



Norwegian University of
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Granåsen Case Study: How Can Location and Design of a Bus Stop Influence the Use of Public Transport?

Karine Gjersø

Civil and Environmental Engineering

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Supervisor: Kelly Pitera, IBM

Co-supervisor: Kai-Arne Riersen, ÅF Reinertsen

Norwegian University of Science and Technology
Department of Civil and Environmental Engineering



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Name: Karine Gjersø			
Professor in charge/supervisor: Kelly Pitera			
Other external professional contacts/supervisors: ÅF Engineering			

<p>Abstract:</p> <p>The increase in Norway's population will provide an increase in travels estimated to about two million travels a day. This will result in a 300 billion NOK infrastructure investment if handled by cars, as well as an increase in greenhouse gas emissions. The Norwegian government has decided that further growth in transportation should be handled by walking, biking or public transport. Public transport (PT) needs to be efficient and environmentally friendly, but also comfortable and accessible, to promote a higher utilization. Thus, it is important to consider both design and location of the stops when designing a PT service.</p> <p>The aim of this study is to research whether location and design of a bus stop can influence people's willingness to use public transport. The thesis is a case study of a bus stop in Granåsen, Trondheim. A survey was sent out to existing and future users of the bus stop to get information on travel habits, and views on the design and location. A stated choice study was included to see if improving the design of a bus stop could influence the respondent's choice of transport mode or destination. Interviews, observations and literature analysis were executed and compared to the results of the survey. The study used data expressed by AtB, ÅF Engineering and Miljøpakken. The literature review looked into earlier research on PT, bus stop design and location, comfort and its effects on utilization of PT. The Bus Rapid Transit (BRT) system and the plans for the Superbuss were also researched. The thesis includes the aspects of mobility, the urban concept of shared space and the effects of outdoor environment.</p> <p>The analysis demonstrates that the public does not view an upgrade in design and location as an incentive for using the bus system, which also reflects previous studies. This is a relevant result as a redevelopment of a bus stop is an investment and thus, it is important to know if the outcome of the investment reflect the goal. However, this have been a small study, and it is recommended that a revealed choice study is executed to see if it people's behavior reflects their conceptions.</p>
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Keywords:

1. Bus Stop
2. Superbuss
3. Granåsen
4. Bus stop design

Preface

This is a master thesis written by Karine Gjersø for the Department of Civil Engineering at the Norwegian university of Science and Technology, spring 2017. The work is a part of the Msc – Master of Science. The topic was developed in collaboration with ÅF Engineering during the fall of 2016, in the pre-study for the master project. The research questions were developed during the pre-study and master thesis.

I would like to thank my supervisor Kelly Pitera, Associate University Professor at NTNU. She has given me continuous support and optimism, as well as great guidance and valuable feedback. I would also like to thank Kai-Arne Riersen, previous employee in ÅF Engineering, for help in developing the study.

I would like to thank Pål Gjersø and Terje Runde for their support, and also the great people in office 2-276 that have always been there with smiles and positivity, as well as great advice.

Trondheim 28.06.2017



Karine Gjersø

Abstract

The increase in Norway's population will provide an increase in travels estimated to about two million travels a day. This will result in a 300 billion NOK infrastructure investment if handled by cars, as well as an increase in greenhouse gas emissions. The Norwegian government has decided that further growth in transportation should be handled by walking, biking or public transport. Public transport (PT) needs to be efficient and environmentally friendly, but also comfortable and accessible, to promote a higher utilization. Thus, it is important to consider both design and location of the stops when designing a PT service.

The aim of this study is to research whether location and design of a bus stop can influence people's willingness to use public transport. The thesis is a case study of a bus stop in Granåsen, Trondheim. A survey was sent out to existing and future users of the bus stop to get information on travel habits, and views on the design and location. A stated choice study was included to see if improving the design of a bus stop could influence the respondent's choice of transport mode or destination. Interviews, observations and literature analysis were executed and compared to the results of the survey. The study used data expressed by AtB, ÅF Engineering and Miljøpakken. The literature review looked into earlier research on PT, bus stop design and location, comfort and its effects on utilization of PT. The Bus Rapid Transit (BRT) system and the plans for the Superbuss were also researched. The thesis includes the aspects of mobility, the urban concept of shared space and the effects of outdoor environment.

The analysis demonstrates that the public does not view an upgrade in design and location as an incentive for using the bus system, which also reflects previous studies. This is a relevant result as a redevelopment of a bus stop is an investment and thus, it is important to know if the outcome of the investment reflect the goal. However, this have been a small study, and it is recommended that a revealed choice study is executed to see if it people's behavior reflects their conceptions.

Sammendrag

Befolkningsøkning i Norge vil i fremtiden gi en økning i antall daglige turer til to millioner turer per dag. Dersom denne økningen skal håndteres med bil vil dette føre til en investering på 300 milliarder kroner, og i tillegg vil det bidra til økt utslipp av drivhusgasser. Regjeringen har derfor bestemt at all fremtidig transportvekst skal håndteres av kollektivtrafikk, sykling og gange. For å oppnå økt bruk må kollektivtilbudet må være effektivt og miljøvennlig, men også komfortabelt så vel som tilgjengelig. Det er derfor viktig å vurdere design og plassering av bussholdeplass ved prosjektering av nytt kollektivtilbud.

Målet med studien er å undersøke om plassering og design av en bussholdeplass kan påvirke folks vilje til å bruke kollektivtransport. Oppgaven er en casestudie om et busstopp i Granåsen, Trondheim. En spørreundersøkelse ble sendt ut til eksisterende og fremtidige brukere av bussholdeplassen for å få informasjon om reisevaner, tanker om design og lokasjon. Det ble også utført en Stated Choice - studie for å se om en forbedring av design og lokasjon vil påvirke folks valg av transport eller destinasjon. Det ble gjort intervjuer, observasjoner og litteratursøk, og disse ble deretter sammenlignet med resultatene av spørreundersøkelsen. Studien brukte også data gjort tilgjengelig av AtB, ÅF Engineering og Miljøpakken. Litteratursøket studerte tidligere forskning om kollektivtransport, design og plassering av bussholdeplass, komfort og påvirkningen dette har på bruk av kollektivtransport. BRT og planene for Superbuss ble også studert. Oppgaven presenterer også tanker om mobilitet, konseptet Shared Space og påvirkninger fra et godt utemiljø.

Studien demonstrerer at folk ikke vurderte en oppgradering av design og plassering av en bussholdeplass som et insentiv for å bruke busstilbudet. Dette reflekterer også tidligere studier. Dette resultatet er relevant da det er viktig å vite om en investering i en bussholdeplass vil ha et resultat som reflekterer målet. Dette har vært en liten studie og det er anbefalt å gjøre en ny studie for å se om folks handlinger reflekterer folks ideer om egne handlinger.

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Abbreviations

NTNU	Norwegian University of Science and Technology
PT	Public Transport
AADT	Annual Average Daily Traffic
BRT	Bus Rapid Transit
ITS	Intelligent Transport System
NPRA	Norwegian Public Road Administration
RTI	Real Time Information
NSD	Norwegian Centre for Research Data
NTP	Norwegian National Transport Plan

1 Introduction

This chapter presents the background and motivation for the study. The chapter also includes an introduction to the locations chosen for the case study, as well as an introduction to the goals and the research questions. In the end of the chapter, there will be an overview of the structure of the thesis.

The aim of this master is to research if improvement of design and location at a bus stop will increase utilization of PT. This is carried out by looking at the implementation of Superbuss in Trondheim, bus stop design as well as the properties of comfort. To provide a good solution for location and surroundings of a bus stop, the thesis looks into the aspects of mobility, the urban concept of shared space and the effects of outdoor environment.

The thesis is a case study of Granåsen in Trondheim. Accordingly, the city of Trondheim will be introduced, as well as Holmenkollen in Oslo. Holmenkollen is used as a comparison to Granåsen because of the similarity in the arena and its activities, and the agglomeration of buildings and activities. The introduction of Superbuss in Trondheim and the development of Granåsen is used as a motivation for the study.

1.1 Background

A report from TØI (Uteng and Julsrud, 2015) announces that the Norwegian society faces a complex set of challenges to balance protection of its environment, balanced population growth, immigration and sustainable urban growth.

The population in Norway is increasing, especially in urban areas and after year 2000, 70% of the population is expected to live in cities or densely populated areas (Butenschøn, 2013). The Trondheim region, introduced in section 1.2.1, expects an increase in population of 28% from 2010 until 2030 (Ruud and Norheim, 2011). This is shown in Figure 1.

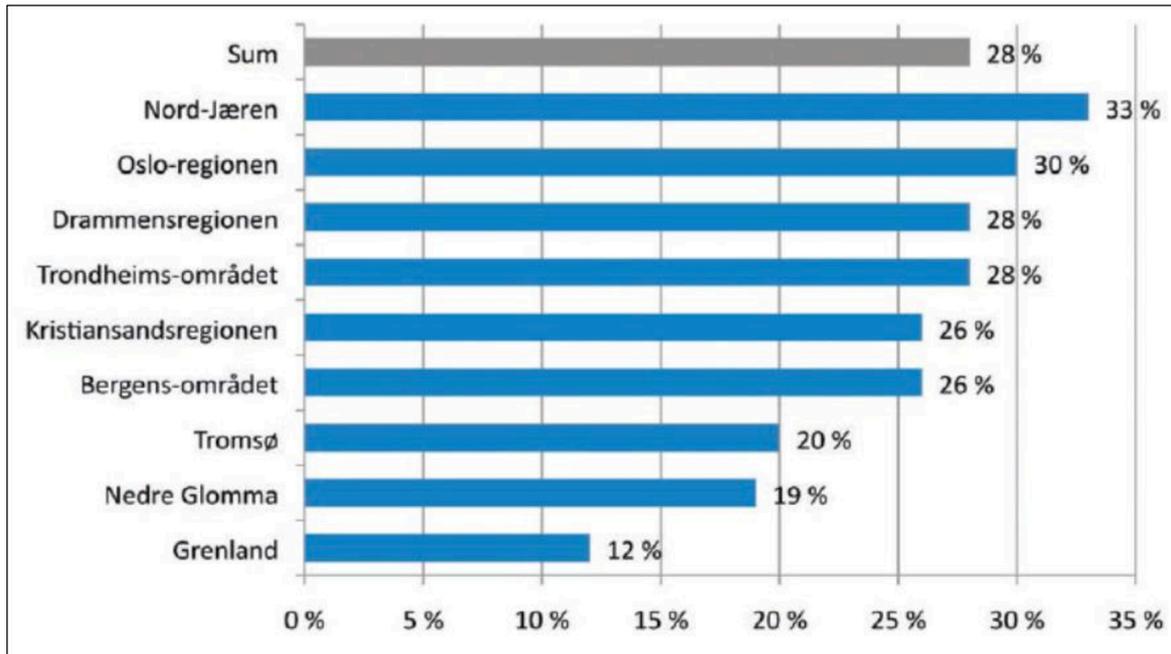


Figure 1: Expected population growth in different regions in Norway from 2010 to 2030. A 28% growth is expected in the region of Trondheim (Ruud and Norheim, 2011).

As the population increases, the need for transport increase simultaneously. The increase in travels in Norway, is estimated to about 2 million travels a day (Ruud and Norheim, 2011). Today, car usage and the share of the population who is using car as their primary mode of transport, is at its highest (Uteng and Julsrud, 2015). If this is to increase with the population, it will demand an infrastructure investment of 300 billion NOK (Ruud and Norheim, 2011).

An increase in car usage affects the city environment through congestion and pollution, as the transport sector is a large contributor to the air pollution (Grepperud, 2015). The increase also causes a considerable demand in oil and non-renewable energy, which impacts the environment. A reduction of the car usage is key to ensure a sustainable transport system for the future. The Norwegian government has therefore decided that all future growth in the transport sector should be handled by walking, biking or public transport (Solli, 2016, Regjeringen, 2011). This strategy, also known as Nullvekstvisjonen, would cost about 142 billion NOK in infrastructure investment over the next twenty years (Ruud and Norheim, 2011). Whereas a car based strategy, where all increase in transport would be by car, would cost double.

The urban transport requirement is an important part of a long-term strategy of city planning and development. To develop a transport system that is efficient, environmentally friendly and accessible, it is important to make a strategy that includes future transport preferences in combination with social growth patterns and travel trends (Uteng and Julsrud, 2015, Grepperud, 2015).

Public transport (PT) has an important transportation function in cities, towns and through regions. Improving public transport can contribute to the solution of the national challenges connected to welfare, mobility, transport, environment and universal design (Statens vegvesen, 2014a, Steinfeld and Maisel, 2012). Universal design is an approach of design that makes the environment usable for all people (Steinfeld and Maisel, 2012).

	Arbeid	Skole/ Studier	Handel/ service	Omsorg/ fritid ¹⁾	Alle reiser
Bil	0,3	0,0	0,5	0,6	1,7
Til fots	0,1	0,1	0,2	0,4	0,8
Sykkel	0,1	0,0	0,0	0,1	0,3
Kollektivt	0,1	0,1	0,1	0,1	0,4
Annet	0,0	0,0	0,0	0,0	0,1
Alle reiser	0,6	0,2	0,8	1,2	3,2

Figure 2: Travels for each person distributed by purpose and transport mode (Miljøpakken, 2016b.)

People travel every day using different transport modes for different activities. As shown in Figure 2, which is a result of a travel survey in Trondheim, the car is still the transport mode that is most used for travel even though 60% of the Norwegian population has good or very good access to a public transport where they live (TØI, 2014a). This means that there are still a large part of the population that needs to transition to other transport modes to meet the governments transportation goal.

Buses are the main element in the collective transport system in Norway. Some cities have trams but it is limited to the larger cities. As trams represent a big investment, the Bus Rapid Transit (BRT) has been developed as a cheaper solution. The BRT will be prioritized in

traffic, similar to the tram, but it will drive on the road network and requires a smaller investment. BRT will function as a comprehensive service with the same design throughout the network (Miljøpakken, 2016a). In Norway, the adapted version of BRT is called Superbuss. Superbuss is planned introduced in Stavanger and in Trondheim (Valmot, 2014).

The bus stop is an integrated part of the bus system, and is required as a part of the street where collective transport passes. In connection with the introduction of Superbuss, new bus stops are projected to meet the requirements of a comprehensive and high standard service (Miljøpakken, 2016a).

1.2 The Selection of Case

The case study was selected with the objective of finding a location that would provide opportunity to investigate the utilization of a bus stop. The case study should be a bus stop that was in daily use, but had a potential to be redeveloped as well as having a selection of potential users in close proximity. The bus stop should be located in Trondheim, out of convenience. It would also be a place where data about the bus stop could be provided.

Granåsen was selected as the case study. This was decided in collaboration with ÅF Engineering (ÅF). As ÅF is a part of the development of the new Granåsen, they provided information about the development. The development is expected to increase the capacity of the arena and nearby offices, which could provide users to the bus service. The bus stop is placed in a rural area with a high level of car use, so it was possible to look at the effects of the bus stop, and be less influenced by other factors. There have also been discussions about making a Superbuss route to Granåsen which will cause for a redesign of the bus stop and also a change in location for the bus stop. This will be presented in chapter 2, Theory.

Holmenkollen was chosen as a comparison to Granåsen as they both are arenas with primary focus on Nordic sport disciplines. Holmenkollen is, as Granåsen, placed outside of the city center and is connected with the city through PT.

The following sections will introduce Trondheim and Granåsen, and the current bus stop, which are the foundation for the case study. Holmenkollen will also be presented. These sections will provide an understanding of why Holmenkollen was chosen as a comparison to Granåsen.

1.2.1 Trondheim



Trondheim is a city municipality in Norway. It is placed in the middle of Norway, see Figure 3. It is an old city with history from the Viking age, but the existing municipality was established in 1964 (Rosvold, 2017).

Trondheim has long traditions as a centre for education, as the largest university in Norway, Norwegian University of Science and Technology (NTNU), has been located in Trondheim since 1910. Trondheim is also the industry and trade centre for its county and the north of Norway.

In a global scale Trondheim is a small city, but it is the fourth largest city in Norway (Statistisk sentralbyrå, 2015). The numbers of habitants and students that lives in Trondheim, are presented in Table 1.

Figure 3: Trondheim’s geographical placement in Norway (Farmers produkter A/S, 2015).

Table 1: Trondheim in numbers (Trondheim Kommune, 2016b).

Habitants	180 000
Students (in addition to habitants)	36 000
Households	83 000
Area	342 km ²

As the population of Trondheim is growing rapidly, the Trondheim municipality decided in 2008 to enter a partnership with Sør-Trøndelag county authority, NPRA and the National Agency for Rail Services to provide a sustainable transport solution for the municipality. This project is called Miljøpakken (Miljøpakken, 2017a).

Miljøpakken invests in new roads, bridges, bike lanes, sidewalks and environmental streets, with an aim to reduce traffic congestion and greenhouse gas emissions, and generate an increase in daily users by providing an efficient, modern and environmentally friendly PT service (Solheim and Nervik, 2013).

A large increase in population demands efficient PT solutions. With an expected population growth of 28% percent, shown in Figure 1, and a goal that future growth in transport will be by other modes than the car, Miljøpakken has decided that the future PT should manage a 60% increase in users (Miljøpakken, 2013b). Superbuss is one of Miljøpakken's investments which should help Trondheim reach the government's goal of zero growth in car traffic (Miljøpakken, 2017b).

1.2.2 Granåsen

The Granåsen arena, shown in Figure 5, was built for the Nordic World Ski Championship of 1997. Today, Granåsen is the main arena in Trondheim for Nordic winter sports as ski jumping, cross country skiing and Nordic combined, with two ski jumps and arenas for cross-country, biathlon and roller ski (Trondheim Kommune, 2017, Trondheim Kommune, 2016b, Trondheim Kommune, 2016a). The arena is located in the outskirts of Trondheim city, see Figure 4. The

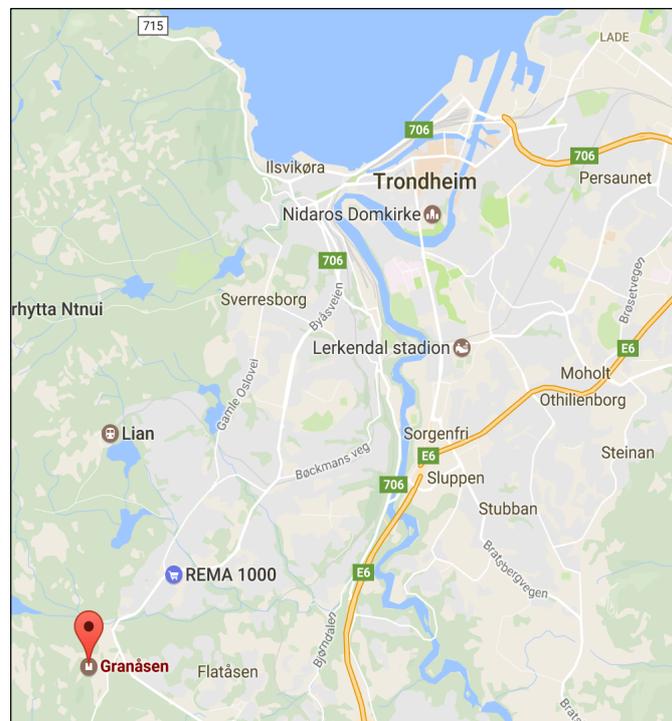


Figure 4: Location of Granåsen (Google, 2017c).

arena also holds a conference centre, a public gym and offices for the Olympic and Paralympic committee.

