than randomly selecting photos based purely on textual tags.

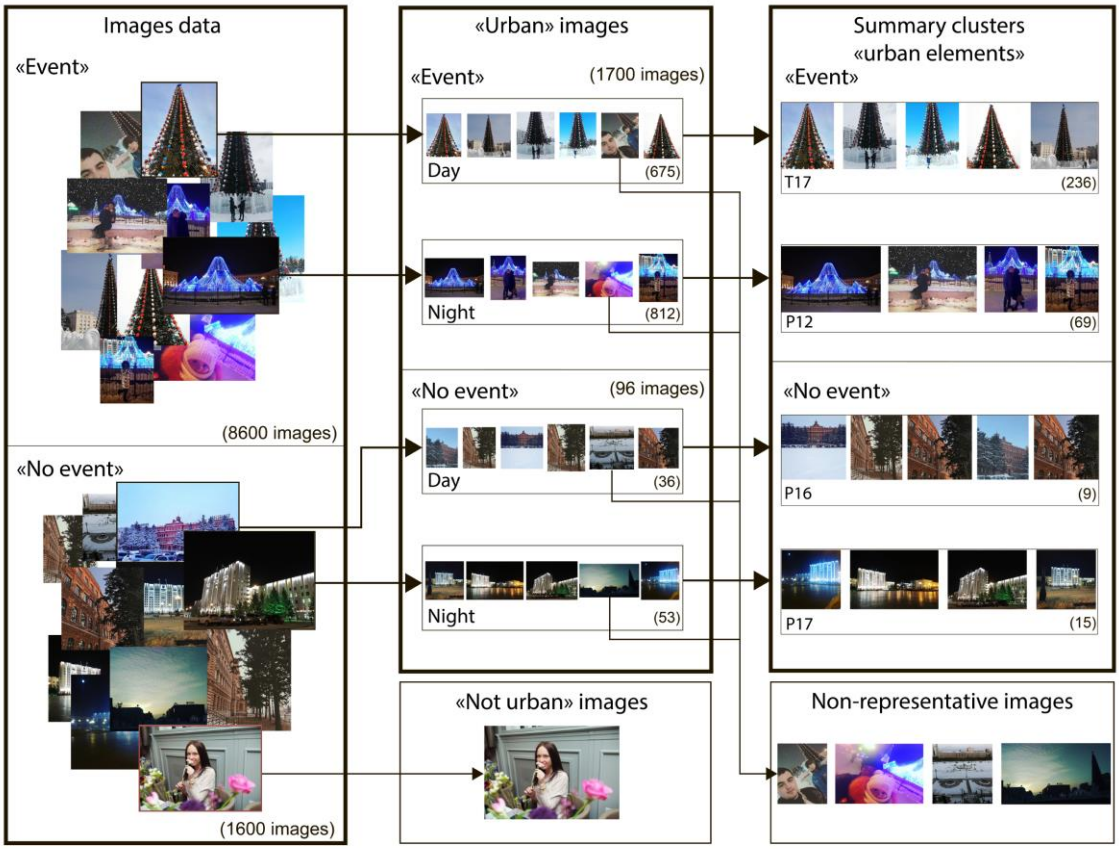


Figure 3-8 Approach of classification of the urban design and elements images.

3.2.5 Urban image classification using deep learning

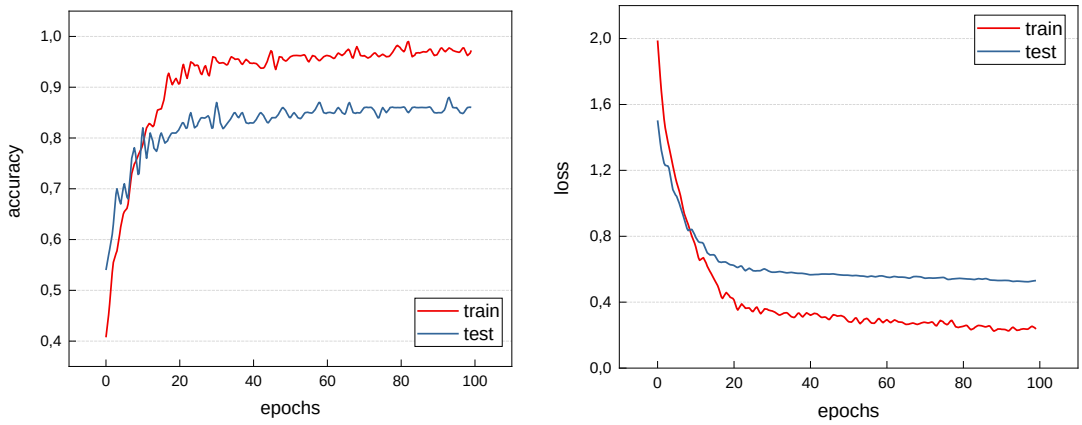
In this paper we proposed transfer learning with pretrained CNN (Convolutional Neural Network) for classifying the Instagram images into clusters that consists of specific urban elements. These days, CNN has become a popular deep learning approach, that is frequently used for various visual recognition tasks including urban image analysis[176,177]. However, training CNN from scratch requires a lot of labeled data and time. Besides, most deep learning datasets are very specialized to a particular domain or even a specific task, and in urban design, such large labeled datasets are not always available. To solve this problem, we applied transfer learning which retraining CNN already trained by large datasets. By using transfer learning, the knowledge gained from large general labeled datasets can be transferred to solve the specific task having less labeled data. In this study, we use the classifier VGG 16[178] trained by ILSVRC

2012 in ImageNet, which is a data set composed of 1000 different classes and 1.2 million learning data[179,180].

Table 3-1 Parameters and classes for training.

Parameters	
Number of training images	400
Number of test images	100
Number of epoch	100
Batch size	1
Input image size, pixels	224×224
Classes	
T7	Snow sculpture ‘2018’
P5a	Alley of trees
T6	Snow sculpture ‘Bear’
T17	Christmas Tree
T14	Snow sculpture ‘Dog’
T15	Ice sculpture ‘Frame’
T2	Ice children labyrinth
T16	Snow sculpture ‘Ded Moroz’ (Santa Claus)
T20	Snow sculpture ‘Snowman’

We trained data on the top 9 classes consist of different urban elements (Table 3-1) and the general class of "not urban" images to verify that CNN has potential to cluster the ‘urban’ images. The training parameters were summarized in Table 1. The verification of the data showed the accuracy of the training data is over the 0,9 (fig. 3-9a), while the loss was reduced to below 0,3 (fig. 3-9b) using 100 epochs. This implies that transfer learning with pretrained CNN was successful in learning different urban elements features. Therefore, this method and trained model can be applied for use in similar studies.



(**a**) (**b**)

Figure 3-9 Train and test data results: a) accuracy; b) loss;

3.2.6 Sentiment analysis of the captions

Attached captions of posted photos can present the author's opinion, experience or/and preferences of event captured on the photo.

Sentiment analysis is a well-known deep learning text classification tool that also known as a text mining or emotion AI (Artificial Intelligence). Sentiment analysis of captions defines whether the primary sentiment is positive, negative our neutral caption. This step helps to understand weather the caption is 'positive', 'negative' or 'neutral' for a related urban photo. Note that each caption attached to 'urban' photos was translated in English using Google Translate API for a better understanding of the research outcomes.

In this study we used Natural Language API provided by Google Cloud Platform in order to define the automatization of the process for future related studies. Thus, it should be mentioned that captions were processed firstly manually to clarify the most reliable approach for analysing sentiment of the text data. The negative, positive or neutral score of sentiment indicates the overall emotion of a caption, where the negative captions include negative keywords, and positive captions include positive keywords. We apply method to analyze sentiment ambiguity, since some captions consist of positive and negative keywords ('The weather is terrible but I'm in a good mood'). This can

be indicated as a neutral experience, that mean mixed emotions with both positive and negative values which cancel each out. In case of the use only keywords extraction, extractive positive or negative keywords (‘good’, ‘terrible’) it is not suitable instrument since it analyzes words as independent.

3.2.7 Extracting keywords from positive captions

This step of analysis assists in defining specific positive experience or emotion associated with urban element captured on the photo. Noted we analyze only positive caption to define the urban elements in creating more positive image of winter. We used developed tool (WORDij) to extract the keywords of the positive captions such as ‘joy’, ‘beauty’, ‘beautiful’, ‘bright’, ‘interesting’. Such tool simplifies the process of the text analysis by decreasing the number of words that have to be analyzed to clarify the important keywords. To decrease the number of provided words, it groups together variant forms of the same word by equating words like ‘joy’, ‘enjoyed’, ‘enjoying’ into their respective single root word ‘joy’. It detects and deletes the 200 most common words in the English such as ‘the’, ‘is’, ‘are’, ‘a’. Other parameter settings can be set as dropping common function words, the numerals, punctuation within words. Additionally, for the analysis of captions we drooped such common keywords as ‘Khabarovsk’, ‘Lenin Square’, ‘winter’, ‘photo’ that not relevant to emotional experience of authors.

3.2.8 Limitation of the study

The data images were processed manually at first in order to determine the best approach for future similar studies focused on small-scale urban elements. We processed only a portion of the data with deep learning due to the lack of images related to the "no event" period. However, the trained model of data is suitable for use in future research related to Lenin Square to develop the guidelines of the events and to clarify the other urban elements that receive the most attention of the residents, with a great number of the images. Another limitation relates to the Instagram data, when authors upload their images using

different location IDs or prefer not to mention any location, is a possible loss of potential data related to the Lenin Square. Moreover, less Instagram posts can relate to private user's accounts, which posts are hidden from strangers and cannot be extracted.

Chapter 4:
People’s behavior on Kita 3-jo plaza in Sapporo during cooling period

4.1 Field survey on Kita 3-jo Square

4.1.1 Introduction

The purpose of this study is to clarify the impact of the environmental conditions on the people's behaviors on public open spaces in winter city Sapporo.

Target areas

Field survey was conducted on the three public open spaces in downtown of Sapporo. The main target area is Kita 3-jo plaza and other two areas are considered in order to clarify the impact of the different spatial composition of public open spaces on the people's behavior in cooling period. Those three target areas were defined as the important public open spaces in downtown Sapporo located between the high-rise buildings and in the center of public facilities.

Survey periods

The survey days were selected between September 2016 and May 2017 with one day in a month without snow cover (Table 4-1). There were eight survey days in all. Each survey was conducted from 12:00 p.m. to 1:00 p.m., when the most sitting behaviors were expected. All of the days were set on holidays in order to eliminate restrictions on sitting time due to office workers' lunchtime and other breaks, as much as possible.

There were two days when the survey could not be conducted depending on the target area. On April 23, the survey could not be conducted in public spaces C-1 and C-2, because the special event was hold on target area C. On April 29, the survey was not conducted in public space B, because the adjacent building was closed, and this was considered to affect the number of sitting groups (fig. 4-1).

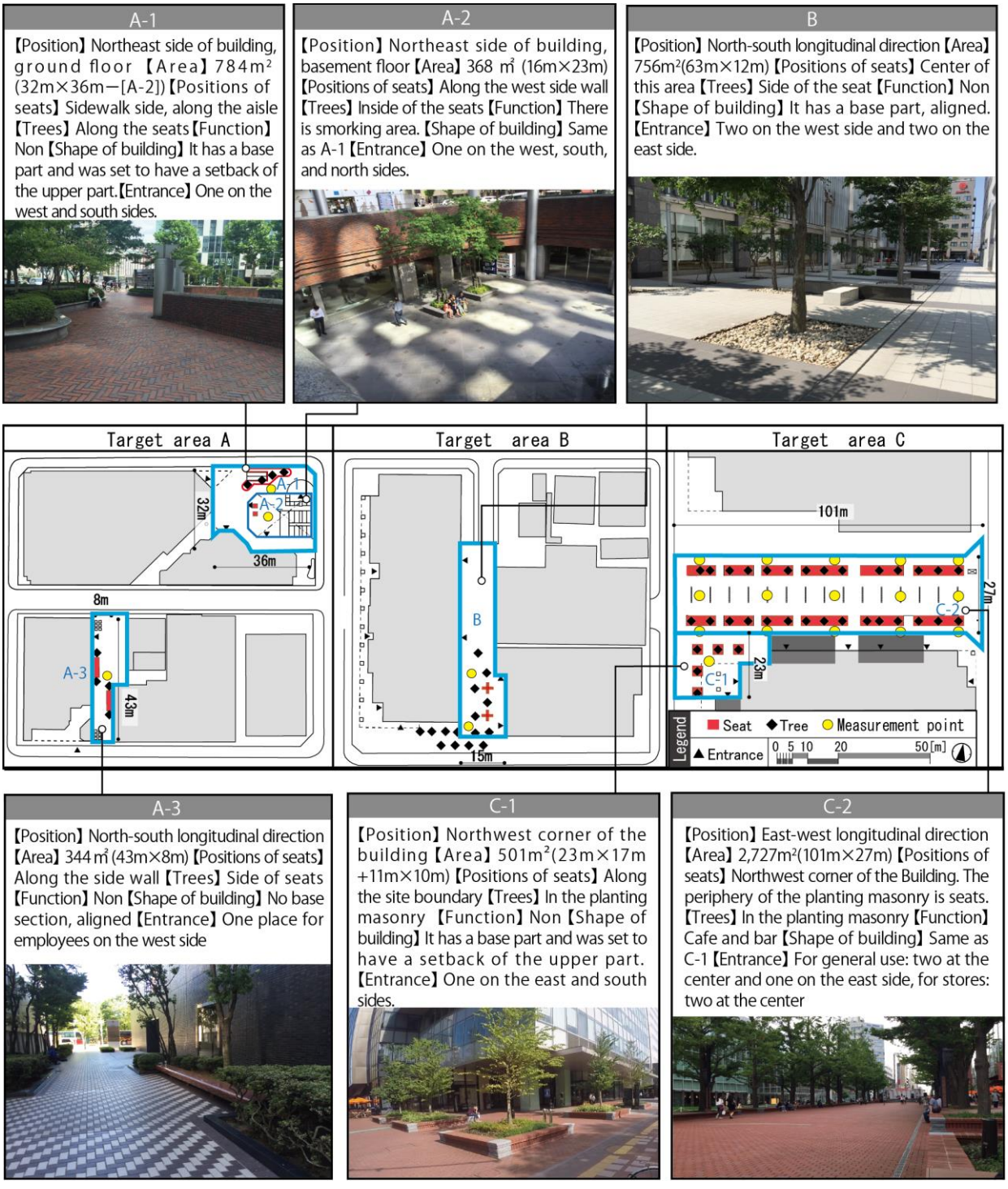


Figure 4-1 Spatial composition of each target area.

Kita 3-jo plaza was labelled as C target area, where C-1 and C-2 are sub target areas. Same for other two public open spaces, that were labelled as A and B target areas, while the A-1, A-2, A-3 means sub target areas.

Outdoor environmental factors were measured on three parameters: temperature, wind speed, and sunlight. Temperature and wind speed were measured for one minute every 15 minutes at the target area measuring points (fig. 4-1). This was done four times in total, and the meteorological data on Sapporo City by JMA (Japan Meteorological Agency) data for each survey date were also obtained. For the measurements, a thermo-anemometer (Kestrel 4500, Nielsen Kellerman Co., United States) was used. The situation of the sunlight was recorded by drawing a shade line.

Table 4-1 Survey dates

Survey dates	
2016	2017
September 3	March 18
September 22	April 23
October 29	April 29
November 12	May 21

4.1.2 Research approach

According to Gehl[39], the activity of people is evaluated by the product of 'the number of events' and 'the duration'. The larger the product, the better the activity in a public space is evaluated. Therefore, this field survey measured the number of sitting groups as 'the number of events' and the sitting time as 'the duration'. In addition, the sitting position of each sitting group was recorded by plotting on a ground plan view. All behaviors during the survey were recorded using a time-lapse camera (Brinno TLC 200 Pro, Brinno Co., TWN).

The relationship between sitting behaviors and each outdoor environmental element was analyzed based on the data obtained from the survey. The number of sitting groups varied depending on the size and location of each public open space. For the analysis, the rate of change in the number of sitting groups from that on the highest temperature day was calculated for each public space. This was done in order to compare the impact of the difference in outdoor environment on the number of sitting groups. The average time of all sitting groups per hour was also analyzed.

4.2 Results

First, the macro weather conditions of the Sapporo area on each survey day were obtained from weather data of JMA (Table 4-2).

Next, the measured data were plotted (fig. 4-2). Of all the survey days, the highest temperature was 25 °C on September 3, and the lowest temperature was 5.3 °C on March 18. There were no significant differences among the target areas in case of temperature. However, the surrounding buildings volumes effected wind speed, thus, large differences of wind speed were seen on each public space. The public spaces with buildings on opposite sides (A-3, B, and C-2) were divided into those with high wind speeds (B, C-2) and one with a low wind speed (A-3). The widths of the public open spaces and the heights of the adjacent buildings were considered to be factors for differences in wind speed. In the public space surrounded by walls on all sides (A-2), the wind speed was low and steady. Compared with the other public spaces, there were variations in the wind speed in the spaces with buildings on two adjacent sides (A-1, C-1). The wind direction was also considered to be an influencing factor. The proportions of the sunny areas to sitting surfaces of each public space were compared. A public space with a sunny area of more than half of its sitting surface was defined as ‘a public space with a large sunny area’. On the other hand, a public space with a sunny area of less than half of its sitting surface was defined as ‘a public space with a small sunny area’ (fig. 4-3).

From the above, the six public spaces were classified based on the environmental conditions with respect to sunlight and wind speed. There were large differences, depending on each target area (Table 4-3).

Table 4-2 General meteorological data for Sapporo.

Survey dates	9/3	9/22	10/29	11/12	3/18	4/23	4/28	5/21
Temperature [°C]	25.1	18.6	5.5	7.8	5.3	8.4	15.1	22.4
Wind Speed [m/s]	6.5	5.4	10.4	0.9	5.2	3.3	4.9	2.9
Weather	Cloudy	Cloudy	Sunny	Sunny	Sunny	Sunny	Sunny	Cloudy

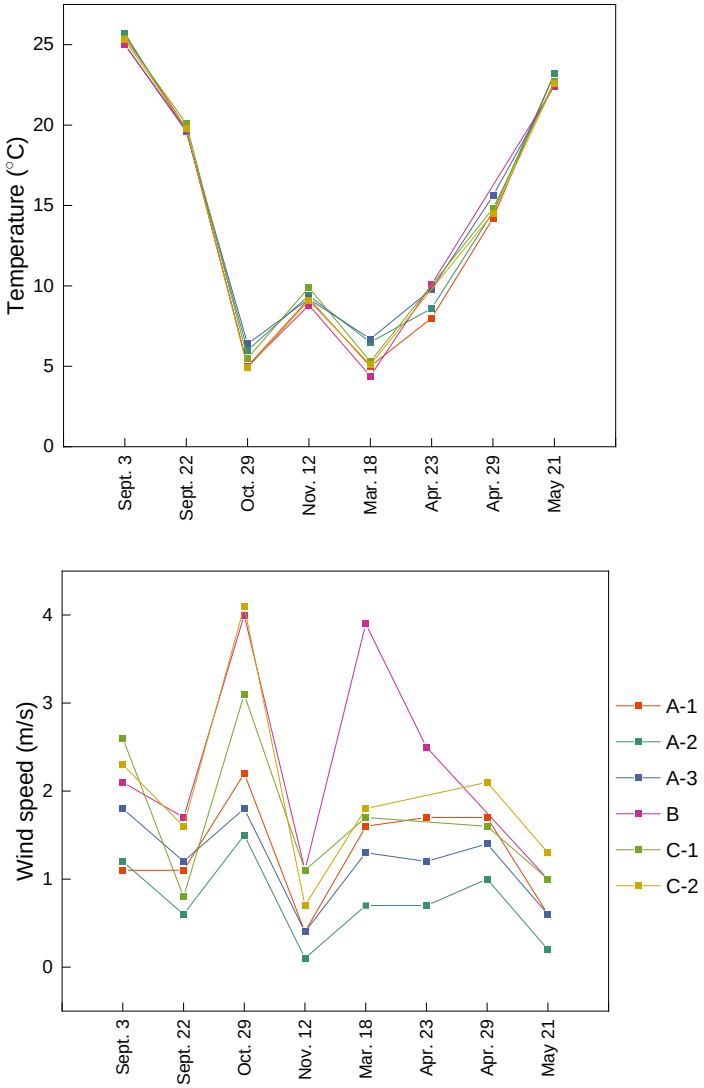


Figure 4-2 Microclimate data for each public open space: a) air temperature, ℃; b) wind speed, m/s.

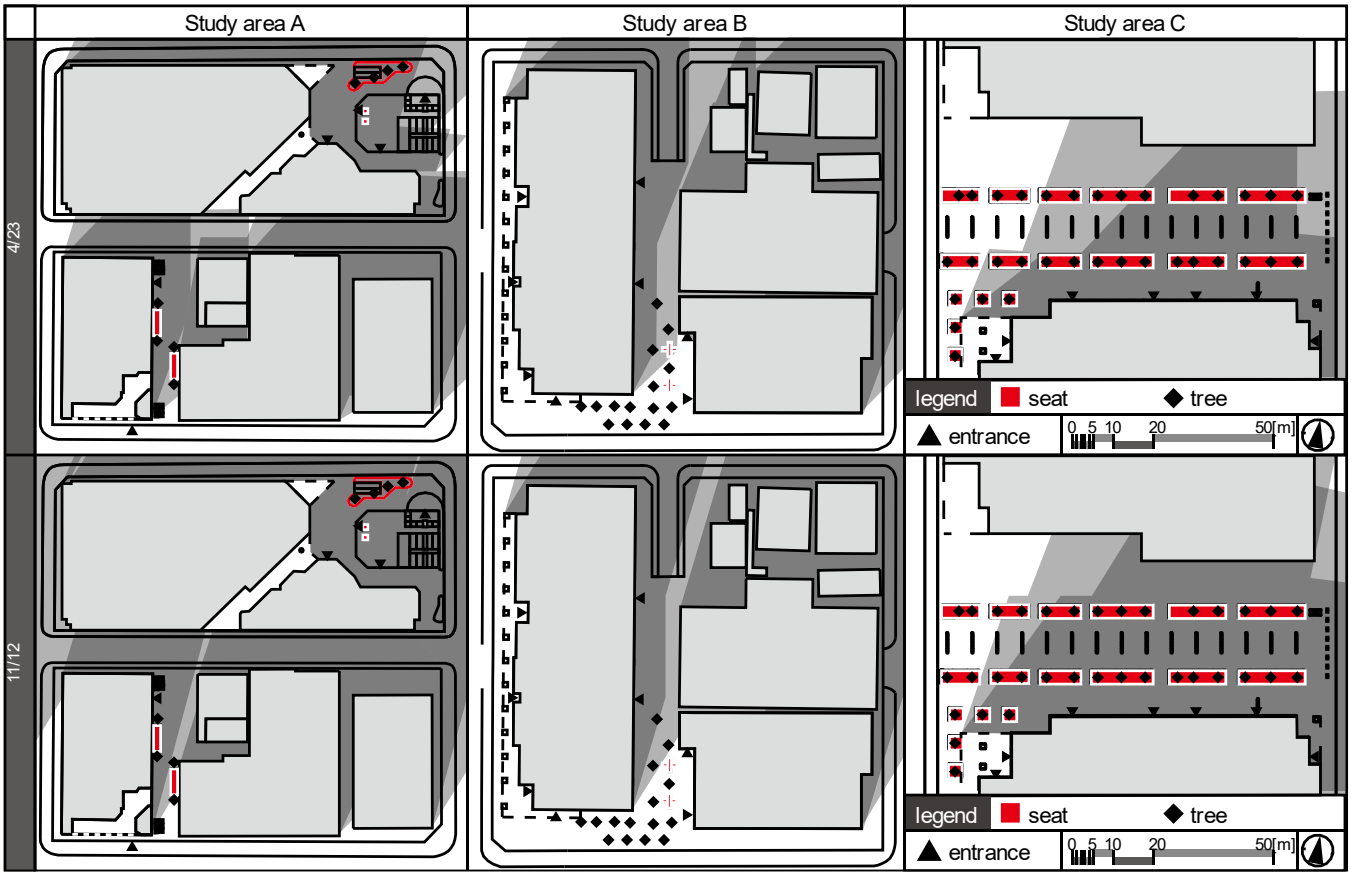


Figure 4-3 Location of sunny places in each public open space.

Next, the sitting behaviors were organized, and the sitting position of each user and the distributions of sitting behavior (fig. 4-4) were plotted. It was found that places around the entrances to buildings were the most used in all of the public spaces.

4.3 Analysis

4.3.1 Impact of temperature on sitting behavior

The changes in the number of sitting groups and the average sitting time caused by the lowering of the temperature in each public space were analyzed. At around 20 ℃ or higher, the influence of the environment was barely observed for both the number of sitting groups and the average sitting time. This was considered to be a comfortable temperature for sitting, and the spaces were used freely. Also, at around 5 ℃ or lower, the sitting behaviors in each public space were very few, almost not seen. That was assumed to be a result of the impact of low temperature on the people's behavior (fig. 4-5).

Table 4-3 Classification of target areas.

		Wind speed		
		Low	High	Changing
Sunny area	Large	-	B	C-1
	Small	A-2, A-3	C-2	A-1

In the temperature zone (cooling period) from 20 ℃ to 8 ℃, there were variations in how the sitting behavior changed depending on the target area. It was inferred that environmental factors such as sunlight and wind speed, which varied depending on the public space, influenced the increase and decrease of sitting behaviors.

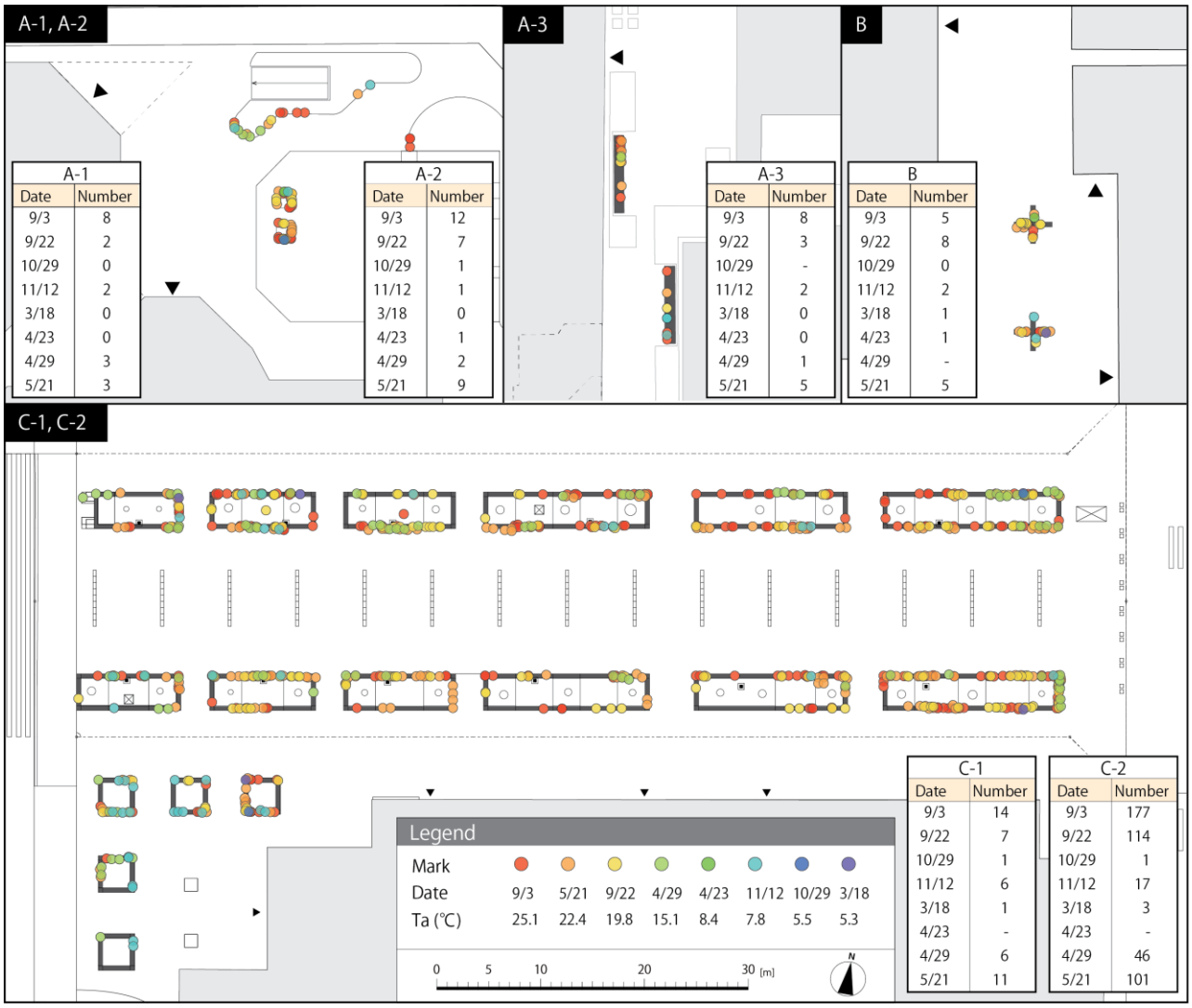


Figure 4-4 Plot of people sitting on each survey day.

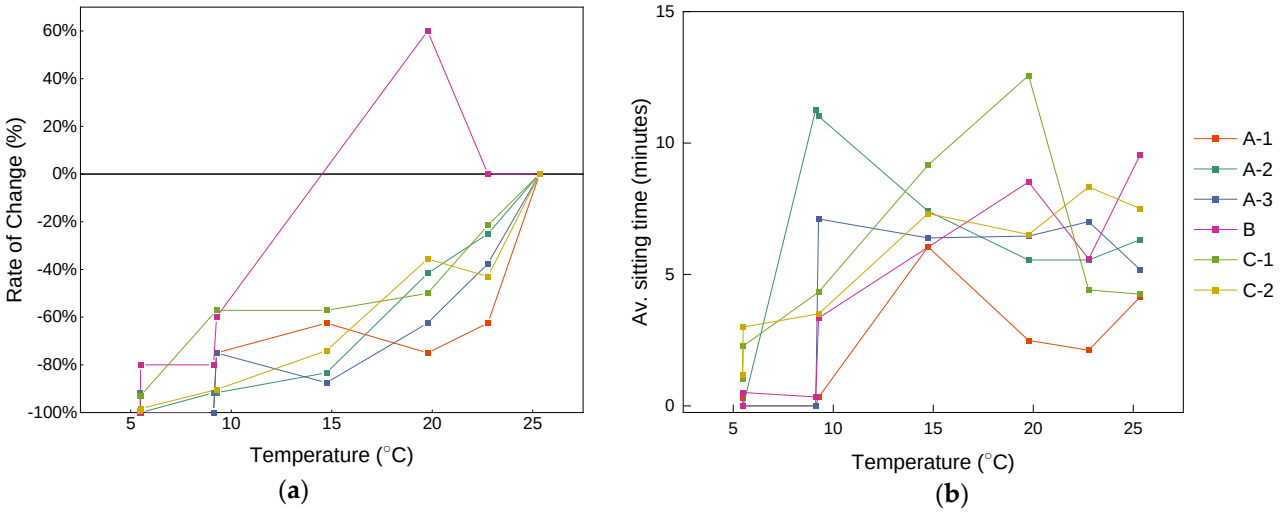


Figure 4-5 Analysis of the relationship between human activity and temperature.

4.3.2 Impact of sunlight on sitting behaviors

Fig. 4-6 shows the shade lines at 12:30 p.m. and the sitting positions during one hour from 12:00 p.m. to 1:00 p.m. on each investigation day at the target site C. The sitting places in the plaza are evenly used on investigation days with temperatures of 15 °C or more. However, on investigation day with a temperature of about 8 °C, the number of people sitting in the shade is fewer than the number of people sitting in the sun. This implies that the areas that are more exposed to sun are preferred for sitting behaviors during the cooling period. On the investigation day with a temperature around 5 °C, sitting behavior is rarely seen regardless of sunlight (fig. 4-6).

Regarding the number of sitting groups, the targets with a large sunny areas (B, C-1) have a higher rate of sitting groups at 8 °C (approximately 40%), compared with the rate for the target with a small sunny area (fig. 4-7).

According to the results, we can assume that a sunny area on public open spaces is preferred for sitting during the cooling period. However, a decrease in the number of sitting groups is observed on the targets that have a large sunny area during cooling period. Therefore, sunlight is the critical factor that induces sitting behaviors. Moreover, the average sitting time does not show a difference relative to the sunny area. It is believed that sunlight has no effect on the time of remaining in a sitting place.