The Ski Jump World Cup is arranged annually at Granåsen, as well as other sports competitions and events. Other types of events such as concerts and school activity days are also part of the arenas activities.

Granåsen is used in both summer and winter seasons for recreational activities such as cross-country skiing, hiking and walking. Granåsen is as a meeting point between the forest area of “Bymarka” and the city.

Development of Granåsen 2023



In August 2016, the city council in Trondheim decided to develop a new arena in Granåsen which includes a new ski jump, a stadium surrounding the ski jump, as well as development of the surrounding areas. The arena will be developed as an every-day stadium as well as a stadium for top-level athletics. The arena in Granåsen should also be able to host large events as the FIS Nordic World Ski Championships (Dahl, 2017). The goal is to stimulate to increased activity for the population in Trondheim and to encourage better public health.

Figure 5: Granåsen (Trondheim Kommune, 2016b).

Trondheim municipality is the owner of the arena and will provide funding for the arena which is estimated to cost about 900 million NOK. The project is estimated to finish in 2023.

The development of Granåsen 2023 will proceed in four steps, where the first step focuses on the cross-country stadium and the second step will be building new ski jumps. Step three and four includes building a new sports arena, media center and other buildings that can be used as offices by the industry (Byplankontoret, 2016).

Representatives for the development in ÅF Engineering have explained that this expansion will cause a higher demand in PT as there will be an increase in users. It is expected that this new development will result in 20% more users in Granåsen than today. This increase in users is assumed to reflect onto PT. It is difficult to estimate how large the increase of use of PT will be, but with a good and efficient system one can imagine that users without cars, students and children, will find the PT to be a good alternative. With a higher demand, it is also easier to improve upon the service and attract more users. Because of the close connection to the city and an expected increase in users, Granåsen is to be considered in connection with the future development of the Superbuss (AtB, 2016b).

PirII, which is the architect firm that collaborates with ÅF, has suggested two alternatives for the development steps three and four, shown in Figure 6 and Figure 7. The alternatives include new buildings that will be housing offices, as well as new indoor sports arenas. The two alternatives are very much alike, but offers different solutions for the placement of the building structure and outdoor areas.

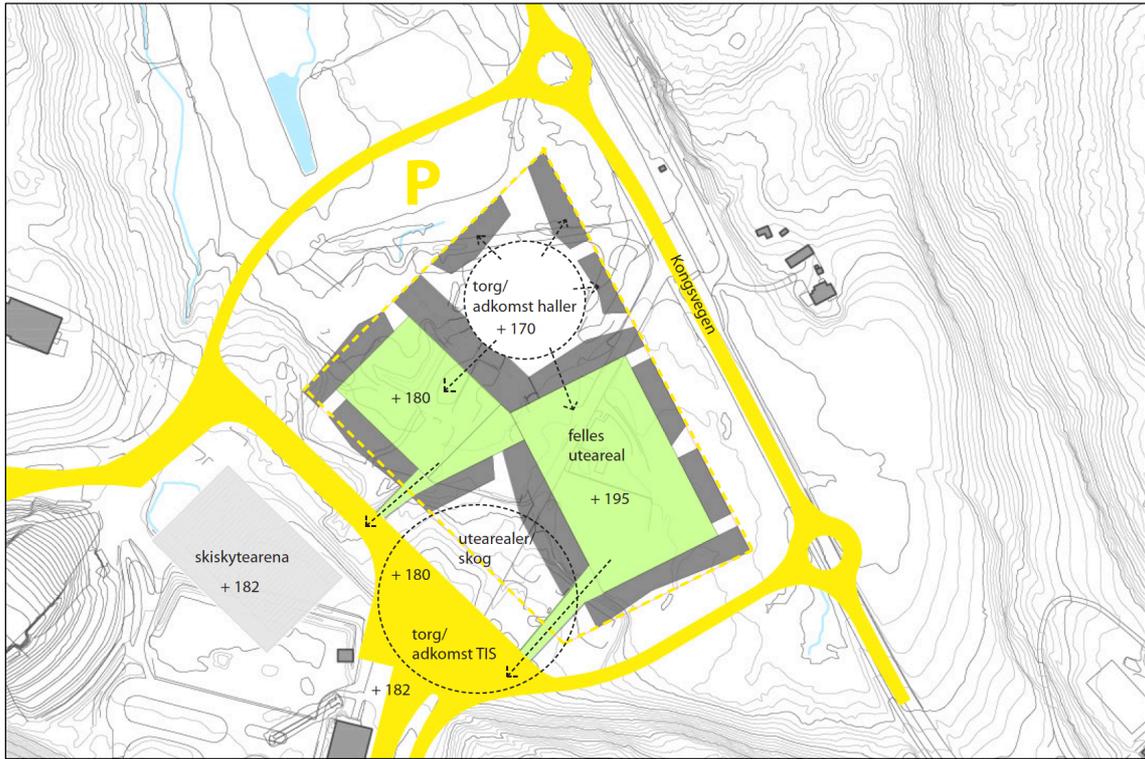


Figure 6: Development Plan A (PirII, 2017).

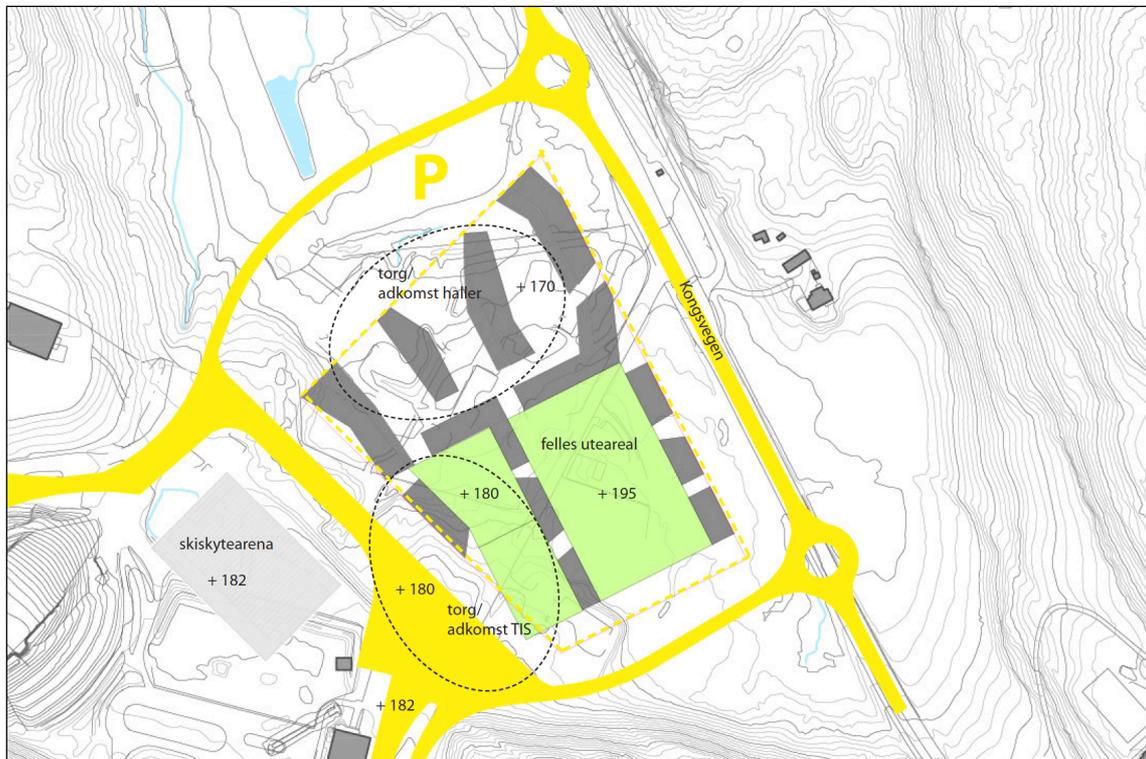


Figure 7: Development Plan B (PirII, 2017).

Both alternatives have a road planned around the new buildings to provide a large circulatory drive. The new road should provide easier access to the ski jump and the biathlon arena. Kongsvegen, the main road passing Granåsen, is at a lower level than the biathlon arena, which makes it important to have a road up to the arena to simplify transport of equipment and also simplify access for people with disabilities. The new road will provide higher capacity when accessing the arena as there are two entrances/exits from Kongsvegen.

Existing Bus Stop

The existing bus stop in Granåsen is located alongside Kongsvegen. This is a two lane county road with a traffic volume of 14000 annual average daily traffic (AADT) (Statens vegvesen, 2016).

The bus stop has a small bus bay, shown in Figure 8 (right). A bus bay should provide a possibility for other cars to pass (Statens vegvesen, 2014a), but as this bay is too small for the width of a bus, the bus cannot pull completely to the side and as a consequence the traffic may stop. In the winter, the bus bay is not ploughed, consequently the small bay disappears and the bus stops within the traffic lane, see Figure 8 (left).

The facilities of the bus stop are comprised of a small shelter, a timetable, a bench and a garbage bin. The shelter is placed behind a small sidewalk and there is no possibility of passage behind the shelter.



Figure 8: Existing bus stop in Granåsen. Left: during winter. Right: bus bay during summer (Google, 2017b).

1.2.3 Holmenkollen

Holmenkollen is an arena for Nordic sports disciplines located in Oslo (Sjulstad, 2017, Skiforeningen, 2016), see Figure 9. Holmenkollen doubles as an arena used for festivals, different competitions and races as well as an arena for other outdoor activities. The arena includes facilities as a ski museum, a zip line and the ski jump tower is also available for visits and are especially interesting for tourists. Holmenkollen is owned and managed by the municipality of Oslo, but The Norwegian Ski Association (Skiforeningen) is responsible for organized training and events, and operates the ski museum.



Figure 9: View over the arena in Holmenkollen, with the ski jump to the left and the biathlon and cross- country arena on the right side.

To get to Holmenkollen, one can take the metro called “T-bane” from the city center. The metro has a capacity of 9000 persons per hour. It is also possible to walk to the arena from the city center and on days without events, there are available parking lots around the arena.

The metro station is built with a “metro standard” which provides a long platform with a lot of seating, protection from the weather by shelters with roofs and walls, and ticket machines that makes it possible to buy tickets before boarding the metro (HAV eiendom, 2017, Wikipedia, 2017). The stations provide real time information on arrival time, through electronic signs on the station, see Figure 10. The “metro standard” is based on similar considerations as the

standard for stations provided by the Superbuss solutions. This will be introduced in chapter 2, Theory.



Figure 10: Metro standard at Holmenkollen station, with a ticket machine and RTI.

1.3 Research Question

The subject of the thesis was developed in collaboration with ÅF. As the Superbuss is planned to be developed in Trondheim, it was decided that the thesis should research how improving a bus stop could influence utilization. During the work of the pre-study it was decided that the study should focus on the bus stop, and it was narrowed down to looking at design and location. The following hypothesis was made:

It is possible to attract users to public transport by improving the design and location of a bus stop.

This hypothesis is the basis of the study. As it is a complex hypothesis, four research questions were made to provide a thorough answer to control the hypothesis legitimacy. The four research questions follow:

1. What are the most important design facilities at a bus stop?
2. Which aspects of a bus service must be present to reach a higher utilization?
3. How can the bus stop be located so it provides good mobility for vehicles and people through the space, both on a normal day and during events?
4. Which facilities, connected to the bus stop, can increase the use of Granåsen?

The first and third questions are directly related to the hypothesis by looking at design facilities and location of the stop. The second question looks into what factors research says increases utilization. The last question does not directly tie into the hypothesis but is relevant because a higher utilization of Granåsen can lead to a higher utilization of PT.

The questions will be answered by analyzing data that is collected by survey, interviews, observations and relevant sources. This will be compared to the literature review to then find an answer to the hypothesis.

1.4 Structure

The thesis consists of six main chapters along with references and appendix. The first chapters introduce the study and the theory that is relevant to the thesis. Then, the method, procedure and the results of the methods will be presented. The final part of the thesis discusses the results and comes to a conclusion based on the discussion. Table 2 outlines the structure of the thesis and contents of the chapters.

Table 2: Structure of the thesis.

<i>Chapter</i>	<i>Content</i>
1 Introduction	The background and reason for the thesis are presented with the selection of the case, as well as research questions.
2 Theory	The theory behind the thesis is presented, which includes BRT, Superbuss, bus stop and more information that is relevant to the analysis.
3 Method and Procedure	Presentation of the methods that were used during the study and how data was collected.
4 Results	Presentation of the result from different methods used in the study.
5 Discussion and Evaluation	Discussion of the results from the analysis and the literature review. The chapter also evaluates weaknesses and limitations of the study.
6 Conclusion and Suggestions for Further Research	Presentation of the conclusion and recommendations for further research.

The appendices that are relevant to the study are attached in the following order:

- Task description
- Information letter to respondents of survey
- Survey
- Observations
- Interviews

2 Theory

This chapter presents the theory relevant for the thesis. The chapter starts with an introduction to how the literature review was executed to be followed by a summary of earlier research on the topic. Subsequently comes an introduction to what public transport is, what the BRT service is and how it will be adapted to the Norwegian Superbuss. This chapter will also introduce seven goals to reach a good bus stop design, as well as the plans for design related to BRT and Superbuss.

The last sections will introduce concepts in connection with bus stop design, such as mobility, the urban concept of shared space and the effects of outdoor environment.

2.1 Literature Review

Literature reviews are used to give an overview of what is previously done in the field of research. Missing research in the field of study will be discovered by systematically searching through relevant literature and analyze the material gathered (Everett and Furseth, 2012).

Search engines, such as Scopus and Oria, were used to find sources to the master thesis that were relevant and reliable. Scopus and Oria are online international databases that are used to find published academic research in the field. Some of the key words used in the searches are shown in Table 3, and they are both in English and Norwegian. EndNote was used as a referencing tool.

Table 3: Research words for the literature review (search words are both in English and Norwegian).

<i>Search Theme</i>	<i>Search Word</i>
Public Transport	Public transport, Kollektivtransport, Public Transport Comfort, Buss over bil, Buss, Superbuss, PT Quality, PT Demand
Shared Space	Shared Space, Shared space bus, Shared space users, The Street, Jan Gehl
Bus Stop	Bus Stop Location, Bus Stop Design, Stasjonsplassering, Quality Attributes
Mobility	Mobility, Mobility Car, Spatial, Heated Shelters, Urban Design Mobility
Comfort	Comfort, Comfort PT, Waiting environment, Demand and comfort PT

2.2 Earlier Research

To find an objective for the study, earlier research was used to see what have been studied previously and which aspects needed still to be studied. The focus of the literature search was to see if there been done studies on how the design of bus stops could influence the utilization of the PT, in this case the utilization of the bus service. In summary, most studies that have been carried out on this topic has focused on the overall effects of improving the service and did not focus on the bus stop as a singled-out part.

There have been studies on PT quality and how these attributes can affect use (Redman et al., 2013). These studies have looked at both physical and perceived quality. Physical attributes include for example reliability, frequency, speed price and information provision. These attributes can be measured without involving PT users, but perceived attributes as comfort, safety, convenience and aesthetics are difficult to measure since the PT users must be observed directly or indirectly (Balcombe et al., 2004, Friman et al., 2001). Balcombe et al. (2004) looks into the effects of quality of service, which also includes effects of a comfortable waiting environment. They look into the value of a trip for service facilities in London and in Edinburgh by using stated preference analysis. With basis in previous studies about the impact of improved shelters and facilities in a bus stop, Balcombe et al. (2004) concludes that

individual improvement of a stop may have a modest impact, while an overall improvement and implementation on all stops in a bus route can have a higher impact.

Research that includes all of the quality attributes have shown that fare prices and speed are critical to the customer satisfaction (Tor Wallin, 1995, Eboli and Mazzulla, 2008). The research has also shown that the age and income of the samples affect the research; as low-income students was the general specification of the users that was in the sample, so the research may not represent the population (Eboli and Mazzulla, 2008).

Car ownership is shown to be related to income which makes the low-income sample more likely to use PT because they have no other choice of transport mode. This can cause this group of passengers to view the PT service more negatively (Redman et al., 2013). The Norwegian Travel Survey of 2013/14 shows that 91% of the adult population holds a driver's license, and 88% belongs to a household with a least one car. A person between the age of 45 to 54, and fulltime employees with an personal income above 500 000 NOK a year, will statistically live in a household with at least one car. (TØI, 2014a)

Zhang (2012) introduced seven goals to design a good bus stop which is explained further in section 2.3.3. This research also showed that urban concepts as shared space can be used to provide good solutions for the surroundings of a bus stop, as well as finding a solution for the surroundings where buses and people can interact in the same area.

During the development of Superbuss in Norway, research has focused on making bus stops with a high level of comfort and universal design. However, it has not been researched how this can affect the utilization. However, the Superbuss is based on an idea that high standard and efficient service will provide higher utilization (Miljøpakken, 2016a, Simonsen, 2016).

2.3 Public Transport

Public transport is represented by transportation modes as tram, railway, bus and metro, where you travel with other passengers in a fixed service that has predetermined stops along a route. Passengers access the service at different stops, provided that they pay for a ticket. The

services are available to the general public. Taxis are also classified as public transport as they can be of general use by the public (Balcombe et al., 2004). However, this master will not look into the taxi service as a part of PT.

Private transport is transportation modes as walking, bicycling, motorized cycling and private cars. These modes of transport can be used at any time and from anywhere provided only with a path or a road. Private transport offers greater flexibility and privacy than PT. Perceived costs may also be smaller with private cars than PT as PT involves tickets for each person, where families can travel together in cars and the costs are divided by the occupants (Balcombe et al., 2004).

Even though PT is not used as much as the car, the PT is used for a range of purposes and by a large spectre of the population with different levels in income and car and car ownership, who lives in different areas and are of different sexes and ages (Balcombe et al., 2004).

2.3.1 BRT

BRT (Bus Rapid Transit) is a rapid mode of transportation that can provide the functions of rail transport modes but with the flexibility of buses (National Research et al., 2007). BRT is also a sustainable and viable alternative to car (Holmgren, 2007). The buses will function as alternatives to metro and trams, and transport larger numbers of passengers over longer distances. This is possible because BRT operate at higher frequencies, fewer stops placed farther apart than compared to regular bus service (Machler and Golub, 2011). See an example of BRT in Figure 11.

Efficiency is an important aspect of a BRT system. This will be ensured by signal priority in traffic, dedicated bus lanes, ticket machines on stations and easy-to-board vehicles. Intelligent Transportation System (ITS) technology such as real-time information (RTI) and ticket applications is important to ensure good efficiency of the system (National Research et al., 2007).

The BRT system should have a distinctive identity which is provided by distinguished design of bus and stations, and special labeling (Machler and Golub, 2011). In the BRT system, the bus stops are referred to as bus stations, to state a similarity to rail services. In this thesis, both “bus stop” and “bus station” will have the same signification.



Figure 11: BRT with separated bus lanes (Ringquist et al., 2014).

The BRT system is cost efficient and flexible. The investment cost will be higher than a local bus service, but far less than by a rail system that needs a separate infrastructure. BRT can also be implemented quickly and incrementally serving a broad variety of city environments (National Research et al., 2007).

BRT was first implemented in Curitiba in Brazil, in 1974. It was a great success as it had a low-cost implementation and operational flexibility. After this success, BRT grew in popularity especially in developing countries with limited resources. Recently larger cities in North America, as Los Angeles, Las Vegas and Boston has also implemented BRT as an alternative to rails transits (Machler and Golub, 2011).

Today, a lot of countries and cities all over the world implements the BRT system. The systems all include the same basic features listed in Table 4, but with local adaptations as every country have local differences in investment, space, users etc. In Norway, the BRT service is

called Superbuss and will be implemented in Stavanger and Trondheim by 2020 (Statens vegvesen, 2014a, Statens vegvesen, 2014b, Jensen, 2015).

Table 4: Main features of BRT system (National Research et al., 2007).

Main features of a BRT system:

Dedicated lanes

Accessible, secure and attractive stations, placed farther apart

High frequency of departures

Easy-to-board vehicles

ITS technology for signal priority and real-time information

Efficient fare collection before boarding

Distinctive system identity

2.3.2 Superbuss

"Envision rails – build bus" (Bråten, 2017)

This section will present and provide information about the Superbuss and the plans for development of Superbuss in Trondheim.

In most Norwegian cities, the regular bus service has been a part of the city environment as it has been the most utilized mode of public transport. Due to the scattered settlements in Norwegian cities, buses have struggled with keeping timetables and are also associated with being delayed by congestion. The regular bus service has therefore not been perceived as efficient as its potential.

Other transport modes like the tram and the underground system have been considered as alternatives to a bus system. These systems are popular and efficient since they will not have to yield for other transport modes. However, the small size of cities and population in Norway, the investment cost of a tram or underground railway system are too high, and not cost efficient. BRT was therefore considered a good alternative.

In Norway, investments in PT are a result of national and municipal transport politics, largely based on the Norwegian National Transport Plan (NTP), which is an outline on how the Government intends to prioritise resources within the transport sector during the next twelve years (The National Agencies, 2017). In Trondheim there are large political expectations to a new PT service (Tran, 2014). An important goal for the development is higher utilization of PT as this will contribute to a better and more environmentally friendly city. This goal is hoped to be fulfilled by developing a BRT system – Superbuss, which is said to be the future of environmental transport in Norway (Sør - Trøndelag Fylkeskommune, 2016).

As previous experiences of BRT have been in cities with much denser populations than the cities in Norway, it has been hard to get comparable experiences. Previous experiences can still show the tendencies even though it cannot be an accurate comparison for the Norwegian system. When looking at these experiences it shows that traffic safety is improved, especially with separate lanes. The system has also had a good effect in passenger number and use, with a large increase in users, from a 24% increase and upwards. Experiences have also reported of good pollution data when it comes to greenhouse emissions, but there are some reports on increase in noise pollution (Miljøpakken, 2013b).

The Superbuss is modified to accommodate for Norwegian conditions and is already being implemented in Stavanger. This modification is mainly based on population and geography (Tran, 2014), as cities in Norway are smaller in population and usually has a challenging topography and climate.

The Superbuss is a comprehensive concept which focuses on efficiency on the stations, when boarding the bus and in traffic. The buses are expected to have good accessibility in the cityscape independent of traffic. High standard and comfort on buses and stations needs to be provided. The Superbuss system will have an incremental development estimated to four years (Miljøpakken, 2013b).

In Trondheim, the bus stations will be located farther apart, from an average distance of 390 meters on the regular bus service today to an average distance of 550 meters with the new Superbuss. There will be developed three primary routes as basis for further development.

- S1: Kattem/Heimdal – Ranheim
- S2: Kattem/Saupstad – Lade/Strindheim/Skovgård
- S3: Hallset – Lohove

The routes are demonstrated with black lines, O's and K's in Figure 12.

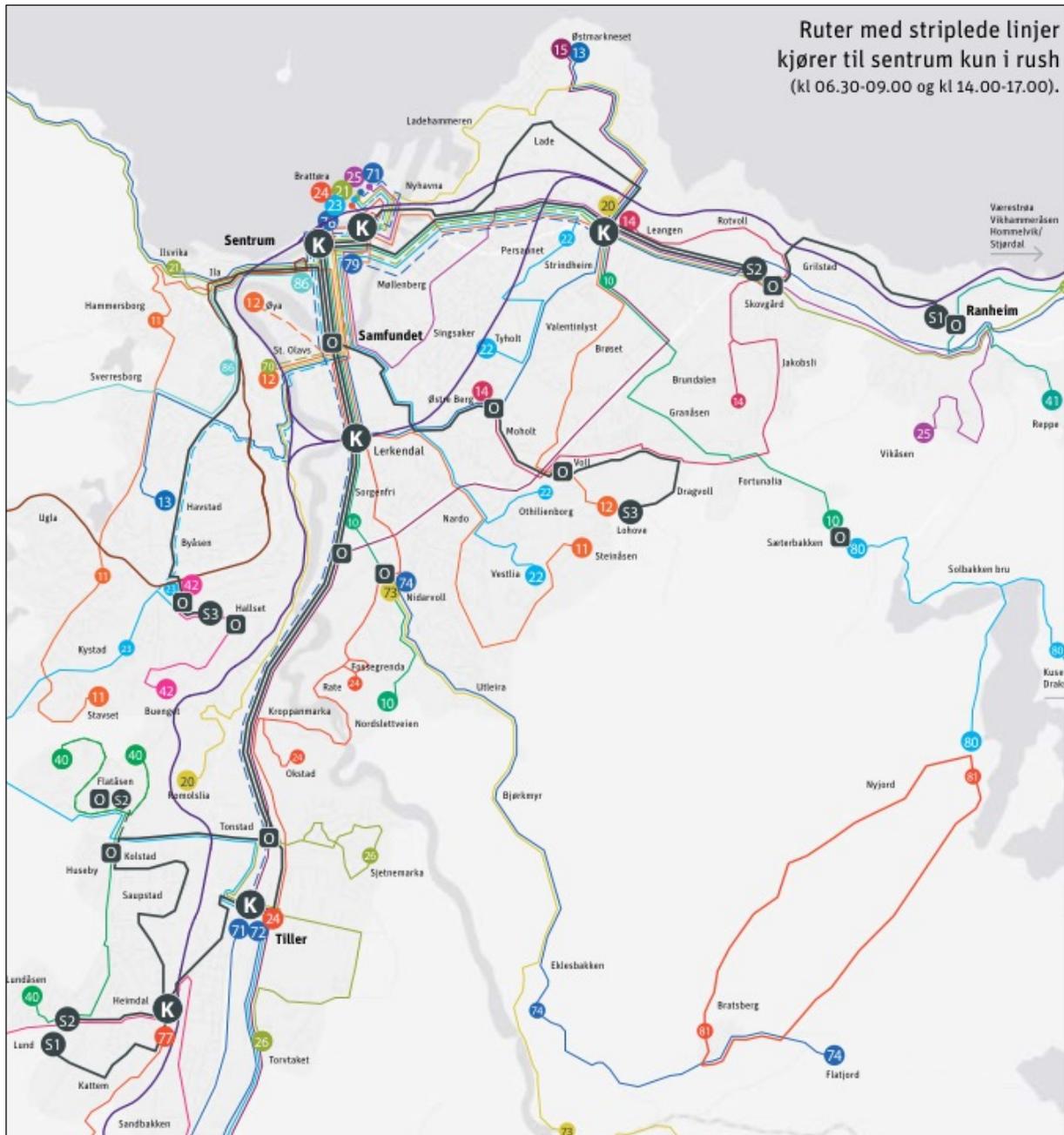


Figure 12: Future bus map for Trondheim including the new Superbuss routes S1, S2, S3 (AtB, 2016a).

To increase efficiency the Superbuss needs safe accessibility with straight distances which will be provided by separated bus lanes. It has not yet been decided if the lanes are going to be centered in the road or placed on the sides of the traffic lanes. These lanes will provide a higher efficiency in traffic, as well as increasing the capacity on the routes which will result in a regular and punctual service. ITS solutions will be used to provide signal priority for buses, and distribute real-time information to passengers. The bus service with its stations should be easy to locate and use, and show a clear identity that is visible in the cityscape (Simonsen, 2016).

The development plans as of today do not include a Superbuss route to Granåsen. However, a study of future service includes plans of a route that goes from Ila to Rydningen, and is extended from Munkvoll to Granåsen when there are larger events in Granåsen. With an increase of demand, the extension to Granåsen is to be considered as a permanent route. The extension is shown in Figure 13 (AtB, 2016b).

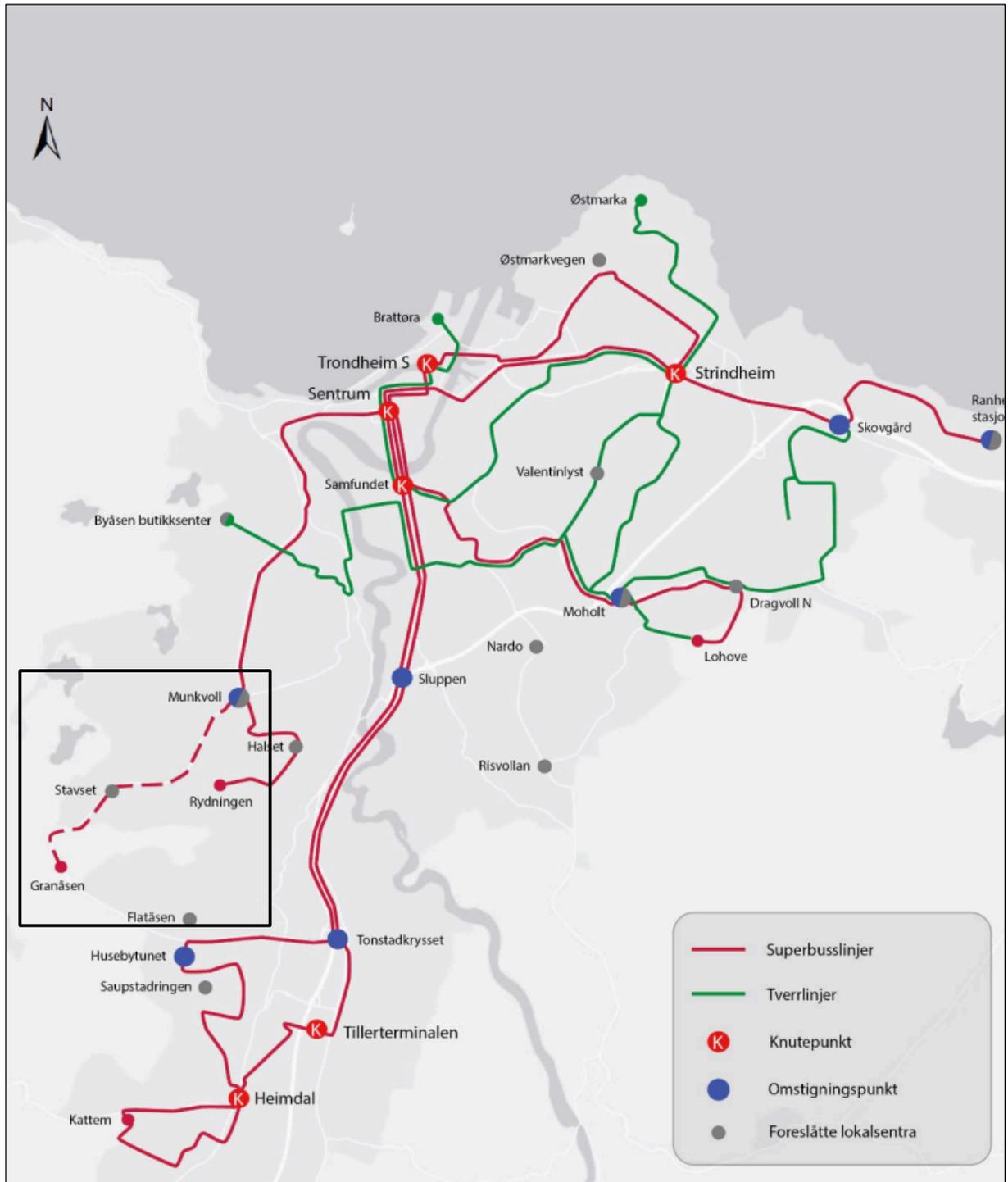


Figure 13: Dotted line shows extension of Superbuss from Munkvoll to Granåsen (AtB, 2016b).

2.3.3 Bus Stop Design

Location and design of a bus stop can serve many purposes: it is a part of the PT system and a part of the urban city life. This section presents the goals for providing a good bus stop, the design of Superbuss stations and an evaluation of existing stops in the city center of Trondheim.

Seven Goals of Bus Stop Design

Improvement of the bus stop leads to a more comfortable waiting environment that again will lead to greater rider satisfaction. This is shown in a study about bus stop design executed in Vancouver, Canada. Zhang (2012) identified seven goals for bus stop design that would increase the comfort by giving a shorter perceived waiting time, which could lead to higher utilization of PT, see Table 5. Five of the mentioned goals relates to the design facilities at the bus stop, and two relates to the location. All of the goals will be further presented underneath the table.

Table 5: Seven goals for designing a good bus stop (Zhang, 2012).

<i>Design facilities</i>	Safety
	Thermal Comfort
	Acoustic Comfort
	Wind Protection
	Visual Comfort
<i>Location</i>	Accessibility
	Integration

Safety, more precisely personal safety, is the basis upon improvements can be evaluated. A low level of perceived safety can be a result of criminal activity as vandalism, high risk traffic situation, the risk of an accident, or an unwelcoming environment. This can cause passengers not to use the bus stop. To avoid risk of accidents, barriers can be built between waiting passengers and high-speed transport modes. This can be physical barriers, traffic lights and crosswalks. Traffic calming techniques can also be used, for example the concept of shared space where separations between travel modes are removed, encouraging eye contact between

the users. Shared space is introduced more thoroughly in section 2.6. Crime and vandalism in public spaces happens because of a window of opportunity occurs. This can be mitigated to by surveillance, either by ensuring nearby activity, making the bus stop observable with lighting at all times, or some form of surveillance. When implementing measures to increase safety, one cannot ensure a complete feeling of safety. This is because the feeling of safety is individual and evaluated differently based on age, gender and familiarity with an area.

Thermal comfort is what primarily determines the level of comfort of an individual. In areas with low or high temperatures, solutions like air-conditioning or heating should be considered to provide a good microclimate for the waiting passenger. People generally adapt their behavior to cool down by cool fluids or heat up with extra layers of clothing, so in most circumstances there are no need for external temperature alteration.

The acoustic environment is not much discussed as a focus of passenger comfort, even though this affect the passenger while using PT. Sounds can be in the background, the foreground, it can consist of traffic noise and other urban noises. People accept a noise level between 40-70 dB, but this can vary depending on the situation. The acoustic comfort may also be influenced by peoples cultural and personal preferences.

It is important to protect the waiting passenger for both the thermal and mechanical effects of wind. The thermal effect of wind refers to the thermal comfort of the waiting passenger, which is mentioned above. The mechanical effect of wind is very noticeable at 10 m/s as walking becomes unpleasant. At lower speeds the wind can give a negative thermal effect, but the mechanical effect will still be felt as tolerable. To decrease the impact of the wind it is important to provide a barrier to hinder both wind speed and turbulence.

People are highly adaptive to lighting, but they always welcome more light, especially sunshine, as it affects their visual comfort. Visual comfort refers to a person's visual attention which seeks activities, or an open part of a site. Improving visual comfort can be done by ensuring light from the sun to reach the bus station, and providing visually stimulating objects.

Accessibility describes the ability to reach certain opportunities or points, and the quality of the travel (SUSTRAN). In this thesis, it is defined as the ability of a person to reach the bus stop. Accessibility is important so that all segments of the population can have access to the bus stop and by that, the bus service. Demands of basic accessibility should be met and it is important to implement universal design to include everyone irrespective of mobility (TransLink, 2007). The goal of accessibility also includes providing connectivity between transport modes. Cycling infrastructure is important in suburban areas where there are longer distances to the bus stop.

The last goal of bus stop design is integration into the surroundings. The orientation of the bus stop and the facilities at the stop should be integrated with the surroundings, and reflect the area. Studies have shown that proximity to shops, catering establishments and businesses contributes to the attractiveness of a bus stop. A bus stop can also be source for new neighborhoods as it is a gateway to other areas.

Design of Superbuss stations

BRT systems worldwide has a wide range of station types and features (National Research et al., 2007). The stations are influenced by cost and performance, and variations in facilities at the stations, occur. National Research et al. (2007) have made a table for different types of BRT stations and their features, see Figure 14.

EXHIBIT 4-64 BRT Station Types and Features

Feature	Curbside Bus Stop		Median Arterial Busway		Busway		
	Typ-ical	Major	Typ-ical	Major	Typ-ical	Major	Inter-modal Center
Conventional shelter ¹	X						
Unique BRT shelter	X	X	X	X	X	X	X
Illumination	X	X	X	X	X	X	X
Telephones/security phone		X	X	X	X	X	X
Temperature control			X	X ²	X ²	X	X
<i>Passenger Amenities</i>							
Seating		X	X	X	X	X	X
Trash containers		X	X	X	X	X	X
Restrooms							X
Public address/automated passenger information systems		X	X	X	X	X	X
<i>Passenger Services</i>							
Vending machines, newsstands		X	X	X	X	X	X
Shops						X	X
Special services (e.g., dry cleaners)						X	X

¹ Conventional shelter is a minimum treatment that generally should not be used for a BRT service.

² In some environments

NOTE: Major stations should be provided at interchanging transit lines, large park-and-ride lots, and important passenger generators.

Figure 14: BRT Station Types and Features (National Research et al., 2007).

The handbook V123 from the Norwegian Public Road Administration (NPRA) was previously used as the main guide for design of bus stops (Statens vegvesen, 2014a). After committing to Superbuss in Trondheim, a projecting guide for the design of bus stations was made. The guide is made on the basis of making the stations attractive, efficient, safe, with a high standard and overall design. It is important that the stations provide coherency despite different functionalities as terminal, hub or stop. The bus stop design of the Superbuss concept will emphasize the identity of Trondheim as a city of technology, as well as making a clear identity as a PT service (Miljøpakken, 2013b) In this section the bus stop design from Miljøpakken (2016a) will be presented. The stations are designed to meet the requirements of a BRT station, adapted to Norwegian conditions.

The furniture design for the Superbuss is based on an existing contract that will provide a module system with a comprehensive design for all stations, independent of the size. The contract is binding out 2018, after which a revision will be made based on experiences from the first bus stops.

Decisions taken about the bus stop design are based on the premises for bus stop design, mentioned in Table 6.

Table 6: Premises for station design (Miljøpakken, 2016a).

The station design should provide:

A thorough and evident image

Attractive stations with high standard that are visible in the cityscape

Straight platforms

Room for more vehicles after each other

Presale of tickets

Moving space and a good distribution of passengers on the platform

Furnishing and bike parking

High traffic safety

Universal design

Trondheim municipality has not decided if the dedicated bus lanes should be on the outside of the car lanes or have a centered concept, see Figure 15. The benefit of building the bus lanes on each side of the car lanes is that the city can continue the use of the existing bus lanes, as well as adding more to make it a continuous lane. The bus lane will also be in connection to the sidewalk which gives passengers an easier access to the platform, as well as a possibility to walk behind the shelter if the platform is crowded. The shelters can then be designed with entrances in the back wall which gives a good distribution of passengers on the platform.