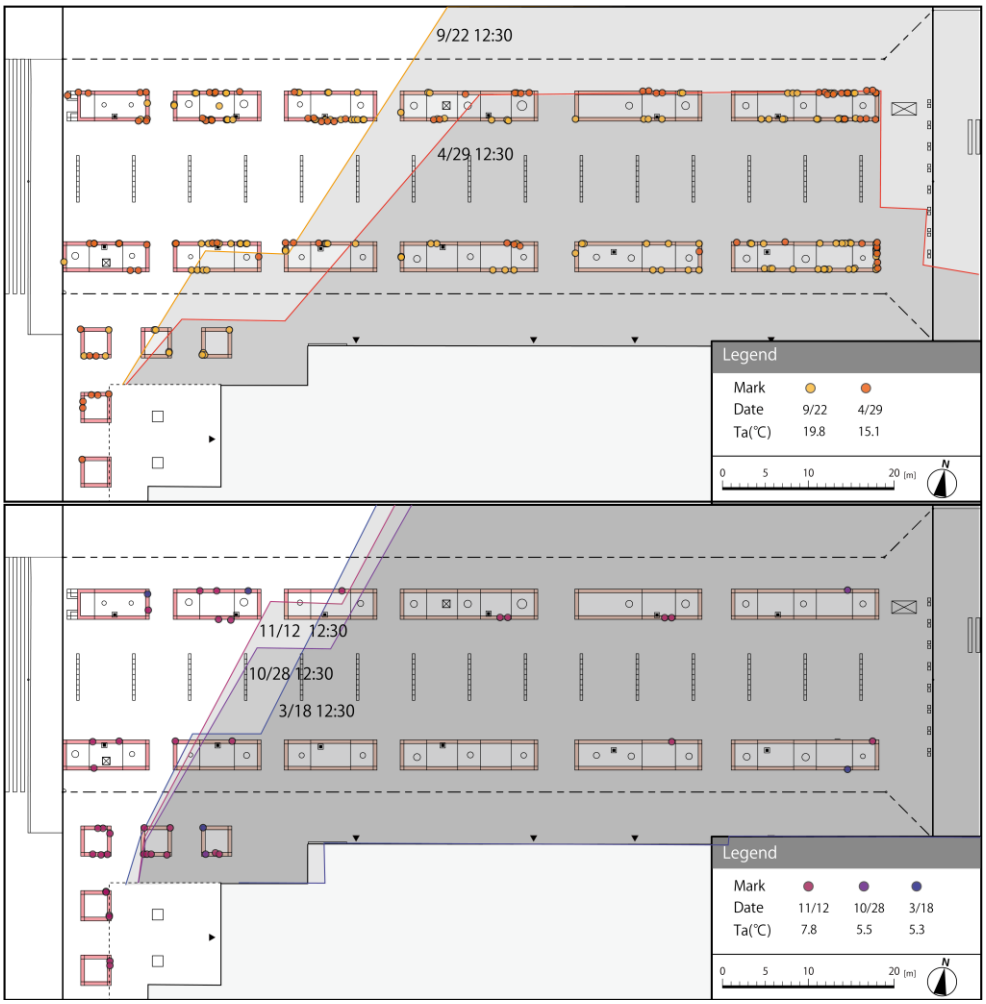


Figure 4-6 Plot of people's sitting locations in sunny places in the target area C.

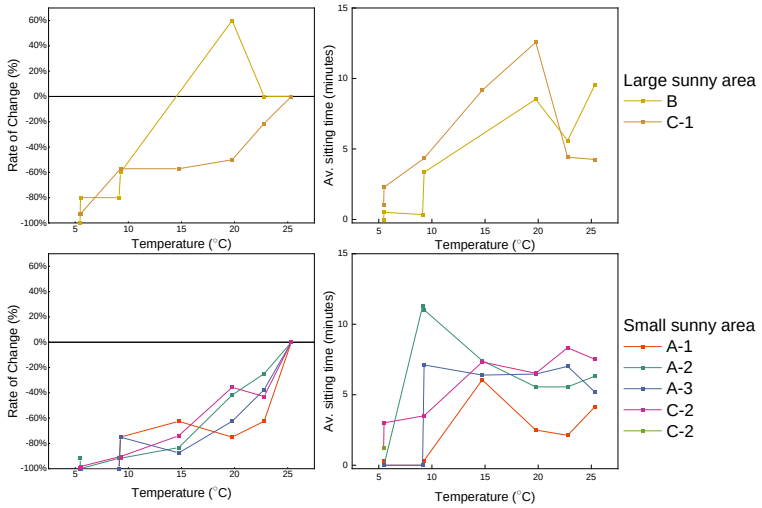


Figure 4-7 The impact of the sunny areas on the people's sitting behavior during cooling period.

4.3.3 Impact of wind speed on sitting behavior

Clarifying the impact of the wind speed on the people's sitting behavior in each public open space. There is no difference in the decrease in the number of sitting groups relative to the trend of the wind speed. However, wind speed effect on the period of use of public open spaces. When the wind speed is lower, the average sitting time is longer, and, when the wind speed is higher, the average sitting time is shorter during the cooling period. In public spaces with low wind speeds (A-2, A-3), the average sitting time during the cooling period is similar to that at 20 °C or more. The maximum value of the average sitting time decreased as the wind speed increased. It revealed that the public open spaces with low wind speeds were used regardless of the temperature. However, when the temperature decreases under approximately 5°C, the sitting behavior tends to disappear on each public open space. Moreover, the average sitting time for public spaces with low wind speed is longer than that for public spaces with high wind speed. Therefore, it is assumed that people sitting longer in public open spaces with lower wind speeds versus those with higher wind speeds, even if the temperature drops (fig. 4-8).

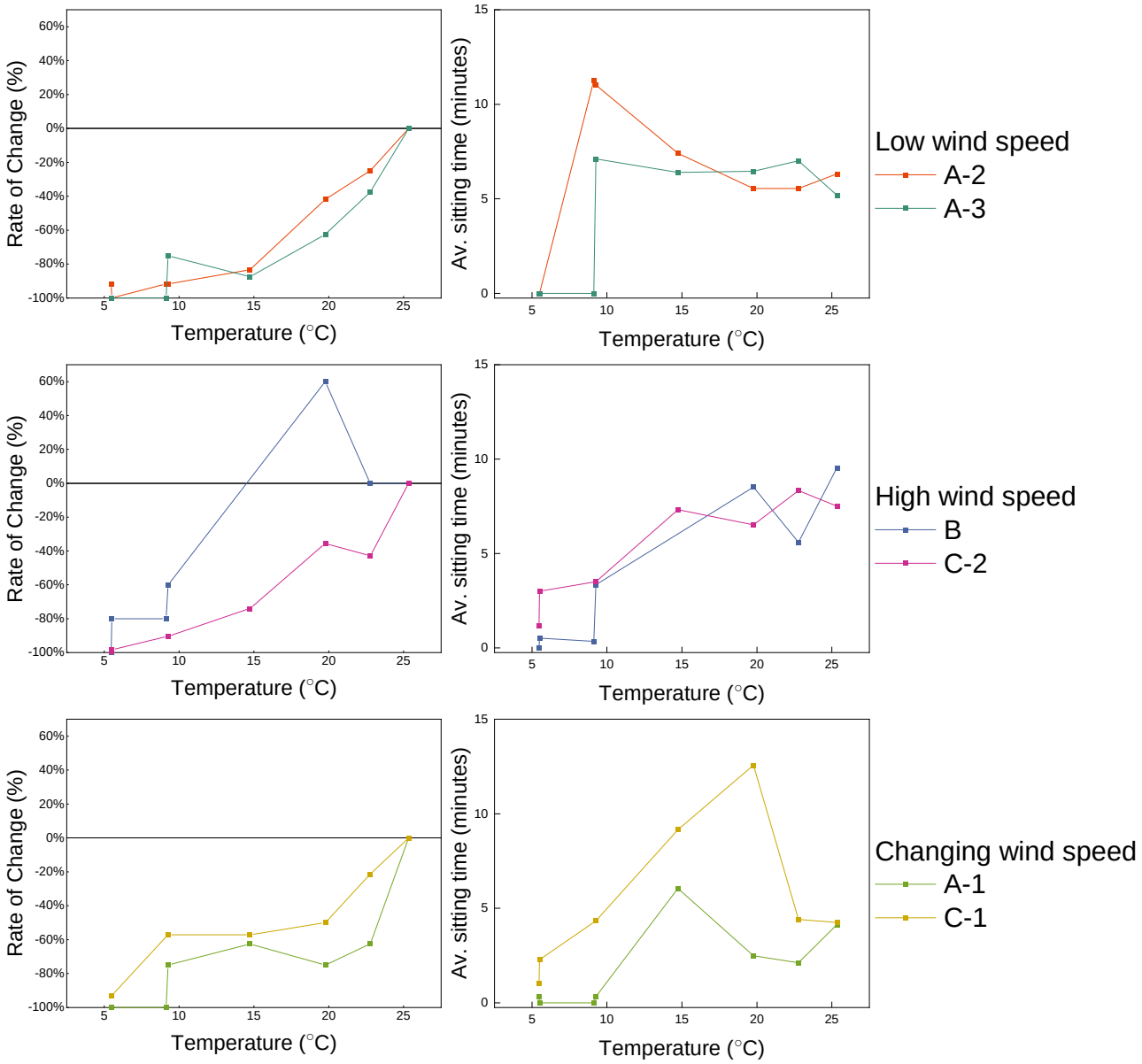


Figure 4-8 The impact of the wind speed on the people's sitting behavior during cooling period.

4.4 Conclusion

This study conducted a field survey and analyzed the relationship between the outdoor environment and sitting behaviors on public open spaces in downtown Sapporo. The outcomes can be divided into three periods of the temperature range based on the people's behavior, that are listed below:

A. At around 20 ℃ or higher, the outdoor environment did not affect the number, time or location of sitting behaviors, and many sitting behaviors were observed in the public open spaces.

B. During the cooling period (around 20 ℃ to 8 ℃), the sitting behaviors decreased with lowering temperatures. However, different microclimates influenced by sunlight and wind speed affected the reduction in the number of sitting groups, sitting time, and sitting behaviors. The reduction in the number of sitting groups was enhanced on public open spaces with large sunny areas until the temperature dropped to approximately 8 ℃. It appeared that a situation with sunlight was a trigger for sitting behaviors. In the public spaces with low wind speeds, the average sitting time was maintained even as the temperature decreased. As the wind speed increased, the average sitting time decreased. Furthermore, the sitting time could be lengthened by reducing the wind speed.

C. Almost no sitting behaviors were observed on public open spaces at temperatures below 5 ℃.

Based on the above results, the design of public open space in winter cities that secures plenty of sunny area and reduced wind speed can enhance sitting behaviors during the cooling period and extend the duration of use. Therefore, it is important to control the microclimates of the public open spaces and to create desirable outdoor environments in order to promote sitting behaviors during cooling period that ranges between 20 ℃ to 5 ℃. However, for the period of temperature below 5 ℃, it is required to consider alternative design approach of public open space in winter cities.

Chapter 5: Impact of temporary design on people’s behavior, Lenin Square

5.1 Results

The results were divided into three sections: two sections explain the outcomes of the 'no event' and the 'event' situation and the third presents a comparative study with statistical analysis and usage patterns.

During the two days which Lenin Square was surveyed, the meteorological climatic characteristics were rather similar. The air temperature fluctuated within a few degrees, from –11.4 to –13.3 °C. The average relative humidity over these two days was approximately 50%. The wind speed was average during the four different study cases. The wind speed during the 'event' was 2.7 m/s. and for the 'no event', it was –1.7 m/s. At night, the wind speed dropped by 1m/s, referring to Table 5-1. According to the nearest meteorological station, no cloud appeared, and the weather was sunny for both daytime situations.

Table 5-1 Collected meteorological data by Pocket Weather Station and total numbers of the users and their activities during survey on the Lenin Square.

Survey dates	19.02.2018 (Event)		24.02.2018 (No event)	
Time	12:30-13:30	19:00-20:00	12:00-13:00	18:00-19:00
Air temperature, [B°C]	–11,4	–12,4	–12,5	–13,3
Relative humidity, RH, [%]	55	49,4	51,7	45,7
Wind speed, WS, [m/s]	2,7	1,7	1,2	0,2
Weather	Sunny	-	Sunny	-
Total users	255	134	138	181
Sedentary activities:	**131**	**64**	**15**	**15**
Standing, talking	75	23	8	10
Taking pictures	54	41	1	5
Feeding the birds	2	-	6	-
Vigorous activities:	**36**	**34**	**14**	**4**
Playing with snow	-	1	14	4
Playing with ice	13	15	-	-
Sliding a slope	23	18	-	-

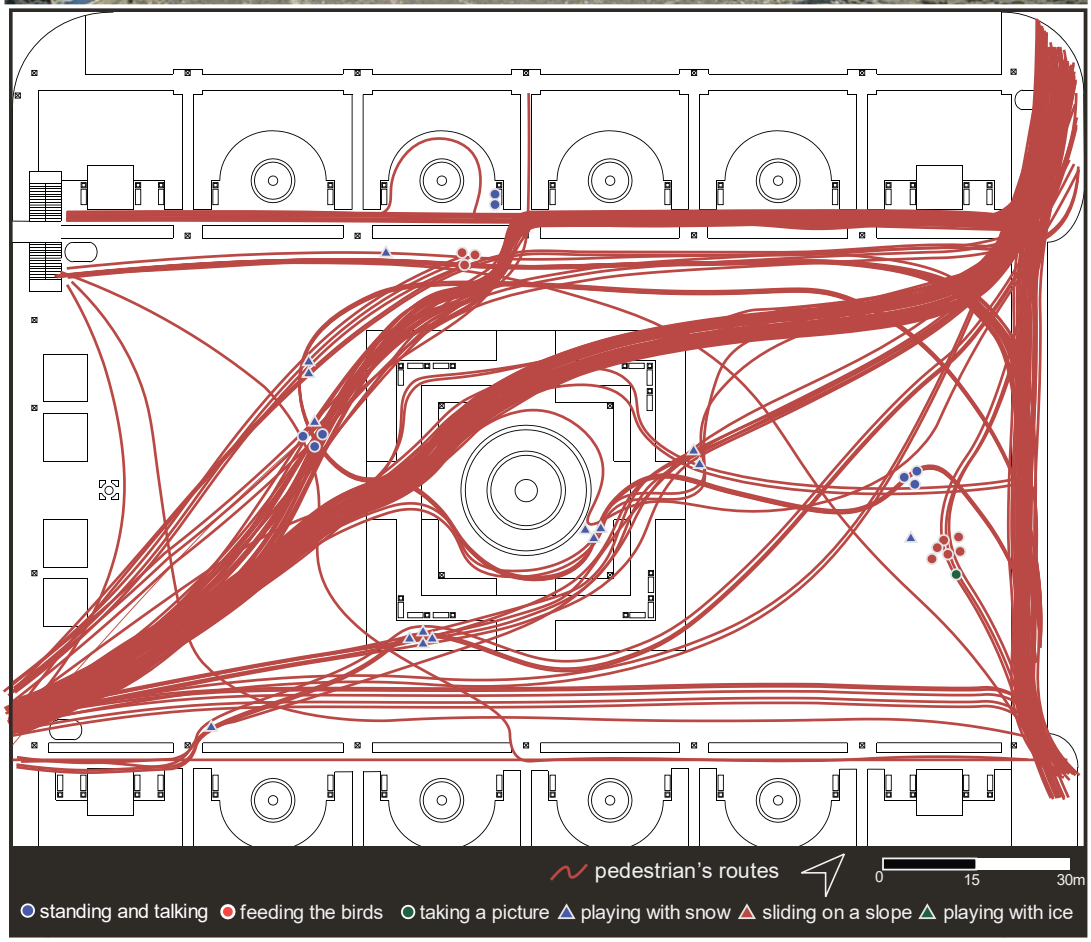
Three levels of activities were observed: sedentary, walking, and vigorous behavior[160]. The sedentary related codes include standing and talking, taking a picture, and feeding the birds. Because playing with snow, playing with ice, and sliding on a slope are more active than just walking, this was identified as

vigorous behavior[159] (Table 5-1). 'Playing with snow' involved playing with the snow cover on the square as well as playing with the snow sculptures. 'Playing with ice' is defined as playing with the ice maze and sculptures (fig. 5-1).

Figure 5-1 Types of activities during field survey on Lenin Square.

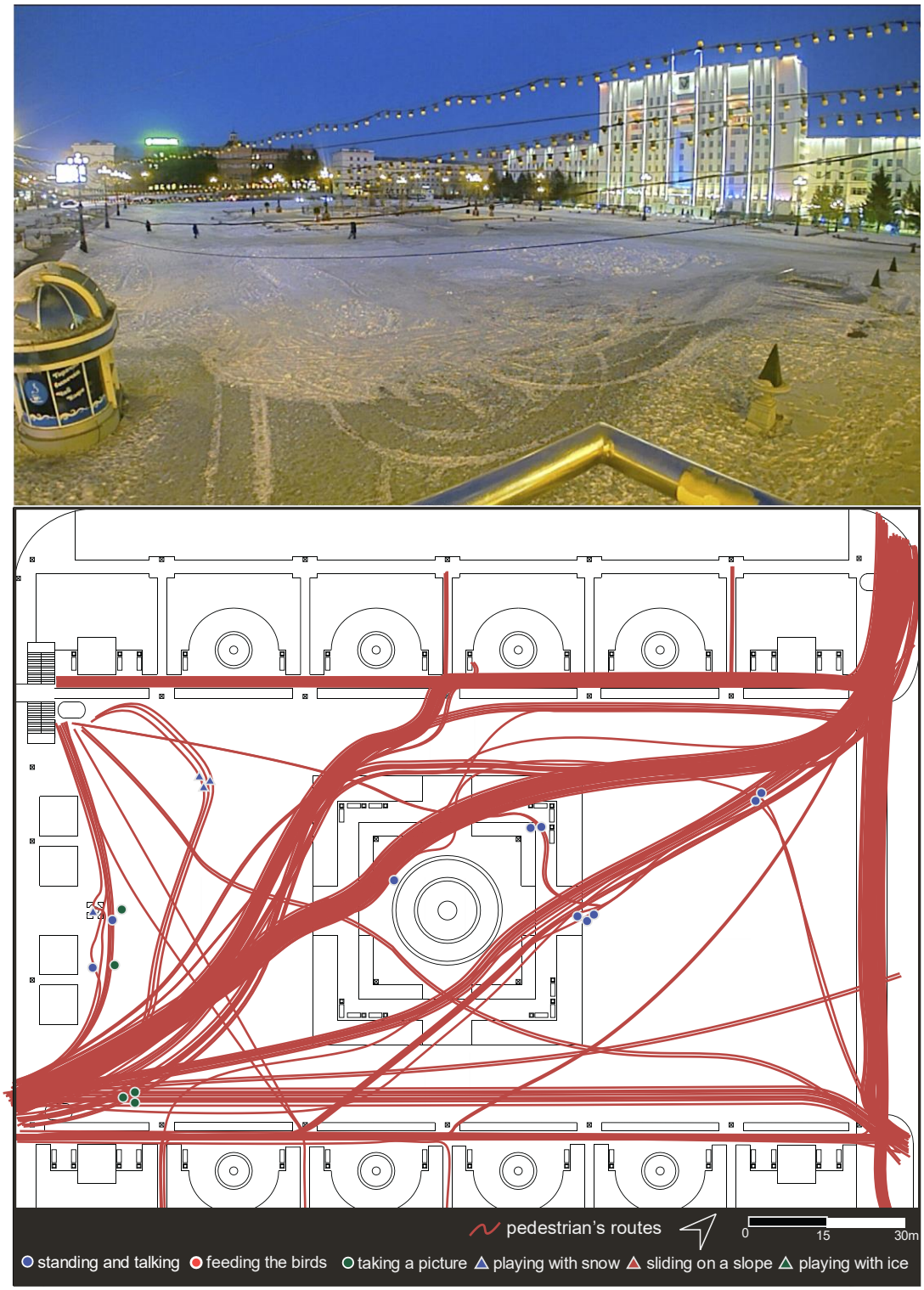
5.2 The impact of the ‘no event’ on the people’s behavior

Data from the ‘no event’ situation on the 24th of February, on a Sunday (fig. 5-2), illustrates the patterns of use after the event. During the day 138 users were observed, while during the night there were 181 (Table 5-1). Both situations present a rather similar pattern of use. The physical activity is low and unrelated to the nearby urban elements and is spread around the perimeter of the square. The main activities are standing and talking and playing with snow. Some people were actively involved in the events on the square while the remaining use the square as a shortcut. Those who took shortcuts tended to use the route which passes by the main fountain in the center of the square. This shows that people tended to use the shortcut despite the border around the fountain area. Overall, a limited amount of territory on the square was utilized; subarea C, for instance, tended to be neglected by pedestrians, especially at night (fig. 5-2, 5-3). During the day, people preferred more intensive activity, such as playing with snow and feeding the birds. Sedentary activity, such as standing and talking, were the main activities during night (Table 1). The distance walked by pedestrians was much higher during the day than it was during the night (fig. 5-3).



NO EVENT DAY

Figure 5-2 Behavioral-mapping data of the two-days survey on the Lenin Square during 'no event' at day.



NO EVENT NIGHT

Figure 5-3 Behavioral-mapping data of the two-days survey on the Lenin Square during 'no event' at night.

5.3 The impact of the 'event' on the people's behavior

The usage pattern during the 'event' design intervention was carried out on 19th of February. During the day, 255 visitors were observed visiting the square, while at night the number decreased to 134 (see Table 5-1). The day and night usage patterns were rather similar. Even though it was a workday, there were various types of activities, and the frequency of these activities was significantly higher. People engaged in various activities involving the temporary elements, such as the ice sculptures, the ice maze, ice slopes, and the 'New Year Tree'. However, it was noticed that people took pictures in situations that were not specifically related to urban elements themselves, but rather to the activities people engaged in with these elements, and this was the most dominant activity on the square. Also, the different types of activities were uniformly distributed around the square. According to the behavioral map of activities during the event, the shortcuts were less traced, and people preferred to walk around and create long curved routes on the square. Besides, users tended to avoid the border of the main fountain area (subarea A) (fig. 5-4) and to walk on the side areas B and C, where there were a variety of elements (fig. 5-5, 5-6). People clearly prioritized certain sedentary activities during the event, such as taking pictures and standing and talking. Additionally, during the night, a high percentage of people stopped to take pictures, and pedestrians walked around more than during the day (Table 5-1).

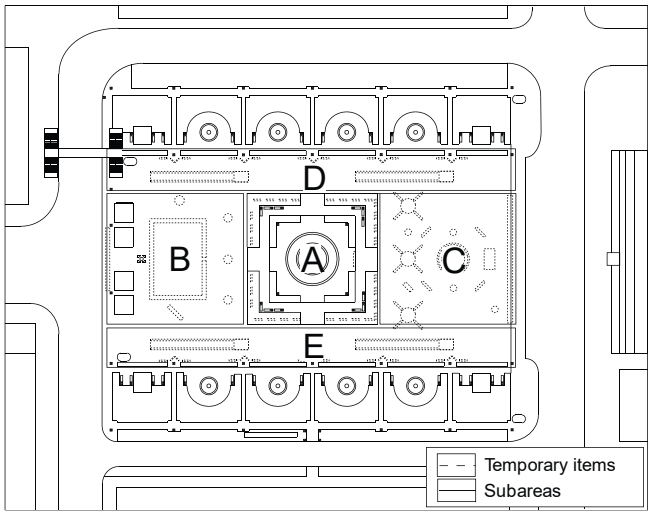


Figure 5-4 Subareas of the Lenin Square.

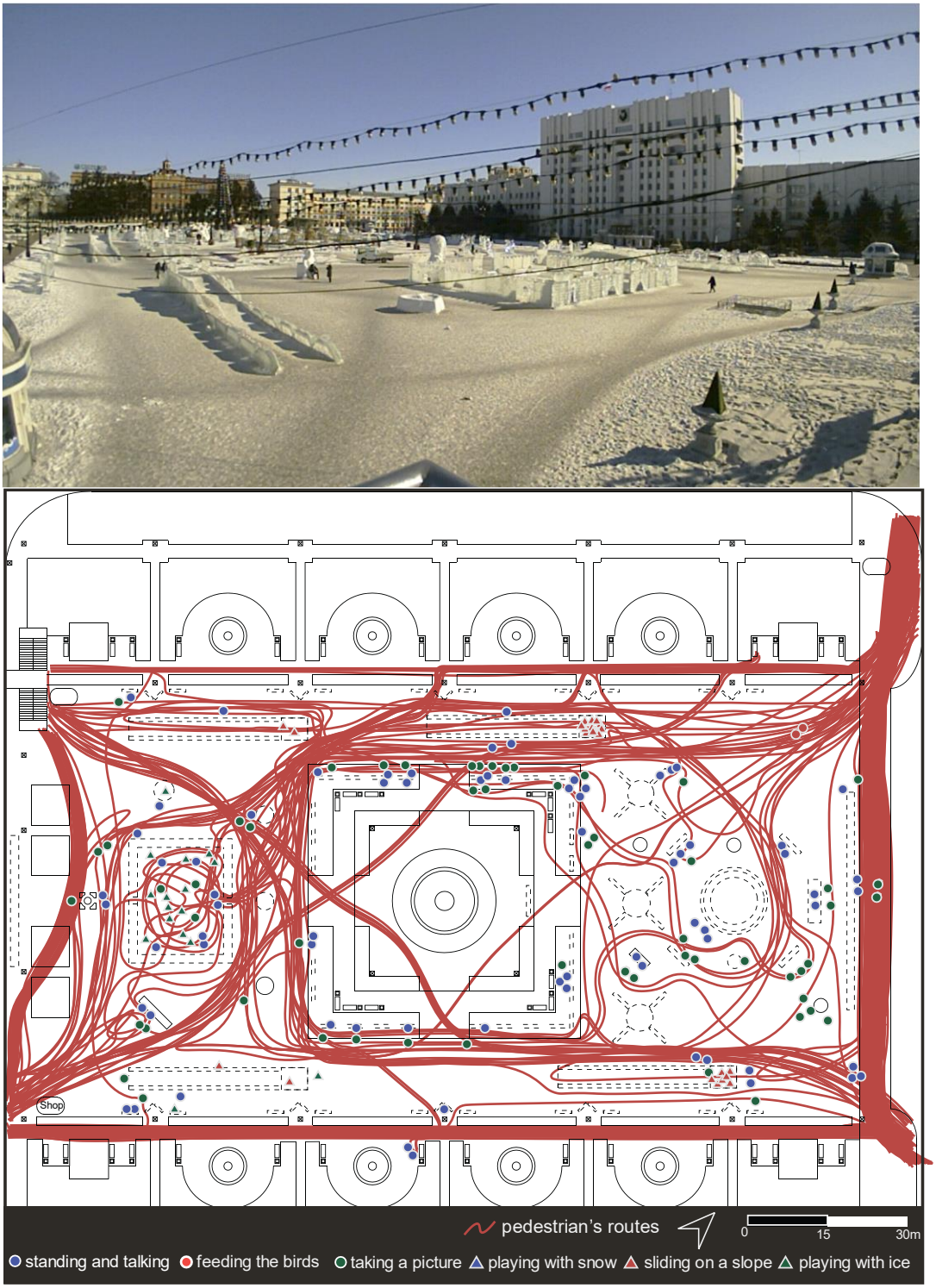


Figure 5-5 Behavioral-mapping data of the two-days survey on the Lenin Square during 'event' at day.

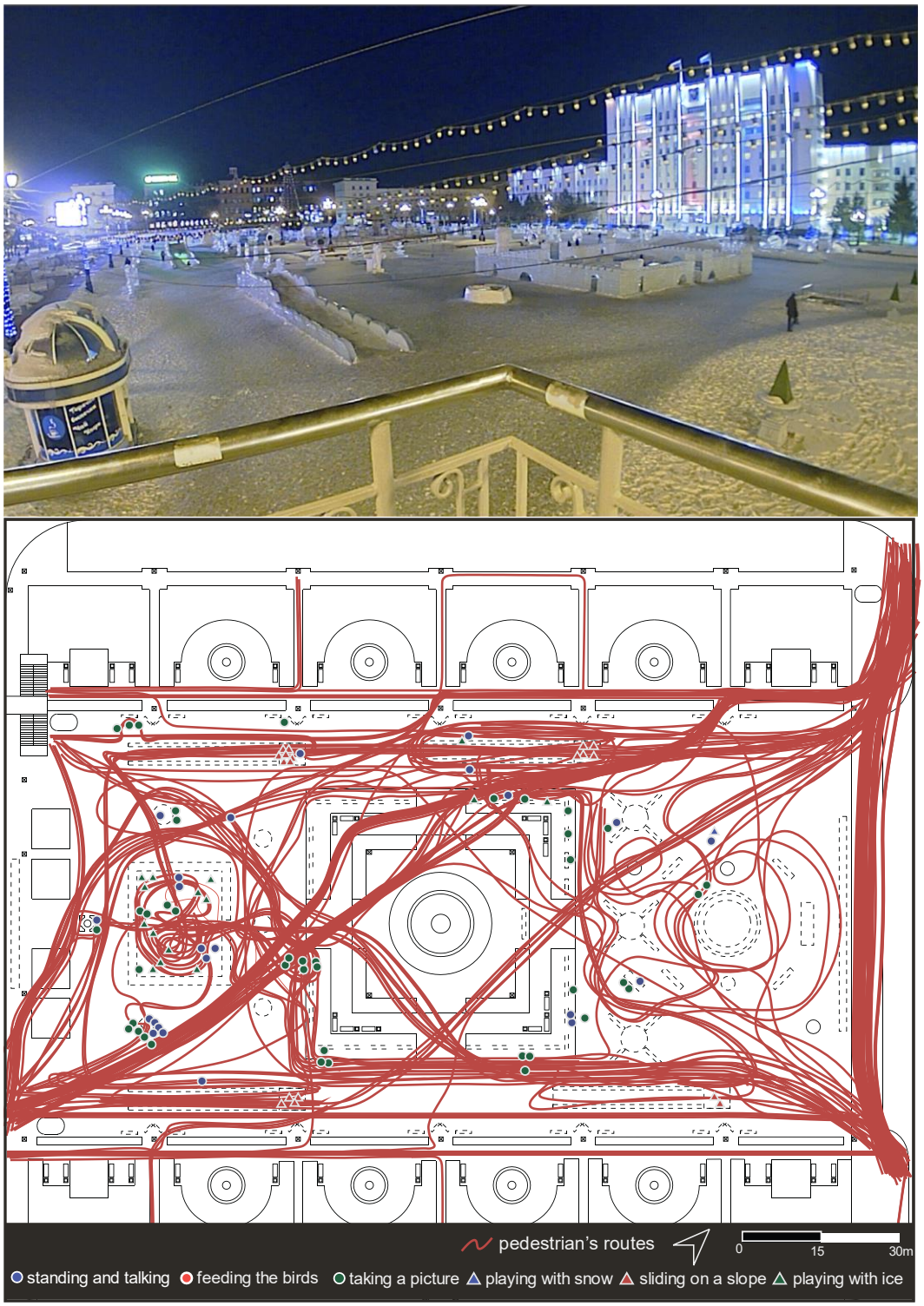


Figure 5-6 Behavioral-mapping data of the two-days survey on the Lenin Square during 'event' at night.

To clarify the usage of the various type of elements and the effect of each subarea on the user's behavior during the event, a statistical analysis was carried out (fig. 5-7). The results were also expected to highlight the particular effect of these elements and their placement on the sedentary (standing and talking; taking a pictures), and vigorous (playing with ice and snow; sliding) level of activities. The graph shows the percentage of each type of activity that was counted in relation to the total number of activities that were recorded over a period of two hours (during the day and evening). Subarea A and B were the areas most-used for activities, with 25% of the total activity in each area. However, different types of activities use were observed in these areas: in subarea A, many people engaged in sedentary activities, like taking pictures (16%) and standing and talking (9%). The frequency of such activities as standing and talking, taking pictures and playing with snow in subarea B was almost equal, at 9%,7%,10%, respectively. In other areas, the percentage of these activities was similar, at 15% of the total activity. However, the areas could be differentiated by the type of use. Subareas D and E were used more for vigorous activities like sliding on the slope, at 9% and 6%, respectively, but subarea C was used for standing and talking and taking pictures, at 7% and 8%, respectively. Overall, the most vigorous activities were in subareas A and B, where a great increase in the amount of playing was observed, as well as such sedentary activities as standing and talking and taking pictures (fig. 5-7).

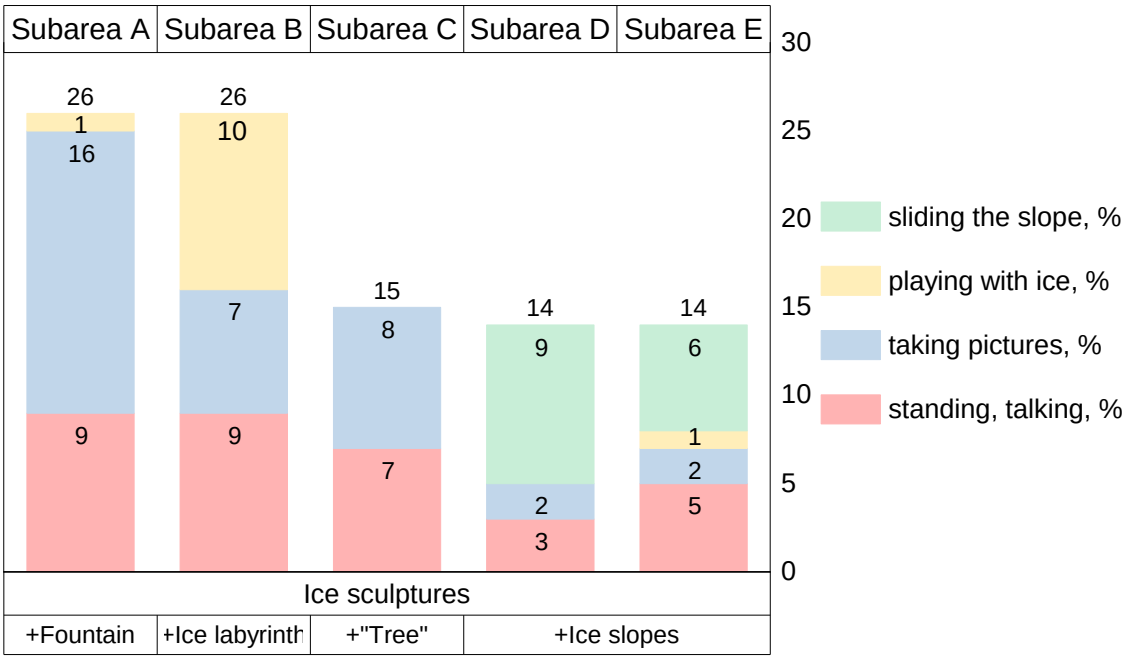


Figure 5-7 Pedestrians' physical activity in each subarea during the 'event'.