A centered concept will be executed using the center lanes as dedicated bus lanes, see Figure 16. This results in a platform that is placed between the car lanes and the bus lanes, which means that passengers must cross the car lanes to access the platform. The passengers are enclosed to only moving on the platform and entrances to the shelter will be from the short

sides. To provide enough space for waiting passengers and moving passengers, the platform needs to be wider. Bike racks must be placed on the sidewalk outside the station to provide enough space.

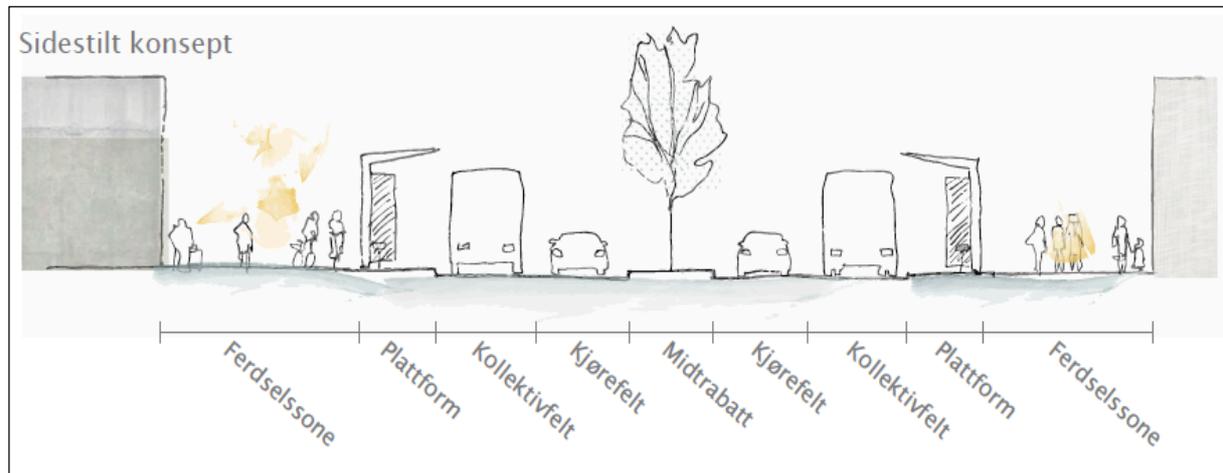


Figure 15: Solution for the concept when bus lanes are outside the car lanes (Miljøpakken, 2016a).

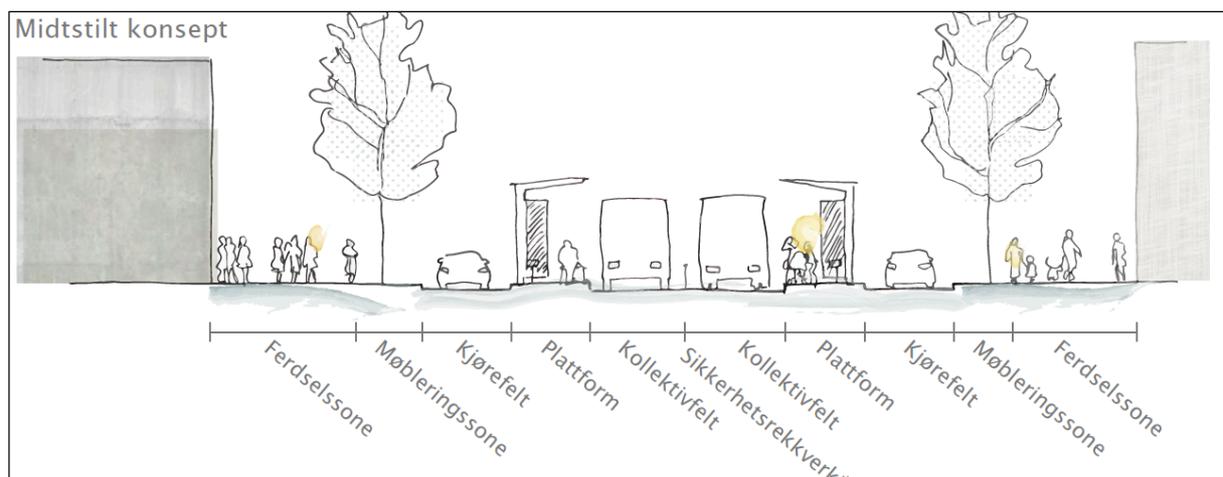


Figure 16: Solution for the concept of centered bus lanes (Miljøpakken, 2016a).

It is feasible to assume that the solution with a bus lane outside the car lanes will be chosen. This is because the solution can take use of the existing bus lanes in Trondheim, which will decrease the cost of implementation. With this solution, the platform of the bus stop will be a minimum of 3.5 meters wide, with a 2 meters deep roofed zone. Behind the bus shelter there will be a 2.5 meters wide walking zone and the shelter will have entrances through the back wall. The shelters will be based on modules so that the sizes of the shelters can be changed

with the need for capacity at each station. A standard shelter length will be 24 meters, which is comparable to the length of 1.5 buses. An example of a shelter is shown in Figure 17.

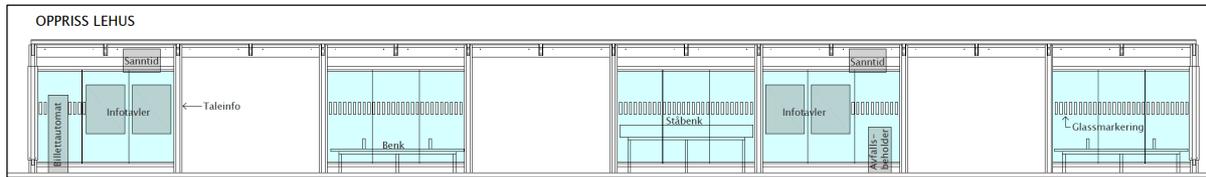


Figure 17: Example of shelter (Miljøpakken, 2016a).

Benches will be placed to best distribute the passengers in the shelter. A ticket machine will be placed near first entrance point. Garbage bins will be placed close to the exits and light will be supplied by integrated lighting in the shelters, giving the passengers good visibility, orientation and safety. Surveillance cameras will also be installed.

Universal design is included by adding audible information, marking the glass of the shelters, using tactile pavement, having a furnishing zone and the platform height is built up to match the height of the bus floor.

Evaluation of Bus Stops in Trondheim

In connection to the planning of the Superbuss in Trondheim, new bus stations were built in Kongens gate in 2012, which lies in the city center of Trondheim. These stations were built to simulate the new stations that were going to be built in the Superbuss system, and they were made according to the projected design. Experiences from these stations were used to evaluate the designs of the stations and are now the foundation for the design templates for bus stations in Trondheim. The evaluation focused on efficiency, attractiveness and universal design. This study revealed that the solution mainly is good, but that there is room for improvement. The need for improvement is related to design of shelters and dimensioning of the station, as it needs more space and more shelter from wind and precipitation. (Kummeneje et al., 2014)

The new stations have been built considering how many people that are going to use the station, which direction the passengers come from, where the pedestrian and bike lanes are

located, which function the design should have and which needs are tied to the station (Miljøpakken, 2016a).

Trondheim municipality has done an evaluation on the public transport implementation of a real time system (Thorinfeldt et al., 2011). This implementation showed an increase in customer satisfaction, but did not show any signs that this in itself gave an increase in users of PT (Thorinfeldt et al., 2011).

2.4 Comfort

For an individual, car travel is considered appealing because of the level of comfort, the flexibility and the perceived efficiency when travelling from A to B. Car travel is also attractive because of its level of privacy, as well as a car being a status symbol and a reflection of identity (Bergstad et al., 2011).

Comfort is an important quality attribute for the PT system, and it affects people's willingness to use the PT services. It is an attribute that is difficult to measure as it is subjective to each passenger. When looking at a journey with public transport, the start of the journey can be determined to be the point of entering the bus, to the point of exiting. This would mean that comfort is judged by "how comfortable the journey is regarding access to seat, noise levels, driver handling, air conditioning" (Redman et al., 2013). Assuming the PT service is a comprehensive solution, it will include the time spent to and from the bus stop and the time spent on the bus stop, as a part of the journey. The whole journey will affect people's feeling of comfort, thus the comfort at the bus stop will be relevant to the comfort of the journey. Hence the comfort of the bus stop is an attribute that reflects on people's willingness to take PT.

2.5 Mobility

Mobility is a big part of our lives. All groups of people take daily trips, move through spaces in order to comply with plans, needs and wishes. Today we move further and travel longer, which increases the time spent travelling. The highest rate of mobility is shown to be within

the regions of high economic and social development standards, for example cities (Kraft, 2014).

Mobility can be defined as the ability to move between different sites of activity (Hanson and Giuliano, 2004), which can be interpreted as efficient movement of people. Mobility can be split into two main types: Spatial mobility and social mobility. Social mobility focuses on the socioeconomic movements in social classes and spatial mobility focuses on territorial mobility processes (Kellerman, 2012, Zelinsky, 1971). Even though the concepts differentiates from each other, they are also linked and interdependent (Wellbeloved, 2004)

Pachenkov and Pachenkov (2013) defines public space as the areas and locals, especially in towns and cities, outside the private spaces of the home and work, where people can congregate, socialize and organize in relatively unregulated ways. Mobility has often been considered in context to public space. This has been because the increase in mobility often have resulted in the decrease in public space. This is related to the increase in roads and transport, which takes up big areas that before was used as public space and then often forms barriers through urban space.

The relevant focus on mobility in Granåsen is how to provide good mobility to get from a starting point, to the parking/bus stop, and how to get from the parking/bus stop, to the destination in Granåsen. The end stop can be offices, kindergarten, ski jump etc.

2.6 Shared Space

Shared space is a design concept where all traffic groups can be included to combine multiple purposes of public space (Havik et al., 2015). It was introduced by Hans Monderman (1945-2008), a Dutch engineer with interests in psychology and urban planning (Johannessen and Norges Teknisk-Naturvitenskapelige Universitet, 2011). The concept is based on removing all separation between transport modes, to create a common ground for all types of traffic and get an effect where safety is provided by eye contact, slower speeds and heightened awareness (Kaparias et al., 2012).

The idea behind shared space is that trucks, buses, cars, motorcycles, bicyclists and pedestrians get the possibility to move next to each other, and with a natural contact will everyone consider each other in the traffic scene (Gehl, 2010). Through the feeling of insecurity will the different traffic groups be able to analyse the situations to interact with each other (Rambøll and Vegdirektoratet, 2008). As the layout emphasizes the function of “space” rather than “traffic”, the concept can invite people to use the space to stay and not just pass through (Havik et al., 2015). However, it can give limitations because kids cannot run around without risk and it can cause discomfort for elders that are not so confident in traffic (Gehl, 2010). Gehl (2010) states that mixed traffic can only be possible if the pedestrians are prioritized. Studies have shown that areas with shared space implemented have lower accident rates even though there is a higher perceived danger (Kaparias et al., 2012). However, implementation relies on people’s familiarity with the concept and can be difficult in areas that never experienced this kind of urban features.

This concept is relevant to the research in this thesis because when considering the location of the bus stop, it is important to consider the surroundings to provide a comfortable environment for the PT users. More importantly, the concept is included as it is a solution where people and buses can interact safely, which can be of interest in Granåsen since the development is going to provide an increase in users and the bus stop might be relocated to interact with the use of the arena.

2.7 Outdoor Activities and Outdoor Environment

A good outdoor environment is directly related to making of an inviting and comfortable environment for the PT users and the users of the arena. As shared space considers the surroundings in connection with people and PT, Gehl (2010) focuses on the importance of the outdoor environment in connection with peoples activities and what they choose to do. A focus on the outdoor surroundings to increase activity will not only provide a comfortable environment for existing PT users, but it can also increase use of Granåsen, which then can cause a higher demand in PT.

Gehl (2010) has put focus on the new cities where planning and prioritization of urban design is of importance. People need to be the focus for future cities as this will provide a lively, safe, sustainable and healthy city. Even though Trondheim is not a large city, it is important to consider the human factor and the social function of public spaces as meeting areas.

Activities can be separated into three categories; necessary, optional and social activities. Necessary activities are represented by activities people undertake on daily basis under any condition, as going to work or school, waiting for and using public transport. Optional activities are largely recreational activities which a person does alone, as strolling in good weather, sitting down to read and watching the view. These activities require access to a good outdoor condition, good weather and a nice environment. Social activities are defined as all social communication and activities with the presence of other people. With crowded areas and high activity there are many social exchanges, which also includes a lot of passive contact like watching others. Active contact is when people exchange some words, talk and interacts with each other. People can ask for directions, comment on the weather etc. Extensive contact can be made among kids at a meeting place. This can lead to acquaintances which again can lead to more or less planned activities as markets, meeting and exercise groups.

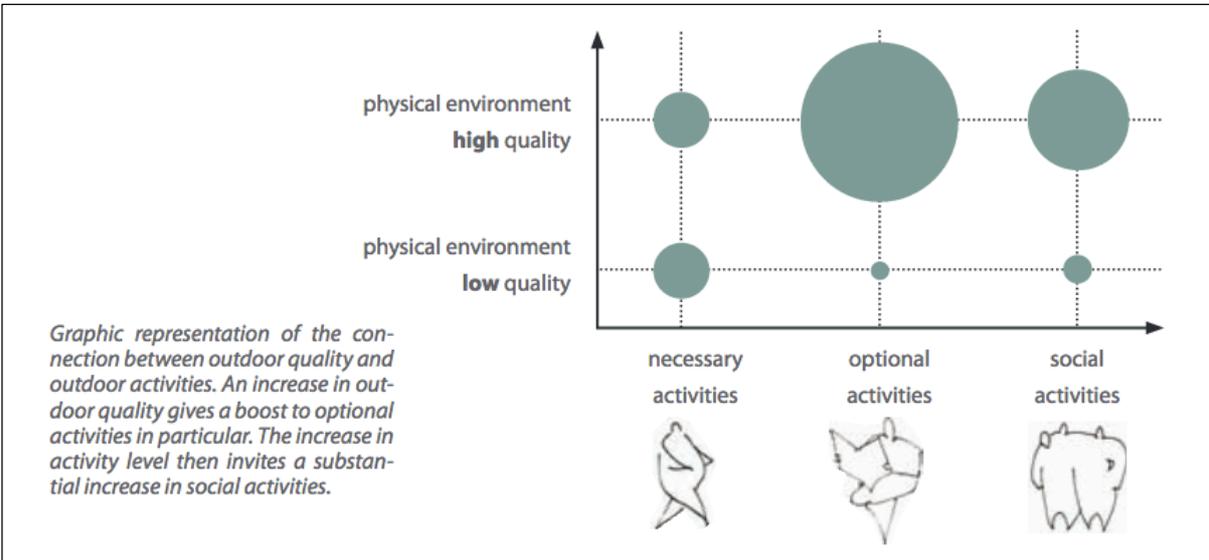


Figure 18: Graphic representation of the connection between outdoor activities and outdoor environment (Gehl, 2010).

It is important to consider how all these activities are influenced by the environment to encourage all types of activities. This is demonstrated in Figure 18. Necessary activities are as mentioned above not affected by the conditions and do not need the same considerations in the urban space to get people to choose to do these activities. Optional activities are very influenced by the environment and often also the climate. If it is raining or snowing, people will often choose other options. As the weather is difficult to predict, it is important to prioritize the physical quality of the space. The physical space can be improved by encouraging people to outdoor activities by installing furniture and gym apparatuses, and providing reasonable space, safety and visual quality. This can also invite to social activities and encourage to arranged activities.

3 Method and Procedure

This chapter describes the different methods used in the work of assembling data to this study. The thesis is a case study of Granåsen, therefore the method of case study will be presented first in this chapter. There will be more information about the data collection later in the chapter. In the end, there will be a brief presentation of the procedure that was used in the study.

The empirical part of the research is based on an analysis of primary and secondary data. The primary data was gathered by a survey of existing and future users, observations and interviews of relevant persons. The secondary data was collected from the bus service company in Trondheim, AtB, which provided data on boarding at the selected stop in Granåsen. The study also took use of data that was provided by ÅF Engineering and Miljøpakken.

For the master thesis it is also necessary with more detailed information about the bus stop and its surroundings. Miljøpakken (2016a) provided information about the design of bus stops for the Superbuss system. NPRA provided information of the general demands of the bus stop and data for these systems.

Both quantitative and qualitative methods have been used to see how design and location affects the utilization. The quantitative method was the survey that was sent out to get information on travel habits, views on design and location of a bus stop and a stated choice study. The interviews, the observations and the literature analysis used qualitative methods to get a variation of answers and a deeper understanding of the quantitative methods.

The first part of the study focused on the main aspects on transport behavior in relation to the chosen activity in Granåsen, which was also reflected in the survey that was made. This part also referred to the main form of spatial mobility. The analysis of the survey focused on the choice of transportation compared to the activity, as well as the type of user and travel time.

At first a pilot study was sent out to students and some professors at the institute for feedback, then the survey was reviewed and corrected before it was sent out to possible respondents. After some weeks, the survey got 100 responses from respondents with variations in personal characteristics.

The second phase consisted of analyzing the bus stop, its design and placement, and how the users viewed these aspects. The respondents also rated the facilities they could want in a bus stop. Two stated choice studies were provided to see if improvement of design and location could influence the respondents' choice of transport mode or destination. The first state choice study was for car users and the other was for bus user. Interviews were used to get more explanatory information of the location and design in the view of the organizations that uses the arenas. Observations were also used to view mobility and behavior.

The last part of the analysis focused on how it could be possible to get people to transition from using their car to take the bus based on the design of the bus stop. This part looked into if any willingness existed among the respondents and what use they prioritized when they chose their transport mode. This part also looked at the facilities that was wanted from the users and organizations, and how that could impact utilization of PT.

3.1 Case Study

As mentioned in section 1.3, the ideas for the framework of this case study came from the initial review of literature, which revealed gaps in the research on bus stops. This led to the first draft of the research hypothesis and the research questions. The case study of Granåsen was then chosen to answer the hypothesis by answering the research questions.

A case study reviews one or few chosen objects based on different sources of data, with the goal to give insights and understanding of a study (Olsson, 2011). It is explanatory research because the questions deal with operational links traced over time, rather than one measured occurrence (Yin, 2014). This case study will give indications of behavior by viewing contemporary events, which is reflected in the survey where the respondents answer to their actions over time and not for one single incident.

The case study method was chosen because of the conditions of the research material, that it was mostly qualitative data. The design of the case study was evolved around four problems: a question to study, finding relevant data, selecting data to collect and consider how to analyze the results (Yin, 2014). To find and select relevant data it was necessary with people to interview, sufficient access to documents or records and to make observations in the field (Yin, 2014).

In a case study the research is quite case specific, especially when using one case. This implies that it is a small basis for scientific generalization as the result is specific to time and place, which can be a disadvantage when looking at the relevance for the study. But the case study can still give a relevant contribution to different disciplines.

Yin (2014) emphasizes that the case study also has a lack of strictness in the research, which can be a prejudice against the method. This can be the outcome of lack of systematic procedures or the author can have biased views that influences the direction of findings and conclusions.

3.2 Survey

In this chapter, the setup of the survey and the reasoning behind the questions will be presented. The stated choice study which also was a part of the survey will be explained in chapter 3.3.

Data collection was needed to provide relevant information to identify whether the public could find an interest in PT by looking at a new solution for bus stops. One of the methods for data collection was a survey. The aim of the survey was to examine possible connections between the users age, gender, work, travel habits to Granåsen, how they travel, their view on bus stop design in Granåsen and to see if it was possible to these users to use collective transport with a change in the design of the bus stop. The survey also provided an overview of what activities or services that can provide an increase in demand at Granåsen.

The survey was made in Typeform, an online survey provider. The survey was reported to the Norwegian Centre for Research Data (NSD) to get permission to collect personal data. The target group for the survey was existing users of the area, potential users, neighbors and users of the existing bus network. The survey was sent out by email, with a link to the survey, to offices, schools, kindergartens and ski groups that were in proximity to Granåsen. It was also sent out to student groups and offices at NTNU which could have an experience with Granåsen. The respondents were all above 18 years old and the survey was written in Norwegian. More information about the respondents is given in Table 13.

The survey mainly contained multiple choice questions and some questions that were written to further explain the answers to these multiple choice questions. Multiple choice questions were chosen to simplify the analysis. The respondents of the survey got different questions based on their answers during the survey, also known as logic jumps.

The first part of the survey focused on the respondents travel habits to Granåsen; how often they visited and which transport mode they used. It also asked how many of the respondents that never had been in Granåsen. Those who never had visited Granåsen were jumped to later questions about bus stop design, while the rest was asked about transportation and thoughts of alternative transport modes.

The second part treated the questions about bus stop design and location, as well as facilities in the area. It was important to get an understanding of what the respondents thought about the existing bus stop at Granåsen, as well to see what was the main requests for facilities at a bus stop. This was done by letting the respondents rate the suggested bus stop facilities. The respondents were also asked to give an answer to which facilities, such as toilets, cafes etc., they were interested in being built in Granåsen.

The third part was a stated choice study that is being presented in chapter 4.6, and finally were questions to reveal socioeconomic variables as gender, age, residency, occupational status, income and number of people in a household.

3.2.1 Composing the Survey

To avoid bias in the questions of the survey, it was important to think of how the questions could affect the results of the survey and how the respondents would interpret the questions. It was important to make sure that participant understood the meaning of the questions so that they would answer correctly and not reject that question or choose a random answer. It was also important that the questions were neutral and objective, to prevent bias and that the respondent got an option that he/she wanted to answer. To avoid this, a pilot study was sent out to a few people at NTNU to get feedback on the questions and flow of the survey. After the review, the questions were altered and the survey was sent out.

The questions in the survey tried to identify what the respondents normally do and what they imagine they can do with changes to the bus stop in Granåsen. To concretize the survey to get questions and answers that were easy for the user to answer, and easy to analyze, was difficult. The reason for the difficulty was the uncertainty of what type of individuals would be responding to the survey, as the targeted group could be anyone over the age of 18 that has a connection to Granåsen for anything from sport, work, recreation etc.

3.2.2 Reflections

The survey was developed during the first months of the master project, concurrent with the literature research. This took more time than expected and delayed the survey. The application for the NSD also got out late and took a while to get answered. The distribution went slower than expected since it proved to be difficult to distribute the survey through the large channels as the hiking network DNT and the bus service AtB. This would probably have been easier with better planning.

The questions have been general and no tools are used to see if the respondents answered correctly to their actual behavior. As a consequence of trying to keep the survey short, there were few explanatory questions involving the election of transport modes, which provides little insight in why respondents answered the way they did.

Some of the questions that was asked in the survey became obsolete during the study. The survey still gave valuable information that have been used in the analysis.

3.3 Stated Choice Study

Louviere and Adamowicz (2000) explains that a stated choice study is a way to investigate the responsiveness of respondents in markets and services by asking people to describe hypothetical decisions. This type of study can show the future behaviors of the population if the respondents of the survey are a representative group, and they understand, are committed to and can respond to the questions of the survey.

The stated choice study was made to see if improving the design on a bus stop could influence the respondents' choice of transport mode or destination. The study was part of the survey and all respondents were asked to choose what transport mode they would use to get to Granåsen. Those who answered car or bus would be jumped to the stated choice study. This study was split into two different studies depending on the first answer. If the first answer was "car", then the respondent was asked to answer if they would change to bus when the bus stop design was improving by different comfort levels. If the first answer was "bus" the respondent was asked if they would change destination from Skistua to Granåsen when the bus stop design was improving by different comfort levels. The comfort levels are shown in Table 9. Skistua was selected as an alternative to Granåsen as it is a destination with similar properties as Granåsen as it is close to Bymarka, only one bus route services the bus stop and the bus frequency is low. Both alternatives are shown in Figure 19.

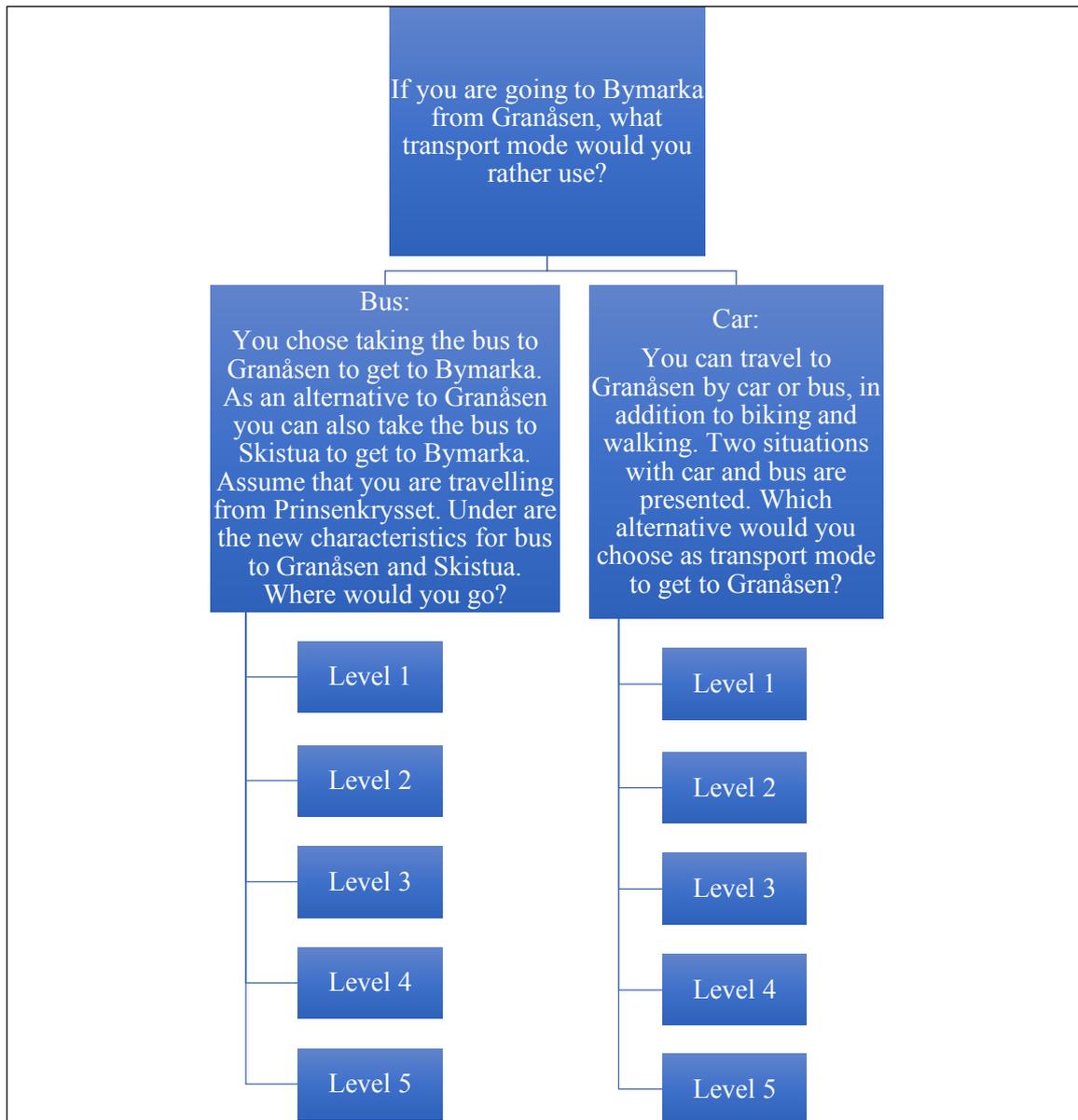


Figure 19: Stated choice study with the choices “bus” and “car”.

For the choice of “car” the respondents chose between the alternative “car” shown at Table 7, and the alternative for “bus” shown in Table 8, with an accompanying comfort level for the bus stop design, shown in Table 9. This means that the respondents chose between the car and the bus stop five times if they always chose the car, each time with a different comfort level of the bus stop design. With this study, it is possible to see if the car driver is willing to change into taking the bus only based on the bus stops design.

Table 7: Basic information for the alternative “car”.

<i>Car</i>	
Cost	100 NOK
Travel Time	20 Minutes
Departures	Whenever
Comfort	Car

Table 8: Basic information for the alternative “bus”.

<i>Bus</i>	
Cost	64 NOK
Travel Time	26 Minutes
Departure	4 Times an Hour

Table 9: Comfort levels of bus stop design that are given to the respondents in the stated choice study.

<i>Comfort level</i>	<i>Comfort attributes</i>	
Level 1	Bench Garbage Bin	Timetable
Level 2	Bench Garbage Bin Timetable	Roof Real Time Information Commercials
Level 3	Bench Garbage Bin Timetable Roof	Real Time Information Commercials WiFi
Level 4	Bench Garbage Bin Timetable Roof Real Time Information	Commercials WiFi Music/TV/Entertainment Charging Station for Electronic Equipment

Level 5	Bench	Music/TV/Entertainment
	Garbage Bin	Charging Station for Electronic
	Timetable	Equipment
	Roof	Heated Area
	Real Time Information	Storage Rooms for Ski/Hiking
	Commercials	Equipment
	WiFi	

When choosing the bus in the first question, the intention was to see if the participant changed their preferred destination depending on the facilities of the bus stop. For the choice of “bus” the respondents chose between the alternative “Skistua” shown at Table 10, and the alternative “Granåsen” shown in Table 11 with an accompanying comfort level for bus stop design, shown in Table 9.

Table 10: Basic information for the alternative “Skistua”.

<i>Skistua</i>	
Travel Time	17 Minutes
Departure	Once an hour
Comfort bus stop	Timetable

Table 11: Basic information for the alternative “Granåsen”.

<i>Granåsen</i>	
Travel Time	22 Minutes
Departure	4 Times an Hour

3.4 Interviews

The purpose of the interviews was to collect explanatory information which could compliment the rest of the data, or illustrate other objectives, to answer the research questions and hypothesis. The interviews were with persons significant to the organizational structure of

Granåsen and Holmenkollen, as they were in charge of organizing the World Cup in their respective arenas, and organizing the operations and activities. They were chosen to get an aspect on how PT could compliment the use of the arena. The reason for talking to a person to Holmenkollen was to see how the PT system contributes in event situations and on every day, in a similar sort of environment as Granåsen.

The interviewees had close relation and knowledge of the arenas, as well as an understanding of the challenges of PT in connection with the arenas. They had been working a long time in the organizations, so they could highlight problems that had been revealed during the years.

A guide for the interviews was developed to ensure that correct questions were asked, and that both interviewees got the same set of questions so that the answers could be compared to each other. The guide was built upon the research questions that was developed. During the interviews, extra questions were added to elaborate the existing questions. The interviews are written down and added in Appendix 5.

The interviews were executed in the interviewees offices with the interviewee and the master candidate. Notes were taken, along with a recording, during the interview and the interview was later written down in notational form and used as material for the results. The interviews were semi structured, which means that the interviewees got information beforehand about the subject of the interview, but they did not get the questions before the interview. The interviews followed the structured guide but let the interviewees answer freely. The conversations sometimes went over to digressions and non-relevant subjects.

The interview is a conversation that will be guided instead of a structured inquiry (Yin, 2014). This means that the answers are fluid and largely dependent on the interview object. The interviewer did focus on following the set line of questions to get answers that reflects the case study protocol, as well as focusing on delivering the questions objectively to avoid the transferring of bias from the interviewer.

3.5 Observations

“To make observations it is necessary to know what and where to observe, to know what to extract from the observations” (Langdridge et al., 2006).

In this study, it was chosen to do qualitative observations as one of the methods for gathering data. These observations were done in Holmenkollen and Granåsen to compare the arenas.

The observations focused on:

- Activities and use
- Accessibility, mobility and flow
- Transport solutions
- Facilities and surroundings
- Good solutions
- Bad solutions
- General impression of the area

As shown in Table 12, observations were done in Granåsen and Holmenkollen. The observations included days without event and days with larger events, such as RAW Air and Skifest.

Table 12: Overview of observations done in study.

<i>Where</i>	<i>When</i>
Granåsen	After large snow fall
	Normal afternoon
	RAW Air
Holmenkollen	Before Skifest
	Skifest

Five observations were executed, and were both structured and unstructured. For the first observation in Granåsen it was made an observation sheet with focus on number of cars parked, utilization of bus and bus stop, and the activities that was done in the arena. The second observation in Granåsen was unstructured, but was done to see if there were any large differences between a normal afternoon and the day after snowfall. The last event in Granåsen

was unstructured. Notes were taken during the event and an observation log was made after the event.

The first observation in Holmenkollen was structured. The travel time between certain points of importance were registered. During the Skifest, notes were taken and these were used to look for patterns and compared to the notes of the event in Granåsen. The observations were used as a foundation for the interviews.

3.6 Reliability and Validity

After gathering data, the quality of the data was analyzed to determine which data to trust and what the data could be used for. As there are several different methods used for collecting data in this study, it was important to judge the reliability and validity for each method.

Reliability looks at the trustworthiness of the data, while the validity looks at the relevance of the data for the research questions (Everett and Furseth, 2012).

As there are used several qualitative methods throughout the study, it is difficult to ensure the reliability of the data. The respondents were also not homogenous in the population as they were not selected randomly but were chosen by their relevance to Granåsen.

Even though the survey was thoughtfully designed, it is not possible to guarantee that problems related to reliability and validity have been avoided. But to limit the problems, there were a comment field in the end of the survey where the respondents could comment on the design and questions of the survey. Some ambiguities were noticed immediately and were corrected to avoid more confusion.

The reliability of the interviews may also be in question as the persons that were asked would convey their personal opinions about the questions, so it not said with certainty that the answers from the interviewees represents the ideas of their organizations. Discussions about PT engages a lot of people as many are in contact with it every day. In addition to the subjectivity of the interviewees, the subjectivity of the interviewer will also influence the presentation of the results.

The interviews are dependent on time and place and the subjective relation that is developed between interviewer and interviewees, this will make it unfitted for re-examination (Dalen, 2004). To keep a descriptive validity, the interviews were recorded before they were written down.

The observations were done by the candidate and may be subjected to bias. As some of the observations were unstructured, some important aspects may have been overlooked when the observations were executed.

4 Results

This chapter presents the relevant results that are collected through the survey, interviews and observations. First, the results from interviews and observations at Holmenkollen and Granåsen are assembled and compared, then the results from the survey are presented. The results from the interviews and observations have an overall look at the bus service, while the results from the survey are more reflecting of the bus stop itself.

4.1 Observations and Interviews

To learn more about Granåsen and Holmenkollen as arenas and their connection to the PT system, there were done observations and interviews. This section of the chapter presents the results from this study and compares the two arenas.

4.1.1 Holmenkollen

Skifest was organized in Holmenkollen a weekend in March 2017. The event was based over three days, with cross country races and the World Cup in ski jumping. The largest amount of people came on the Saturday when 50 km cross-country skiing for men was arranged. During the event, parking in the arena was not allowed. The metro system going from the city center and up to Holmenkollen had a capacity that was estimated to 9000 pers/h. Because of the high density of people, the police had to intervene at the center stations in Oslo centrum to channel the stream of people that were entering the stations, so that it was safe to stand on the station platforms. This was necessary as there were sold 39 000 tickets and approximately 60 000 people were out in the forest, outside the priced arena. Most of the people used the metro service to get to the location and this caused a high constrain on the PT service (Sjulstad, 2017).

The mobility through the area was regulated by fences and signs showing the direction to certain parts of the arena. It was obvious that the organizers had thought about the flow in and out of the arena. Outside the arena, the military police made sure that both traffic and the

public was out of each other's paths. The flow into the arena went along Holmenkollveien, up to entrance B and entrance C, and the flow out went inside the arena and out entrance A. The entrances are shown in Figure 20.

The walking time from the metro station was registered to 12 min to entrance A, 14 min to entrance B and 16 min to entrance C. This was timed one day ahead of the event when there were free flow and no congestion.



Figure 20: Overview of Holmenkollen with different entrances to the arena (Google, 2017d).

4.1.2 Granåsen

Later in March, RAW Air was arranged in Granåsen. This was the World Cup in ski jumping, the same concept as previously organized in Holmenkollen earlier the same month. It was expected a turnout of 20 000 people, but as there only were 9000 people that attended the event, there were few problems associated with the size of the crowd that showed up to the

event. But still, to meet the expected increased demand for the event of Raw Air in Granåsen, AtB made all the extra buses they had available to increase the capacity at route 19 which stops at Granåsen. The capacity of the bus fleet at the event is dependent on the amount of buses that are available from AtB. There will be more capacity in evenings, Sundays and in holidays, when there are less scheduled departures on the normal routes (Morseth, 2017).

The bus used 21 min from Prinsenkrysset P1, the bus stop in the city center, to Leirbrua Gård, where the public walked 13 minutes to get to the arena. The bus stops closest to Granåsen, marked with red arrows in Figure 21, were closed off during the event to get a better flow of cars and charter buses to the parking lot. By closing the bus stop next to the arena the bus was able to keep its schedule as it was not hindered by charter buses and cars that were trying to enter/exit the parking lot.

The parking lot that is in front of the arena has a capacity of 800 cars and has a parking fee of 50 NOK (Morseth, 2017), while a bus ticket one way costs between 33 NOK and 50 NOK, depending on the payment method (AtB, 2017).

The mobility and flow was ensured by police and volunteers. They directed the public around the car parking area, and to the arena as well as directing the public flow to the bus stops after the competition.

Granåsen were also observed on regular days. During a normal weekday the parking lot next to Toppidrettssenteret, parking C in Figure 21, is well used by the workers, athletes and people that come to exercise at the gym. The other parking lots are less used. The ones closest to the cross-country tracks, parking A and B, are having some traffic on days with snow, but at the days of observations it was about 30 cars on parking lot A, which has a capacity of 800 cars.



Figure 21: Overview Granåsen with different parking lots (Google, 2017a).

Short Comparison of the Locations

There are several differences between Holmenkollen and Granåsen. First and foremost, the locations of the arenas are quite different. Even though it takes the same time to get to both of the arenas from the city center with PT, the Holmenkollen arena is visible from the city and makes it feel closer than it is. In Holmenkollen you also get a view over the city that draws a lot of tourists. The arena in Granåsen has not focused much on tourists, but on the local population and on outdoor activities such as cross-country skiing and biathlon in the winter, and hiking, running and other summer activities. Holmenkollen has previously invested a lot in getting a wide offer to all the city's population as Frisbee golf, roller ski track, private events and festivals, in order to attract people to Holmenkollen without being users of the athlete part of the arena. Up until now, the athletes have been the main focus in Granåsen, but with the new development it can open the arena for other interest groups.

4.2 Existing Users of PT System in Granåsen

This section presents the information and existing data on PT usage at Granåsen that was gathered and analyzed during the study.