5.4 Comparing the ‘no event’ and the ‘event’ people’s behavior

5.4.1 The statistical analysis of the behavior of the ‘no event’ and the ‘event’

To clarify the extent of change in physical activity during an ‘event’ situation, we analyzed the length of the user’s routes and the level of activity in relation to the total number of users. The percentage of each type of activity was calculated in relation to the total number of users during each observation period. The length of the user route was determined by dividing the total length of all routes by the total number of the users in each hour (fig. 5-8).

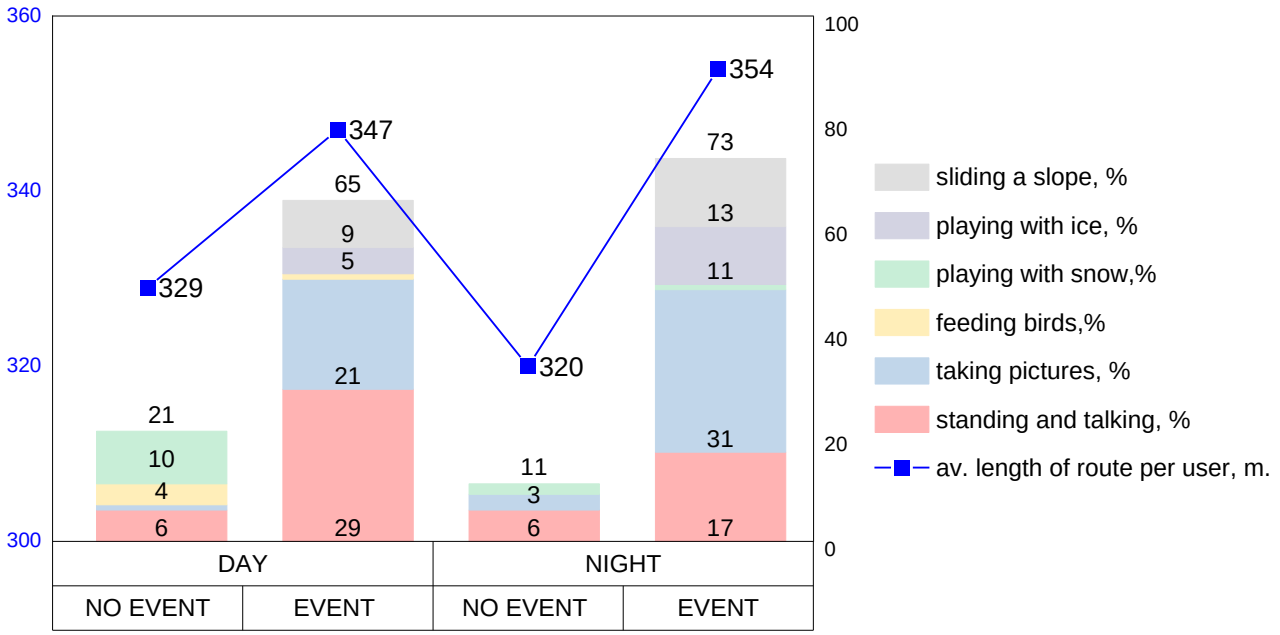


Figure 5-8 Pedestrians’ physical activity and average lengths of the routes taken by users in different situations: no event day; event day; no event night; event night.

A comparison of the activities during the days and the nights of the ‘no event’ shows that the place-related activities remained with a few percentage points during the day, at around 21%. A total 10% of all this activity is the specific site activity, playing with snow. At night the place related activity

dropped by 10% and the user route decreased by 9 m. A comparison of the 'no event' and 'event' situations during the day indicates that the user route increased by 18 meters during the event, and the user's activity increased by 44%. Such sedentary behavior as taking pictures, and standing and talking were the main activities, at 50% of all users, while such vigorous activities as sliding down a slope and playing with snow accounted for 15%. A greater difference in the activity level and route length were observed at night between the 'no event' and the 'event'. The walking length increased by 34 meters during the 'event'. Besides, 73% of users engaged in activities instead of simply passing through, while during the 'no event', only 11% of the users engaged in activities on the square. Additionally, during the event, the frequency of playing with snow and sliding a slope was similar at 11-13%. A total of 31% of activities related to taking pictures, and standing and talking accounted for 17%. The difference between day and night for the event is that the amount of vigorous activity increased at night by 10% and route of users increased by 7 meters. Besides, 10% more people took pictures during the night than during the day. Overall, it was concluded that event design intervention has a critical impact on the people's place related activity and length of routes at night. The physical activity increased by 44% to 62%, while the length and complexity of the route taken by each individual increased by 18 to 34 meters (fig. 5-8).

5.4.2 Spatial usage patterns of the 'no event' and the 'event'

Besides the statistical analysis of the activities, the spatial usage patterns were analyzed to determine the differences between the 'no event' and the 'event' patterns of behavior. The 'directional' distribution was determined using calculations by Arc Map software (fig. 5-9). The 'directional' distribution creates ellipses to summarize the spatial characteristics of the geographic features: the distribution mean center, dispersion, and directional trends, where the mean center is the average values of the x y coordinates of all objects in the

study area. These features allow the tracking of changes in distribution, and therefore allow the distributions for different types of behavior to be tracked with regard to the different objects. Knowledge of where the mean center of activities is during daylight hours and night hours allows urban planners and designers to better allocate elements and lighting on the square. Therefore, determining the spatial usage patterns is useful for in design.

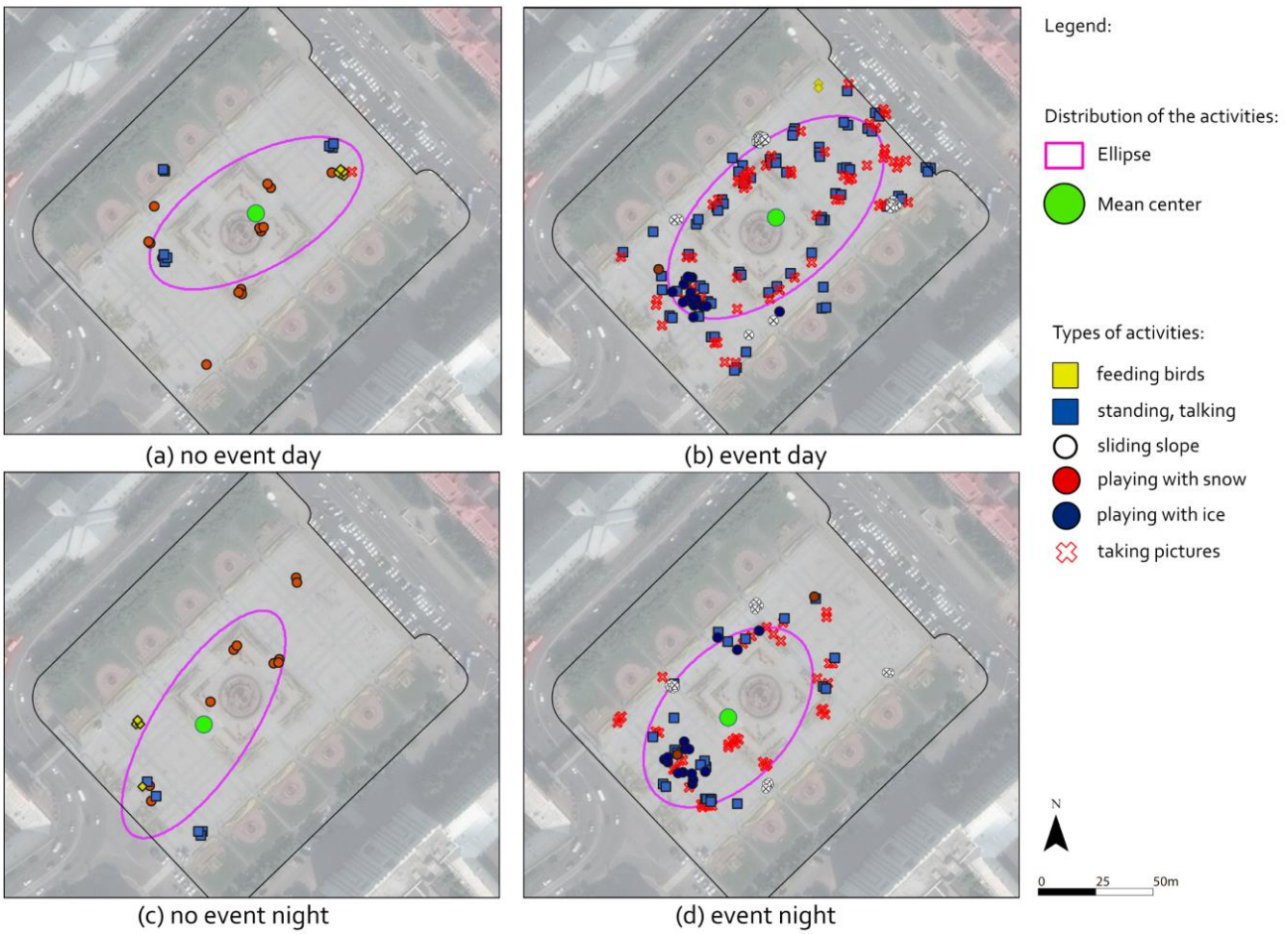


Figure 5-9 Distribution of user's activity in different situations of square: (a) no event day (b) event day (c) no event night (d) event night.

The common and different attributes were clarified by comparing the 'no event' and the 'event' use patterns at day and night. The results, shown in Fig.

5-7, indicate that the mean center of the distribution is similar for day and night in both the 'no event' and the 'event' event situations. The directional trends of the ellipses are slightly different in all four situations, however the 'no event' and the 'event' at day and same at night have similar patterns of distribution. Comparing the 'no event' and the 'event' usage patterns, the central fountain is the mean center of the activity in both cases. Besides, the dispersion of the ellipse during the 'event' covers the entire perimeter of the square, whereas that of the 'no event' is more centred. A comparison of the distributions indicates some common attributes to the 'no event' and the 'event' situations at night, when the mean center of activity distribution was shown to move to the south-west side central fountain. The ellipse of the distribution is also similar (fig. 5-9c and d). Even though the number of the activities significantly increased in the 'event' and new types of activities appeared, the mean centers and sites of activity distribution remained the same. Additionally, the ellipse dispersion and deviation in the mean center of the activity distribution at night to the southwestern side of the square revealed a lack of lighting in the square in the north-eastern part (fig. 5-9c and d). The results show a few common but significant attributes that define spatial use during the 'no event' and also during the 'event'. This confirms the spatial usage interrelationship between the 'no event' and the 'event' patterns.

5.5 Discussion

The results of this study confirm that temporary design interventions significantly influence people's activity and the length of the routes traversed. The outcomes show the demand of users for outdoor space even at night even when the temperature falls to below –12 °C. We clarified that outdoor activity depends not on the climate condition but on the urban design approach. An approach that provides diversity of use is especially important in winter cities. The increase in the number of users during an event where all types of elements were made of ice and snow shows not only the needs of citizens for a diverse urban environment and outdoor activities, but a willingness to enjoy winter.

5.5.1 The 'no event' and the 'event' spatial patterns of use

Since the 'no event' scenario represents the short-cut or fastest way, the Permanent design shows the users' need for convenience with few regular activities. That again reflects the usage patterns during the 'event'. During the 'event', however, people tend to take a long-curved route and engage in activities designated by the types of elements provided. Therefore, temporary design assists by creating more complex routes and more supplementary physical activities than those designated by permanent elements. Moreover, consideration of the usage patterns during the 'no event' situation indicates the wide-open side areas which can be used for a wide range activity and activated during the 'event' situation to spread usage evenly around the square. Thus, we believe the Permanent design can serve the basic stage, and that it provides convenience with regard to point of use. Besides, by providing the 'buffer' zone[33] for the secondary design, a more ergonomic and detailed temporary design serves the constant changing urban environment in both the winter as well as the summer season. Such changes attract people's interests in a diverse environment throughout the year and encourage them to stay longer outside even during extreme low temperatures.

5.5.2 Temporary design elements that enhanced activity

In the temporary design that encourages outdoor activity in severe climate cities, temporary elements in the form of ice and snow as well as constructions for the celebration of winter are recommended. These help the residents to enjoy the positive aspects of the season, and this helps them to accept the climate as an integral part of culture. Such cultural aspects as taking pictures, walking around and talking are encouraged by the placement of variety of the art ice and snow sculptures in open public spaces.

When the design of ice or snow sculptures is varied, pedestrians take more photographs and become involved in discussions about the different sculptures. They stay longer on the square and enjoy the event, as is clear from the longer routes they take. The more steps a pedestrian takes to enjoy them is an increase in physical activity. Mazes and slides made of ice provide a unique and positive concept of playing with the resource of winter, and also equate to an increase in vigorous activity. Because such intense activity keeps pedestrian warm, the consequence is that they remain longer outdoors. However, a more creative approach to the design of ice and snow temporary elements is required.

By further investigating the use of temporary design in winter cities, we can comprehend how people's behavior changes, particularly with regard to their routes, the type of activity and their attention by using a variety of temporary elements. It is critical to continue analyzing the effect of different temporary elements on people's behavior to gain a better understanding of which elements are most effective at encouraging physical and social activities and which attract people's attention in winter. This will allow us to identify the most-suitable the temporary design for winter cities.

5.5.3 Comparing field survey on Kita 3-jo plaza and Lenin square

Comparing the people's behavior on the Kita 3-jo plaza and field survey on Lenin Square, it revealed that permanent design in cold climate cities cannot support the people's activities. During the cooling period the number

ofactivities decrease due to the impact of the low temperature and increased wind speed. Especially in severe cold climate cities as Khabarovsk during winter few activities are appeared on public open space.

5.6 Conclusion

In this study, the people's behavior on Lenin Square in the Russian city of Khabarovsk during 'event' and the 'no event' situations was investigated using behavioral mapping, further statistical analysis and activity distribution patters to determine the spatial use paradigms of temporary and permanent design. An understanding of the relationship between temporary and permanent design in public open spaces in winter cities is expected to reveal the design approach for these spaces with the purpose of improving the experience of winter by encouraging them to spend more time outdoors talking and engaged in activities. The main findings of this investigation can be summarized as follows:

(a) In winter, during the 'no event' situation, pedestrians tend to pass by or take shortcuts through public open spaces, especially at night. Few people lingered in the Square, there was no interaction between pedestrians, few took the pictures, but some fed the birds or played with snow. In the evening, there was a dramatic drop in activities;

(b) More than half of the passing pedestrians actively used public open space during temporary event in winter, becoming involved in a variety of supplementary activities, including walking around, talking, taking pictures, playing on the slides, and playing with the designed items;

(c) Even at night, which is considered as the most unsatisfactory time for activities in winter, when the area was well-lit, temporary event was successful even when the temperature was extremely low, at –12 °C;

(d) The interrelationship between permanent and temporary design was clearly illustrated by the behavior of the people in Lenin Square during event periods by comparison with that of the 'no event' period. This clearly indicates that these two design concepts should be considered as complementary to each other;

(e) The case study of Lenin Square in Khabarovsk clearly illustrated that the permanent design of Soviet era open public space is well-suited to the implementation of temporary design.

The results of this study indicate that permanent design provides an enduring and basic design for regular needs, such as fast transportation, convenient routes, comfortable place for rests. It does not impose regular behavior but provides a basic framework and tools for it in the form of street furniture and shortcuts. Temporary design is an effective tool to increase the physical and social activities in winter cities even in severe cold climates. This does not imply that temporary design is an alternative to Permanent design. Rather, creating temporary design based on the permanent is proposed as a method to increase the interaction of pedestrians with the outdoor environment. Since temporary design complements permanent design by providing supplementary activities, the permanent features are a necessary component of the temporary design. Thus, it is critical to consider a combination of these approaches. The guidelines for permanent design that are suitable for temporary design are those which create value for temporary design, such as wide-open areas with only a few, or easily removable, items. Additionally, it is recommended that public space should not be fully enclosed but provide openness to create a feeling of ‘invitation’. Regarding the guidelines for temporary design, the convenient routes should be maintained as a shortcuts, but should be combined with complex walking routes. The complex routes can be managed to attract pedestrians using a variety of art objects made of ice or snow. Moreover, temporary items that highlight the composition of permanent design are recommended by, for example, placing ice sculptures along the fountain borders. Further exploration into the creative combination of the permanent and temporary items to increase activity levels is required.

In designing public open space for winter cities, the permanent design provides basic design for regular use and provides the ‘stage’ for temporary design. Temporary design implies flexible design that provides variable

'scenarios' for effective and supplementary use. This study is the first step in a debate about developing the urban design approach to include temporary design and consider it in relation to permanent design in winter cities. Moreover, this urban design approach is considered an effective tool for developing unutilized Soviet-design public spaces and improving the quality of life of the residents of cities with harsh winters.

Chapter 6: Impact of temporary design on people's perception

6.2 'Ice Town', Lenin square, Khabarovsk

6.2.1 Weather parameters and 'urban' images

All of the data collected were images taken within 100m of the geographical location of Lenin Square. We downloaded over 10 200 datasets (Table 6-1) of Instagram posts generated and shared during winter season when the temperature tends to be below 0 °C (fig. 6-1), from 1st November of the 2017 to 15th of March of 2018. It is clear that there was no relationship between the number of images posted and the weather parameters, such as the wind velocity (in m/s) and air temperature (in °C). However, A comparison of the patterns of the weather and number of images per day highlights the impact of the winter event on the people's impression of the urban environment. This is true regardless of the severity of the climate, with low temperature ranging from 7 °C to –28 °C, according to fig. 6-1. While no images were posted on the 'no event' periods, as many as 120 images were posted during the 'event' periods. Also, with the exception of the New Year holidays from 1st to 8th of January, there were between 10 and 60 images related to urban design per day, while during the 'no event' period, that number was close to 0 (fig.6-1).

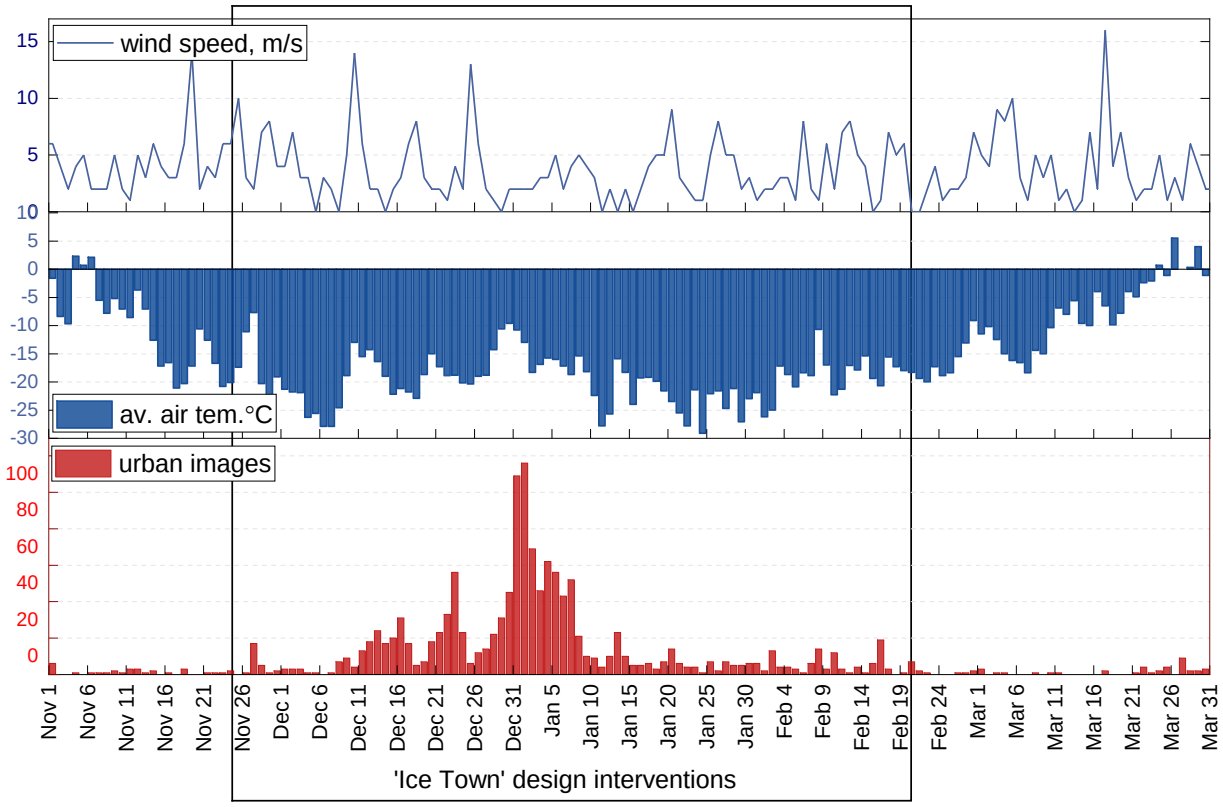


Figure 6-1 Comparison of the 'no event' period and 'event' period of the climatic data and number of urban design related images

6.2.2 'Urban elements' images

Table 6-1 Collected Instagram data and processed images on the Lenin Square.

	'No event'		**'Event'**	
	1.11.2017 – 24.11.2017 20.02.2018 – 15.03.2018		25.11.2017 – 19.02.2018	
total Instagram posts	1600		8600	
'urban' images	**96 (6%)**		**1700 (20%)**	
	Day	Night	Day	Night
'urban element' images	**30**	**35**	**561**	**708**

There were 8404 images related to 'not urban' class, while there were 1796 'urban' images, representing 21% of all data. We divided the data into two situations for Lenin Square: the 'no event' period, for images posted before (1.11.2017-24.11.2017) and after the event (20.02.2018-15.03.2018); and the 'event' period, for images posted from 25.11.2017 to 19.02.2018. From the 1600 images, 96 were related to the urban issues, representing 6% for the 'no

event' period. In case of the 'event' period, an 8600-point dataset was collected, with 1700 'urban' images representing 20% of the total. The content in some of the images was hardly recognizable or included the image of the whole square from the birds eye view, which made it difficult to relate to one urban element as the target object. These 'urban' images were not classified as summary clusters. A total of 675 'urban' images were posted and generated during the 'event' during the day, with 561 of the images related to 'urban elements' clusters. Similarly, at night we collected 812 'urban' images: 708 of them were summary clusters of the urban elements. For the two 'no event' periods, 53 and 36 images were related to urban design issues, while 30 and 35 images were summary clusters (Table 6-1).

Although there were very few images of the permanent elements during the 'no event' period, some elements were more popular than others and some were given no attention at all. Among the daytime images, the element which appeared most frequently in the photographs was the red brick historical building, followed by the white stone Government building, then the alley of the trees, the street furniture, the statue of Lenin and the central fountain. At night, the main element was the landmark of the square, white stone Government building, and there were just a few images of the other features: the Management university building, the Medical University building, the alley of the trees and the street furniture (fig.6-2).

During the 'event' period, a larger number of the images was related to the main temporary landmark, the Christmas Tree, both during the day and night. Besides, there were many more images of some of the snow sculptures, including the 'bear', 'snowman' and 'dog' and the ice sculpture '2018', than the other snow and sculptures temporary elements during the daytime. At night, another element appeared: the well-lit central fountain was the most common image, followed by ice sculpture '2018' and the snow sculptures - the 'dog', 'bear', and 'snowman' (fig. 6-3).

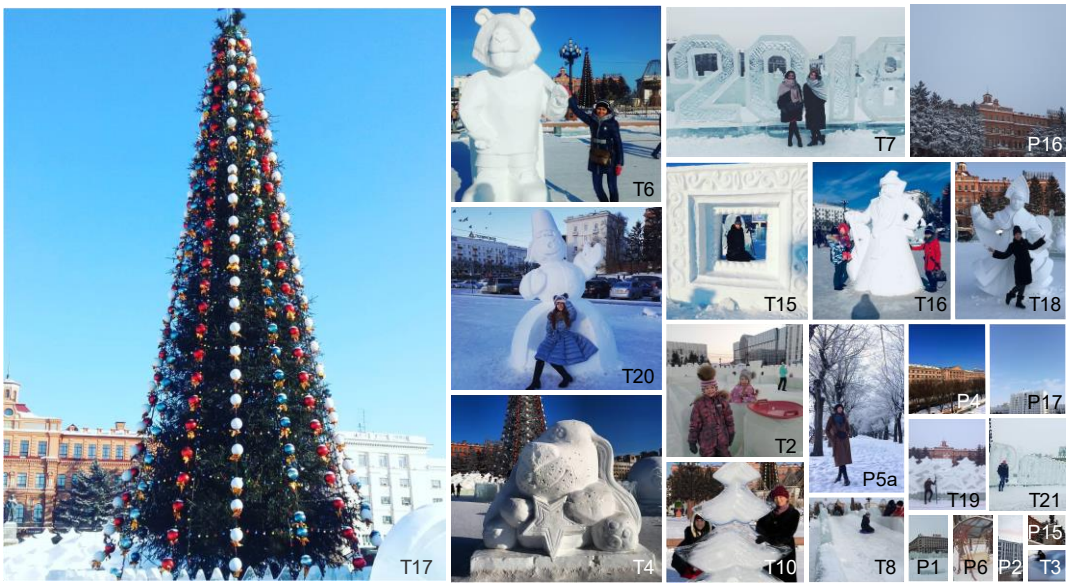
Prominent landmarks, such as the surrounding historical buildings in case of the ‘no event’ period, and the Christmas Tree for the ‘event’ period, had the biggest impact on the pedestrians. Also, the natural element, in this case the

alley of trees, appeared in a great number of images in all four different periods, indicating the significant impact natural elements have on the pedestrians. Additionally, while snow sculptures had a greater impact on the pedestrians during the day, it was the ice sculptures which had a greater impact at night. This can be explained by the greater reflection of light at night.

(a) NO EVENT DAY

(b) NO EVENT NIGHT

Figure 6-2 Proportional representation of the numbers of ‘urban element’ images: (a) ‘No event’ during the day; (b) ‘No event’ at night;



(a) EVENT DAY

(b) EVENT NIGHT

Figure 6-3 Proportional representation of the numbers of 'urban element' images: (a) 'Event' during the day; (b) 'Event' at night.

6.2.3 Ranking of the urban element images, comparing the ‘no event’ and ‘event’

In order to illustrate the link between Temporary design and Permanent design, we generated a ranking system (RankFlow, n.d.) based on the numbers of images related to urban elements between the ‘no event’ period and the ‘event’ period, and compared the different patterns at night and during the day. A considerable number of images related to the permanent elements during the event would indicate a clear link between Temporary design and Permanent design and emphasize the importance of Temporary design as a tool for improving the impression of the urban environment on residents. The permanent urban elements are indicated in dark blue, and the temporary urban elements are indicated in light blue. By using this ranking system, we can define which of the urban elements had a critical impact on the perceptions of the people during the different periods (fig. 6-4 and 6-5).

A comparison of the ‘no event’ and the ‘event’ patterns during the day reveals that the historical building on Pushkin St. (P16) appeared in the greatest number of images, with 9 during the ‘no event’ period, increasing to 23 during the event. It was 6th in the ranking among other urban elements. During the ‘event’ period, there were a few images of other historical buildings, the Medical university (P4) and Management university (P1) and the building on the Gogol St. (P2), with 7, 3, 2, images respectively, while during the ‘no event’ period, no images were generated. However, there was one less image related to Government building (P17) during event (fig. 6-4).

Nighttime patterns show diverse ranking among the objects photographed, since some of the urban elements were well-lit. For instance, there was a marked contrast in the number of images for the central fountain (P12), which was temporarily lit for the event, with 0 images during the ‘no event’ period and 69 images during the ‘event’ period. Images featuring the Government building (P17) increased during the event from 15 to 20 images. Other surrounding historical buildings on Gogol (P2) and Pushkin (P16) Streets increased from 0

images to 2 and 3 images, respectively, while the Management university (P1) and Medical university (P4) were featured in fewer images from 7 to 6 and 5 to 3, respectively. Besides, the number of images of alley of trees (P5a) increased by 13 during the event (fig.6-5).

It is evident that the 'event' improved the pedestrians' impression of the urban environment. Not only were they impressed by the temporary urban elements but also a combination of the temporary and permanent elements of the square. Evidence of this is the increased number of the images related to the permanent elements at the event. Moreover, the impact of lighting on permanent elements had a considerable impact on the perceptions of the square.

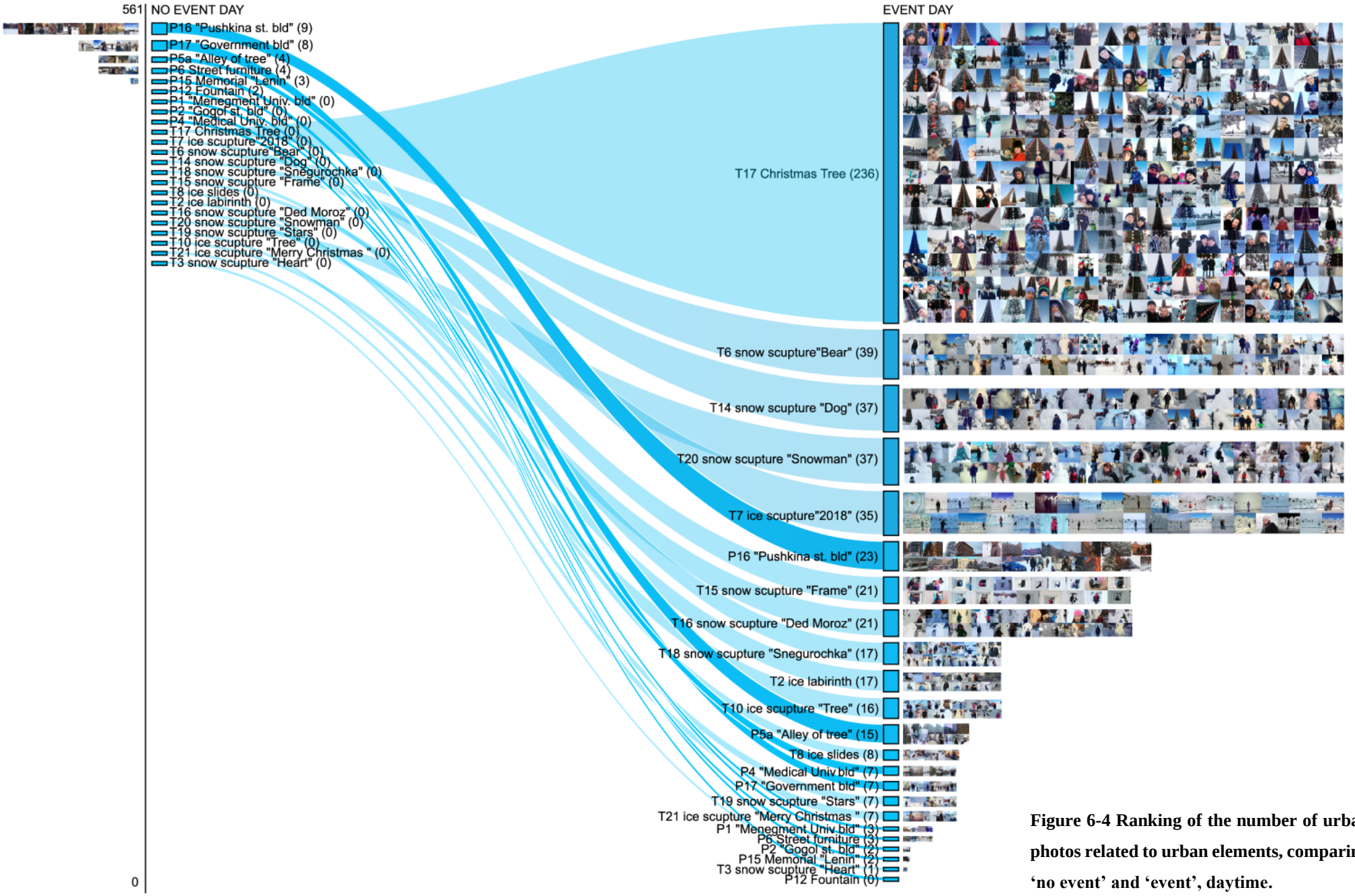


Figure 6-4 Ranking of the number of urban photos related to urban elements, comparing 'no event' and 'event', daytime.