In Trondheim, an average of 11% of trips are taken with public transport during a year (Miljøpakken, 2016b). Some of these trips are taken to and from Granåsen. To get to Granåsen it is possible to take bus 19 that stops in front of the site, or take bus number 4, 7 or 8, and then walk 2.5 km to the arena (Morseth, 2017).

To use the bus system in Trondheim provided by AtB, you can pay for tickets at ticket machines, fill up an electronic card (AtB card) with a sum of money or a period of validity, use the Mobillett app, pay by SMS or by cash to the driver when boarding the bus (AtB, 2017).

The figures below are made with data provided by AtB and shows the use of the PT from the stop of Granåsen to the city center and out to Sandmoen. The data is only based on the users that have the AtB card and scans this on entry. This means that everyone that uses the app, SMS or pays in cash are not accounted for. During 2016, 148 124 persons used the app, so the majority of habitants in Trondheim (population 180 000, see Table 1) have this application and uses it at least on time a year. The data does not give information on how many that exits the bus at Granåsen, having Granåsen as their destination. With this knowledge, it is possible to assume that the data reflects the trends of the use and not the accurate number of users.

Figure 22 and Figure 23 are based on the user data from AtB and shows that the bus into the city center from Granåsen is more used than in the other direction. It also shows that the bus is more used in the winter than during the summers. The graph is fluctuating, which is explained by change in utilization during the week and the weekend. The outliers are special events as the world cup and concerts.

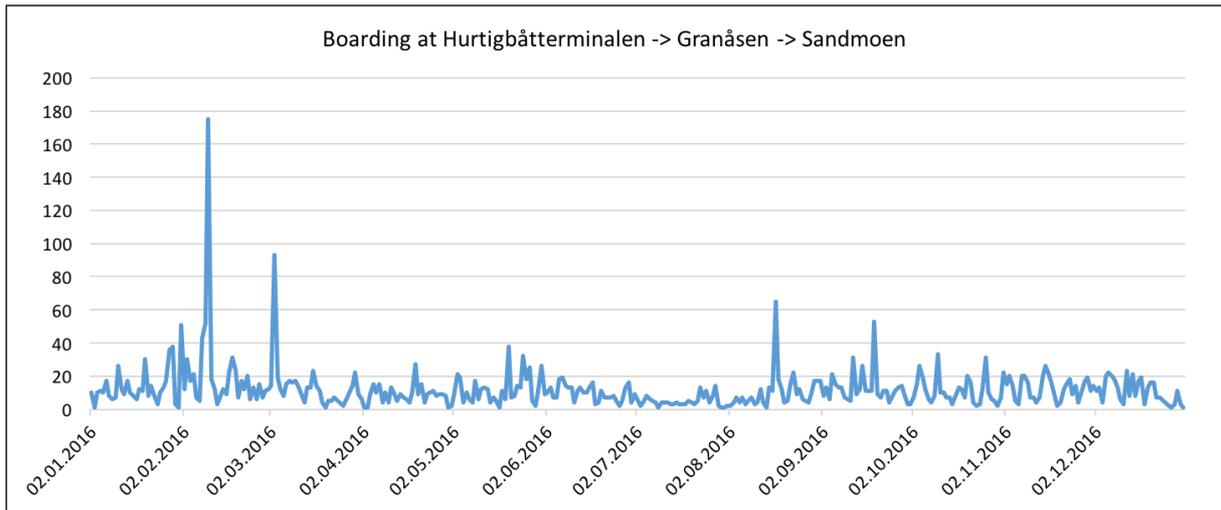


Figure 22: Number of people entering the bus at Granåsen in the direction towards Sandmoen (away from the city center), that uses AtB card.

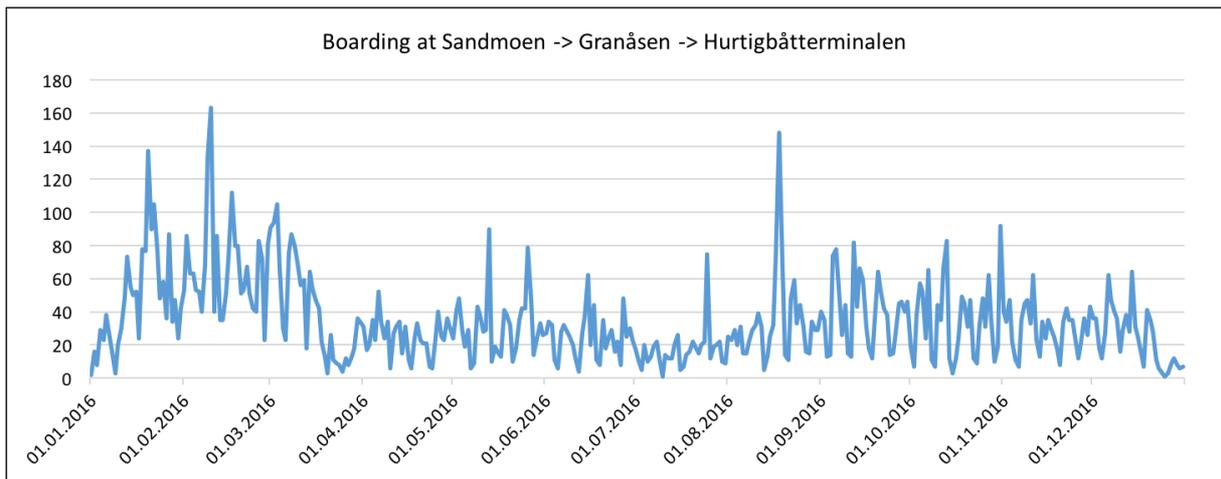


Figure 23: Number of people entering the bus at Granåsen in the direction towards the city center, that uses AtB card.

4.3 Survey

This section will present the results from the survey. The survey got 100 respondents, 3 responses were not qualified as the respondents did not finish the survey.

Table 13 shows the demographic of the respondents. Information about the demographics of the respondents is important to show what kind of persons answered so it is known which part of the population that the answers represent (Wyse, 2012). With this information, it is also possible to compare the responses from different groups.

Table 13: General information about the respondents of the survey divided into transport modes.

	Car	Bus	Bike	Walk	Never Visits	Total	Percentage
Gender							
Women	18	15	1	0	9	43	43 %
Men	21	15	8	1	9	54	56 %
Total	39	30	9	1	18	97	100 %
Percentage	40 %	31 %	9 %	1 %	19 %	100 %	
Age							
18-25	5	18	2	0	11	36	38 %
26-35	14	9	4	0	5	32	33 %
36-45	13	2	2	1	1	19	20 %
46-55	5	1	1	0	1	8	8 %
56-65	1	0	0	0	0	1	1 %
>65	0	0	0	0	0	0	0 %
Total	38	30	9	1	18	96	100 %
Percentage	40 %	31 %	9 %	1 %	19 %	100 %	
Occupational status							
Student	8	20	2	0	11	41	42 %
Work fulltime	30	9	7	1	7	54	56 %
Work part time	1	0	0	0	0	1	1 %
Leave of absence	0	1	0	0	0	1	1 %
Retired	0	0	0	0	0	0	0 %
Total	39	30	9	1	18	97	100 %
Percentage	40 %	31 %	9 %	1 %	19 %	100 %	
Household Income							
< 249 999 NOK	4	16	2	4	4	30	30 %
250 000-499 999 NOK	5	5	1	0	0	11	11 %
500 000-749 999 NOK	7	6	1	0	0	14	14 %
750 000-999 999 NOK	6	2	1	0	0	9	9 %
1 000 000-1 500 000 NOK	10	0	2	0	0	12	12 %
> 1 500 000 NOK	12	0	3	1	1	17	17 %
Do not want to provide	5	1	0	0	0	6	6 %
Do not know	0	0	1	0	0	1	1 %
Total	49	30	11	5	5	100	100 %
Percentage	49 %	30 %	11 %	5 %	5 %	100 %	

About the same amount of men and women have taken the survey. The difference in age is more significant, as it is the youngest part of the scale that is represented, and also persons that work fulltime or are students. Respondents with a household income of < 249 999 NOK are most likely to be students.

Households that are most represented have two persons above the age of 18, and no children. This is shown in Figure 24.

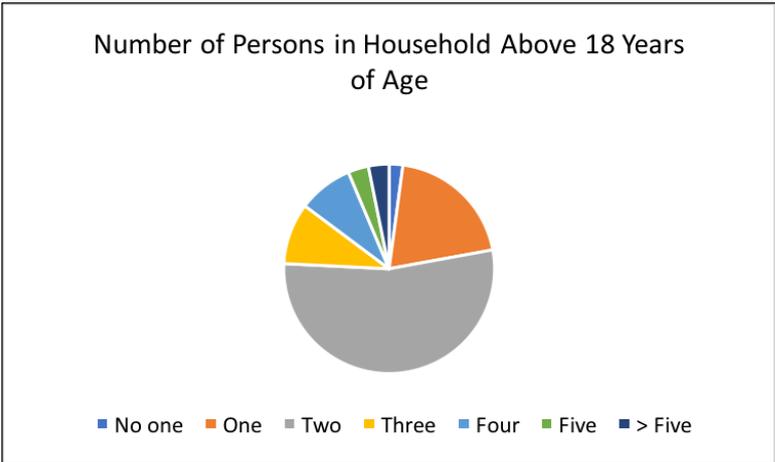


Figure 24: Number of persons in household above the age of 18.

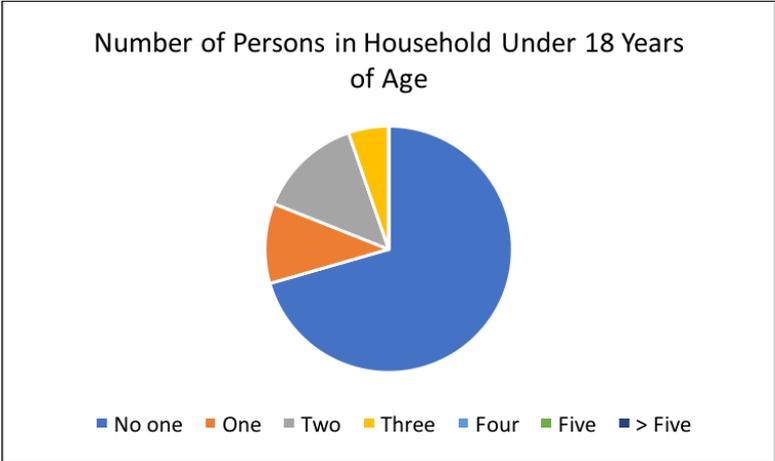


Figure 25: Number of persons in household under the age of 18.

The respondents were asked how often they visited Granåsen. 19% of the respondents have never visited Granåsen. These persons were jumped to the questions about facilities in Granåsen, and later answered the stated choice study. As mentioned in section 3.3, the stated choice study was about the design of a bus stop.

The respondents that have visited Granåsen were asked more in details about their visits. Figure 26 shows often these respondents visit Granåsen and what transport mode they use.

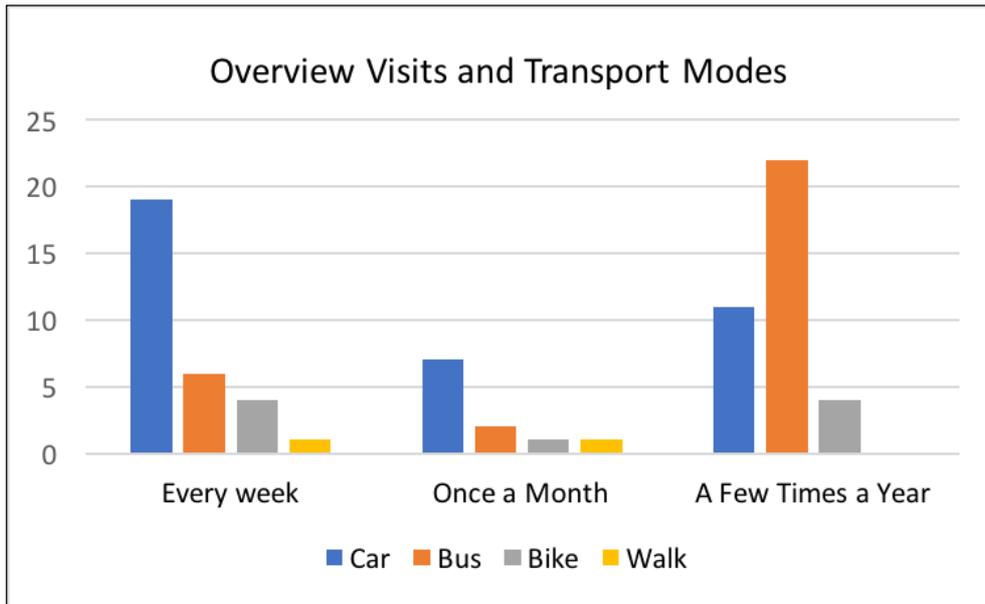


Figure 26: How often the respondents visit Granåsen and what transport mode they use.

Figure 27 shows that for nearly all activities, car is the preferred mode. It is only at events that there are a larger percentage of people that uses the bus. This could also be because of the respondents' option to answering with several activities when asked what they do in Granåsen, while they just answered for the transport mode they use most.

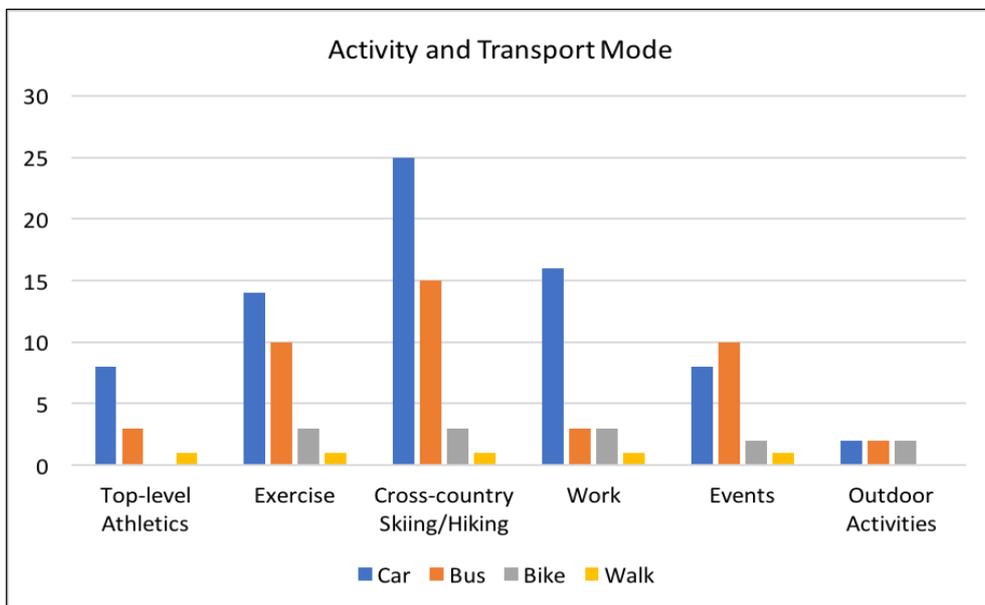


Figure 27: Transport mode related to activity.

The travel time, shown in Figure 28, shows the transit time the respondents use on their trip to Granåsen. Those who use the longest time, take the public transport that is available. They were asked about the estimated travel time on their whole travel so this can also include walking time to nearest public transport.

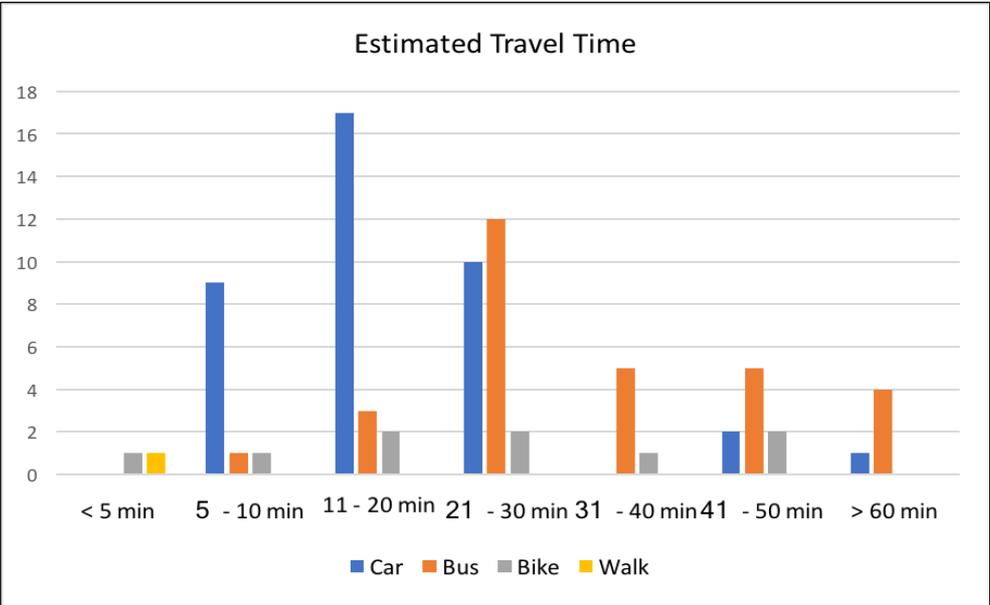


Figure 28: Estimated travel time to Granåsen with chosen transport mode.

4.4 Facilities in Granåsen

To increase the number of visitors, new facilities can attract new and existing users. The respondents of the survey answered what they wanted as facilities in Granåsen by checking boxes of choices for facilities in Granåsen, and they could choose as many as they wanted. The results show that basic facilities as toilets and a place for shelter and food, as a café or a kiosk, are of interest, see Figure 29. There is an interest for new types of activities in the area, for example zip line, climbing wall and gym apparatuses, to provide more reasons to visit Granåsen. There is also interest in building a hotel as well as making a storage facility to store skis and other equipment, by the stadium.

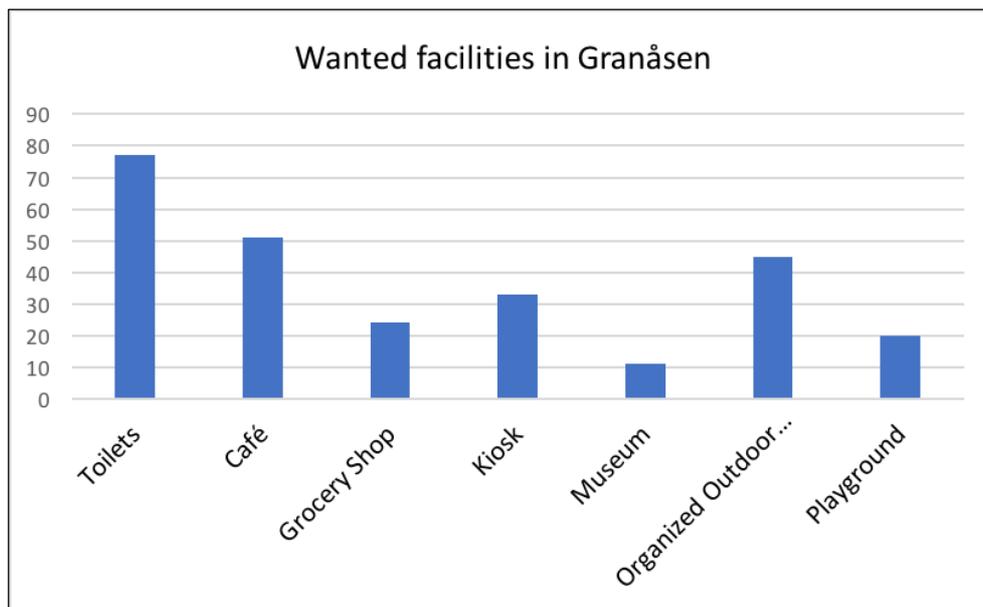


Figure 29: Wanted facilities in Granåsen shown by number of votes.