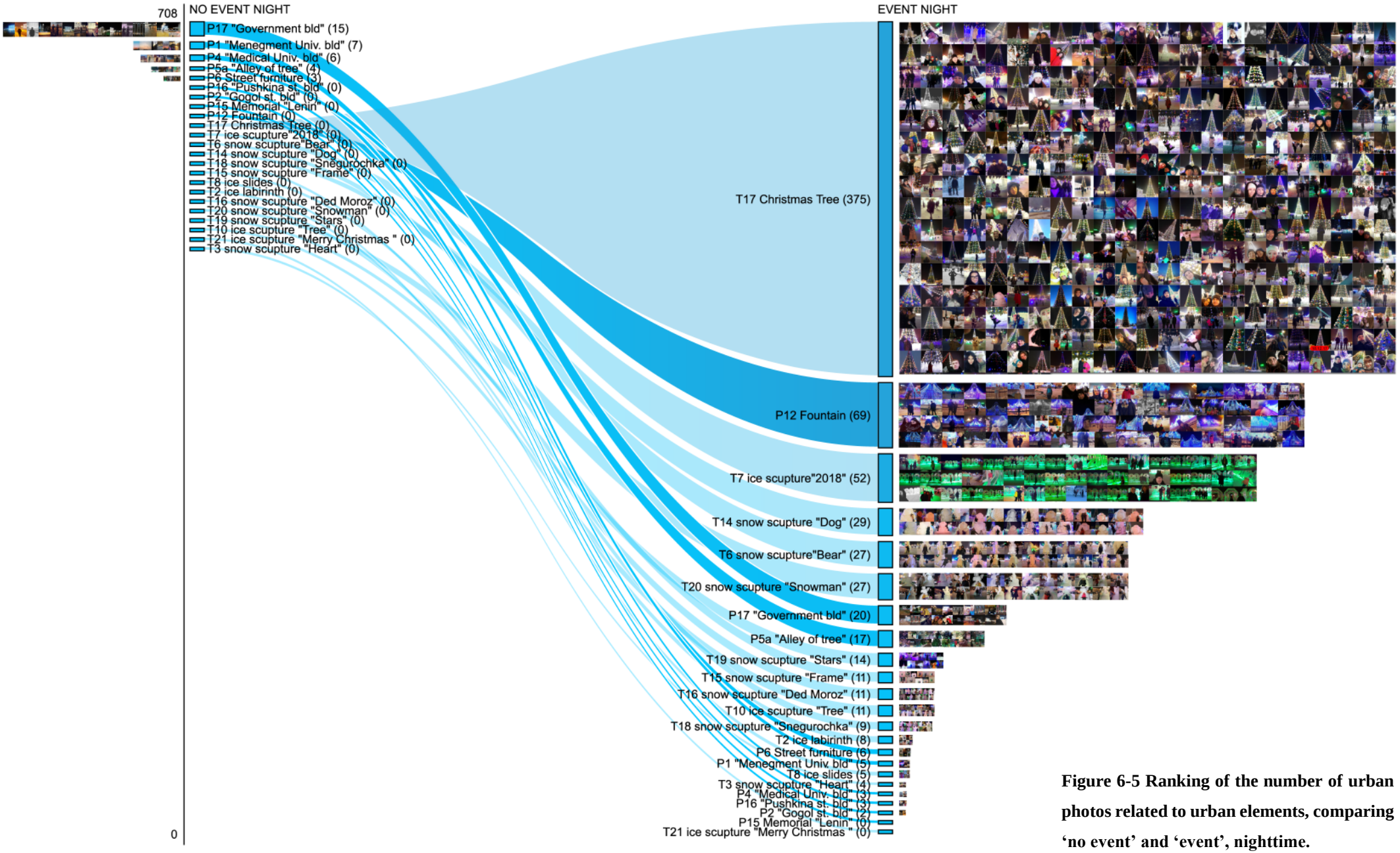


Figure 6-5 Ranking of the number of urban photos related to urban elements, comparing 'no event' and 'event', nighttime.

6.2.4 Spatial distribution of the urban elements and their number of images

To clarify the spatial pattern of the pedestrians' perception of the urban elements, a GIS map was generated using ArcMap software (ArcMap, n.d.). The urban element related images were placed on the map and attached to the location of the urban element, rather the point where the photograph was taken. Issues arise with understanding of accurate geographical location where the photographs were taken.

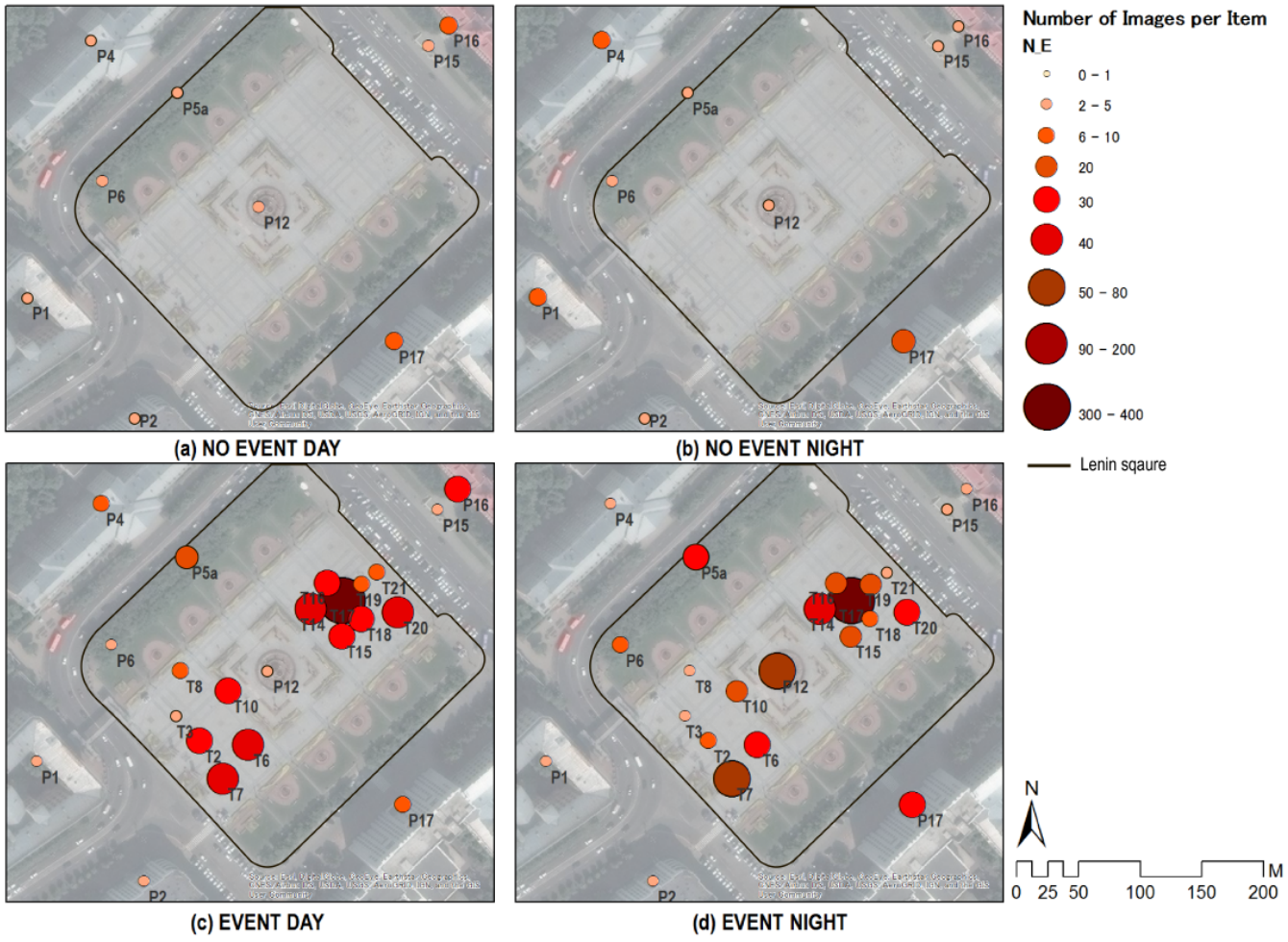


Figure 6-6 Spatial pattern of intensity of the images related to urban elements: (a) 'no event' at day; (b) 'no event' at night. (c) 'event' during the day; (d) 'event' at night.

The event increased the number of impressions from 20 images to 400 images per urban element. Pedestrians perceived the permanent urban elements as clearly symmetrical, according the designated design classical composition. Comparing the day pattern of the 'no event' and 'event' periods, similar spatial patterns can be noticed during the day and at night for the images related to the permanent elements. For instance, the photographs captured the following element during the day: P16, P15, P5a, P4, P1, P2, P12, P17 and P6, with more images for P16 and P17 (fig. 6-6 a, c). The other small-scale permanent elements are disregarded, including the side fountains, memorials and street furniture. Similarly, at night, the following appeared in images: P16, P15, P5a, P4, P1, P2, P12. P17, P6, with more images for P17 (fig. 6-6 b, d).

It is evident that such great scale distinctive elements as historical buildings and the Christmas Tree during event have the most significant impact on the pedestrians. However, some elements appeared in more photographs than others. For example, for the 'no event' period during the day, the building on the Pushkin St. (P16) was a main landmark, while the Government building was more photographed at night (P17). During the 'event' period, the Christmas Tree (T17) was the element that had the greatest impact on the pedestrians. Positioning an element in the center of the space is not a guarantee that it will be photographed a great number of times. For instance, the central fountain (P12) was captured in the photographs only during the event because of the temporary lighting (fig. 6-6).

6.2.5 Sentiment analysis of captions

The purpose of the sentiment analysis is to clarify whether the impression of urban environment is positive or negative. We analyzed tone of the sentiments of each given caption using Natural Language API and additionally, procced it manually.

During 'no event' were collected 65 post with urban images, the 44 out of them include captions. While, during 'event' from 1269 urban image posts were

collected 901 with the captions. Note, that the different numbers of the total posts and posts with captions relate to the optional function of attachment of captions to photos. The sentiment analysis showed that during ‘no event’ most of the captions identified as a neutral with number of 36 (82%), rest of the captions were positive with 8 (18%). Roughly similar proportion of neutral and positive captions were posted during ‘event’ with 625 (69%) and 244 (27%), respectively (fig. 6-7). However, few captions (32) contained negative sentiments during ‘event’ (Table 6-2.). These negative captions were mostly related to the cold weather condition.

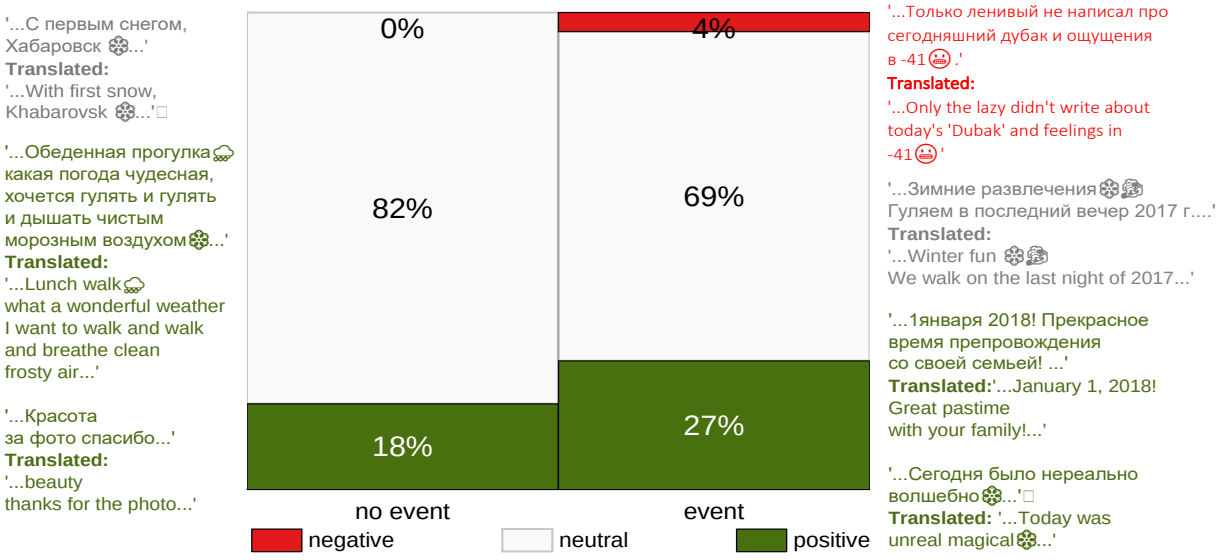


Figure 6-7 Sentiments of the captions during ‘no event’ and ‘event’.

Table 6-2 Sentiment analysis of the captions attached to photos during ‘event’ and ‘no event’.

Situation	**‘No event’** 2017.11.1 – 2017.11.24 2018.02.20 – 2018.03.15	**‘Event’** 2017.11.25 – 2018.02.19
‘urban’ images	65	1269
captions	44	901
positive	8	244
neutral	36	625
negative	0	32

The content analysis of the caption related to the ‘no event’ period shows a few keywords occurred due to the few taken photos on public open space.

Keywords repeated twice in the captions are a 'warm', 'thankful', 'photo', 'good' (fig. 6-8a).

(**a**) (**b**)

Figure 6-8 Word clouds of all captions content: (a) 'no event'; (b) 'event'.

While for the 'event' about 500 diverse words were revealed, where the most repeated words were 'Khabarovsk', 'new_year', 'Christmas_tree', 'winter', 'happy', 'Lenin square', 'Far East', 'Photo', 'family', 'snow', 'walk', 'beaty' (fig. 6-8 b).

6.2.6 Keywords related to urban elements

The next step revealed the keywords related to each urban element in order to clarify not only the urban elements that affect the most on the people's positive impression of public open space but also specific experience related to this object. This step is critical in developing urban design approach for analysing people's perception of urban environment, especially, in developing guidelines for temporary interventions of public open spaces.

Only keywords from the positive captions were extracted. Moreover, we excluded the keywords that reflect the entities of place or time and do not present a value for defining specific experience of individuals, such as 'Khabarovsk', 'Lenin Square', 'Christmas_tree', 'winter', 'walk', 'snow', 'photo'. The results revealed that the keywords related to the permanent elements are more diverse compared to it to the temporary elements, however, each keyword repeated no more than 5 times in the captions. Although the

keywords related to temporary urban elements are less diverse, some repeated more than 40 times (fig. 6-9,10).

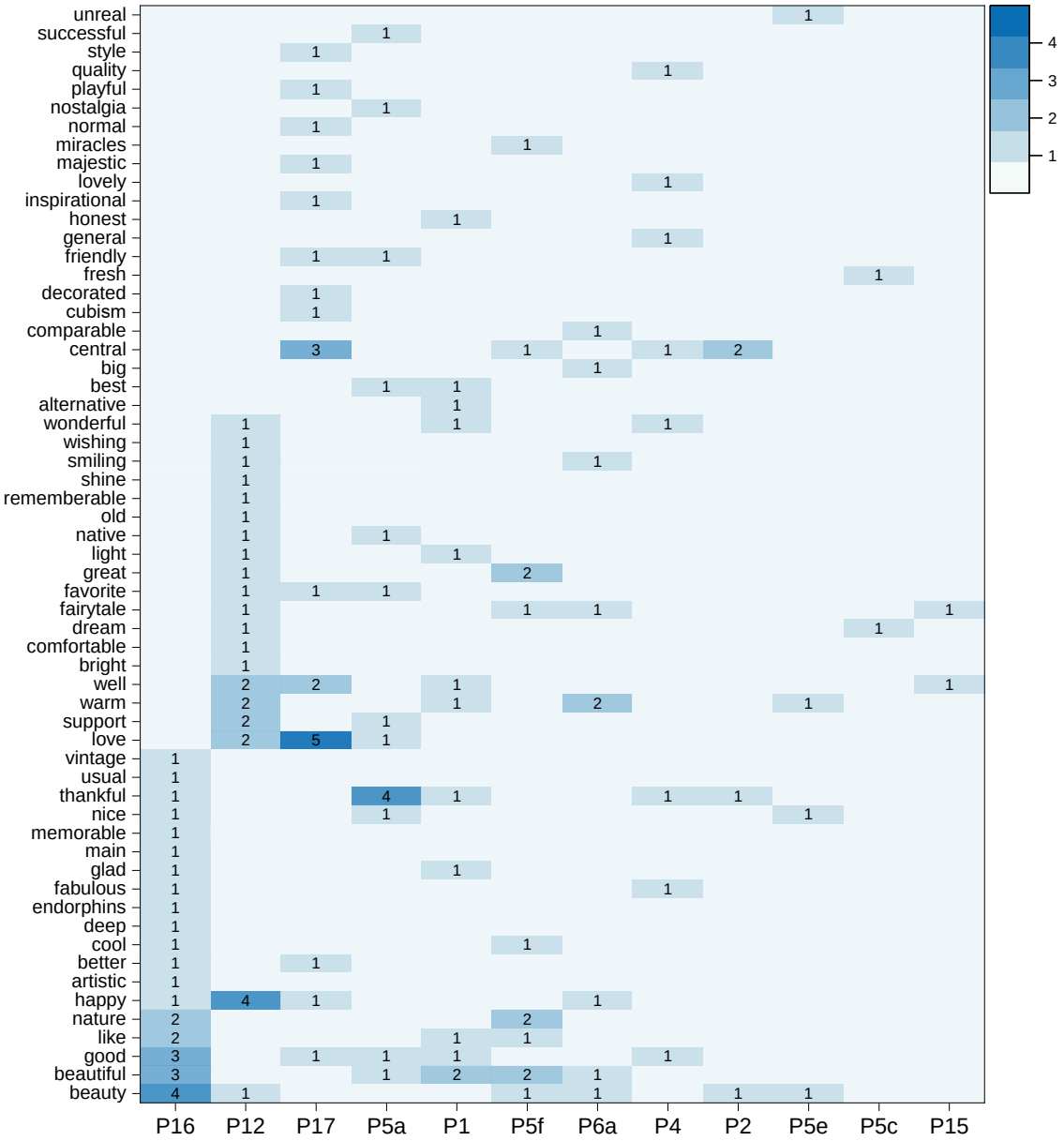


Figure 6-9 Repetition of the keywords extracted from the positive captions related to permanent urban elements during 'event'.

About 50 diverse keywords were extracted from the positive captions related to permanent urban elements. Among permanent urban elements red brick building (P16) received the greatest number of positive keywords, however, the difference in the number is not that critical. Other permanent urban

elements as decorated by Christmas light central fountain (P12), Government white bld. (P17), alley of tree (P5a) received relatively similar number of keywords. Urban elements as Lenin statue (P15) and alley of tree near the government bld. (P5c) received the least number of positive keywords (fig. 6-9, 6-11).

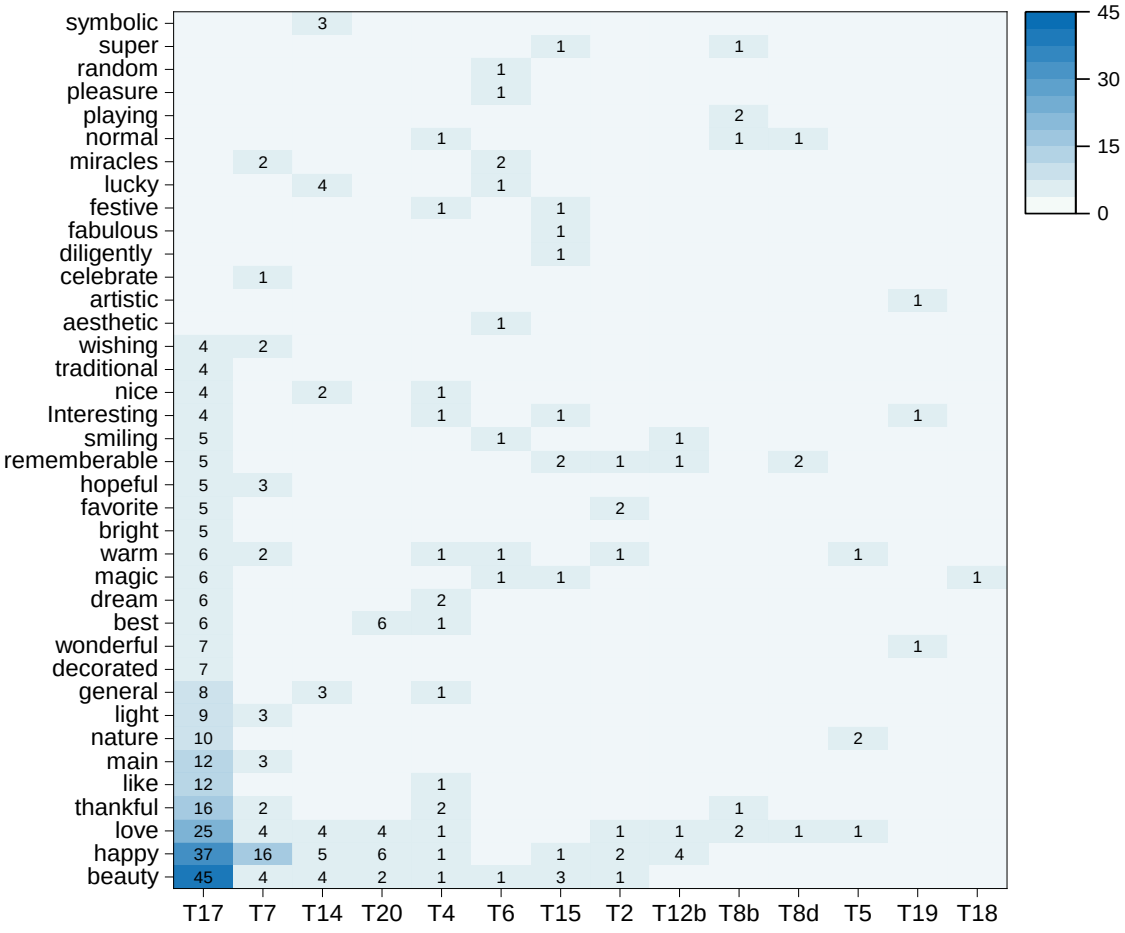


Figure 6-10 Repetition of the keywords extracted from the positive captions related to temporary urban elements during 'event'.

Considering the temporary urban elements 38 keywords were defined, where the keyword 'beaty' was repeated more than 50 times. The 45 time out of around 50 repetitions of the keyword 'beauty' was address to Christmas tree/ main tree. Main Tree/Christmas tree (T17) has a greatest positive impact on people's impression of public open space in winter. That reflect in the highest number of positive keywords as 'beaty', 'happy', 'love', 'thankful', 'like',

‘main’, ‘nature’, ‘light’, ‘general’, ‘decorated’, ‘wonderful’, ‘best’, ‘dream’, ‘magic’, ‘warm’, ‘bright’, ‘favorite’. The ice sculpture ‘2018’ (T7) is the next urban element that has a greatest positive impact on the people’s impression (fig. 6-10, 6-11).

Additionally, the network connection between extracted keywords from captions of related photo and captured on this photo urban element were illustrated on the fig. 6-12 (permanent urban elements during ‘event’) and 6-13 (temporary urban elements during ‘event’).

Number of positive captions per item:

>100
50
10
5
1

Keywords:

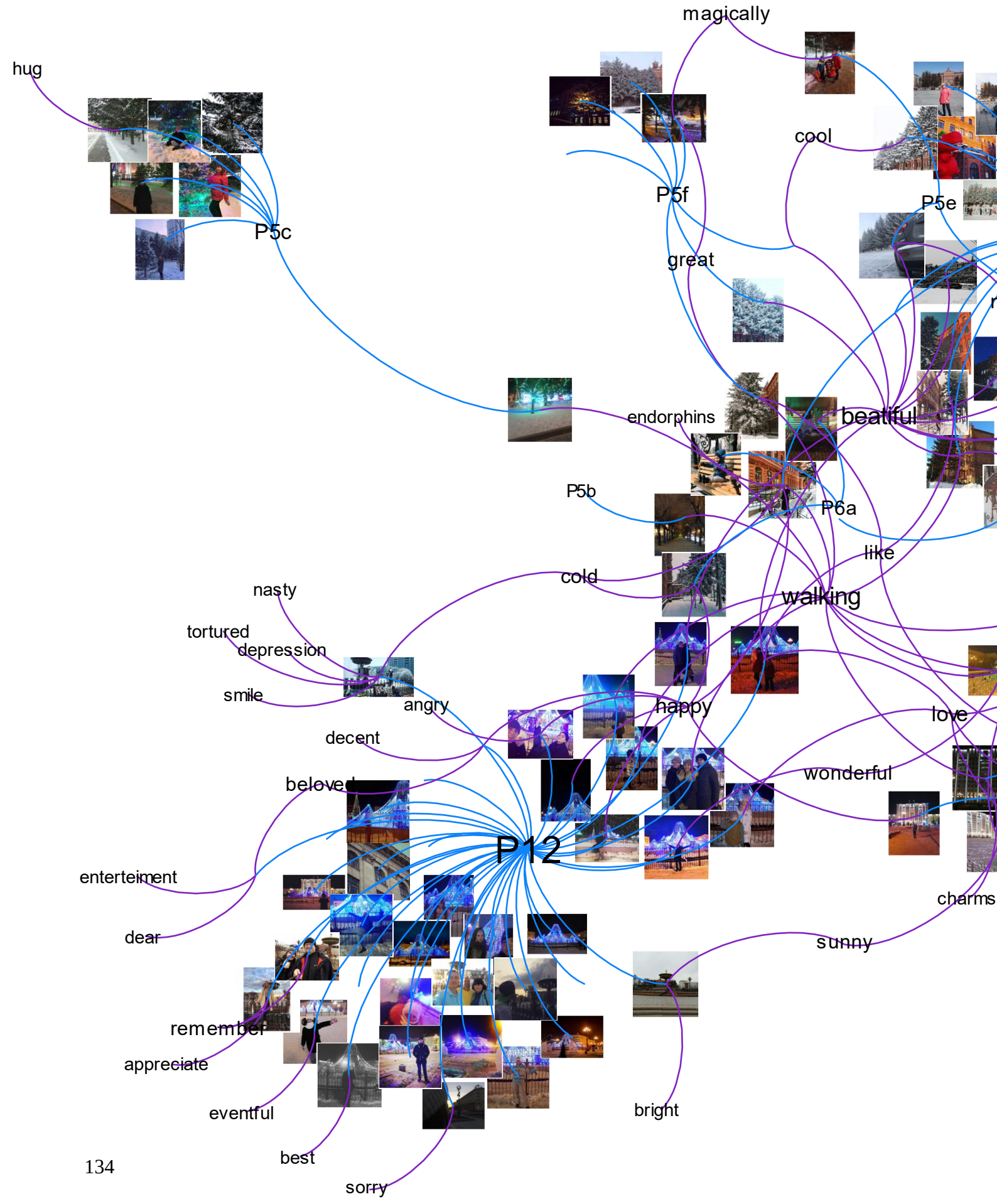
Number of occurrences:

front size >44
front size 37-44
front size 13-36
front size 8-12
front size 6-7
front size 4-5
front size 3
front size 2
front size 1

1 : 2,201
0 0.07 mi
0 0.11 km

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN and the GIS C

Figure 6-11 Location of the urban elements and their positive impact on the people's impression during 'event'.


magically
hug
cool
P5f
P5e
P5c
great
endorphins
beatiful
P5b
P6a
like
cold
walking
nasty
tortured
depression
smile
angry
happy
love
decent
wonderful
beloved
P12
enterteiment
charms
dear
sunny
remember
appreciate
eventful
bright
best
sorry

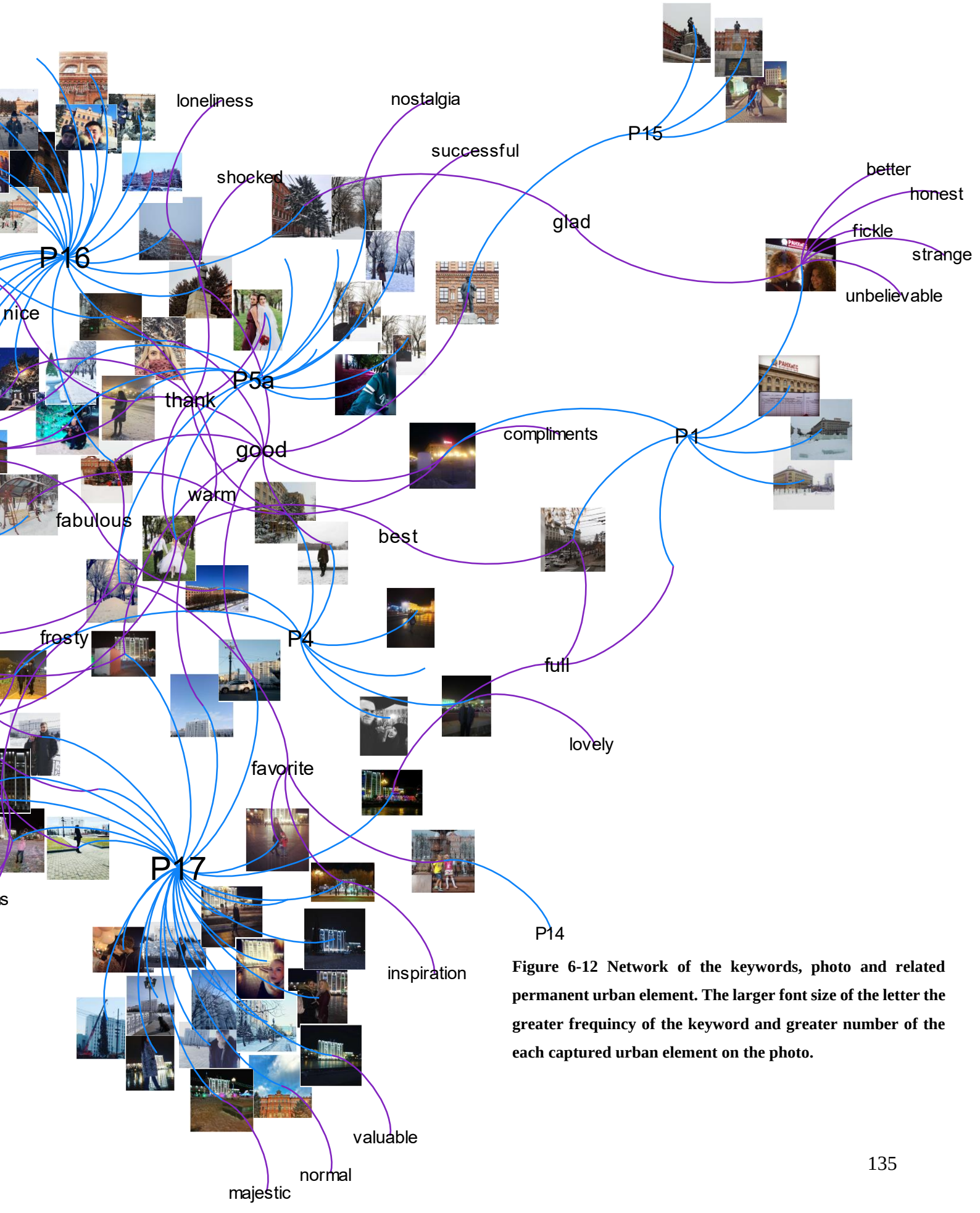
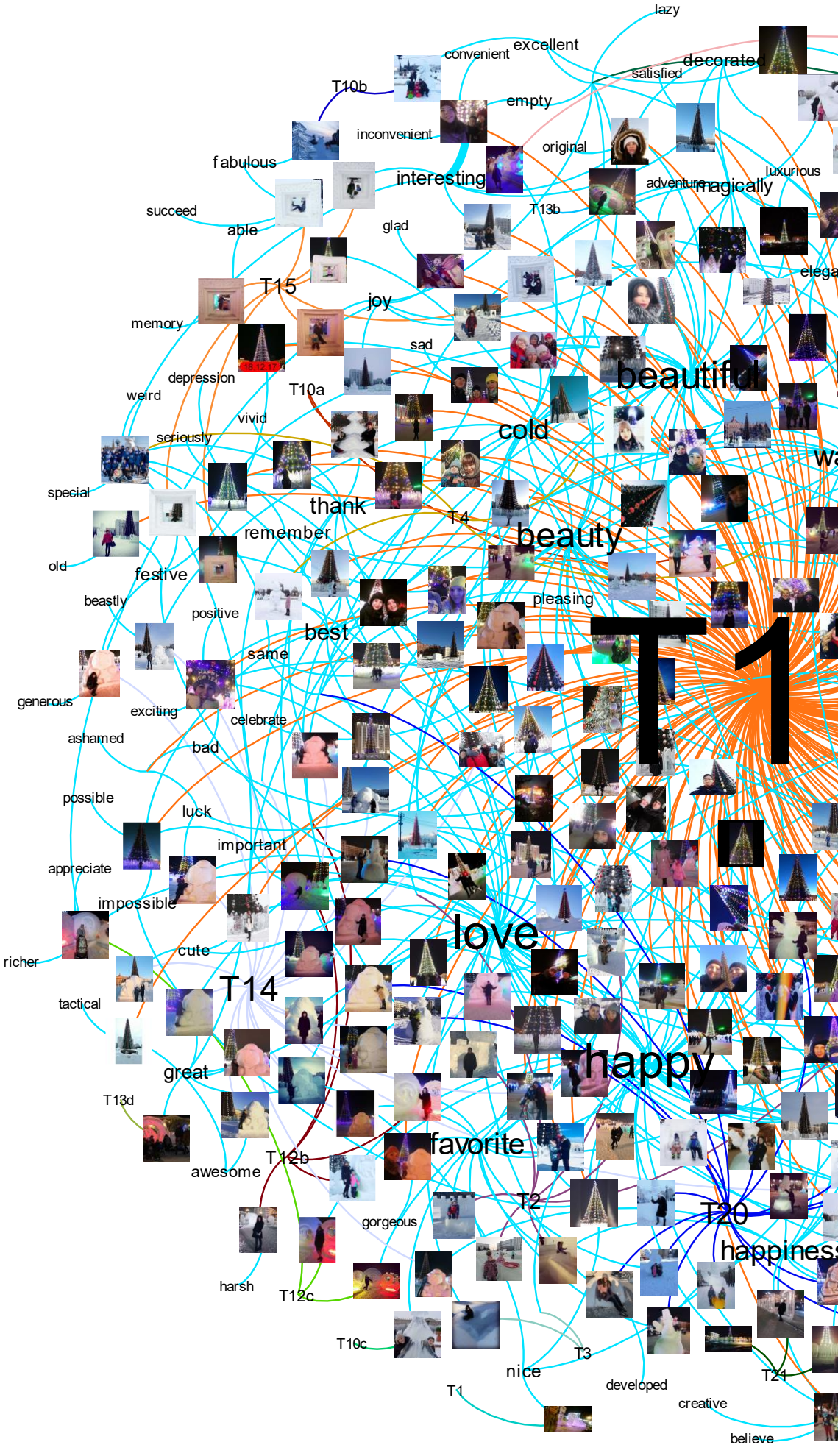


Figure 6-12 Network of the keywords, photo and related permanent urban element. The larger font size of the letter the greater frequincy of the keyword and greater number of the each captured urban element on the photo.


lazy
excellent
convenient
decorated
satisfied
T10b
empty
inconvenient
original
fabulous
interesting
luxurious
adventure
magically
T13b
succeed
able
glad
T15
joy
memory
sad
beautiful
depression
T10a
weird
vivid
cold
seriously
special
thank
T4
beauty
remember
old
festive
pleasing
beastly
positive
best
T1
same
generous
exciting
celebrate
ashamed
bad
possible
luck
important
appreciate
impossible
love
cute
richer
T14
tactical
great
happy
T13d
favorite
T12b
awesome
T2
T20
gorgeous
happiness
harsh
T12c
T10c
T3
nice
T21
developed
T1
creative
believe

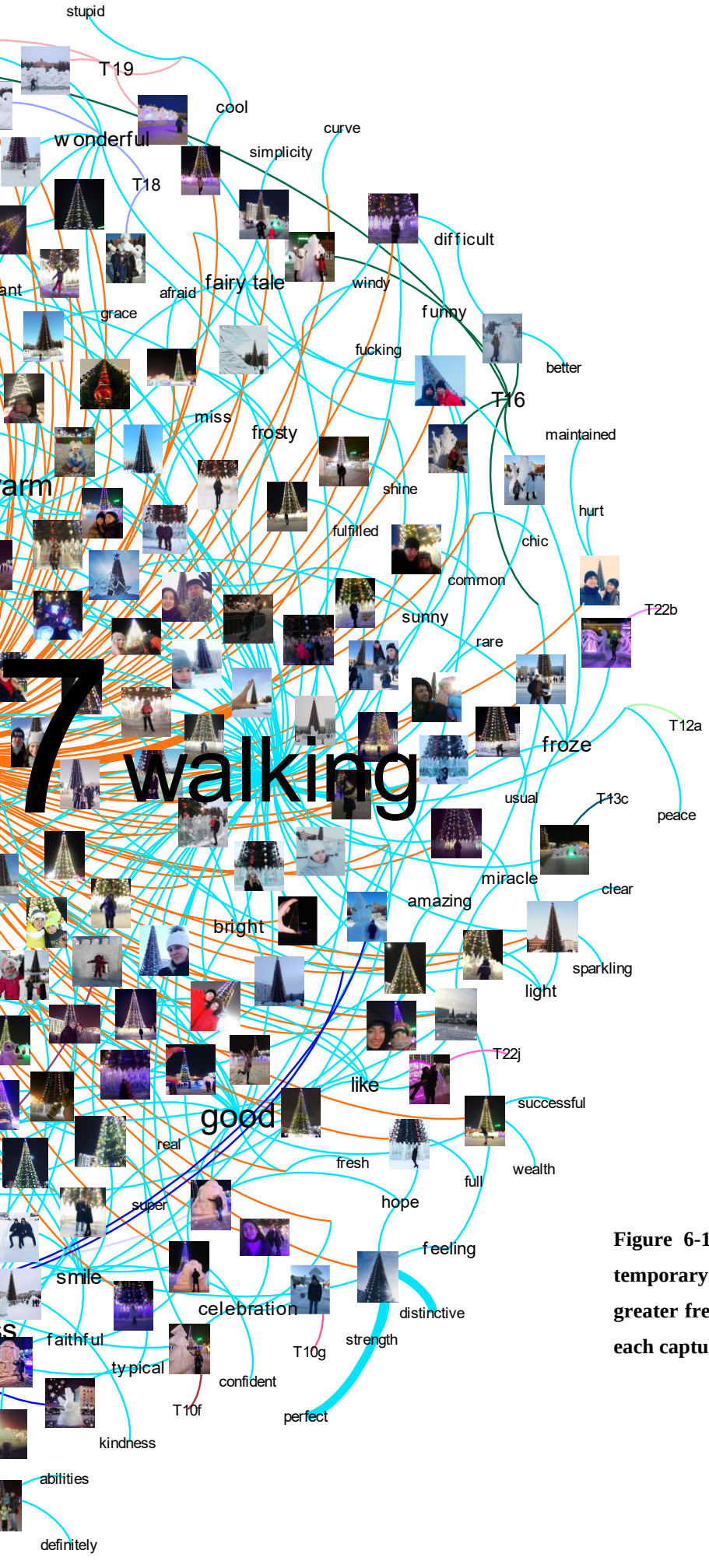


Figure 6-13 Network of the keywords, photo and related temporary urban element. The larger font size of the letter the greater frequincy of the keyword and greater number of the each captured urban element on the photo.