4.5 Facilities of a Bus Stop

The respondents of the survey were asked which facilities were important at a bus stop and they were asked to rate each facility from 1-5 where 1 was “not desired” and 5 was “desired”. The average of the ratings is presented in Figure 30.

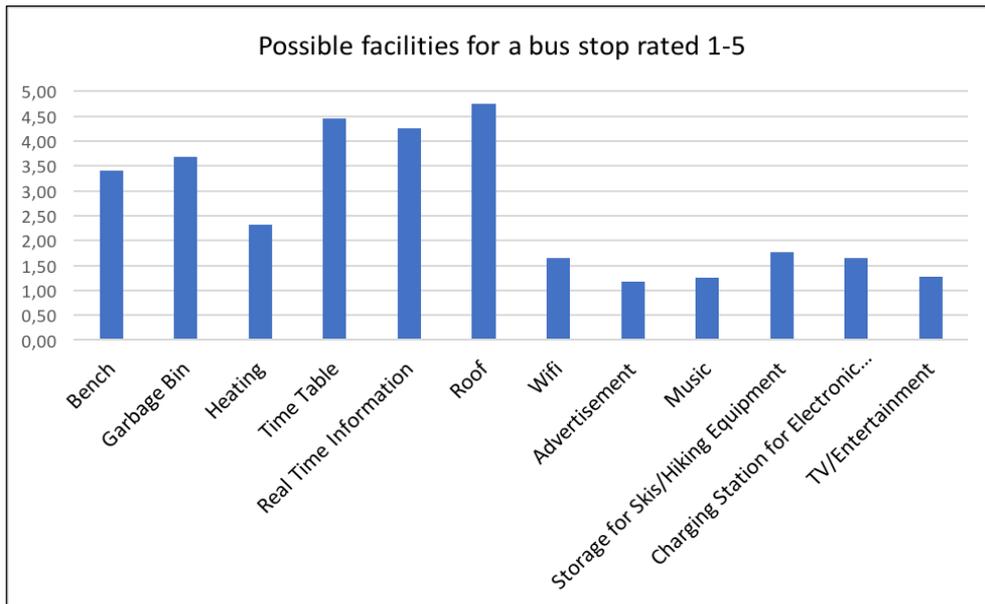


Figure 30: Rating of facilities at a bus stop.

4.6 Stated Choice Study

The design of the stated choice study was previously described in section 3.3. Here will the results from the study, which were a part of the survey, be presented.

As previously mentioned in section 3.3, the respondents were asked about what transport mode they would prefer when going to Granåsen, and their response would separate the respondents into questions for car users and questions for bus passengers. Subsequently, the car users were asked what transport mode they would prefer if the facilities of the bus stop changed. The results are shown in Table 14.

Table 14: Results from car users in stated choice study. Transition from car to bus at different comfort levels.

	Change from car to bus at level 1	Change from car to bus at level 2	Change from car to bus at level 3	Change from car to bus at level 4	Change from car to bus at level 5	Chooses car regardless
Would you consider using the bus stop if it had a better design and location? YES	10	1	0	0	0	11
Would you consider using the bus stop if it had a better design and location? NO	6	0	1	0	0	23

The respondents who would travel by bus were then asked to which location they were likely to travel to, choosing between Skistua and Granåsen, with a change in design facilities at Granåsen. The results are shown in Table 15.

Table 15: Results from bus passengers in stated choice stud. Transition from Granåsen to Skistua at different comfort level.

	Chooses Granåsen at level 1	Change from Skistua to Granåsen at level 2	Change from Skistua to Granåsen at level 3	Change from Skistua to Granåsen at level 4	Change from Skistua to Granåsen at level 5	Chooses Skistua regardless
Would you consider using the bus stop if it had a better design and location? YES	25	1	0	0	0	4
Would you consider using the bus stop if it had a better design and location? NO	8	1	0	0	1	3

Table 16 compares the respondents' answers to their answers about attractiveness of the existing design and location of the bus stop in Granåsen, with the answers of what transport mode they are likely to use when going to Bymarka via Granåsen.

Table 16: Compares the answers about the existing bus stop with the answers on choice of transport mode to Granåsen.

	Total	Attractiveness design: YES	Attractiveness design: YES	Attractiveness design: NO	Attractiveness design: NO
If you are going to Bymarka from Granåsen, what transport mode would you rather use? BUS	35	17	2	11	5
Percentage		49 %	6 %	31 %	17 %
If you are going to Bymarka from Granåsen, what transport mode would you rather use? CAR	52	24	7	13	8
Percentage		46 %	13 %	25 %	15 %
		Attractiveness location: YES	Attractiveness location: NO	Attractiveness location: YES	Attractiveness location: NO

Table 17 shows the distribution, in number and percentage, on how the respondents changed their original choice because of the changes in design at the bus stop.

Table 17: Stated Choice Study shows the distribution on change in respondents' choice.

	Chooses bus	Chooses Granåsen at level 1	Change from Skistua to Granåsen at level 2	Change from Skistua to Granåsen at level 3	Change from Skistua to Granåsen at level 4	Change from Skistua to Granåsen at level 5	Chooses Skistua regardless
If you are going to Bymarka from Granåsen, what transport mode would you rather use?	35	27	2	0	0	1	5
Percentage		77 %	6 %	0 %	0 %	3 %	14 %
	Chooses car	Change from car to bus at level 1	Change from car to bus at level 2	Change from car to bus at level 3	Change from car to bus at level 4	Change from car to bus at level 5	Chooses car regardless
If you are going to Bymarka from Granåsen, what transport mode would you rather use?	52	16	1	1	0	0	34
Percentage		31 %	2 %	2 %	0 %	0 %	65 %

5 Discussion and Evaluation

This chapter discusses the results presented in chapter 4 with existing literature. The focus of this study was to justify whether the hypothesis about design and location was true or false. By discussing the research questions, this thesis can give an answer to the hypothesis. This will be the foundation for a conclusion and suggestions for further research, which follows in the next chapter.

As mentioned in section 1.3 the main hypothesis is:

You can attract users to public transport by improving the design and location of a bus stop.

I will answer this hypothesis by looking at the research questions:

1. What are the most important design facilities at a bus stop?
2. Which aspects of a bus service must be present to reach a higher utilization?
3. How can the bus stop be located so it provides good mobility for vehicles and people through the space, both on a normal day and during events?
4. Which facilities can increase the use of Granåsen?

The last section of the chapter discusses the weaknesses and limitations of the study.

5.1 Comparison of Mode Choice

As the survey provided few responses, it was important to see if the respondents' answers of mode choice were representative for the population. This was researched by comparing some of the results from the survey with two previous travel habit reports, Miljøpakken's report and The Norwegian Travel Survey. This section looks into the results of mode choices to see if the results are in agreement.

In 2016 Miljøpakken published a report on the travel habits in Trondheim (study years 2014 and 2015). The study was done four weeks spread throughout the year to get the differences represented by seasons. The study was done with a foundation of 1000 persons above the age

of 14 that answered about their travel habits. The results of the survey were weighted to manage prospective imbalances in the average of the population to get representative results (Miljøpakken, 2016c).

The Norwegian Travel Survey (RVU) is a survey that researches the Norwegian populations' travel habits. It has been regular to every fourth year since 1992. The goal is to get an outline of travels and travel habits. The last was done in 2013/2014 and had 61 314 respondents throughout the country to provide a representative sample (TØI, 2014b).

Figure 22 and Figure 23, which shows the results from the survey, shows an increase of bus passengers in the winter months, from October to March 2016, with the highest use of PT around February. This trend is confirmed by the RVU 2014 – 2015 in Figure 31, where you can see the change in use in collective transport between February 2014 and August 2014. May in 2014 had the lowest activity, while the highest activity on PT were in February. This is probably because a lot of citizens in Trondheim use other transport modes as for example bikes, when the snow has melted and the asphalt is brushed and cleaned. August 2015 has the third highest registration of use of PT which shows that the assumption that people use transportation alternatives in summer is not irrefutable.

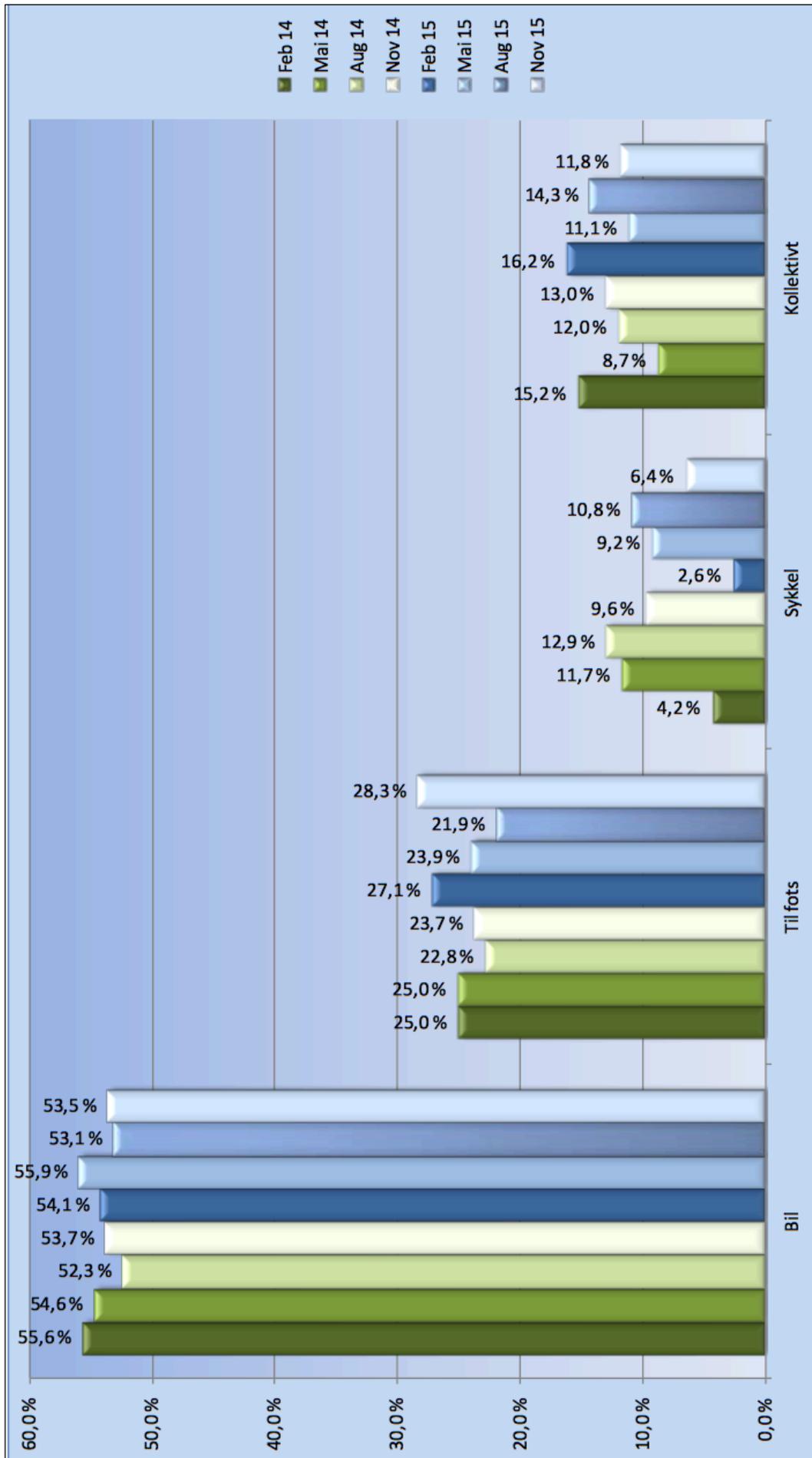


Figure 31: Mode split for Trondheim for the elected months in 2014-2015 (Miljøpakken, 201.6c).

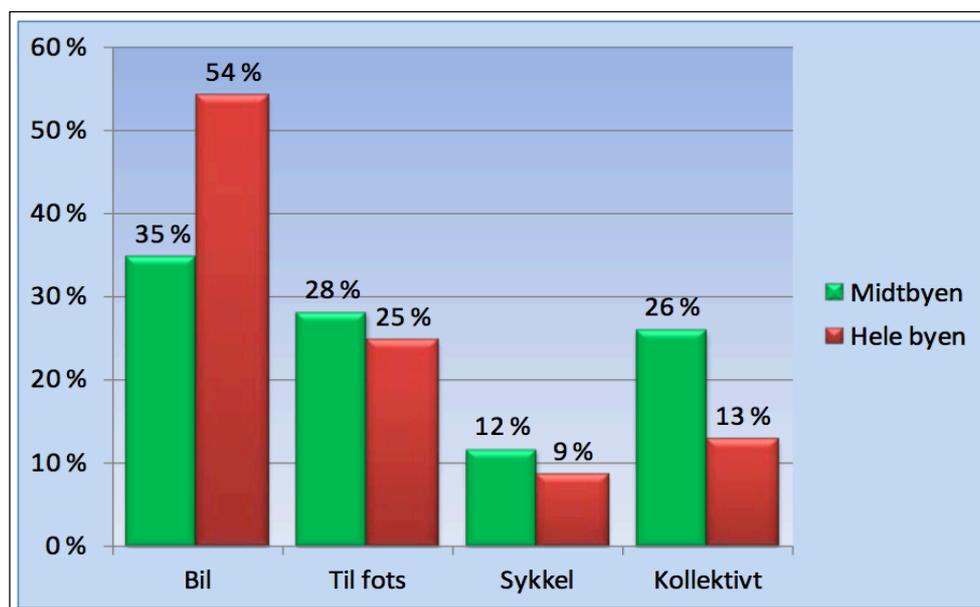


Figure 32: Mode split for travels that ends in the city centre, compared to the whole city (Miljøpakken, 2016c).

Figure 32, shows that PT is more used in the city centre, and that other forms of transportation are dominating when looking at the whole city. As Granåsen lies outside the centre of Trondheim there is a higher percentage of car use. This is also reflected in the survey where 40% percent of the respondents are using their cars and only a few of the respondents walks to the arena, see Table 13.

The survey done in this study has a higher percentage representation of PT users than the RVU, but this is probably caused by the limited participant group. There is also a higher percentage of women that uses PT in the RVU than in the survey. The survey has only gotten respondents of a limited age interval as the respondents are mainly between the age of 18 to 45 and no older age groups, see Table 13. This is also reflected in the results of occupational status as there are no retired respondents, and mostly fulltime workers or students. These missing groups of respondents allows the sample to be regarded as imbalanced, and will not properly reflect the populations' habits.

The RVU and the travel habit report in Trondheim are representative samples of travel habits. Since the mode choices in the survey reflects the mode choices in these reports, this can indicate that the survey in this study also is representative in terms of transport mode choices, even though it is missing some groups of respondents.

5.2 What Are the Most Important Design Facilities at a Bus Stop?

Passengers who have to wait for a bus prefer to wait in conditions of comfort, safety and protection from the weather (Balcombe et al., 2004). This section discusses which facilities that are most important for the individual using a bus stop, to get an understanding of what facilities that needs to be provided to make a comfortable and inviting environment for potential PT users.



Figure 33: Old bus stop (Gulakov, 2012).

The design facilities at a bus stop has been changed during the years and has also had different focus of appeal. Some old shelters have been very closed off, se Figure 33, where some other bus stops have only been marked by a sign with the related timetable. The new design of facilities should comply with five of the seven goals for designing a good bus stop. These goals are safety, thermal comfort, acoustic comfort, wind protection and visual comfort, see Table 5. The two last goals, accessibility and integration, are related to the location of the stop, and will be discussed in section 5.4.

Including to these goals, access to information is really important. Figure 30 in the results shows the most important facilities of a bus stop for the respondents of the survey. The facilities rated highest are based on access to information, such as a timetable and real-time information (RTI). Reliable information at the stations is also important to the interviewees as a factor that the can improve the bus stop. This positive attitude towards RTI is also reflected

in the evaluation that was executed in Trondheim (Thorinfieldt et al., 2011) where the installation of RTI showed a decrease in the passengers' waiting time and an increase in customer satisfaction. The city bus stops provide information through timetables, screens with RTI and also through an application on smart phones. As Granåsen is placed in a rural area RTI would be practical as the passenger would then have knowledge on when the next bus is coming, as there are large headway between the buses. Morseth (2017) underlines the importance of RTI, but also wishes for information about other transportation alternatives from Granåsen. Examples could be information on how far it is to walk to the city center, where the nearest bus stop with another route is located, and if there are other transport modes located nearby.

When designing a bus stop, thermal comfort of the waiting passengers should be considered a priority as it is the most important factor of comfort (Zhang, 2012) and because of the fluctuating climate that occurs during a year. In 2012 - 2014 there were recorded 165 - 207 days of precipitation annually in Værnes, which is located close to Trondheim (Meteorologisk institutt, 2013, Meteorologisk Institutt, 2015). This causes a demand for shelters that will shield the waiting passenger from the precipitation and thus, increase the comfort of the waiting passengers. This is reflected in the results as roof is rated as the most attractive facility of the bus stop, see Figure 30.

The shelter should prevent wind to blow on the waiting passengers, as the wind may increase the feeling of low temperatures by providing a negative thermal impact. The shelter should also protect against the mechanical impact on the waiting passengers. The thermal impact of the wind can be positive as it provides a cooling effect in hot summer temperature. In Trondheim, the summers are short and with an average temperature of 15 degrees Celsius in July 2016, while the winters are considerably colder with an average temperature of -1 degree in December same year (Yr, 2017). This implies that it is more important to prioritize a shelter that shields the waiting passengers against the negative effects of the wind, instead of using the wind as air condition.

External heating can improve the thermal comfort. This can be provided by heated seats or a closed shelter with heating. Even though this will provide an improvement in thermal

comfort, heated bus stops could be difficult to fund. They are expensive to build and it requires significant work to connect them to the power grid (Boesveld, 2013). In Bodø, two bus stops with heating costed 1.57 million NOK in investment and 247 000 NOK in operational costs during half a year (Aanstad, 2012). To increase user participation and year-round usability in a city like Trondheim where you have both summer and winter conditions, the creation of micro-climatic conditions can be valuable (Pressman, 1996). As it is a large investment, it is worth researching if external thermal heating actually provides a higher utilization of PT. Heated pavements will still be part of the new bus stop design for Superbuss, as it provides a safe walking zone which is part of the universal design adaption (Miljøpakken, 2013b).

Seating is an attractive facility of a bus stop. It was highly rated in the survey and it is important when considering universal design (Kummeneje et al., 2014). Previous studies in Vancouver has shown that extra seating makes waiting more comfortable, which also is beneficial for universal design (Zhang, 2012). Implementing benches to the bus stop is a small investment to the bus stop, but are important to the users, and will reflect positively on the bus service.

Visual comfort should be provided by pedestrian scaled lighting as it gives a feeling of security as well as visual comfort (Zhang, 2012). The Superbuss will have shelters with integrated lighting that is adapted to the surroundings and aims to provide security as well as function (Miljøpakken, 2016a). This will be important in Granåsen as the location is rural and has low activity at night.