6.3 'Illumination Festival', Sapporo Station South Square

6.3.1 'Weather parameters and 'urban' images

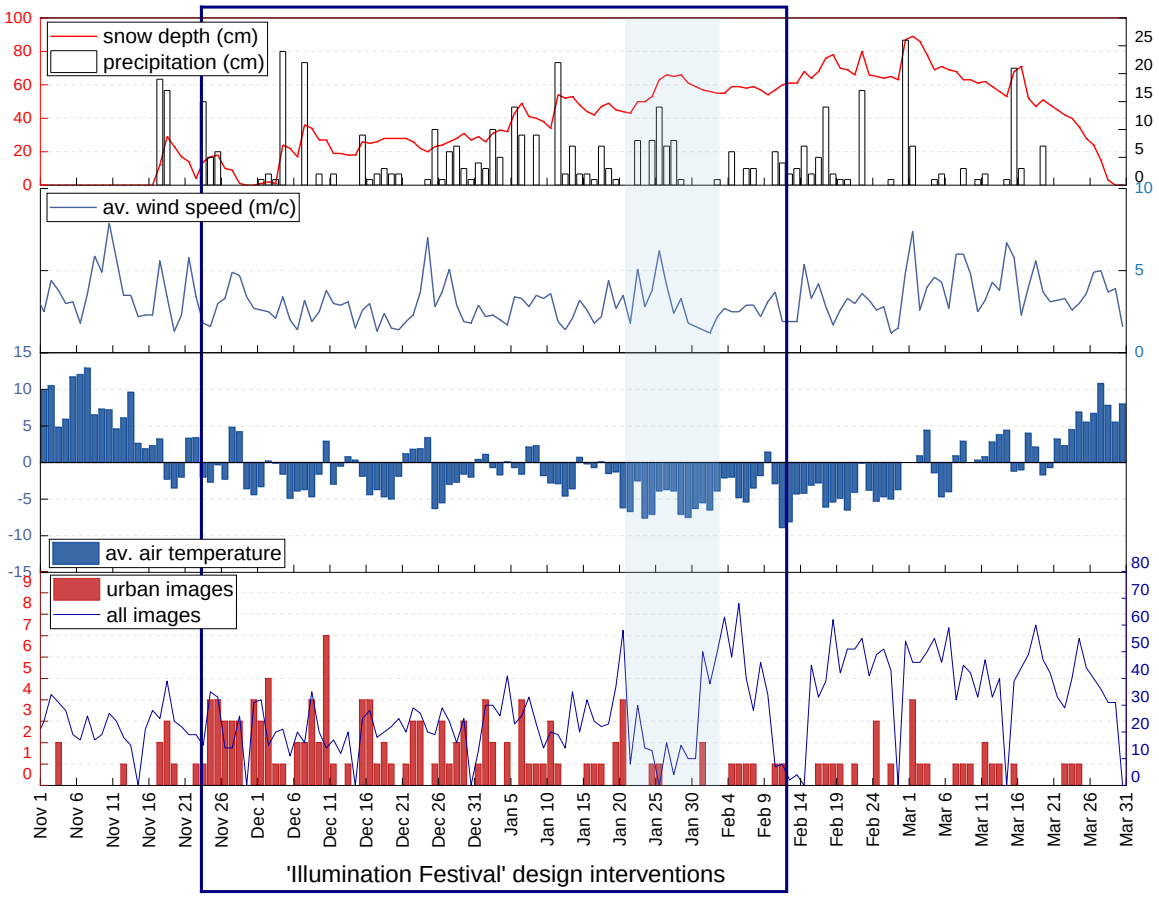


Figure 6-14 Comparison of the 'no event' period and 'event' period of the climatic data and number of urban images and total posted images.

We collected over 4200 datasets of Instagram posts generated and shared during winter season on Sapporo Station South Square from 1st November 2017 till 31st March 2018. A comparison of the patterns of the weather and number of images per day highlights the demand of the public open space even when the air temperature is below freezing. Although during the temporary design interventions it shows slightly change in the number of the urban images per day, the number of total urban images critically increased by three times, from 2% to 6% of all collected data (Table 6-3). During 'no event' the number of urban images relatively low.

We compared the patterns of urban images frequency per day and frequency of overall posted images on Sapporo Station to define whether the number of urban images correlates to temporary design interventions or to the increase of the number of visitors as a tourist. The results revealed that the patterns of the urban images related more to the impact of the temporary design rather than the number of visitors per day. Since the patterns of the number of overall images and urban images are dramatically different during 'event' and 'no event'.

It should be noted that during period from 25th of January to 11th of February is relatively few urban images during temporary design interventions, that can correlate to the decrease of the air temperature and increase of the wind speed with high accumulation of precipitation on the streets. However, if we compare the total number of images and urban images during this period it shows decrease in overall use of public open space. Thus, we tend to think that the reason of a few urban images is the decrease of overall use of Sapporo Station, rather than cold weather. Moreover, if we consider the warming period during end of the March it shows fewer urban images than during the cold period. This also implies that the number of urban images related less to weather conditions than to temporary design (Fig. 6-14).

6.3.2 ‘Urban elements’ images

Table 6-3 Collected Instagram data and processed images on the Sapporo Station South Square.

Situation	**‘No event’**		**‘Event’**	
Date	1.11.2017 – 22.11.2017 11.02.2018 – 31.03.2018		22.11.2017 – 11.02.2018	
total posts	2300		1961	
‘urban’ images	**37 (2%)**		**119 (6%)**	
	Day	Night	Day	Night
‘urban element’ images	**19**	**18**	**6**	**113**

Out of 4261 collected images on Sapporo Station South Square about 150 were ‘urban’ images, representing 8% of all data. We divided the data into two situations: the ‘no event’ period, for images posted before (1.11.2017 – 22.11.2017) and after the event (11.02.2018 – 31.03.2018); and the ‘event’ period, for images posted from 22.11.2017 to 11.02.2018. From the 2300 images, 37 were urban images, representing only 2% during ‘no event’. In case of the ‘event’ period, an 1961-point dataset was collected, with 119 ‘urban’ images representing 6% of the total. The images taken indoor which contained public open space images from bird’s eye view were not considered as ‘urban’ images. During ‘no event’ were classified 19 ‘urban’ images at day and 18 ‘urban’ images at night. Only 6 ‘urban’ images were posted and generated during the ‘event’ during the day. While at night the number increased to 113 images (Table 6-3).

We indicated on the map the number of the urban elements images that were defined as a target objects of the photos. The 11 urban elements appeared on the collected images on the Sapporo Station South Square. Those are permanent urban elements such as P1, P2, P3, P4, P6, P7, P8, P9 and temporary urban elements such as T1, T2, T3. Nevertheless, 12 groups of similar images were classified. Twelfth cluster of images contained two target objects as Main Sapporo Station bld. and central glass tower that was labeled as P5 on the map

(fig. 6-15). Temporary urban elements were classified into three similar patterns of urban images or cluster of urban images which are: T1('Illumination screen'), T2 ('Illuminated trees' and 'Main Tree') and T3 (only 'Main Tree' as a target) (fig. 6-15).

Although there were very few images of the urban elements during the 'no event' at day and night and during 'event' at day period, some elements were more popular than others and some were given no attention at all (Table.6-4).

Among images for 'no event', the element which appeared most frequently in the photographs were the Sapporo Station bld. (P1), followed by the central glass tower (P4), then JR Tower (P9), Dimaru bld. (P5). For 'event', the main elements were 'Illumination Festival' design interventions such as main tree (T3), illuminated natural trees (T2) and screens (T1) (fig. 6-16, 6-17,6-18).

Table 6-4 Defined clusters of the urban element images on the Sapporo Station South Square.

Label	Category	'No event'	'Event'
P1	permanent	6	12
P2	permanent	1	4
P3	permanent	1	0
P4	permanent	4	2
P5	permanent	2	2
P6	permanent	1	8
P7	permanent	1	0
P8	permanent	1	0
P9	permanent	2	0
T1	temporary	0	7
T2	temporary	0	53
T3	temporary	0	30

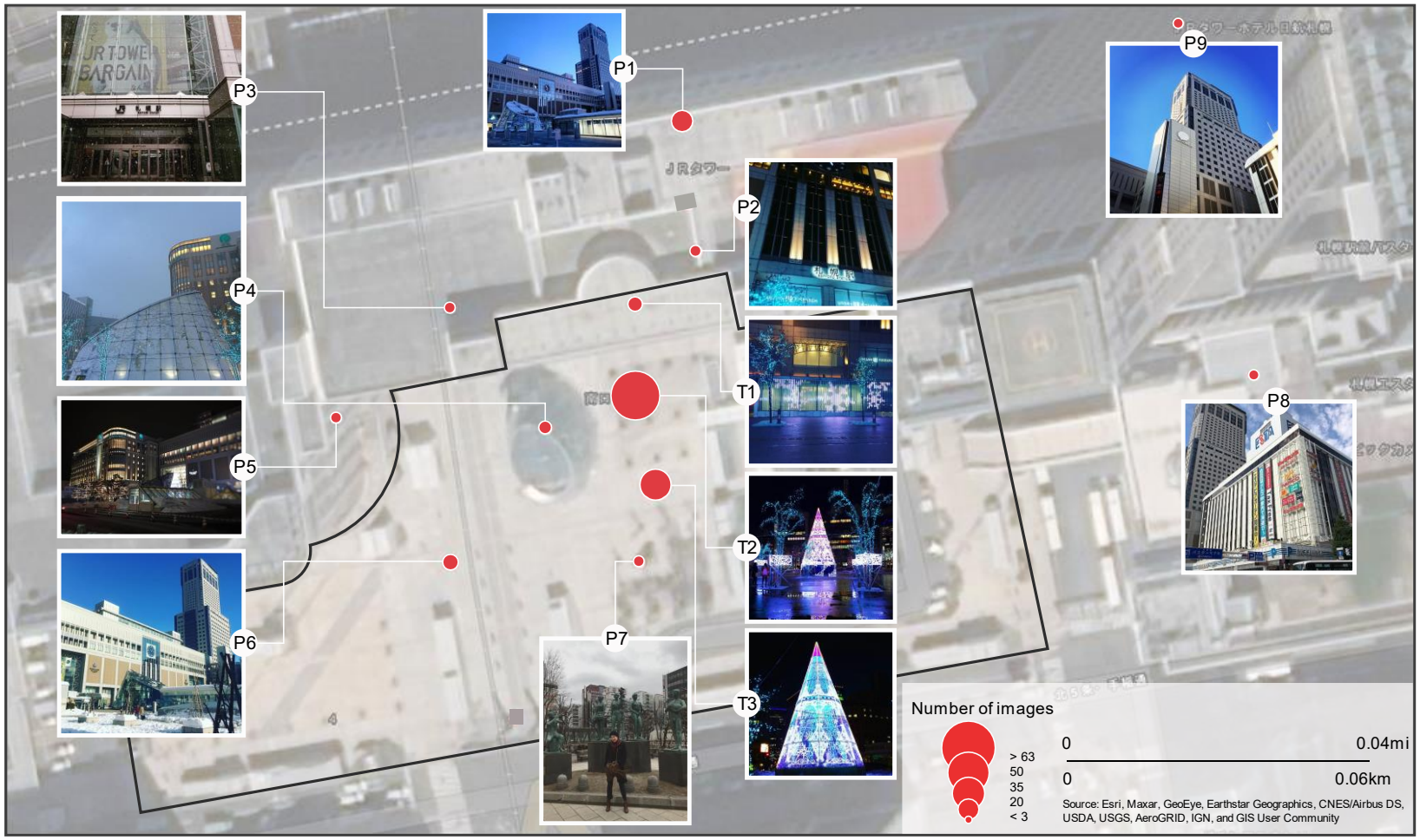


Figure 6-15 Location of the urban elements and their impact on the people's impression for the winter period on Sapporo Station South Square.

Figure 6-16 Proportional representation of the numbers of 'urban element' images for 'no event'

Figure 6-17 Proportional representation of the numbers of 'urban element' images for 'event'.

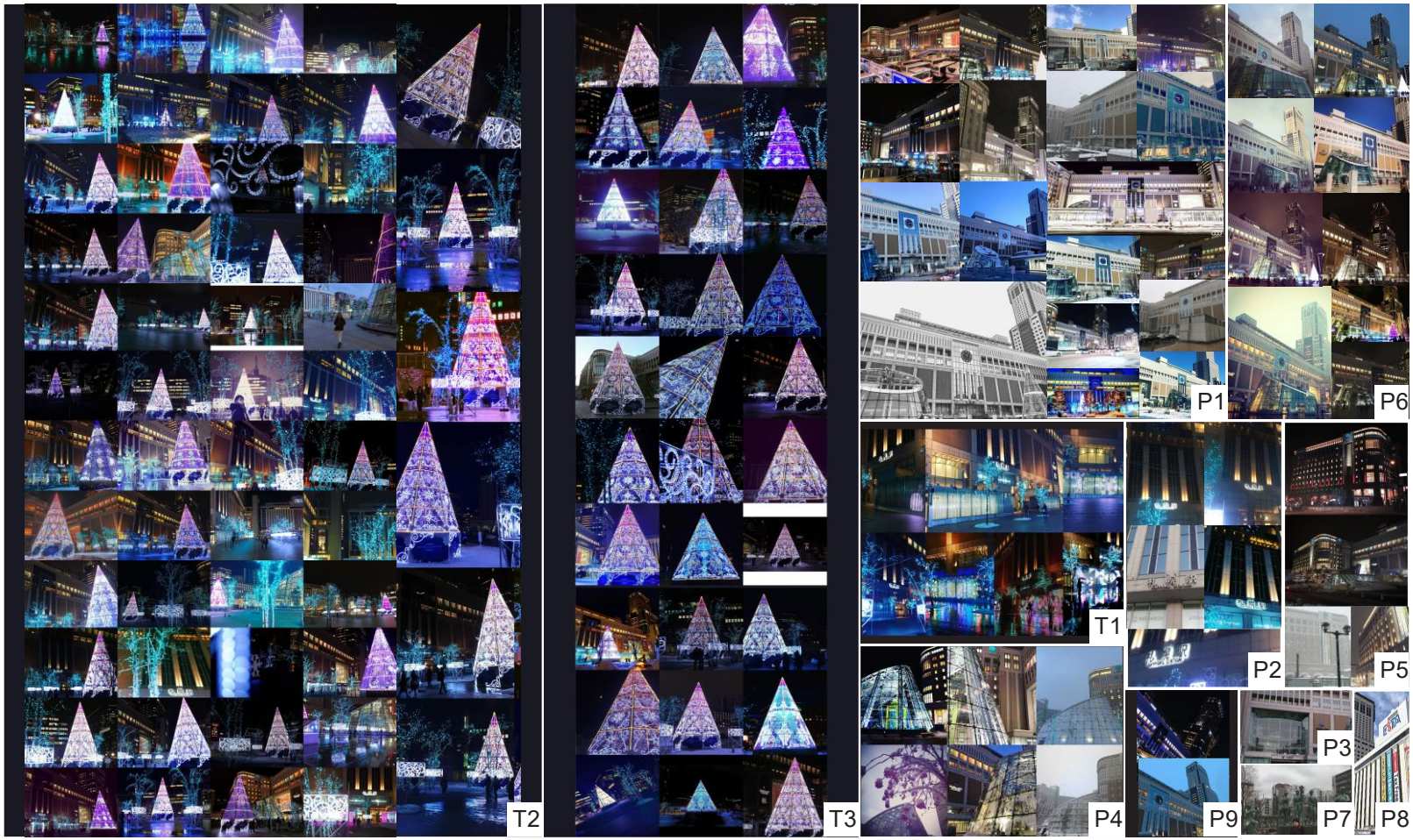


Figure 6-18 Proportional representation of the total number of all 'urban element' images during winter period.

6.3.3 Sentiment analysis of the captions

During 'no event' were collected 37 posts with urban images, the 33 out of them include captions. While, during 'event' from 119 urban image posts were collected 105 with the captions (Table 6-5). The sentiment analysis showed that during 'no event' most of the captions identified as a neutral with number of 20 (57%), rest of the captions were positive with 11 (33%). More positive captions were posted during 'event' with 60 (57%) by approximately 20% than during the 'no event'. While the captions contained neutral sentiments accounted for 41(39%) (fig. 6-19). Considering negative captions, during the 'event' the percentage of the negative captions decreased, however, that presents only 2-4 captions, thus, should not be taken into account. The content of the negative captions related to the negative impact of the weather condition. Overall, we can conclude that the 'Illumination Festival' provided a more positive experience than negative or neutral compared to the 'no event' period.

Table 6-5 Sentiment analysis of the captions attached to photos during 'event' and 'no event'.

Situation	**'No event'** 1.11.2017 – 24.11.2017 20.02.2018 – 15.03.2018	**'Event'** 22.11.2017 – 11.02.2018
'urban' images	37	119
captions	33	105
positive	11	60
neutral	20	41
negative	2	4

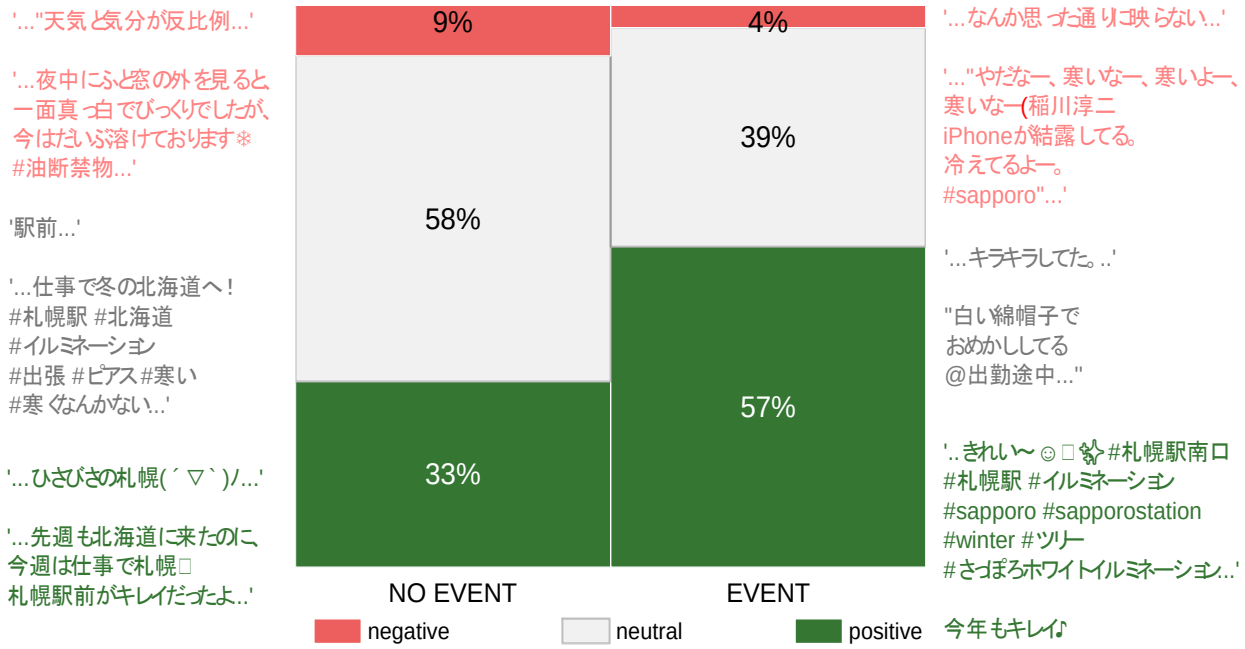


Figure 6-19 Sentiments of the captions during 'no event' and 'event' collected on the Sapporo Station South Square.

6.4 Discussion

6.4.1 Different and Common attributes of the pedestrians' perception between the 'no event' and 'event'

Pedestrians rarely take pictures of Lenin Square and urban elements in winter. Only 6% of urban design related images in Instagram were posted during winter in the absence of an event. However, during the winter event, this increased to 20%. Such temporary elements as an ice and snow sculptures, a Christmas Tree and ice slides, had an increased impact on pedestrians' impression of the urban environment, even when the temperature was ranging between 7 °C and –28 °C. Such elements as the Christmas Tree, ice sculpture '2018', 'Bear' 'Snowman', 'Ded Moroz' (Santa Clause), 'Snegurochka' and the 'Dog' were photographed most often. These elements have symbolic meaning of the winter and attracted most of the attention. During the 'no event' period, people preferred to photograph historical buildings, including the Government building, Pushkin St. building, the Medical University building. Natural elements like the alley of trees had considerable impact on the pedestrians' perceptions as well. This is consistent with the assumption that, in the case of the Permanent design, the most important elements in the pedestrians' impression were the largescale historical buildings and natural component of the environment alley of the trees. During the periods of Temporary design, the great scale symbolic landmarks like the Christmas Tree had a considerable impact on pedestrians. Small-scale urban elements made from ice and snow were also shown to effectively improve the impressions of the pedestrians.

The perception of the permanent elements has similar pattern during the event. It was shown that pedestrians tended to disregard such small-scale permanent elements as the memorials, the statue, and the street furniture during the event. Historical buildings and the natural component – the alley of trees – had a strong impact on pedestrians not only during the 'no event' period, but also during the 'event', despite the many temporary elements designed to attract the attention of people.

6.4.2 The common and different attributes between day and night

There was a 17% increase in the number of the photos taken at night, with 150 images in total. This increase was due to the growth number of the photos of Christmas Tree. Besides, well-lit permanent elements were shown to critically enhance the impression of the pedestrians. While no photographs were taken of the permanent element 'Central Fountain' during the 'no event' period at night, and only two photographs were taken during the day, during the 'event' period, when the element was highlighted by 'New Year' illumination, 69 more images were taken. This emphasizes the significance of well-lit urban elements in winter cities. It can be concluded that lighting should be prioritize in the design of winter cities, since it improves pedestrian's perceptions of the urban environment. Also, it is clear by the large number of photographs taken that pedestrians were impressed by well-lit temporary elements, with the ice sculpture '2018', with 17 more images at night. However, some urban elements received less attention at night: the snow sculptures, the 'dog', 'bear' and 'snowman' were photographed less at night. It is assumed that this difference between ice and snow sculptures is due to the reflection of light by ice, making the ice sculpture more attractive at night than the snow sculptures.

6.5 Conclusion

In this study, the people's impression of the Lenin Square in Khabarovsk during the events 'Ice Town' and Sapporo Station South Square during the 'Illumination Festival' was investigated by analysing the content of the images and caption analysis posted within the squares to determine to what extend the temporary design affects people's perception of the public open spaces in winter. An understanding the pedestrians' perception of temporary design is expected to define its role for public open space design in winter cities and assist in developing temporary design guidelines. The main findings of this investigation can be summarized as follows.

6.5.1 Pedestrians less perceive public open space in winter

Pedestrians had a little impression of the public open space in winter. Their attention draws to few urban elements as a historical buildings and natural environment that surrounds the public open space. Moreover, pedestrians disregarded the small-scale elements as fountains, statues or flowerbeds, street furniture.

6.5.2 The urban design elements improving people's perception of public open spaces in winter

However, the people's impression of public open spaces was enhanced to three times with the temporary elements, even when the temperature is below freezing. An element, that enhanced impression the most, had a symbolic meaning of the winter celebration Christmas Tree/Main Tree of the two case studies. Moreover, ice and snow sculptures had a great impact on the people's perception of the Lenin Square. It is revealed that combination of the ice and light enhanced impression at night, while snow sculptures had significant impact during the day. Also, an effect of the event on the people's perception of public open space depended on the combination of the temporary and permanent elements. For example, well-lit fountain by New Year Illumination created greater impression of the place. The lighting played an important role in

creating greater impact, since temporary and permanent elements drawn more attention at night than it at day. Considering the 'Illumination Festival' the light had critical impact on the people's impression and created more positive perception of the public open space. Overall, despite the extreme low outdoor temperature during the 'Ice Town' and relatively cold during 'Illumination Festival' on Sapporo Station Square people still willing to enjoy the visual aspect of the public open spaces in winter that, as a result, enhance the outdoor activity in winter cities. Therefore, it is critical to include the temporary design as a second stage in the design process of the public open spaces in winter cities.

6.5.3 Analysing the Instagram images on the content of the urban elements

Photo-sharing platform as Instagram provide a suitable basis to understand the pedestrians' perception of urban and natural environment and define the places that draw people's attention. Indeed, we cannot fully understand Instagram author's actual experience of urban environment and intention of posting photo. However, the understanding of what urban elements are captured on the photo and what is the target object, is significant point in enabling researchers of urban environments, urban designers and architects to define the distinctive or attractive urban elements. As a tool for analysing these photos, the image classification using transfer learning with pretrained CNN has a great potential. This can simplify the processing of the classification of the data and is a faster overall process capable of scaling to the global scope of data. Moreover, the trained model based on the Instagram images posted on the Lenin Square can be applied to the temporary design-related studies of the squares in winter cities. This approach based on analyzing Instagram images on the content of the urban elements not only assist in decision-making process but also involve pedestrians to take part in building urban environment that better response resident's needs and, consequently, facilitate in the building sense of place.

6.5.4 Temporary design elements based on permanent design in severe climate cities

In addition, not only are the pedestrians impressed by the variety of temporary elements, but their attention is also drawn to permanent elements during two case studies. However, to enhance the people's impression of public open spaces temporary design is required in winter cities. Temporary design is trigger that initiate interaction with the physical environment and improves the positive impression of the public open spaces, while the permanent design provides the 'stage' for it. The features of permanent design must be considered when planning the temporary design. Therefore, combination of temporary design and permanent design is considered as an approach for public open spaces to enhance the people's perception in winter cities, especially in severe climate.

Chapter 7: Conclusion

This study considers three main issues. The first one and the main is the matter of a few number of outdoor activities on public open spaces in winter in winter cities and a lack of the academic studies related to it. Second one is the matter of unused public open spaces inherited from Soviet-era in Russia that are in the process of transformation for developing. Final third matter relates to a lack of the studies of developing design approach based on the people's perception of urban environment using content of the photos shared online. Additionally, a few studies were conducted on public open spaces in extreme cold climate when the temperature drops below -10 °C.

In order to enhance the outdoor activity on public open spaces in winter, the temporary design was suggested as an effective tool to improve people's perception of winter and winter cities. This study is the first attempt to implement temporary design in urban design process of winter cities and suggests temporary design as a unified solution for developing Soviet-era public open spaces. The developed design approach for analysing people's perception was provided. Such design approach useful not only for developing public open space design in hot and humid climate cities but for developing the temporary design guidelines for winter cities.

Main outcomes presented in the 4th, 5th and 6th chapters revealed:

Fourth chapter clarified that the environmental conditions have a considerable impact on the people's behavior during cooling period. As temperature drops the people's activity decrease and below 5 °C a few sitting behaviors are found on public open spaces. However, during cooling period from 20 °C to 5 °C people stay longer if the wind speed is low and sitting behaviors increased in number if public open space provides sunny areas.

Fifth chapter revealed that the temporary design on public open space enhanced people's behavior by several times in winter even at extreme temperature at night, when the situation is considered as a most unsatisfied for outdoor activities. Also, study clearly illustrated that Soviet era open public space is well-suited for implementation and developing of temporary design and benefits from it.

Sixth chapter revealed that the temporary design enhanced by several times the people's impression and improved people's perception of public open space in winter. The urban design approach based on the people's perception using social media for developing public open spaces was defined.

The new design approach of public open space in winter cities are suggested. The subchapters present the steps of design process toward public open spaces, that enhance outdoor activity even in extreme cold climate.

7.1 Preventing uncomfortable staying on public open spaces

To enhance outdoor activity on public open spaces in winter cities, the first and essential step is to prevent uncomfortable staying by controlling the microclimate of the public open space through design interventions. Providing plenty of sunny area and optimizing wind speed are the main aspects of design process. This will enhance outdoor activity during cooling period that ranges between 20 °C to 5 °C and assisting in more comfortable staying during minus temperatures with implementation of temporary design. Below the 5 °C, when a few people's behaviors are found it is necessary to implement temporary design as a trigger for outdoor activity.

7.2 Considering permanent design features for temporary design

In winter cities during cold periods outdoor activity on public open spaces are rarely found. It is imperative to consider unique design approach of public open spaces in winter cities to enhance necessary outdoor activity in winter. Developing public open space design focused on temporary design is considered as an alternative design approach of public open space in winter cities to traditional one, that mostly oriented on hot and temperate climate cities.

The design approach focusing on temporary design implies that the ultimate aim of public open space in winter city is to create value for successful temporary design. Therefore, it is important to consider permanent design features for temporary design implementations, where is the permanent design implies long-term design as a streetlight, street furniture, buildings, pavement, trees etc.

In winter cities permanent design must present a basic design that simplified, accessible, clearly structured to maintain shortcuts, convenient routes and basic activities as standing, talking, sitting.

As an example of such permanent design Soviet-era design public open space as a ‘Lenin Square’ in Khabarovsk, in its present, most simplified design, has sufficient inbuilt flexibility to allow temporary design development to occur. Squares that occurred to be the main public open space for the people's activities in Soviet-era served the stage for the important city events. Such design of the squares can be characterized as wide-open great scale area located in the center of the city, and that are not enclosed by the surrounded buildings but adjoined to the wide avenue. Squares were equipped with the minimal number of street furniture and memorials that were emphasized on the flat concrete area. Such features present well-suited example of the permanent design for successful temporary design.

Overall, such features of permanent design should be considered when planning temporary design:

- Location
- Scale
- Pedestrians accessibility
- Transportation accessibility as adjoined avenues
- Street furniture and other urban elements
- Size of the vacant area

7.3 Temporary design on public open space enhances pedestrian's activity

While permanent design serves the 'stage' for temporary design, temporary design provides 'flexible' design that maintain variables 'scenarios' of public open space for enhancing the number of activities and supplementary use. Temporary design defined as a short-term design intervention as ice and snow sculptures, festivals decorations and light can significantly enhance outdoor activity in winter. Indeed, temporary design as an event always enhances activities on public open spaces in some degree. Nevertheless, the striking change that temporary design can enhance people's activity for seven times even in severe cold climate, when the temperature is below –10℃. Particularly, temporary design enhances activity at night when the light illuminates the public open space. Furthermore, temporary design can enhance not only passive activity by maintaining people walk around the various temporary elements as ice figures but also the vigorous activity by ice and snow slides. Temporary design enhances supplementary activities as a walking around, playing with snow and ice, take the pictures, sliding by creating pleasure environment for such activities.

7.4 Temporary design on public open space improves pedestrian's perception

Temporary design is trigger that initiate interaction with the urban environment and improves the people's perception of the public open space. The aesthetic of the urban elements in winter play critical role in improving pedestrian's perception of the public open space creating appealing public open spaces.

People's attention draws to few urban elements as a historical buildings and natural environment that surrounds the public open space in winter. However, with temporary design intervention on public open space people's impression of public open space was enhanced by three times. Particularly, Illumination plays an integral part of the appealing urban environment in winter cities that had a major impact on the pedestrian's positive impression. Symbolic as a Main Tree, '2018', Snowman, Santa Claus elements are popular at day and night. In addition, not only are the pedestrians impressed by the variety of temporary elements, but their attention is also drawn to well-lit permanent elements. Therefore, the analysis of the urban elements that has a major impact on the people's perception can be divided into three groups: day and night; only at day, only at night. The elements that have major impact on the pedestrians' perception of the temporary and permanent elements can be summarized as follows:

- Day and night: Symbolic elements that define particular time, place or event (Main Tree, Snowman, Santa Claus, '2018')
- Day: snow sculpture, ice slides, natural elements (tress)
- Night: the combination of light and ice, permanent elements (fountain), natural elements (trees).

Remarkably, the results of study of the people's perception in Sapporo and Khabarovsk did not show that position or scale had much impact on the pedestrians' impression. Pedestrians drew attention to a small-scale urban

element if they find it aesthetically appealing. However, further studies are required to develop temporary design guidelines.

7.5 Developing temporary design using social media

Next step in enhancing the people's perception of public open space in winter cities is developing temporary design guidelines based on the people's perception using social media. Provided approach of analysing people's perception can assist in defining urban elements that improve or enhance positive perception of the public open space.

Photo-sharing platform as Instagram provide a suitable basis to understand the pedestrians' perception of urban and natural environment and define the places that draw people's attention the most. Indeed, we cannot fully understand Instagram author's actual experience of urban environment and intention of posting photo. However, the understanding of what urban elements are captured on the photo and what is the target object, is significant point in enabling researchers of urban environments, urban designers and architects to define the distinctive or attractive urban elements.

Analysing keywords gives a great opportunity to learn the author's site-specific emotion of the place. In contract to studies using online questioner with given keywords the analysis of the social media provides present the understanding of the people's perception of place based on their own experience rather than evaluation of the images online. It can define the spectrum of people's emotions related to public open space whether the place 'dark' or 'bright', 'pleasing' or 'upsetting'. Indeed, the description may not relate to particular element but gives an overall perception of the place.

As a tool for analyzing the photos, the image classification using transfer learning with pretrained CNN has a great potential. This can simplify the processing of the classification of the data and is a faster overall process capable of scaling to the global scope of data. Moreover, the trained model based on the Instagram images posted on the Lenin Square can be applied to the temporary design-related studies of the squares in winter cities. This approach based on analyzing Instagram images on the content of the urban elements not only assist

in decision-making process but also involve pedestrians to take part in building urban environment that better response resident’s needs and, consequently, facilitate in the building sense of place.

Publications associated with this research

1. **Paukaeva A**., Setoguchi T., Watanabe N., Luchkova V. Temporary design on Public Open Space for Improving the Pedestrian's Perception using Social Media Images in Winter Cities, Sustainability 2020, 12(15), 6062; https://doi.org/10.3390/su12156062
2. **Paukaeva A.**, Setoguchi T., Luchkova V., Watanabe N., Hayato S. Impacts of the Temporary Urban Design on the Pedestrian's Activity - The case study on the "Winter City", Khabarovsk, Russia, Cities 2019 (under 3rd round review) submitted on 27 of April 2019.
3. Minori Kusaka, Tsuyoshi Setoguchi, Norihiro Watanabe, Zhiming Guo, **Anastasiia Paukaeva** (2018) Human Behavior in Downtown Public Spaces during Cooling Periods in Winter Cities, Journal of Civil Engineering and Architecture, Vol. 12, pp 1-10, 2018, DOI: 10.17265/1934-7359/2018.01.001, 査読有
4. **Paukaeva A.**, Setoguchi T., Luchkova V. (2019). Impact of the Temporary Urban Design on the Pedestrian's Activity. - The case study on the "Winter" City, Khabarovsk, Russia The New Ideas of New Century – 2019: The Nineteenth International Scientific Conference Proceedings. Vol. 1. – 438 p. ISBN 978-5-7389-2799-7

Acknowledgements

I would like to acknowledge the people who help me to finish this thesis and the people who give suggestions, opinions and concerns when I encounter difficulties on writing this thesis.

Firstly, I would like to express my thanks to my patient and supportive supervisor, Prof. Setoguchi. Without his patience, enthusiastic guidance, this thesis cannot accomplish successfully. I am very grateful to Prof. Setoguchi for accepting me three years ago, letting me choose my own research direction, and supporting me, encouraging me to complete this thesis. He has shown me, by his example, what a good scientist (and person) should be.

Secondly, thanks also to Dr. Watanabe. He continuously provided encouragement and was always willing and enthusiastic to assist in any way he could throughout the research project. From the bottom of my heart I would like to say big thank you to all members of our laboratory Urban and Regional Design, who were very supportive during my study.

Fourthly, I would like to express my appreciation to Prof. V. I. Luchkova and the students from Pacific National University in Russia who helped me to conduct the survey on Lenin Square in Khabarovsk.

Finally, I would like to express my sincere appreciation to my mom and my brother. Without their love, support and encouragement, I would not have been able to through the hard time and finish the doctoral course.

I would like to show my gratitude to E3 (English Engineering Education program) program who supported my study at Hokkaido University. This work would not have been possible without the financial support of JREX fellowship program (Japan Russia Youth Exchange Center), particularly to OKUBO Kana, who support me during my first year of study in this program.

References

1. Pressman, N. *Northern cityscape*. (Winter Cities Association, Canada, 1995).

2. Wagner, A. L., Keusch, F., Yan, T. & Clarke, P. J. The impact of weather on summer and winter exercise behaviors. *J. Sport Heal. Sci.* **8**, 39–45 (2019).

3. Hatakeyama, Y., Oku, T. & Mori, S. The Changing Appearance of Color of Architecture in Northern City A Comparison Study of Architecture's Appearance in Summer and in Winter, in Sapporo City-. *J. Asian Archit. Build. Eng.* **4**, 161–167 (2005).

4. Stout, M. *et al.* "Celebrated, not just endured:" Rethinking Winter Cities. *Geogr. Compass* **12**, e12379 (2018).

5. The World Winter Cities Association for Mayors (WWCAM). https://wwcam.org/en.

6. Pressman, N. & Zepic, X. *Planning in Cold Climates : A Critical Overview of Canadian Settlement Patterns and Policies*. (Institute of Urban Studies, University of Winnipeg, 1986).

7. Togo, F., Watanabe, E., Park, H., Shephard, R. J. & Aoyagi, Y. Meteorology and the physical activity of the elderly: the Nakanojo Study. *Int. J. Biometeorol.* **50**, 83–89 (2005).

8. Tucker, P. & Gilliland, J. The effect of season and weather on physical activity: A systematic review. *Public Health* **121**, 909–922 (2007).

9. Kimura, T., Kobayashi, H., Nakayama, E. & Kakihana, W. Seasonality in physical activity and walking of healthy older adults. *J. Physiol. Anthropol.* **34**, 33 (2015).

10. Schepps, M. A., Shiroma, E. J., Kamada, M., Harris, T. B. & Lee, I.-M.

Day length is associated with physical activity and sedentary behavior among older women. *Sci. Rep.* **8**, 6602 (2018).

11. Goličnik, B. & Ward Thompson, C. Emerging relationships between design and use of urban park spaces. *Landsc. Urban Plan.* **94**, 38–53 (2010).

12. Bosselmann, P., Arens, E., Dunker, K. & Wright, R. *Sun, wind, and pedestrian comfort: a study of Toronto's Central Area*. (Toronto: City of Toronto, Planning & Development Dept., 1991).

13. Zacharias, J., Stathopoulos, T. & Wu, H. Microclimate and Downtown Open Space Activity. *Environ. Behav.* **33**, 296–315 (2001).

14. Eliasson, I., Knez, I., Westerberg, U., Thorsson, S. & Lindberg, F. Climate and behaviour in a Nordic city. *Landsc. Urban Plan.* **82**, 72–84 (2007).

15. Ali-Toudert, F. & Mayer, H. Numerical study on the effects of aspect ratio and orientation of an urban street canyon on outdoor thermal comfort in hot and dry climate. *Build. Environ.* **41**, 94–108 (2006).

16. Bourbia, F. & Boucheriba, F. Impact of street design on urban microclimate for semi arid climate (Constantine). *Renew. Energy* **35**, 343–347 (2010).

17. Andreou, E. Thermal comfort in outdoor spaces and urban canyon microclimate. *Renew. Energy* **55**, 182–188 (2013).

18. Andreou, E. & Axarli, K. Investigation of urban canyon microclimate in traditional and contemporary environment. Experimental investigation and parametric analysis. *Renew. Energy* **43**, 354–363 (2012).

19. Andreou, E. The effect of urban layout, street geometry and orientation on shading conditions in urban canyons in the Mediterranean. *Renew.*

Energy **63**, 587–596 (2014).

20. Shahrestani, M., Yao, R., Luo, Z., Turkbeyler, E. & Davies, H. A field study of urban microclimates in London. *Renew. Energy* **73**, 3–9 (2015).

21. Bosselmann, P., Flores, J. & Gray, W. *Sun, Wind, and Comfort A Study of Open Spaces and Sidewalks in Four Downtown Areas*. *UC Berkeley IURD Monograph Series Title* (1993) doi:10.11436/mssj.15.250.

22. Givoni, B. *Climate considerations in building and urban design*. (New York : Van Nostrand Reinhold, 1998).

23. Setoguchi, T. Public Square Design with Snow and Wind Simulations Using Wind Tunnel. (2003).

24. Setoguchi, T. & Tsutsumi, T. Snow and Wind Environmental Assessment on the Public Space Comparing High-Rise and Medium-Rise Building Blocks Using the Wind Tunnel Simulation. *J. Archit. Plan. (Transactions AIJ)* **72**, 167–174 (2007).

25. Setoguchi, T. the Development of Urban Design Planning Process Linking With Snow and Wind Environmental Assessments on the Urban Complex Redevelopment Project in Snowy and Cold Cities. *J. Archit. Plan. (Transactions AIJ)* **74**, 1777–1786 (2009).

26. Watanabe, N., Setoguchi, T., Sato, K. & Tsutsumi, T. New City Block Design Approaches Incorporating Environmental Assessment for Downtown Districts in Cities with Severe Winter Climates. *J. Asian Archit. Build. Eng.* **15**, 455–462 (2016).

27. Watanabe, N. *et al.* Sustainable Block Design Process for High-Rise and High-Density Districts with Snow and Wind Simulations for Winter Cities. *Sustainability* **9**, 2132 (2017).

28. Meng, X. W. & Setoguchi, T. Development of Urban Design Guidelines

with Wind Tunnel Simulations for Downtown Districts in Winter Cities - New Urban Design Approaches for Cold Region Cities-. *J. Asian Archit. Build. Eng.* **9**, 355–362 (2010).

29. Erell, E. *Urban Microclimate*. *Urban Microclimate* (2012). doi:10.4324/9781849775397.

30. Hatakeyama, Y., Oku, T. & Mori, S. Peculiarity of Winter Townscape in Snowing-Cold Region by the Changing Appearance of Color. *J. Archit. Plan. (Transactions AIJ)* **73**, 1915–1922 (2008).

31. Ittelson, W. H., Rivlin, L. G. & Prohansky, H. M. . *The use of behavioural maps in environmental psychology. Environmental Psychology: Man and his Physical Setting, Holt*. (New York: Rinehart & Winston., 1970).

32. Bechtel, Robert; Marans, Robert, M. W. *Methods in environmental and behavioral research*. (Krieger Pub Co, 1990).

33. Golicnik, B. People in Place : A Configuration of Physical Form and the Dynamic Patterns of Spatial Occupancy in Urban Open Public Space. (University of Edinburgh, 2005).

34. Hall, E. T. *et al.* Proxemics1. (2011).

35. Newman, O. *Creating Defensible Space*. (U.S. Department of Housing and Urban Development Office of Policy Development and Research, 1996).

36. Lyman, S. M. & Scott, M. B. Territoriality: A Neglected Sociological Dimension. *Soc. Probl.* **15**, 236–249 (1967).

37. Pallasmaa, J. *The Eyes of the Skin: Architecture and the Senses. Chichester: John Wiley and Sons*. (Chichester: John Wiley and Sons., 1996).

38. Gehl, J. *City for People*. (Island Press, 2010).

39. Gehl, J. *Life between buildings: using public space*. (Washington, DC: Island Press., 1987).

40. Gehl, J. & Gemzøe, L. *Public spaces - public life*. (Arkitektens Forlag, 2004).

41. Carr, S., Francis, M., Rivlin, L. & Stone, A. *Public space*. (1992).

42. Maruani, T. & Amit-Cohen, I. Open space planning models: A review of approaches and methods. *Landsc. Urban Plan.* **81**, 1–13 (2007).

43. Nikolopoulou, M. & Lykoudis, S. Use of outdoor spaces and microclimate in a Mediterranean urban area. **42**, 3691–3707 (2007).

44. Thorsson, S., Honjo, T., Lindberg, F., Eliasson, I. & Lim, E. M. Thermal comfort and outdoor activity in Japanese urban public places. *Environ. Behav.* **39**, 660–684 (2007).

45. Ahmed, K. S. Comfort in urban spaces: defining the boundaries of outdoor thermal comfort for the tropical urban environments. *Energy Build.* **35**, 103–110 (2003).

46. Cheng, V. & Ng, E. Thermal comfort in urban open spaces for Hong Kong. *Archit. Sci. Rev.* **49(3)**, 236–242 (2006).

47. Cheng, V., Ng, E., Chan, C. & Givoni, B. Outdoor thermal comfort study in a sub-tropical climate: a longitudinal study based in Hong Kong. *Int. J. Biometeorol.* **56**, 43–56 (2012).

48. Andrade, H., Alcoforado, M.-J. & Oliveira, S. Perception of temperature and wind by users of public outdoor spaces: relationships with weather parameters and personal characteristics. *Int. J. Biometeorol.* **55**, 665–680 (2011).

49. Lai, D., Guo, D., Hou, Y., Lin, C. & Chen, Q. Studies of outdoor thermal comfort in northern China. *Build. Environ.* **77**, 110–118 (2014).

50. Guo, Z., Setoguchi, T., Watanabe, N. & Huo, K. Optimization Design of Open Space Based on Microclimate and Behavior in China. *J. Civ. Eng. Archit.* **11**, 617–634 (2017).

51. Chapman, D. *Urban Design of Winter Cities; Winter Season Connectivity for Soft Mobility*. (Luleå University of Technology, Graphic Production 2018, 2018).

52. Chapman, D., Nilsson, K. L., Rizzo, A. & Larsson, A. Winter City Urbanism: Enabling All Year Connectivity for Soft Mobility. *Int. J. Environ. Res. Public Health* **16**, 1820 (2019).

53. Hou, T., Lu, M. & Fu, J. Microclimate perception features of commercial street in severe cold cities. *Energy Procedia* **134**, 528–535 (2017).

54. Lynch, K. *The Image of the City*. (Cambridge, MA, MIT Press, 1960).

55. Cullen, G. *The Concise Townscape*. (Architectural Press of Elsevier, Linacre House, Jordan Hill, oxford OX2 8DP, UK, 1961).

56. Bosselmann, P. *Representation of Places: Reality and Realism in City Design*. (Berkeley, Los Angeles, London: University of California Press, 1998).

57. Bosselmann, P. *Urban Transformation: Understanding City Form and Design*. (Washington: Island Press, 2008).

58. Craik, K. H. & Zube, E. H. *Perceiving Environmental Quality: Research and Applications*. (1976).

59. Tuan, Y.-F. *Space and Place: The Perspective of Experience*. (Minneapolis MN: University of Minnesota Press, 1977).

60. Stokols, D. *Perspectives on Environment and Behavior. Theory, Research, and Applications.* (New York, London: Springer US., 1977).

61. Altman, I., Rapoport, A. & Wohlwill, J. F. *Human behaviour and environment: advances in theory and research. vol. 4: Environment and culture.* (New York: Plenum Press, 1980).

62. Collier, J. & Collier, M. *VISUAL Photography as a Research Method*.

63. Hull, R. B. & Stewart, W. Validity of photo-based scenic beauty judgments. *J. Environ. Psychol.* **12**, 101–114 (1992).

64. Stewart, T. R., Middleton, P., Downton, M. & Ely, D. JUDGMENTS OF PHOTOGRAPHS vs . FIELD OBSERVATIONS IN STUDIES OF PERCEPTION AND JUDGMENT OF THE VISUAL ENVIRONMENT. (1984).

65. Kellomäki, S. & Savolainen, R. The scenic value of the forest landscape as assessed in the field and the laboratory. *Landsc. Plan.* **11**, 97–107 (1984).

66. Scott, M. J. & Canter, D. V. PICTURE OR PLACE? A MULTIPLE SORTING STUDY OF LANDSCAPE. *J. Environ. Psychol.* **17**, 263–281 (1997).

67. Dakin, S. There's more to landscape than meets the eye: towards inclusive landscape assessment in resource and environmental management. *Can. Geogr. G?ographe Can.* **47**, 185–200 (2003).

68. Clifton, K., Ewing, R., Knaap, G. J. & Song, Y. Quantitative analysis of urban form: A multidisciplinary review. *J. Urban.* **1**, 17–45 (2008).

69. Quercia, D., O'Hare, N. & Cramer, H. Aesthetic capital: What makes london look beautiful, quiet, and happy? *Proc. ACM Conf. Comput. Support. Coop. Work. CSCW* 945–955 (2014) doi:10.1145/2531602.2531613.

70. Naik, N., Philipoom, J., Raskar, R. & Hidalgo, C. Streetscore-predicting

the perceived safety of one million streetscapes. *IEEE Comput. Soc. Conf. Comput. Vis. Pattern Recognit. Work.* 793–799 (2014) doi:10.1109/CVPRW.2014.121.

71. Dubey, A., Naik, N., Parikh, D. & Raskar, R. arXiv : 1608 . 01769v2 [cs . CV] 12 Sep 2016 Deep Learning the City : Quantifying Urban Perception At A Global Scale. 1–23.

72. Krizhevsky, A. & Hinton, G. E. ImageNet Classification with Deep Convolutional Neural Networks. 1–9 (2017) doi:https://doi.org/10.1145/3065386.

73. Rossetti, T., Lobel, H., Rocco, V. & Hurtubia, R. Explaining subjective perceptions of public spaces as a function of the built environment: A massive data approach. *Landsc. Urban Plan.* **181**, 169–178 (2019).

74. Naik, N. & Philipoom, J. Streetscore -- Predicting the Perceived Safety of One Million Streetscapes Streetscore - Predicting the Perceived Safety of One Million Streetscapes. (2015) doi:10.1109/CVPRW.2014.121.

75. Barwell, A., Quercia, D. & Crowcroft, J. UrbanGems: Crowdsourcing Quiet, Beauty and Happiness. http://urbangems.org/.

76. Dunkel, A. Visualizing the perceived environment using crowdsourced photo geodata. *Landsc. Urban Plan.* **142**, 173–186 (2015).

77. Liu, L., Zhou, B., Zhao, J. & Ryan, B. D. C-IMAGE: city cognitive mapping through geo-tagged photos. *GeoJournal* **81**, 817–861 (2016).

78. Martí, P., Serrano-Estrada, L. & Nolasco-Cirugeda, A. Using locative social media and urban cartographies to identify and locate successful urban plazas. *Cities* **64**, 66–78 (2017).

79. Qian, X. & Heath, T. Examining three roles of urban “portals” in their relationship with “places” using social media photographs. *Cities* **90**,

207–215 (2019).

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

81. Pressman, N. Images of the North : Cultural Interpretations of Winter. *Winter Communities* 28 (1987).

82. Setoguchi, T. New Urban Design Approaches with Snow Simulations for Cold and Snowy Cities. *J. Asian Archit. Build. Eng.* **7**, 93–99 (2008).

83. Davies, W. K. D. *Theme Cities: Solutions for Urban Problems*. vol. 112 (Springer Netherlands, 2015).

84. Hundt, B. Minneapolis' love/hate relationship with the skyway, and how to make it suck a lot less. http://www.citypages.com/news/minneapolis-lovehate-relationship-with-the-skyway-and-how-to-make-it-suck-a-lot-less/414065113 (2017).

85. Rink, D. & Haase, A. Wayne K.D. Davies (ed.) 2015: Theme Cities: Solutions for Urban Problems . London: Springer (GeoJournal Library No. 112) . *Int. J. Urban Reg. Res.* **42**, 174–175 (2018).

86. Smith, A. 'Borrowing' Public Space to Stage Major Events: The Greenwich Park Controversy. *Urban Stud.* **51**, 247–263 (2014).

87. Theodore, D. Sense of the City: An Alternative Approach to Urbanism - Edited by Mirko Zardini. *J. Archit. Educ.* **60**, 69–70 (2006).

88. Whyte, W. H. *The Social Life of Small Urban Spaces*. (New York: Project for Public Spaces, 1980).

89. Rota, F. S. & Salone, C. Place-making processes in unconventional cultural practices. The case of Turin's contemporary art festival Paratissima. *Cities* **40**, 90–98 (2014).

90. Jacobs, J. *The death and life of great American cities*. (New York : Random House, 1961).

91. Eizenberg, E. & Cohen, N. Reconstructing urban image through cultural flagship events: The case of Bat-Yam. *Cities* **42**, 54–62 (2015).

92. Unt, A. L. & Bell, S. The impact of small-scale design interventions on the behaviour patterns of the users of an urban wasteland. *Urban For. Urban Green.* **13**, 121–135 (2014).

93. Bishop, P. & Williams, L. *The temporary city*. *Routledge Taylor & Francis Group* (Routledge Taylor & Francis Group, 2012).

94. Casagrande, M. Paracity: Urban Acupuncture. *Int. Conf. Public Spaces Bratislava* 1–32 (2015).

95. Németh, J. & Langhorst, J. Rethinking urban transformation: Temporary uses for vacant land. *Cities* **40**, 143–150 (2014).

96. Madanipour, A. Temporary use of space: Urban processes between flexibility, opportunity and precarity. *Urban Stud.* **55**, 1093–1110 (2018).

97. Oswalt, P., Overmeyer, K. & Misselwitz, P. *The power of temporary use*. (Berlin, Germany : Dom Pubilishers, 2013).

98. Diniz, E. & Riou, M. Bottom up Urbanism Exploring the potential of bottom up initiatives as. (KTH Royal Institute of Technology, 2017).

99. Kennedy, L., Naaman, M., Ahern, S., Nair, R. & Rattenbury, T. How flickr helps us make sense of the world: Context and content in community-contributed media collections. *Proc. ACM Int. Multimed. Conf. Exhib.* 631–640 (2007) doi:10.1145/1291233.1291384.

100. Ferreri, M. Pop-up shops as interruptions in (post-)recessional London. in *Cities Interrupted* 1–15 (Bloomsbury Publishing Plc, 2016). doi:10.5040/9781474224451.ch-009.

101. Beekmans, J. & Boer, D. J. *Pop-up City : City-making In a Fluid World*. (BIS Publishers B.V., 2014).

102. Temel, R. The Temporary in the City. in *Temporary Urban Spaces: Concepts for the Use of City Spaces* 55–67 (Birkhauser; 1 edition, 2006).

103. Colomb, C. Pushing the urban frontier: Temporary uses of space, city marketing, and the creative city discourse in 2000S Berlin. *J. Urban Aff.* **34**, 131–152 (2012).

104. Unt, A.-L. & Bell, S. The impact of small-scale design interventions on the behaviour patterns of the users of an urban wasteland. *Urban For. Urban Green.* **13**, 121–135 (2014).

105. Gehl. Urban Prototyping – Exploring Temporary and Permanent. https://gehlpeople.com/blog/urban-prototyping-exploring-temporary-permanent/ (2012).

106. Bubalo, M., van Zanten, B. T. & Verburg, P. H. Crowdsourcing geo-information on landscape perceptions and preferences: A review. *Landsc. Urban Plan.* **184**, 101–111 (2019).

107. Tieskens, K. F., Van Zanten, B. T., Schulp, C. J. E. & Verburg, P. H. Aesthetic appreciation of the cultural landscape through social media: An analysis of revealed preference in the Dutch river landscape. *Landsc. Urban Plan.* **177**, 128–137 (2018).

108. Kandra, S. & Ghosh, M. Environmental Perception: Image Based Analysis of People's Impression of Places. *Int. J. Appl. Environ. Sci.* **12**, 1223–1239 (2017).

109. Montgomery, J. Making a city: urbanity, vitality and urban design. *J. Urban Des.* **3**, 93–116 (1998).

110. Bater, J. H. *The Soviet City Ideal and Reality*. (Edward Arnold

(Publishers) Ltd 41 Bedford Square, London WC1B 3DQ British, 1980).

111. Kotkin, S. Magnetic Mountain: Stalinism as a Civilization. *Stalinism Essent. Readings* 107–126 (1995) doi:10.1002/9780470758380.ch5.

112. Gibberd, F. *Town Design*. (Architectural Press, London., 1969).

113. Buchanan, P. What city? A plea for place in the public realm. *Archit. Rev.* **11 01**, 31–41.

114. Carmona, M., Heath, T., Oc, T. & Tiesdell, S. *Urban spaces-public places: The dimensions of urban design*. (2003).

115. Jacobs, A. & Appleyard, D. Towards an urban design manifesto: A prologue. *J. Am. Plan. Assoc.* 2–20 (1987).

116. Duany, A., Plater-Zyberk, E. & Speck, J. *Suburban Nation: The rise of sprawl and the decline of the American Dream.* (North Point Press, New York., 2000).

117. Brenner, N. *New Urban Spaces: Urban Theory and the Scale Question*. *Journal of Chemical Information and Modeling* vol. 53 (2016).

118. Appleyard, D. *Liveable Streets*. (University of California Press, Berkeley, 1981).

119. Matveyeva, N. M. *Obshchestvennyye tsentry gorodov. Arkhitektura SSSR*. (Stroyizdat, 1972).

120. Engel, B. Public space in the Blue Cities in Russia. *Prog. Plann.* **66**, 147–239 (2006).

121. Snopek, K., Świetlik, T., Petro, V. & Moore, N. W. Spectacle Square. https://www.thesitemagazine.com/read/spectacle-square.

122. Terekhovich, M. Vsesoyuznyye fizkul’turnyye parady 1930-1940-ye gody. (2013).

123. Madanipour, A. *Public and private spaces of the city*. *Public and Private Spaces of the City* (2003). doi:10.4324/9780203402856.

124. Burnham, D. & Bennett, E. *Plan of Chicago*. (COMMERCIAL CLUB OF CHICAGO LIBRARY, 1908).

125. Svetlichnyy, V. I. *et al. Pravila i Normi planirovki i zastroiki gorodov*. (1959).

126. Shuklina, M. A. Urban Public Spaces: the Transformations in the Paradigm of Urban Planning from the Soviet Period to the Present Day. (Master's Thesis, Vysokovsky Graduate School of Urbanism, Moscow, Russia, 2017).

127. Susannah Hagan. *Designing london's public spaces post war and now*.

128. Lebedeva, E. Public Space in Post-Soviet Cities: Sociability and 'Crisis of Publicity'. *Zhurnal Sotsiologii i Sotsialnoy Antropol. (The J. Sociol. Soc. Anthropol.* **XX. № 1**, 74–92 (2017).

129. Dvorcovaja 1924. https://commons.wikimedia.org/wiki/File:Dvorcovaja1924.jpg (2011).

130. Dyminskaya, A. V., Shokurova, L. B., Yankevich, M. K. & Laskin, A. R. *«Ob"yekty kul'turnogo naslediya (pamyatniki istorii i kul'tury) Khabarovskogo kraya»*. (Khabarovsk: Ministry of Culture of the Khabarovsk Territory, 2013).

131. Ekshtut, S. *Tovarishch Stalin, slyshish' li ty nas?!* (Kuchkovo pole, Moscow, 2017).

132. Osmolovskiy, A. Aktsii «E.T.I.-tekst» — 25 let! https://artguide.com/posts/1019 (2016).

133. Koljasnikov, V. A. & Mazkova, M. V. Principles of Design Of Public Space In General Plans Of Cities Of Russia. *Akad. Vestn. Ural. Raasn*

(2014).

134. Zukin, S. *The Cultures of Cities*. (Blackwell Publishers; 1 edition, 1996).

135. Hatherley, O. *Across the plaza. The public voids of the post-soviet city*. («Strelka Press», 2012).

136. Ladogina, E. V. Nastoyashcheye i budushcheye rossiyskikh obshchestvennykh prostranstv. *J. Russ. Psychol. J.* **10**, 62–69 (2013).

137. Kalyukin, A., Borén, T. & Byerley, A. The second generation of post-socialist change: Gorky Park and public space in Moscow. *Urban Geogr.* **36**, 674–695 (2015).

138. Neugebauer, C. S. & Rekhviashvili, L. Loss and (re-)construction of public space in post-Soviet cities. *Int. J. Sociol. Soc. Policy* **35**, IJSSP-04-2015-0042 (2015).

139. Lehtovuori, P. & Ruoppila, S. Temporary uses as means of experimental urban planning. *Serbian Archit. J.* **4**, 29–54 (2012).

140. Unt, A.-L. & Bell, S. The impact of small-scale design interventions on the behaviour patterns of the users of an urban wasteland. *Urban For. Urban Green.* **13**, 121–135 (2014).

141. Lydon, M. & Garcia, A. *Tactical Urbanism*. (Island Press/Center for Resource Economics, 2015). doi:10.5822/978-1-61091-567-0.

142. SP 131.13330.2018 (SNiP 23-01-99) Stroitel'naya klimatologiya. https://www.srogen.ru/upload/files/doc/MSN_22-01.pdf (2018).

143. Spravochno-informatsionnyy portal 'Pogoda i klimat'. http://www.pogodaiklimat.ru/climate/31735.htm.

144. Galuzova, M. & Luchkova, V. Features of Urban Sphere of Khabarovsk Squares Architectural Formation (On Example Of Lenin Square And

Komsomol Square). in *New Ideas of New Century* vol. 1 31–35.

145. Live Cameras Khabarovsk Redcom. https://cameras.redcom.ru/ (2019).

146. Dorevolyutsionnaya Rossiya Na Fotografiyakh. Yekaterinburg. Chast' 2. https://www.liveinternet.ru/users/irena_69/post196982871/ (2011).

147. Porunova, E. History: 78 years ago, a Christmas tree first appeared on square 1905. https://www.ekburg.ru/news/19/58364-istoriya--let-nazad-na-ploshchadi--goda-vpervye-poyavilas-elka/ (2015).

148. Zolnichkova, A. The history of one town When did the ice town appear and how did it change in Yekaterinburg. https://itsmycity.ru/2018-11-29/kogda-poyavilsya-i-kak-menyalsya-ledovyj-gorodok-v-ekaterinburge (2018).

149. Lopatin, M., Matveev, O., Tsatsurov, A., Markov, E. & Penin, A. Yekaterinburg+Sverdlovsk. http://1723.ru/.

150. Pyatunin, E. Gorod Kirov. Provody russkoy zimy (1960-ye - 1980-ye gody) 56/5000 The city of Kirov. Seeing off the Russian winter (1960s - 1980s). https://tornado-84.livejournal.com/.

151. Kasanov, A. No. https://kasanof.livejournal.com/.

152. Japan Meteorological Agency. https://www.jma.go.jp/jma/indexe.html (2020).

153. Figueiredo, M., Goes, J. & Evans, G. *Reference-Free CMOS Pipeline Analog-to-Digital Converters*. (Springer New York, 2013). doi:10.1007/978-1-4614-3467-2.

154. de Smet, A. The role of temporary use in urban (re)development: examples from Brussels. *Brussels Stud.* (2013) doi:10.4000/brussels.1196.

155. Ikeda, M. Temporary Use of Vacant Urban Spaces in Berlin: Three Case Studies in the Former Eastern Inner-city District Friedrichshain. *Geogr. Rev. Japan Ser. B* **91**, 1–16 (2018).

156. Kusaka, M., Setoguchi, T., Watanabe, N., Guo, Z. & Paukaeva, A. Human Behavior in Downtown Public Spaces during Cooling Periods in Winter Cities. **12**, 1–10 (2018).

157. Zacharias, J., Stathopoulos, T. & Wu, H. Microclimate and Downtown Open Space Activity. *Environ. Behav.* **33**, 296–315 (2001).

158. Nordic Council of Ministers. *Nordic Solutions for Sustainable Cities*. http://www.arup.com/~/media/Files/PDF/Publications/Research_and_whitepapers/FINALVERSION_Nordic8Catalogue_normalpageviewversion.ashx (2012).

159. McKenzie, T. L., Cohen, D. a, Sehgal, A., Williamson, S. & Golinelli, D. System for Observing Play and Recreation in Communities (SOPARC): Reliability and Feasibility Measures. *J. Phys. Act. Heal.* **3**, S208–S222 (2006).

160. Cohen, D. A. *et al.* How much observation is enough? Refining the administration of SOPARC. *J. Phys. Act. Heal.* **8**, 1117–1123 (2011).

161. Martí, P., Serrano-Estrada, L. & Nolasco-Cirugeda, A. Using locative social media and urban cartographies to identify and locate successful urban plazas. *Cities* **64**, 66–78 (2017).

162. Wu, C., Ye, X., Ren, F. & Du, Q. Check-in behaviour and spatio-temporal vibrancy: An exploratory analysis in Shenzhen, China. *Cities* **77**, 104–116 (2018).

163. Encalada, L., Boavida-Portugal, I., Cardoso Ferreira, C. & Rocha, J. Identifying Tourist Places of Interest Based on Digital Imprints: Towards a Sustainable Smart City. *Sustainability* **9**, 2317 (2017).

164. Mashable. Instagram now has more daily active users on mobile than twitter. http://mashable.com/2012/09/27/instagram-passes-twitter-users/ (2012).

165. Instagram. Total Number of Daily Active Instagram Users. https://about.instagram.com/about-us.

166. Lee, E., Lee, J. A., Moon, J. H. & Sung, Y. Pictures Speak Louder than Words: Motivations for Using Instagram. *Cyberpsychology, Behav. Soc. Netw.* **18**, 552–556 (2015).

167. Manovich, L. Cultural Analytics Lab. *Instagram and Contemporary Image* 148 http://lab.culturalanalytics.info/2016/05/instagram-and-contemporary-image-new.html (2017).

168. Winter, J. Selfie-Loathing Instagram is even more depressing than Facebook. Here's why. https://slate.com/technology/2013/07/instagram-and-self-esteem-why-the-photo-sharing-network-is-even-more-depressing-than-facebook.html (2013).

169. Lup, K., Trub, L. & Rosenthal, L. Instagram #Instasad?: Exploring Associations Among Instagram Use, Depressive Symptoms, Negative Social Comparison, and Strangers Followed. *Cyberpsychology, Behav. Soc. Netw.* **18**, 247–252 (2015).

170. Trifiro, B. Instagram Use and It ' s Effect on Well-Being and. (Master's Thesis, Bryant University, Smithfield, Rhode Island, USA, 2018).

171. Boy, J. D. & Uitermark, J. How to study the city on instagram. *PLoS One* **11**, 1–16 (2016).

172. Crandall, D., Backstrom, L., Huttenlocher, D. & Kleinberg, J. Mapping the World ' s Photos. in *Track: Social Networks and Web 2.0 / Session: Photos and Web 2.0* 761–770.

173. Abbott, W., Donaghey, J., Hare, J., & Hopkins, P. An Instagram is Worth a Thousand Words: An Industry Panel and Audience Q&A. Library Hi Tech News. **30**, 1–6 (2013).

174. Analytical Service Picodash. https://www.picodash.com/about/products.

175. Bogorov, V., Novikov, A. & Serova, V. Self-Exploration of the City. *Archeology of the Peryphery. Research for the Moscow Urban Forum* 355–373 https://projects.habidatum.com/#muscovites-emotions/ (2013).

176. Dominguez-Sanchez, A., Cazorla, M. & Orts-Escolano, S. A New Dataset and Performance Evaluation of a Region-Based CNN for Urban Object Detection. *Electronics* **7**, 301 (2018).

177. Xie, M., Jean, N., Burke, M., Lobell, D. & Ermon, S. Transfer learning from deep features for remote sensing and poverty mapping. in *30th AAAI Conference on Artificial Intelligence, AAAI 2016* 3929–3935.

178. Simonyan, K. & Zisserman, A. Very Deep Convolutional Networks for Large-Scale Image Recognition. in *3rd International Conference on Learning Representations, ICLR 2015 - Conference Track Proceedings* 1–14.

179. Deng, D.-P., Chuang, T.-R. & Lemmens, R. Conceptualization of place via spatial clustering and co-occurrence analysis. in *Proceedings of the 2009 International Workshop on Location Based Social Networks - LBSN '09* 49 (ACM Press). doi:10.1145/1629890.1629902.

180. Russakovsky, O. *et al.* ImageNet Large Scale Visual Recognition Challenge. *Int. J. Comput. Vis.* **115**, 211–252 (2015).

Figures

Tables

sustainability

MDPI

Article

Temporary Design on Public Open Space for Improving the Pedestrian's Perception Using Social Media Images in Winter Cities

Anastasiia A. Paukaeva [1,*], Tsuyoshi Setoguchi [2], Norihiro Watanabe [1] and Vera I. Luchkova [3]

[1] Division of Architecture, Faculty of Engineering, Hokkaido University, Sapporo, Hokkaido 060–8628, Japan; n-watanabe@eng.hokudai.ac.jp
[2] Dean, Faculty of Engineering, Hokkaido University, Sapporo, Hokkaido 060–8628, Japan; setoro@eng.hokudai.ac.jp
[3] Institute of Architecture and Design, Pacific National University, Khabarovsk 68 0035, Russia; luchkova-vi@rambler.ru
* Correspondence: paukaeva.nasty@mail.ru; Tel.: +81-80-9576-1268

Received: 19 June 2020; Accepted: 21 July 2020; Published: 28 July 2020

Abstract: Due to the severe climate, residents of winter cities tend not to utilize public open spaces in winter. Temporary design interventions such as emblematic events are always proposed in winter cities to enhance pedestrian activity by celebrating the season and improving the perception of winter. In this study, we clarify the impact of the event on pedestrians' perception to determine the role of temporary design in improving the perception of public open spaces in winter cities. Using the example of event known as "Ice Town" on the Lenin Square in Khabarovsk, the content of the Instagram images was analyzed to determine their perception during and after the event. The analysis includes classification of the images into clusters related to different urban elements using transfer learning with CNN (convolutional neural network). A total of 10,200 generated images on the Lenin Square were considered, with 1700 images which relate the event itself. This accounts for approximately 20% of all data, while those which related to the during the permanent use of Lenin Square accounted for just 6%. Temporary design of public open spaces has great potential to involve pedestrians in interacting with urban and natural environments in winter cities, even in severe cold climate, by improving an impression of a place.

Keywords: winter cities; temporary design; event; perception; public open space; social media; image classification

1. Introduction

Winter cities situated in regions, where the average maximum daytime temperature is equal or less than zero degrees Celsius for a period at least two months or longer. Prolonged periods of cold and restricted hours of daylight with heavy snowfall are a direct cause of psychological and physiological discomfort [1]. During the winter season, the appearance of the urban design is very different from that in other seasons. The city landscape is divided into two distinct scenes: day and night. Well-lit urban elements combined by the white covering (snow), including precipitation, coverage and thaw [2], can turn the night into a dark scene without distinctive hierarchies of the architectural elements [3]. Residents of winter cities tend not to utilize the public open spaces in winter and stay indoors, that cause a worsening their mental and physical condition. Festivals and a variety of events are proposed in so-called winter cities [4–7] to enhance the esthetic "appreciation" of a winter, consequently, the activity in the public open spaces. The emblematic festivals of the cold season tend to involve innovative uses of snow and ice and are designed to rehabilitate the negative perception of

winter [8]. Moreover, it is reported that art event can assist in strengthening social inclusion [9], creating or renovating local identity, consequently, fostering place-making processes [10]. Flagship events are considered as an urban strategy, playing role in reconstructing urban image and stimulating economic of a place or city itself [11]. The employing variety of multiple physical forms to urban space, including maps, plans, models and designs—is an important objective of these events [12]. Even minor design interventions such as benches, a changing cabin lead to a greater number of users than before these insertions were made [13].

In this study, the events imply temporary design, which is defined as specifically and purposely time-limited [14] design intervention [13]. Although the temporary design has been given increasing attention, and has become more integrated in urban planning and design practices over time [15–17], it tends to be considered apart from traditional or permanent design, as "provisional" or "secondary" [18]. Temel notes, " . . . it shares qualities with the provisional, but temporary also has its own qualities use and should not be viewed as merely a substitute for the fully adequate". [19]. This study investigates the impact of the temporary design on the pedestrians' perception in relation to permanent design to emphasize the critical role of the temporary design with a focus on how this could contribute to a stronger impression of urban design, particularly, public open spaces in winter cities.

One of the assumptions in this study is that the combination of permanent design with temporary design has significantly greater impact on the pedestrians' perception, than permanent design. The primary aim is to emphasize the impact of temporary design on the pedestrians' impression in relation to traditional or permanent design. On the example of winter-oriented event "Ledyanoy gorodok" ("Ice Town") at the Lenin Square we consider permanent design as a "no event" situation of the square and the combination of the permanent design and temporary design is considered as the "event" (Figure 1).

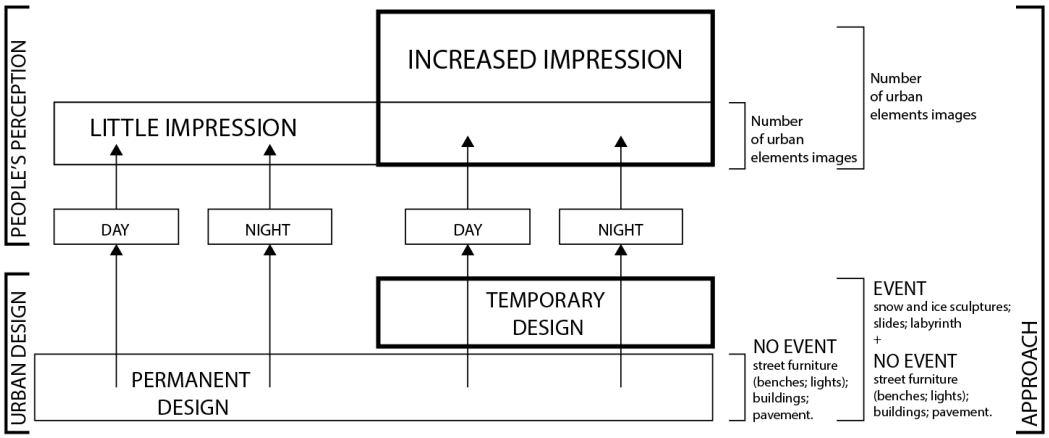


Figure 1. Theoretical framework and approach of the study.

There is a growing interest in landscape [20,21] and urban design [22] by employing social media to gather impressions of people's perception of urban and natural environments that implies people's reactions evoked [23] or emotional experience of urban objects. The individual's impression or emotional experience of an event, which is evoked from events themselves, can be captured in the photographs they take within spaces [22]. Therefore, to define the urban design that make a strong impression on the pedestrians [24], a large number of photos related to the urban environment posted on social media was analyzed. The focus was not only on the surrounded constructions but also on the small-scale urban design, since most people acquire knowledge of a place by a piecemeal 'bottom-up' process which is itself dependent on direct experience [25]. Such elements as street furniture, fountains, statue, buildings and pavements were considered as permanent design, while an ice, snow sculptures, maze, New Year decorations and illumination—as temporary design. Moreover, the perception of the public open space during day and night were analyzed, considering their different impacts on

the appearance of the urban environment. We believe that some urban forms can stimulate activity, create a positive or distinctive image [24] and therefore foster a strong impression (Figure 1).

2. Materials and Methods

2.1. Case Study

2.1.1. Post-Soviet Public Open Spaces

Plans to restructure Soviet-era cities, where public open spaces tend to be unutilized nowadays, need to be flexible and to serve alternative scenes. That is, the role for temporary activities and interim phases of development should be considered at the design stage [14].

Most public spaces in Russian cities have been inherited from the Soviet-era. All of these large-scale spaces were designed for a variety of functions and have distinct characteristics. The proportions of many of the squares are monumental: a large square is adjoined to a wide and long avenue, allowing state events to be viewed from many angles, providing space for massive public gatherings and providing access for military transport [26,27]. The squares were equipped with minimal street furniture, such as monuments and benches, and the placement of the benches is such that the attention of the users will be towards either the monument placed in the square or to one of the various symbols of ideology and power that can typically be found in the squares [28].

While these spaces are open and accessible today, they are deeply unpopular. With regard to their potential for social activity, many spaces in modern cities are impeccable in terms of composition and esthetics of modernism, but turn out to be "empty" [28]. Those "voids" [29] have great potential for city planners to implement a variety of behavioral strategies through design [30]. Reconstruction work on many of the Soviet era squares is still ongoing [31,32]. According to Kuba Snopek, all post-communist city squares are in the process of "transformation" [33,34], with some places having developed a final model of urban space, and others in a state of "deep chaos" [33]. Clearly, there is no one pattern for developing these spaces. The authors of this study suggest temporary design intervention [13] as a unified model for developing such spaces as social and cultural places of attraction.

2.1.2. Target Area, Lenin Square, Khabarovsk

The chosen target area, Lenin Square, is located in Khabarovsk in the cold region of the Far East Russia. Khabarovsk experiences extreme winters, with an average temperature in winter of −21 °C. The temperature hit a record low of −40 °C [35] in January 2011. Lenin Square in Khabarovsk is one of the ten largest squares of Russia, with a size of 25,300 м^2. Like many Soviet era squares, Lenin Square has a clear perimeter and a central focus. In our study, we consider Lenin Square as a permanent design example, with potential for numerous short-term interventions.

Lenin Square played a central role in the development of democracy in the city (Figure 2). Historically, the central square was a natural meeting place—a space where people deliberated, made policies and decided their course of action [36]. Because it is positioned at the intersection of two main streets which provide numerous public facilities, the square served to unify the surroundings. Among the characteristic features of the Soviet era squares are their accessibility to large masses of the population and the wide view from the surrounding buildings. In this way, the squares assume a truly open character. It should be noted that the historical image of Lenin Square has been retained. In the post-Soviet years, it has been well-preserved and no dramatic planning changes have been implemented [37] (Figure 2). That is, its scale and composition remain the largely same as during the Soviet era. Only the central fountain and Statue of Lenin have been relocated from their original places. While the role of the main buildings of most of the squares in Russia has been reassigned such that they have become cathedral squares or railway station squares, this has not been the case in Lenin Square. Lenin Square does not have a central vertical dominant tall building like that found in many squares throughout Russia. That is, rather than have a key building in the composition of

the city center, the "void" created by Lenin Square is its dominant feature. This "incompleteness" [37] in the spatial composition of the square allows various strategies to be implemented. Temporary design elements have the potential to attract the people's attention: in fact, temporary design could well become the dominant feature of Lenin Square.

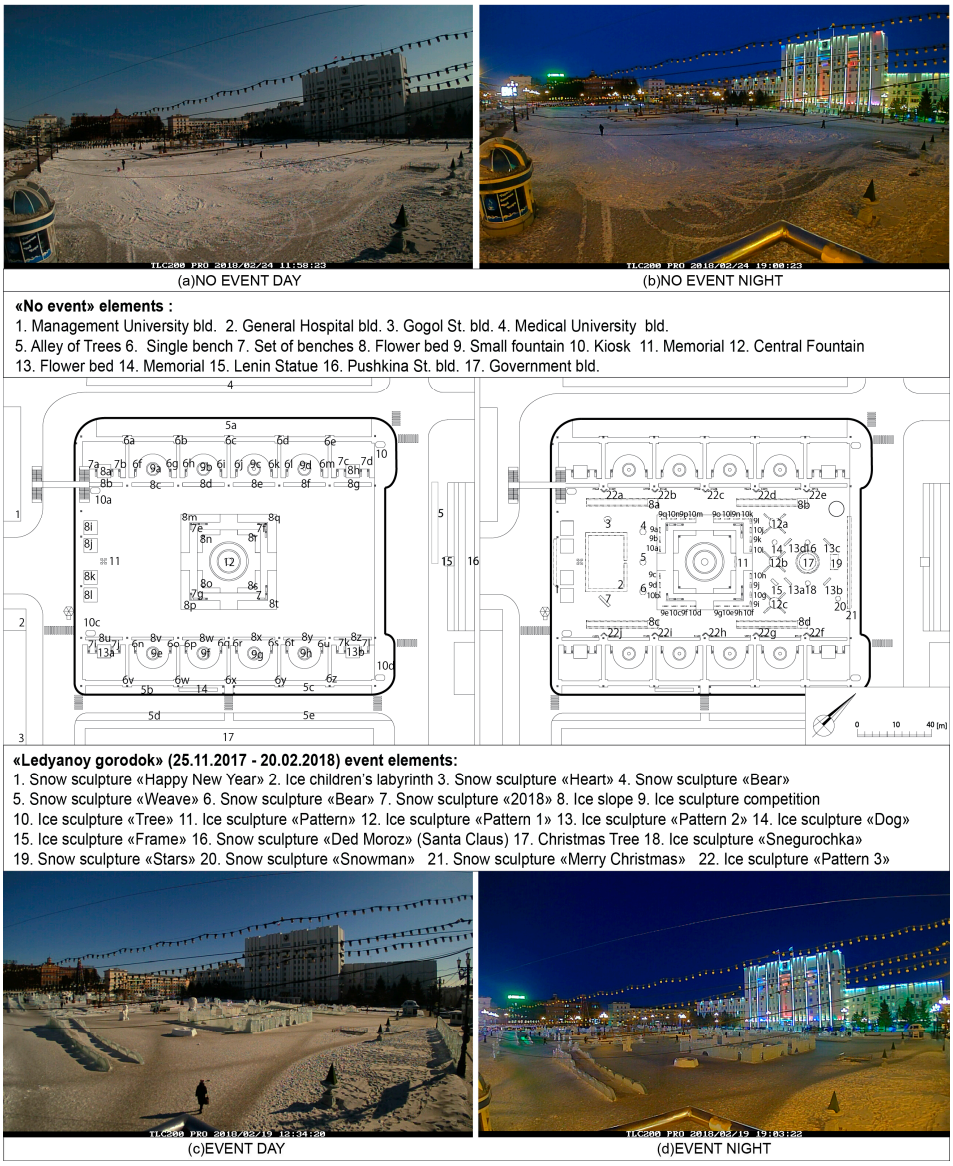


Figure 2. Four scenes of the Lenin Square (**a**) "No event" during the day (24.02.2018; 11:50); (**b**) "no event" at night (24.02.2018; 19:00); (**c**) "event" during the day; (19.02.2018; 12:30) (**d**) "event" at night (19.02.2018; 19:00).

2.1.3. Winter-Oriented Event the "Ledyanoy Gorodok" ("Ice Town")

Lenin Square was selected as the target area due to the annually held "Ledyanoy gorodok" ("Ice Town") event. A unique element of winter celebrations in many winter cities, records indicate that structures have been built for similar "Ice Palace" events from as early as the 18th century most notably in Montreal in Canada [1]. In Russia, this winter-oriented event has been held since 1903 and remains a part of the culture in many winter cities. The basic elements of the event include a massive scale Christmas Tree and a slide. During "Ledyanoy gorodok" in Lenin Square, there are different patterned ice sculptures, snow sculptures, ice slides and labyrinths, as well as a Christmas Tree. It is different

from other winter-oriented events, such as contemporary Christmas markets, in that it does not aim to contribute to economic and social vibrancy [7]. Instead, the aim of the "Ledyanoy gorodok" is to exploit the opportunities provided by the of ice and snow for the sole purpose of celebration of winter [38] and to promote acceptance of the climate as an integral part of the cultural framework [1]. It should be stressed that while these cultural events do not facilitate economic vibrancy in the city, they certainly contribute by successfully addressing the ecological challenge to hold zero-waste events.

At the initial stage, the digital map of the urban elements was prepared for the "no event" and the "event" for both the day and night situations on Lenin Square. All the urban elements were labeled with numbers according to their position. Four scenes in Lenin Square were observed, for the "no event" on 24th February of 2018, and for the "event" on 19th of February during the daytime and at night when the urban elements were well-lit (Figure 2).

2.2. Analysis of the Pedestrians' Perception of the Urban Environment through Social Media

Many studies have explored important aspects of landscapes using social media sources: these include the evaluation of attractive areas [39], places of interest [40], landmarks and cityscape [41] and user travel preferences [42]. One study utilized Foursquare geolocation to reveal the degree of social relevance and livability of plazas [39]. In many studies, the scale of the urban environment has been explored, with a particular focus on the impression that public open spaces make on visitors. The focus of the case study is demonstrating the impact of temporary architectural and design interventions on pedestrians' perception. The methodology is similar to that used by Xiao Qian, who explored transition spaces between streets and squares using people-generated image analysis based on the similarities of the features and by clustering them by text analysis of the caption [22]. However, this method of this study focuses on clustering the images into the groups of urban elements and their number.

2.2.1. Collecting Dataset

Instagram was selected as the platform for data collection in this study. As the fastest growing social network, with a seemingly ever-increasing number of users, Instagram was the obvious choice. Since the launch of Instagram in October 2010, the number of users today exceeds one hundred million. At the end of 2012, Instagram passed Twitter with 7.3 million daily mobile users in one month [43], and in 2020 it reached 500 million [44]. Instagram is a photo-sharing web platform that allow users to instantly upload photographs on a daily basis. It is reported that the primary motivations for Instagram users are self-expression [45] and to signal identity [46]. When individuals post on Instagram, they try to present the best or distinctive version of themselves and their lives [41], because they place their identities on public display for others to evaluate [47]. Researches and journalists have agreed that this image-driven feature of Instagram encourages representation of only a desirable and polished narrative of one's life [48–50]. Thus, as a rule, Instagram users are selective about the content of their personal images [51], and tend to take photos because they think a subject is visually interesting, pleasing or distinctive in order to represent themselves in specific manner for followers [52]. This implies that it is as if photo of an urban element is a "vote" for a special experience or impression [53]. Therefore, we assume that a higher number of images related to specific urban elements indicates a stronger impression and, consequently, greater impact on the people's perception.

Each photo in Instagram has identification metadata through which users can search, navigate and order according to their interests and priorities. For exporting datasets, online analytical service Picodash [54] was used. Datasets include the URL of the image, captions hashtags, the date, the time, the geographic location of the location IDs and the location name. Text data as a caption is an optional function for users: it allows them to express the intention of taking the photograph [22] and make reference to the place using hashtags. The amount and correctness of the dataset of the place can be distinct due to the exporting options. We collected data generated from within 100 m of the physical location of Lenin Square that captured all related to the place–location IDs. The export of the data using

a one location ID will limit the amount of actual data and in the case of exporting data by designated hashtags, not all data will correspond to the image or actual location.

2.2.2. Analyzing Content of the Images

A total of 10,200 datasets related to Lenin Square were downloaded for the period of 1 November 2017–15 March 2018 The dataset was prepared for analysis by considering the content of the images and automatically excluding data that has no value for the urban design issues. For instance, the data that relate to commercial issues and promoting of the products was excluded. In the case of Lenin Square, captions of the images that contain such hashtags as "cost", "discount", "client", "sell", "rent", "buy", "order", "customer", "delivery', "bank" and "massage" were excluded from the dataset. This reduced the size of the dataset by 50% before analyzing the content of the images.

The analysis of the content of the images involved three main steps: selecting the images related to the urban design issue, defining the clusters of the urban elements and labeling the summary clusters. We collected data for two equal periods on a number of days. For the "no event" periods (1–24 November 2017 and 20 February–15 March 2018) we collected 1600 datasets, while for event period (25 November 2017–19 February 2018), 8600 data sets were collected. Later, the data were classified according the whether the image represented indoor or outdoor content— "not urban" and "urban", respectively. This is a critical stage since only 10% [55] of the content data relates to the urban design issues as a rule.

Our second task was to consider the question of what was being photographed in each given image, by selecting the targeted object of the photography. By clarifying the target, more subtle precision issues can arise for the personal photographs that are shared online. For example, while some users more interested in the urban elements, other prefer to take a photograph of themselves or their family members standing in front of a visited place or urban element. If the shape of the target object can be easily traced on those images, they were included into the summary clusters that present captured urban elements on the square. However, selfies or portraits that represent more 70% of people's image of the total photo, blurry photos, and the images that show a discarded view of the urban elements, where the object in question was hardly recognizable, were not included in the analysis. Similarly, many users take an artistic approach to personal photography; for example, some photos were extreme closeups of the urban element or were so far away that it was difficult to clarify the targeted object of the photo. For example, the bird view photos were disregarded since the target object, as a rule, is the square or the cityscape. The target object of the other taken photos from a distance was decided by its centrality.

The third step was to label the photos that present clusters related to specific urban element. Many landmarks and locations can be frequently captured from a number of distinct viewpoints. Because most of the images are photographs of the urban elements taken from similar angles, it is easy to cluster the images into groups for the different urban elements. Thus, we find representative images of the different urban elements, such as the Christmas Tree, the central fountain and the ice sculptures, by visually distinguishing the clusters from among the most salient subset (Figure 3). Next, we labeled the clusters with the number allocated to the urban element positions; for example, "Christmas Tree" was labeled with number "T17" where "T" refers to the temporary urban element and "17" is the number of position (Figure 2). The same process was followed for the permanent items; "central fountain" was labeled with "P12", for example. This was a more lightweight, faster overall process, capable of scaling the global scope of our data with deep learning and also producing significantly better results than randomly selecting photos based purely on textual tags.

Figure 3. Approach of classification of the urban design and elements images.

2.2.3. Urban Design Image Classification Using Transfer Learning with Pretrained Convolutional Neural Network

In this study, we propose transfer learning with pretrained CNN (convolutional neural network) for classifying the Instagram images into clusters that consists of specific urban elements. These days, CNN has become a popular deep learning approach, that is frequently used for various visual recognition tasks including urban image analysis [56,57]. However, training CNN from scratch requires much labeled data and time. Moreover, most deep learning datasets are very specialized to a particular domain or even a specific task in urban design, such large labeled datasets are not always available. To solve this problem, we applied transfer learning which retraining CNN already trained by large datasets. By using transfer learning, the knowledge gained from large general labeled datasets can be transferred to solve the specific task having less labeled data. In this study, we use the classifier VGG 16 [58] trained by ILSVRC 2012 in ImageNet, which is a data set composed of 1000 different classes and 1.2 million learning data [59,60].

We trained data on the top 9 classes consist of different urban elements (Table 1) and the general class of "not urban" images to verify that CNN has potential to cluster the "urban" images. The training parameters are shown in Table 1. The verification of the data showed the accuracy of the training data are over the 0.9 (Figure 4a), while the loss was reduced to below 0.3 (Figure 4b) using 100 epochs. This implies that transfer learning with pretrained CNN was successful in learning different urban elements' features. Therefore, this method and trained model are applicable for use in similar studies.

Table 1. Parameters and classes for training.

Parameters	
Number of training images	400
Number of test images	100
Number of epoch	100
Batch size	1
Input image size, pixels	224 × 224
Classes	
T7	Snow sculpture "2018"
P5a	Alley of trees
T6	Snow sculpture "Bear"
T17	Christmas Tree
T14	Snow sculpture "Dog"
T15	Ice sculpture "Frame"
T2	Ice labyrinth
T16	Snow sculpture "Ded Moroz" (Santa Claus)
T20	Snow sculpture "Snowman"

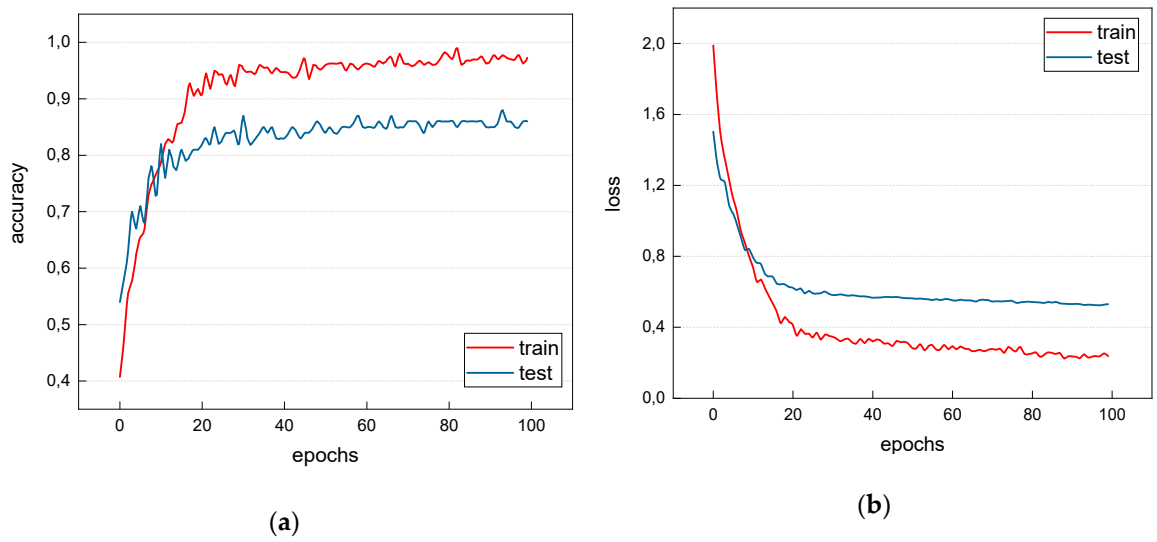


Figure 4. Train and test data results: (**a**) accuracy; (**b**) loss.

2.2.4. Limitations of the Study

The data images were processed manually at first in order to determine the best approach for future similar studies focused on small-scale urban elements. We processed only a portion of the data with deep learning due to the lack of images related to the "no event" period. However, the trained model is suitable for use in future research related to Lenin Square to develop the guidelines of the events and to clarify the other urban elements that receive the most attention of the residents, with a great number of the images. Another limitation relates to the Instagram data, when authors upload their images using different location IDs or prefer not to mention any location, is a possible loss of potential data related to the Lenin Square. Moreover, less Instagram posts can relate to private user's accounts, which posts are hidden from strangers and cannot be extracted.

3. Results

3.1. Weather Parameters and "Urban" Images

All of the data collected were images taken within 100 m of the geographic location of Lenin Square. We downloaded over 10,200 datasets (Table 2) of Instagram posts generated and shared during

winter season when the temperature tends to be below 0 °C (Figure 5), from 1st November of the 2017 to 15th of March of 2018. It is clear that there was no relationship between the number of images posted and the weather parameters, such as the wind velocity (in m/s) and air temperature (in °C). However, A comparison of the patterns of the weather and number of images per day highlights the impact of the winter event on the people's impression of the urban environment. This is true regardless of the severity of the climate, with low temperature ranging from 7 °C to–28 °C, according to Figure 5. While no images were posted on the "no event" periods, as many as 120 images were posted during the "event" periods. In addition, with the exception of the New Year holidays from 1st to 8th of January, there were between 10 and 60 images related to urban design per day, while during the "no event" period, that number was close to 0 (Figure 5).

Table 2. Collected Instagram data and processed images on the Lenin Square.

Situation	"No event"		"Event"	
Date	1–24 November 2017; 20 February 2018–15 March 2018		25 November 2017– 19 February 2018	
Total Instagram posts	1600		8600	
"not urban" images	1504 (94%)		6900 (80%)	
"urban" images	96 (6%)		1700 (20%)	
Time of the day	Day	Night	Day	Night
"urban element" images	30	35	561	708

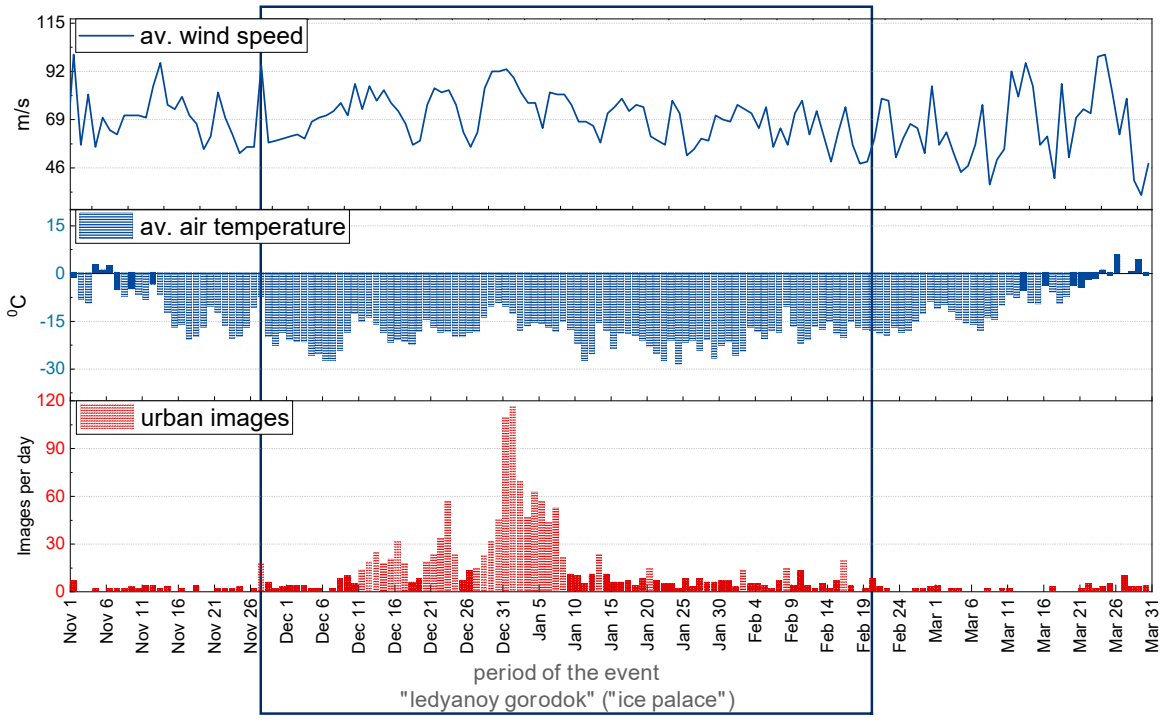


Figure 5. Comparison of the "no event" period and "event" period of the climatic data and number of urban design related images.

3.2. *"Urban Elements" Related Images*

There were 8404 images related to "not urban" class, while there were 1796 "urban" images, representing 21% of all data. We divided the data into two situations for Lenin Square: the "no event" period, for images posted before (1–24 November 2017) and after the event (20 February

2018–15 March 2018); and the "event" period, for images posted from 25 November 2017–19 February 2018. From the 1600 images, 96 were related to the urban issues, representing 6% for the "no event" period. In case of the "event" period, an 8600-point dataset was collected, with 1700 "urban" images representing 20% of the total. The content in some of the images content was hardly recognizable or included the image of the whole square from the bird's eye view, which made it difficult to relate to one urban element as the target object. These "urban" images were all classified as summary clusters. A total of 675 "urban" images were posted and generated during the "event" during the day, with 561 of the images related to "urban elements" clusters. Similarly, at night we collected 812 "urban" images: 708 of them were summary clusters of the urban elements. For the two "no event" periods, 53 and 36 images were related to urban design issues, while 30 and 35 images were summary clusters (Table 2).

Although there were very few images of the permanent elements during the "no event" period, some elements were more popular than others and some were given no attention at all. Among the daytime images, the element which appeared most frequently in the photographs was the red brick historical building, followed by the white stone Government building, then the alley of the trees, the street furniture, the statue of Lenin and the central fountain. At night, the main element was the landmark of the square, white stone Government building, and there were just a few images of the other features: the Management university building, the Medical University building, the alley of the trees and the street furniture.

During the "event" period, a larger number of the images was related to the main temporary landmark, the Christmas Tree, both during the day and night. Moreover, there were many more images of some of the snow sculptures, including the "bear", "snowman" and "dog" and the ice sculpture "2018", than the other snow and sculptures temporary elements during the daytime. At night, another element appeared: the well-lit central fountain was the most common image, followed by ice sculpture "2018" and the snow sculptures—the "dog", "bear" and "snowman" (Figure 6).

Figure 6. Proportional representation of the number of the images related to a specific "urban element" (**a**) "No event" during the day; (**b**) "event" during the day; (**c**) "no event" at night; (**d**) "event" at night.

Prominent landmarks, such as the surrounding historical buildings in case of the "no event" period and the Christmas Tree for the "event" period, had the biggest impact on the pedestrians. Moreover, the natural element, in this case the alley of trees, appeared in a great number of images in all four different periods, indicating the significant impact natural elements have on the pedestrians. Additionally, while snow sculptures had a greater impact on the pedestrians during the day, it was the ice sculptures which had a greater impact at night. This can be explained by the greater reflection of light at night.

3.3. Ranking of the Urban Element Related Images, Comparing the "No Event" and "Event"

In order to illustrate the link between temporary design and permanent design, we generated a ranking system [61] based on the numbers of images related to urban elements between the "no event" period and the "event" period, and compared the different patterns at night and during the day. A considerable number of images related to the permanent elements during the event would indicate a clear link between temporary design and permanent design and emphasize the importance of temporary design as a tool for improving the impression of the urban environment on residents. The permanent urban elements are indicated in dark blue, and the temporary urban elements are indicated in light blue. By using this ranking system, we can define which of the urban elements had a critical impact on the perceptions of the people during the different periods (Figures 7 and 8).

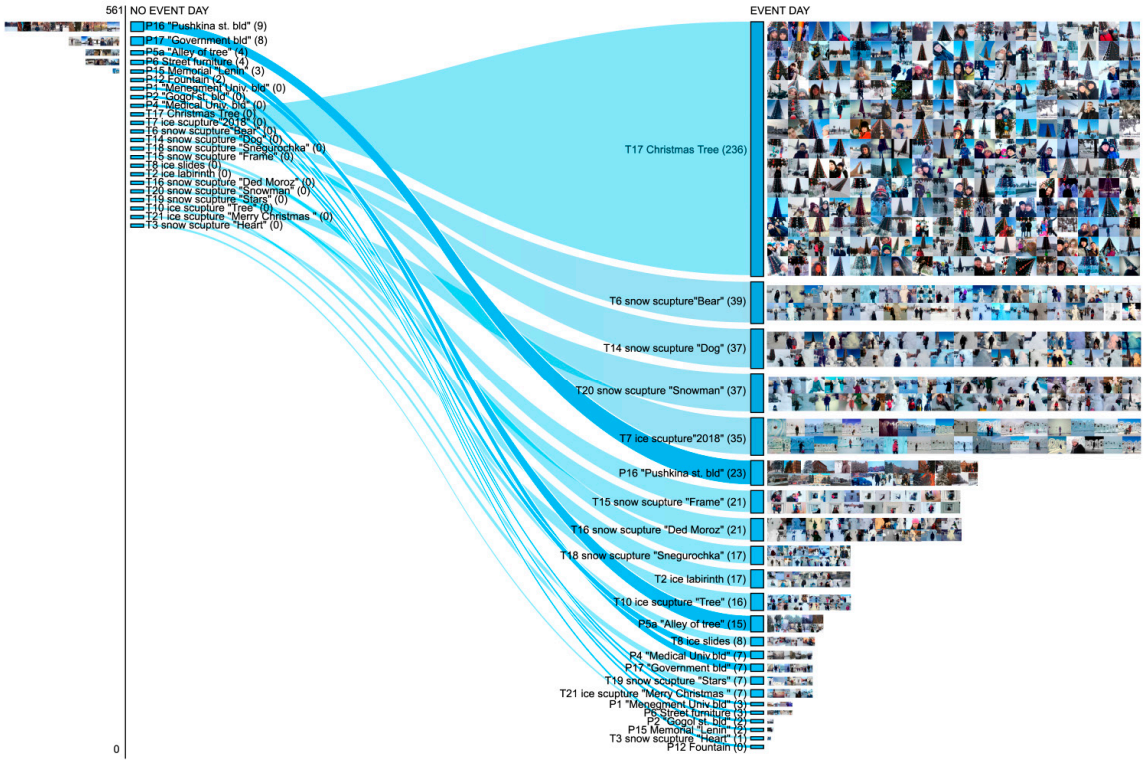


Figure 7. Comparison of the "no event" and the "event" during the day, using a ranking of the number of images related to urban elements.

A comparison of the "no event" and the "event" patterns during the day reveals that the historical building on Pushkin St. (P16) appeared in the greatest number of images, with 9 during the "no event" period, increasing to 23 during the event. It was 6th in the ranking among other urban elements. During the "event" period, there were a few images of other historical buildings, the Medical university (P4) and Management university (P1) and the building on the Gogol St. (P2), with 7, 3, 2, images respectively, while during the "no event" period, no images were generated. However, there was one less image related to Government building (P17) during event (Figure 7).

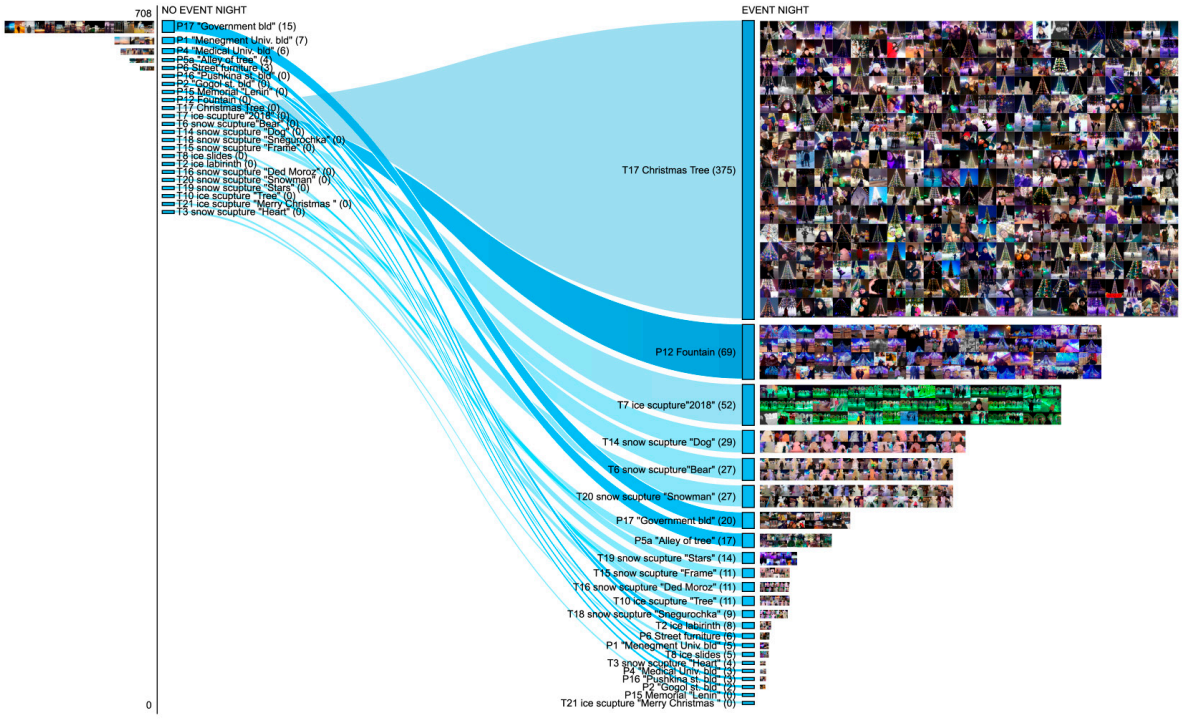


Figure 8. Comparison of the "no event" and the "event" at night, using a ranking of the number of images related to the urban elements.

Nighttime patterns show diverse ranking among the objects photographed, since some of the urban elements were well-lit. For instance, there was a marked contrast in the number of images for the central fountain (P12), which was temporarily lit for the event, with 0 images during the "no event" period and 69 images during the "event" period. Images featuring the Government building (P17) increased during the event from 15 to 20 images. Other surrounding historical buildings on Gogol (P2) and Pushkin (P16) Streets increased from 0 images to 2 and 3 images, respectively, while the Management university (P1) and Medical university (P4) were featured in fewer images from 7 to 6 and 5 to 3, respectively. Moreover, the number of images of alley of trees (P5a) increased by 13 during the event (Figure 8).

It is evident that the "event" improved the pedestrians' impression of the urban environment. Not only were they impressed by the temporary urban elements but also a combination of the temporary and permanent elements of the square. Evidence of this is the increased number of the images related to the permanent elements at the event. Moreover, the impact of lighting on permanent elements had a considerable impact on the perceptions of the square.

3.4. Spatial Distribution of the Urban Elements and Its Impact on the Pedestrians' Perception of the Square

To clarify the spatial pattern of the pedestrians' perception of the urban elements, a GIS map was generated using ArcMap software [62]. The urban element related images were placed on the map and attached to the location of the urban element, rather the point where the photograph was taken. Issues arise with understanding of accurate geographic location where the photographs were taken.

The event increased the number of impressions from 20 images to 400 images per urban element. Pedestrians perceived the permanent urban elements as clearly symmetrical, according the designated design classical composition. Comparing the day pattern of the "no event" and "event" periods, similar spatial patterns can be noticed during the day and at night for the images related to the permanent elements. For instance, the photographs captured the following element during the day: P16, P15, P5a, P4, P1, P2, P12, P17 and P6, with more images for P16 and P17 (Figure 9a,c). The other small-scale

permanent elements are disregarded, including the side fountains, memorials and street furniture (Figure 2). Similarly, at night, the following appeared in images: P16, P15, P5a, P4, P1, P2, P12. P17, P6, with more images for P17 (Figure 9b,d).

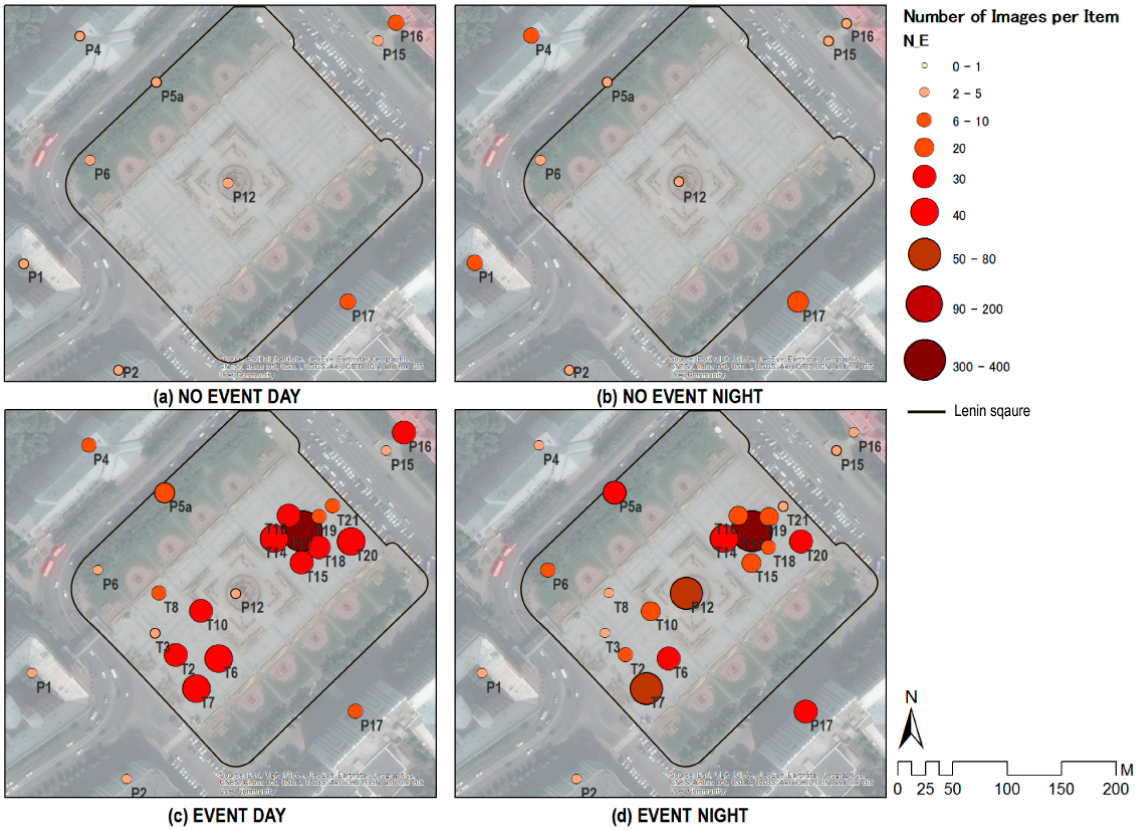


Figure 9. Spatial pattern of intensity of the images related to urban elements. (**a**) "No event" at day; (**b**) "no event" at night (**c**) "event" during the day; (**d**) "event" at night.

It is evident that such great scale distinctive elements as historical buildings and the Christmas Tree during event have the most significant impact on the pedestrians. However, some elements appeared in more photographs than others. For example, for the "no event" period during the day, the building on the Pushkin St. (P16) was a main landmark, while the Government building was more photographed at night (P17). During the "event" period, the Christmas Tree (T17) was the element that had the greatest impact on the pedestrians. Positioning an element in the center of the space is not a guarantee that it will be photographed a great number of times. For instance, the central fountain (P12) was captured in the photographs only during the event because of the temporary lighting (Figure 9).

4. Discussion

4.1. Different and Common Attributes of the Pedestrians' Perception Between the "No Event" and "Event"

Pedestrians rarely take pictures of Lenin Square and urban elements in winter. Only 6% of urban design related images in Instagram were posted during winter in the absence of an event. However, during the winter event, this increased to 20%. Such temporary elements as an ice and snow sculptures, a Christmas Tree and ice slides, had an increased impact on pedestrians' impression of the urban environment, even when the temperature was ranging between seven degrees Celsius and–28 °C. Such elements as the Christmas Tree, ice sculpture "2018", "Bear" "Snowman", "Ded Moroz" (Santa Clause), "Snegurochka" and the "Dog" were photographed most often. These elements

have symbolic meaning of the winter and attracted most of the attention. During the "no event" period, people preferred to photograph historical buildings, including the Government building, Pushkin St. building, the Medical University building. Natural elements like the alley of trees had considerable impact on the pedestrians' perceptions as well. This is consistent with the assumption that, in the case of the permanent design, the most important elements in the pedestrians' impression were the largescale historical buildings and natural component of the environment alley of the trees. During the periods of temporary design, the great scale symbolic landmarks like the Christmas Tree had a considerable impact on pedestrians. Small-scale urban elements made from ice and snow were also shown to effectively improve the impressions of the pedestrians.

The perception of the permanent elements has similar pattern during the event. It was shown that pedestrians tended to disregard such small-scale permanent elements as the memorials, the statue and the street furniture during the event. Historical buildings and the natural component—the alley of trees—had a strong impact on pedestrians not only during the "no event" period, but also during the "event", despite the many temporary elements designed to attract the attention of people.

4.2. The Common and Different Attributes between Day and Night

There was a 17% increase in the number of the photos taken at night, with 150 images in total. This increase was due to the growth number of the photos of Christmas Tree. Moreover, well-lit permanent items were shown to critically enhance the impression of the pedestrians. While no photographs were taken of the permanent element "Central Fountain" during the "no event" period at night, and only two photographs were taken during the day, during the "event" period, when the element was highlighted by "New Year" illumination, 69 more images were taken. This emphasizes the significance of well-lit urban elements in winter cities. It can be concluded that lighting should be prioritize in the design of winter cities, since it improves pedestrian's perceptions of the urban environment. In addition, it is clear by the large number of photographs taken that pedestrians were impressed by well-lit temporary elements, with the ice sculpture "2018", with 17 more images at night. However, some urban elements received less attention at night: the snow sculptures, the "dog", "bear" and "snowman" were photographed less at night. It is assumed that this difference between ice and snow sculptures is due to the reflection of light by ice, making the ice sculpture more attractive at night than the snow sculptures.

5. Conclusions

In this study, the pedestrians' impression of the Lenin Square during the event "Ledyanoy gorodok" ("Ice Town") and after the event in winter was investigated by analyzing the number of the images posted within the square, that contained urban elements to determine to what extend the temporary design affects pedestrians' perception of the public open spaces in winter. An understanding the pedestrians' perception of temporary design is expected to define its role for public open space design in winter cities. The main findings of this investigation can be summarized as follows.

5.1. Pedestrians Less Perceive Public Open Space in Winter

Pedestrians had a little impression of the public open space in winter. Their attention draws to few urban elements as a historical buildings and natural environment that surrounds the public open space. Moreover, pedestrians disregarded the small-scale elements as fountains, statues or flowerbeds.

5.2. The Urban Design Elements Enhancing Pedestrian's Perception

However, the pedestrians' impression of public open space was enhanced to three times with the temporary elements, even when the temperature was ranging between seven degrees Celsius and–28 °C. An element, that enhanced impression the most, had a symbolic meaning of the winter celebration Christmas Tree. Moreover, ice and snow sculptures had a great impact on the pedestrians' perception of the place. It is revealed that combination of the ice and light enhanced impression at

night, while snow sculptures had significant impact during the day. In addition, an effect of the event on the pedestrians' perception of public open space depended on the combination of the temporary and permanent elements. For example, well-lit fountain by New Year Illumination created greater impression of the place. The lighting played an important role in creating greater impact, since temporary and permanent elements drawn more attention at night than it at day. Overall, despite the extreme low outdoor temperature, ranging from −10 to−30 °C degrees people still willing to enjoy the visual aspect of the public open space, that, as a result, enhance the outdoor activity in winter cities. Therefore, it is critical to include the temporary design as a second stage in the design process of the public open spaces in winter cities.

5.3. Analyzing the Instagram Images on the Content of the Urban Elements

A photo-sharing platform as Instagram provide a suitable basis to understand the pedestrians' perception of urban and natural environment and define the places that draw people's attention. Indeed, we cannot fully understand Instagram author's actual experience of urban environment and intention of posting photo. However, the understanding of what urban elements are captured on the photo and what is the target object, is significant point in enabling researchers of urban environments, urban designers and architects to define the distinctive or attractive urban elements. As a tool for analyzing these photos, the image classification using transfer learning with pretrained CNN has a great potential. This can simplify the processing of the classification of the data and is a faster overall process capable of scaling to the global scope of data. Moreover, the trained model based on the Instagram images posted on the Lenin Square can be applied to the temporary design-related studies of the squares in winter cities. This approach based on analyzing Instagram images on the content of the urban elements not only assist in decision-making process, but also involve pedestrians to take part in building urban environment that better response resident's needs and, consequently, facilitate in the building sense of place.

5.4. Temporary Design Elements Based on Permanent Design in Severe Climate Cities

In addition, not only are the pedestrians impressed by the variety of temporary elements, but their attention is also drawn to permanent elements. However, to enhance the pedestrians' impression of public open spaces temporary design is required in winter cities. Temporary design is trigger that initiate interaction with the physical environment and improves the impression of the public open space, while the permanent design provides the "stage" for it. The features of permanent design must be considered when planning the temporary design. Therefore, combination of temporary design and permanent design is considered as an approach for public open spaces to enhance the pedestrians' perception in winter cities, especially in severe climate.

Author Contributions: Conceptualization, A.A.P. and T.S.; methodology, A.A.P.; T.S.; software, A.A.P.; validation, T.S., N.W.; formal analysis, A.A.P.; investigation; A.A.P.; resources, A.A.P.; data curation, N.W.; writing—original draft preparation, A.A.P.; writing—review and editing, A.A.P.; visualization, A.A.P.; supervision, T.S.; V.I.L. All authors have read and agreed to the published version of the manuscript.

Funding: JSPS KAKENHI Grant Number 19K15159.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Pressman, N. *Northern Cityscape*; Winter Cities Association: Edmonton, AB, Canada, 1995.
2. Hatakeyama, Y.; Oku, T.; Mori, S. The Changing Appearance of Color of Architecture in Northern City A Comparison Study of Architecture's Appearance in Summer and in Winter, in Sapporo City-. *J. Asian Archit. Build. Eng.* **2005**, *4*, 161–167. [CrossRef]
3. Hatakeyama, Y.; Oku, T.; Mori, S. Peculiarity of Winter Townscape in Snowing-Cold Region by the Changing Appearance of Color. *J. Archit. Plan. (Trans. AIJ)* **2008**, *73*, 1915–1922. [CrossRef]
4. Pressman, N.; Zepic, X. *Planning in Cold Climates: A Critical Overview of Canadian Settlement Patterns and Policies*; Institute of Urban Studies, University of Winnipeg: Winnipeg, MB, Canada, 1986.
5. Rink, D.; Haase, A. Wayne K.D. Davies (ed.) 2015: Theme Cities: Solutions for Urban Problems. London: Springer (GeoJournal Library No. 112). *Int. J. Urban Reg. Res.* **2018**, *42*, 174–175. [CrossRef]
6. Smith, A. "Borrowing" Public Space to Stage Major Events: The Greenwich Park Controversy. *Urban Stud.* **2014**, *51*, 247–263. [CrossRef]
7. Stout, M.; Collins, D.; Stadler, S.L.; Soans, R.; Sanborn, E.; Summers, R.J. "Celebrated, not just endured:" Rethinking Winter Cities. *Geogr. Compass* **2018**, *12*, e12379. [CrossRef]
8. Theodore, D. Sense of the City: An Alternative Approach to Urbanism—Edited by Mirko Zardini. *J. Archit. Educ.* **2006**, *60*, 69–70. [CrossRef]
9. Whyte, W.H. *The Social Life of Small Urban Spaces*; Project for Public Spaces: New York, NY, USA, 1980.
10. Rota, F.S.; Salone, C. Place-making processes in unconventional cultural practices. The case of Turin's contemporary art festival Paratissima. *Cities* **2014**, *40*, 90–98. [CrossRef]
11. Jacobs, J. *The Death and Life of Great American Cities*; Random House: New York, NY, USA, 1961.
12. Eizenberg, E.; Cohen, N. Reconstructing urban image through cultural flagship events: The case of Bat-Yam. *Cities* **2015**, *42*, 54–62. [CrossRef]
13. Unt, A.L.; Bell, S. The impact of small-scale design interventions on the behaviour patterns of the users of an urban wasteland. *Urban For. Urban Green.* **2014**, *13*, 121–135. [CrossRef]
14. Bishop, P.; Williams, L. *The Temporary City*; Routledge Taylor & Francis Group: New York, NY, USA, 2012.
15. Lehtovuori, P.; Ruoppila, S. Temporary uses as means of experimental urban planning. *Serb. Archit. J.* **2012**, *4*, 29–54.
16. Lydon, M.; Garcia, A. *Tactical Urbanism*; Island Press/Center for Resource Economics: Washington, DC, USA, 2015.
17. Madanipour, A. Temporary use of space: Urban processes between flexibility, opportunity and precarity. *Urban Stud.* **2018**, *55*, 1093–1110. [CrossRef]
18. Németh, J.; Langhorst, J. Rethinking urban transformation: Temporary uses for vacant land. *Cities* **2014**, *40*, 143–150. [CrossRef]
19. Temel, R. The Temporary in the City. In *Temporary Urban Spaces: Concepts for the Use of City Spaces*, 1st ed.; Birkhauser: Berlin, Germany, 2006; pp. 55–67.
20. Bubalo, M.; van Zanten, B.T.; Verburg, P.H. Crowdsourcing geo-information on landscape perceptions and preferences: A review. *Landsc. Urban Plan.* **2019**, *184*, 101–111. [CrossRef]
21. Tieskens, K.F.; Van Zanten, B.T.; Schulp, C.J.E.; Verburg, P.H. Aesthetic appreciation of the cultural landscape through social media: An analysis of revealed preference in the Dutch river landscape. *Landsc. Urban Plan.* **2018**, *177*, 128–137. [CrossRef]
22. Qian, X.; Heath, T. Examining three roles of urban "portals" in their relationship with "places" using social media photographs. *Cities* **2019**, *90*, 207–215. [CrossRef]
23. Kandra, S.; Ghosh, M. Environmental Perception: Image Based Analysis of People's Impression of Places. *Int. J. Appl. Environ. Sci.* **2017**, *12*, 1223–1239.

24. Montgomery, J. Making a city: Urbanity, vitality and urban design. *J. Urban Des.* **1998**, *3*, 93–116. [CrossRef]
25. Lynch, K. *The Image of the City*; MIT Press: Cambridge, MA, USA, 1960.
26. Lebedeva, E. Public Space in Post-Soviet Cities: Sociability and "Crisis of Publicity.". *Zhurnal Sotsiologii i Sotsialnoy Antropol. (The J. Sociol. Soc. Anthropol.)* **2017**, *XX. № 1*, 74–92. [CrossRef]
27. Matveyeva, N.M. *Obshchestvennyye Tsentry Gorodov. Arkhitektura SSSR*; Stroyizdat: Moscow, Russia, 1972.
28. Shuklina, M.A. Urban Public Spaces: The Transformations in the Paradigm of Urban Planning from the Soviet Period to the Present Day. Master's Thesis, Vysokovsky Graduate School of Urbanism, Moscow, Russia, 2017.
29. Hatherley, O. *Across the Plaza: The Public Voids of the Post-Soviet City*; Strelka Press: Moscow, Russia, 2012.
30. Ladogina, E.V. Nastoyashcheye i budushcheye rossiyskikh obshchestvennykh prostranstv. *J. Russ. Psychol. J.* **2013**, *10*, 62–69. [CrossRef]
31. Kalyukin, A.; Borén, T.; Byerley, A. The second generation of post-socialist change: Gorky Park and public space in Moscow. *Urban Geogr.* **2015**, *36*, 674–695. [CrossRef]
32. Neugebauer, C.S.; Rekhviashvili, L. Loss and (re-)construction of public space in post-Soviet cities. *Int. J. Sociol. Soc. Policy* **2015**, *35*. [CrossRef]
33. Snopek, K.; Świetlik, T.; Petro, V.; Moore, N.W. Spectacle Square. Available online: https://www.thesitemagazine.com/read/spectacle-square (accessed on 18 December 2019).
34. Rossetti, T.; Lobel, H.; Rocco, V.; Hurtubia, R. Explaining subjective perceptions of public spaces as a function of the built environment: A massive data approach. *Landsc. Urban Plan.* **2019**, *181*, 169–178. [CrossRef]
35. Spravochno-informatsionnyy portal "Pogoda i klimat". Available online: http://www.pogodaiklimat.ru/climate/31735.htm (accessed on 3 July 2020).
36. Hansen, A. Public space in the Soviet city: A spatial perspective on mass protests in Minsk. *Nordlit* **2017**, *39*, 33–57. [CrossRef]
37. Galuzova, M.; Luchkova, V. Features of Urban Sphere of Khabarovsk Squares Architectural Formation (On Example Of Lenin Square And Komsomol Square). In Proceedings of the New Ideas of New Century, Khabarovsk, Russia, 20–27 February 2012; Volume 1, pp. 31–35.
38. Pod"yapol'skaya, A.; Pod"yapol'skiy, N. *Chto i kak delat' izo l'da i Snega na Zimney Ploshchadke*; Narkompros RSFSR, Glavsotsvos, Gosudarstvennoye izdatel'stvo; Moskva-Leningrad: Moscow, Russian, 1930.
39. Martí, P.; Serrano-Estrada, L.; Nolasco-Cirugeda, A. Using locative social media and urban cartographies to identify and locate successful urban plazas. *Cities* **2017**, *64*, 66–78. [CrossRef]
40. Wu, C.; Ye, X.; Ren, F.; Du, Q. Check-in behaviour and spatio-temporal vibrancy: An exploratory analysis in Shenzhen, China. *Cities* **2018**, *77*, 104–116. [CrossRef]
41. Dunkel, A. Visualizing the perceived environment using crowdsourced photo geodata. *Landsc. Urban Plan.* **2015**, *142*, 173–186. [CrossRef]
42. Encalada, L.; Boavida-Portugal, I.; Ferreira, C.C.; Rocha, J. Identifying tourist places of interest based on digital imprints: Towards a sustainable smart City. *Sustainability* **2017**, *9*, 2317. [CrossRef]
43. Fiegerman, S. Mashable. Instagram Now has More Daily Active Users on Mobile than Twitter. Available online: http://mashable.com/2012/09/27/instagram-passes-twitter-users/ (accessed on 9 April 2020).
44. Instagram. Total Number of Daily Active Instagram Users. Available online: https://about.instagram.com/about-us (accessed on 9 April 2020).
45. Lee, E.; Lee, J.A.; Moon, J.H.; Sung, Y. Pictures Speak Louder than Words: Motivations for Using Instagram. *Cyberpsychology Behav. Soc. Netw.* **2015**, *18*, 552–556. [CrossRef]
46. Manovich, L. Cultural Analytics Lab. Available online: http://lab.culturalanalytics.info/2016/05/instagram-and-contemporary-image-new.html (accessed on 20 July 2020).
47. O'Donnell, N.H. Storied Lives on Instagram: Factors Associated With the Need for Personal-Visual Identity. *Vis. Commun. Q.* **2018**, *25*, 131–142. [CrossRef]
48. Winter, J. Selfie-Loathing Instagram is even More Depressing than Facebook. Here's Why. Available online: https://slate.com/technology/2013/07/instagram-and-self-esteem-why-the-photo-sharing-network-is-even-more-depressing-than-facebook.html (accessed on 8 July 2020).
49. Lup, K.; Trub, L.; Rosenthal, L. Instagram #Instasad?: Exploring Associations Among Instagram Use, Depressive Symptoms, Negative Social Comparison, and Strangers Followed. *Cyberpsychology Behav. Soc. Netw.* **2015**, *18*, 247–252. [CrossRef]
50. Trifiro, B. Instagram Use and It's Effect on Well-Being and. Master's Thesis, Bryant University, Smithfield, RI, USA, 2018.

51. Boy, J.D.; Uitermark, J. How to study the city on instagram. *PLoS ONE* **2016**, *11*, e0158161. [CrossRef] [PubMed]
52. Crandall, D.; Backstrom, L.; Huttenlocher, D.; Kleinberg, J. Mapping the World's Photos. In Proceedings of the Track: Social Networks and Web 2.0/Session: Photos and Web 2.0, Madrid, Spain, 20–24 April 2009; pp. 761–770.
53. Abbott, W.; Donaghey, J.; Hare, J.; Hopkins, P. An Instagram is Worth a Thousand Words: An Industry Panel and Audience Q&A. *Libr. Hi Tech News* **2013**, *30*, 1–6.
54. Analytical Service Picodash. Available online: https://www.picodash.com/about/products (accessed on 9 April 2020).
55. Bogorov, V.; Novikov, A.; Serova, V. Self-Exploration of the City. Available online: https://projects.habidatum.com/#muscovites-emotions/ (accessed on 24 July 2020).
56. Dominguez-Sanchez, A.; Cazorla, M.; Orts-Escolano, S. A New Dataset and Performance Evaluation of a Region-Based CNN for Urban Object Detection. *Electronics* **2018**, *7*, 301. [CrossRef]
57. Xie, M.; Jean, N.; Burke, M.; Lobell, D.; Ermon, S. Transfer learning from deep features for remote sensing and poverty mapping. In Proceedings of the 30th AAAI Conference on Artificial Intelligence, AAAI 2016, Phoenix, AZ, USA, 12–17 February 2016; pp. 3929–3935.
58. Simonyan, K.; Zisserman, A. Very Deep Convolutional Networks for Large-Scale Image Recognition. In Proceedings of the 3rd International Conference on Learning Representations, ICLR 2015—Conference Track Proceedings, San Diego, CA, USA, 7–9 May 2015; pp. 1–14.
59. Russakovsky, O.; Deng, J.; Su, H.; Krause, J.; Satheesh, S.; Ma, S.; Huang, Z.; Karpathy, A.; Khosla, A.; Bernstein, M.; et al. ImageNet Large Scale Visual Recognition Challenge. *Int. J. Comput. Vis.* **2015**, *115*, 211–252. [CrossRef]
60. Deng, D.-P.; Chuang, T.-R.; Lemmens, R. Conceptualization of place via spatial clustering and co-occurrence analysis. In Proceedings of the 2009 International Workshop on Location Based Social Networks - LBSN '09; ACM Press: Seattle, WA, USA, November 2009; p. 49.
61. Rieder, B.; Uechi, F.F. RankFlow. Available online: http://labs.polsys.net/tools/rankflow/ (accessed on 24 July 2020).
62. Geographic Information System Company Esri. ArcMap. Available online: https://desktop.arcgis.com/ru/arcmap/ (accessed on 24 July 2020).