Acoustic comfort can consist of traffic and other urban noises. As Granåsen lies on a rural site, traffic noise is the prevailing disturbance. To adapt the surroundings to provide acoustic comfort, it is possible to register the noise level and then create noise barriers. This will not be considered further in the solution for Granåsen.

In the bus station design for Superbuss it is emphasized that the stations should be attractive with a high standard that reflects the identity of the cityscape, and that it should implement universal design. The design includes shelters with entrances through the back wall and a

furnishing zone. In this furnishing zone, there should be room for vegetation, benches, ticket machines, bicycle racks, garbage bins, lighting, signs etc. There will also be an information column that is going to act as an information provider as well as an identification marker of the stations (Miljøpakken, 2016a). An example of a station is showed in Figure 34.

The plans for the new bus stops comply with the results of the survey and earlier research.

The question that comes to mind is if the design will be good enough to provide thermal comfort. With open back walls, wind and precipitation will enter the shelter, and with narrow roofs the protection from direct precipitation will be minor. This has also been pointed out in the study of the existing stops in Kongens gate, in the city center



Figure 34: Example of a Superbuss station (Miljøpakken, 2013a).

of Trondheim (Kummeneje et al., 2014). Respondents of the survey pointed out that it was essential with a big enough shelter so that all waiting passengers at the bus stop can be protected from wind and precipitation. To ensure this, it needs be estimated how many people will be using the station in the future, including an increase in use due to the new development in Granåsen.

As there are a lot of different activities in the arena and in proximity of Granåsen, the survey intended to see if adaption of the bus stop to the activities could help improve the user's willingness to use PT. When asked about the facilities that was wanted in Granåsen, storage, Wi-Fi and charging stations was not of much interest. There were a lot of respondents that used Granåsen for skiing, but the interest in storage for skis were lower than expected. This might be that the ones that are skiing are driving their car, so they do not think that storage is going to change that, or that it has not been tested and the respondents cannot imagine that it will have an effect. For families that do not have a car, a storage room could imagine to be

helpful as they would not have to bring skis, sleighs etc. back and forth every time. This would be an aspect to research further.

When asked if there were other facilities at the bus stop of interest, many respondents answered with “making a connecting sidewalk from the bus stop” and “higher frequency of buses”. As this is not directly related to the design or location, it proves that the PT system is a comprehensive system where it is difficult to separate different elements of the service as all elements need to be adapted to the passengers’ preferences to improve the quality of the PT service.

Universal design is important when building new bus stations (TransLink, 2007). By considering the elite users in every aspect of building a bus stop, one may hope to attract every person to use the PT system. The new stations for the Superbuss will be equipped with guiding pavement that is implemented into the ground, as well as making access to all the vital parts of PT; ticket machines, RTI screens, benches, accessing the bus etc. It is important that information is visible, and that the ticket machines are easy to use and access. For tourists, the information should also be available in English. The surroundings should be adapted for universal design so that it is easy to access the station as well as accessing related areas nearby. Accessibility is discussed further in section 5.3.

A comfort factor that is difficult to do something with, is the comfort of privacy. PT tries to be efficient by carrying as many people as possible from A to B, which forces people to communicate and interact with strangers. This aspect may for some people be seen as unpleasant as some people smoke, some do not, some people like to talk to strangers, some do not. These are aspects of people’s habits that is difficult to change but it is possible to be aware of and meet when planning a bus station, by for instance planning a smoking area, make single seats and/or wider seats.

Summary of important aspects from this section:

- Good thermal comfort provided by shelters that shield from wind and precipitation.
- Cost efficient heating should be researched.

- Important that the Superbuss will provide high standard bus stations that ensures enough seating, room in shelters as well as garbage bins, parking etc.
- Should be researched if safe storage on bus stations could increase use of PT, especially at a station associated with outdoor activity access.
- Universal design must be prioritized.

5.3 Which Aspects of a Bus Service Must be Present to Reach a Higher Utilization?

There have been multiple studies on how to get people from using their cars to using public transport (Redman et al., 2013, von Seth et al., 2013, Balcombe et al., 2004). They all agree on one thing; that it is a complex and difficult task. To get people to transition from car to PT, the PT service is required to meet a lot of demands of transportation; high frequency, short travel time, high efficiency, fully integrated offer, low prices and a high level of comfort during the travel (Redman et al., 2013, Balcombe et al., 2004, Miljøpakken, 2017a, Solheim and Nervik, 2013). It is difficult for a PT service to mimic all of these properties, therefore it is important to meet the user demands as well as possible.

Gender, environmental friendliness, age and income influences why people choose to use PT (Solheim and Nervik, 2013). It is also shown that an improvement of the bus services has positive effect on the utilization, however studies struggle to agree on what is the most effective measure (Thorinfieldt et al., 2011).

When looking at the attributes of the bus system, one often looks at all the quality attributes which includes frequency, prices and comfort. Studies have concluded that reduction of prices has an initial effect of getting car users to transition to PT services (Thøgersen, 2009, Fuji and Kitamura, 2003), but other attributes are important to keep the new users. Frequency is also of key importance as it is the most targeted factor when developing new PT systems, as an increase of frequency has provided an increase in ridership both from the group of new users and from existing car users (Levinson et al., 2003). The importance of these factors was

confirmed by the interviewees, as they wanted to ensure PT with high frequency and low prices, to provide easier access to the arena for everyone.

The travel time is also important to the users. The respondents estimated travel time is shown in Figure 28, and this shows that the bus travel time is longer than the ones that drives to Granåsen, as most of the respondents that uses the bus has a travel time above 21 minutes and the ones that drives uses between 5 to 30 minutes. This makes it more inviting to drive a car to Granåsen. So, to increase utilization of PT to Granåsen, the travel time of the bus needs to decrease.

Comfort is an attribute that is always mentioned as important to the individual. To increase the quality attribute of comfort at a bus stop, it is common to think of the facilities at the stop. As discussed in the section above, there are many aspects which needs to be considered when improving comfort.

The results from the study showed that improvement of facilities at the stop would likely not increase the utilization of PT, see Table 17. As it was a stated choice study it is hard to know if this actually would be the case when tested in practice. The results state that the comfort of the stop will not make a person change destination or change transport mode. This result needs to be researched more as this study only had 100 respondents, many of whom primarily used the bus regardless. It seemed like the questions were not clear enough as there were 31% of the ones that chose the car to Granåsen that immediately changed their answer to take the bus. At this point the bus stop design had not changed and were at comfort level 1, which included a bench, a garbage bin and a timetable. Of the rest of the car users, there were only two respondents that chose to change transportation mode from car to bus. One respondent changed at comfort level 2 and the other at comfort level 3. Of the people that originally chose the bus, only three people changed their destination because of the changes in the design. Two respondents changed at comfort level 2 and the last one changed at comfort level 5.

The results of the survey is correlating with the results of Balcombe et al. (2004) that individual improvement of a stop may have a modest impact. The interviewees did not answer

directly about the facilities but had an overall view of the bus service and believed that an overall improvement would provide higher utilization.

A change in the bus stop design may not change the travel habits of the users, but it may increase the customer satisfaction (Redman et al., 2013). It is also possible that the idea of comfort having an impact on choice of transport mode can be a bit difficult for people to get their head around, as it is normal to only think of frequency and travel time when talking about getting people to use PT.

Access to cars may decrease the utilization for PT, as travelers with access to cars are more responsive to fare changes than others (Balcombe et al., 2004). So, when there are limited parking and access for cars, people choose to use PT (Sjulstad, 2017). Today, Granåsen has high access to parking, which makes taking the car an easy choice. The parking fee at events is only 50 NOK, which provides a valuable income to the arena, while a one-way bus ticket is between 33 NOK and 50 NOK. The car is then perceived as a cheaper and more comfortable option. The downside is that the amounts of cars cause congestion at large events, which again leads to negative comments and reflects badly on the event. This was a problem in Holmenkollen during previous World Cup events, so to avoid congestion, no parking is allowed during events, except for persons with special permissions. The public is recommended to use PT or to walk to the arena. There have also been established commuter parking with a shuttle bus to the arena. So, to reduce the car activity and congestion in Granåsen, it is important to decrease the capacity of parking at the arena. But as the parking fee goes back to the arena, it is also a possibility to decrease the capacity of the parking lot and increase the fee, so that it is less attractive to take the car, but the arena still gets an income from the ones that still choose to drive. Another solution could be to use commuter parking with the same car fee, and provide a shuttle bus to the arena.

The PT system should comply with the needs of families as they are a group of the public that often will take the car as it is easier to control the situation. This need was requested in the survey where the respondents asked for a service that can have room for families and storage space for equipment for their activities. The respondents of the survey also mentioned that a trip with children is cheaper in a car than taking the bus. The families that use cars instead of

PT teach the children that a car is the easier and more flexible way of transportation that may give grounds for the children's habits as adults.

Accessibility is an important factor. If the bus stop is just outside the front door it is easier to choose PT instead of a car. Accessibility often comes in dilemma with travel time. This is because people want to have the bus stop outside their door but they do not want the bus to stop often, as that increases travel time. Respondents of the survey commented on that the reason for not travelling to Granåsen with bus was the low access to the bus route 19 which resulted in many transitions of bus routes, which again increased the travel time. This proves that an improvement of accessibility can be improved by covering more areas by changing the route so that it meets user demands and connects more areas of the city, or provide an extra route that covers another part of the city than the existing route 19. Still, with an increase in accessibility it is important to consider the travel time, as car users will typically choose the car if there is a large difference in travel time.

Accessibility is also related to universal design by referring to the process of finding, boarding and alighting at a bus stop (TransLink, 2007). It is important to provide surroundings that helps locating the bus stop, and provides a safe and comfortable waiting area. Accessibility is closely linked to the location of the bus stop which will be discussed in chapter 5.4.

The investment cost of a BRT system is considerably lower than investing in a rail service. Still, BRT will cost more than a local bus service. For instance busway development is a cost that includes land acquisition, construction, and engineering (National Research et al., 2007), but are important to provide the efficiency that is expected of the service. When simplifying, the cost of a high standard bus stop with a lot of facilities will cost more than a simple bus stop with only a timetable. Another important factor is the cost of operation and maintenance. A high standard bus stop will improve the passenger comfort, but only if it is kept intact. Vandalism can easily decrease the comfort as the waiting passenger can feel unsecure and offended. Littering is also something that can decrease comfort. To avoid vandalism and crime, it can be necessary with frequent surveillance and maintenance which also can be a high expense.

Prices of the service is one of the factors that are most important to get people to use a bus service (Redman et al., 2013). Thus, it is important to consider the investment cost, the maintenance and the operational costs when designing bus stops so that the costs will not result in an increase in the ticket fee of the bus service. An increase in prices could cause a negative effect as fewer would use the bus service and the service would be perceived as less attractive, which could result in increased car use.

Summary of important aspects from this section:

- Frequency is the most targeted factor when improving PT services.
- Low prices get car users to transition to PT, therefore it is important to have an investment, maintenance and operation cost that prevents increased prices.
- Limitation in car access and parking increases utilization of PT.
- Increasing the comfort at a bus stop cannot on its own increase utilization of the bus service, but it increases customer satisfaction.

5.4 How Can the Bus Stop Be Located So It Provides Good Mobility for Vehicles and People Through the Space, Both on a Normal Day and During Events?

In Table 5, Zhang (2012) introduces accessibility and integration as necessary parts of the bus stop design. When looking at accessibility it is important to consider the area surrounding the bus stop, and plan for making the bus stop a node for a majority of the users in proximity to the bus stop. The bus stop in Granåsen should be placed so that it is accessible for the public, which includes people of various physical abilities.

In Handbook V123 (Statens vegvesen, 2014a), recommendations for location of a bus stop is introduced. These recommendations are based on the new development for buses and stations. Distance between stations should be between 500 meters to 800 meters. This distance will influence the travel time between the passenger's home and the bus stop, shown in Figure 35.

	Hastighet	Avstand til holdeplass			
		200 meter	500 meter	800 meter	1500 meter
Gange	45 m/min (barn/eldre)	4,5	11	18	33
	85 m/min (voksne)	2,5	6	9	18
Sykkel	10 km/t	1,2	3	5	9
	15 km/t	0,8	2	3	6
	20 km/t	0,6	1,5	2,5	4,5

Figure 35: Guiding values of travel time, in minutes, to and from bus stop for pedestrians and bikers (Statens vegvesen, 2014a).

By placing the bus stop close to important contact points, it is possible to shorten the travel time to and from the bus stop for a lot of passengers in a certain area. As mentioned in section 1.2.2, the development of Granåsen will have an expected increase of users by 20%. Thus, it is important to place the bus stop so that it is accessible for the integral part of its users.

The previous bus stop in Granåsen was designed as a bus bay, but did not have enough space so that the traffic could pass the bus when it stopped. This was not ideal for neither rush hour traffic or for events. New criteria for the bus stop should therefore be that it is placed outside of the traffic lane. It is also important to have a solution where people can walk or bike by the bus stop without being hindered by waiting passengers. The design of the new Superbuss stations incorporates these needs as the bus will have its own busway, and private transport, such as cars, will pass by in another lane. The design also incorporates a travel zone behind the bus stop, shown in Figure 36, to provide safe passage for pedestrians and cyclists.

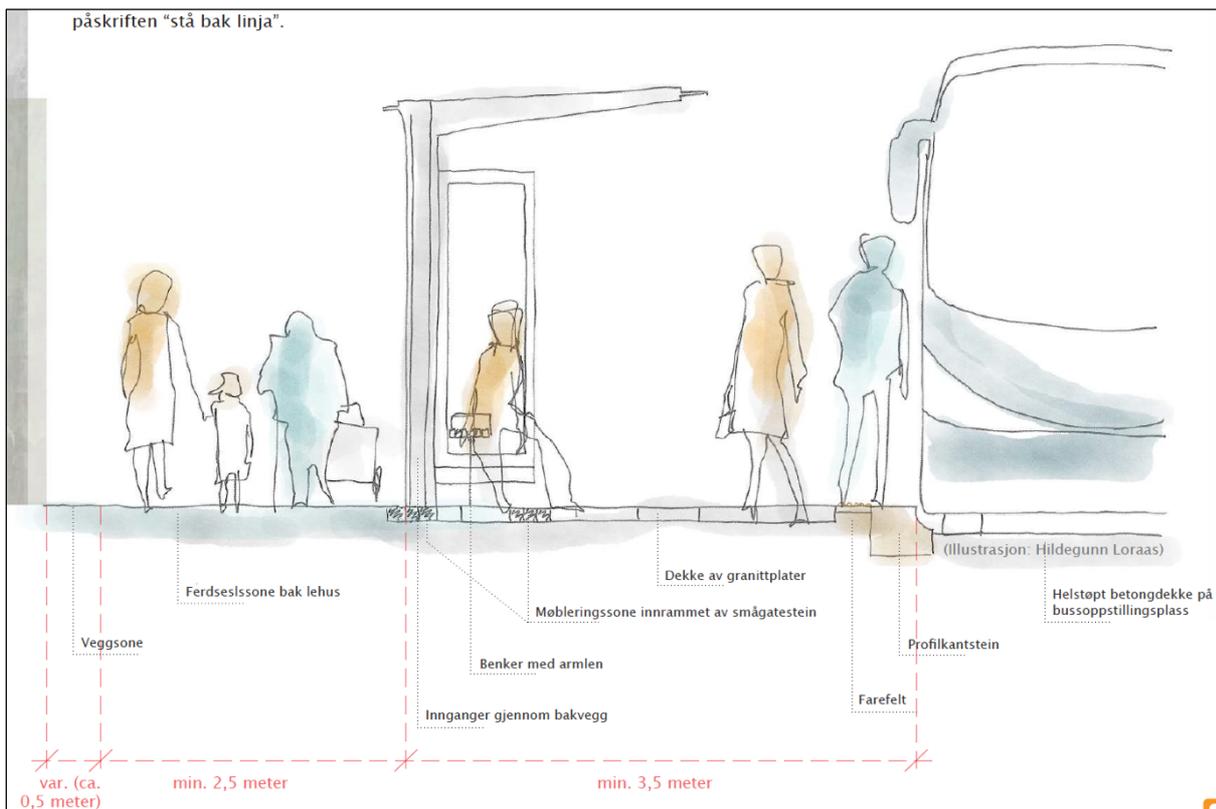


Figure 36: Design of bus stations for the new Superbuss concept. Travel zone for other road users as pedestrians is showed on the left (Miljøpakken, 2016a).

To get the shortest travel time with the bus, the bus stop should remain located in Kongsvegen, as it is today. By implementing the new design for the station, it will be easier for pedestrians to pass by the stop as well as more room for passengers that are waiting for the bus. To avoid traffic jam on days with high demand on PT, the bus stop needs to be placed next to a separate PT lane or provide a bus bay where the bus is completely moved out of the traffic lane. This could be done by using a solution as shown in Figure 37, where the pedestrian lane and biking lane passes behind the bus shelter to avoid conflicts with the waiting passengers, and have enough room for the waiting passengers when there are many people, as a school class. Sidewalks and bike lanes also increases accessibility.

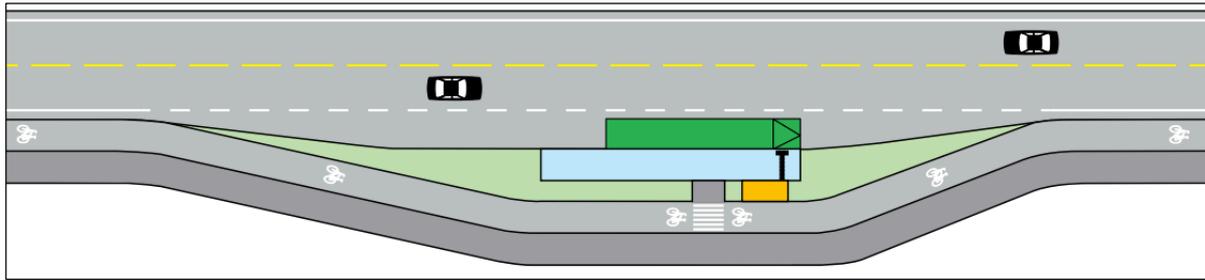


Figure 37: Bus stop with pedestrian and bicycle lane behind bus shelter (Statens vegvesen, 2014a)

Another solution for removing traffic jam in situations with high demand on the PT, is to move the bus stop to an alternative location, as a side road. This can provide space for a passenger platform away from the traffic. This will be a similar solution to the metro station in Holmenkollen. The new plans that are shown in Figure 6 and Figure 7, show that there will be made a circulatory drive around the new sports halls. By placing the bus stop close to the biathlon arena, the buses will be out of the normal traffic and have possibilities for making a bus stop that is a normal size for week days and can expand on events so that busses can wait and take on the passenger load when events are finished. It can also be a temporary solution provided only for larger events as it is important that the public is maneuvered away from Kongsvegen, so that traffic can run as normal. The negative effects of placing the bus stop so close to the ski jump is that after events people will be clogged up waiting for the bus instead of having the possibility to disperse. Granåsen has previously avoided this by closing the nearest bus stop during larger events, so that the public needs to walk 10 minutes to the next stop, where the bus departs. This is similar to the solution in Holmenkollen, where the T-bane station is placed a 10-minute walk from the arena. This helps improve the mobility in and around the arena as well as separating the people that are going to the PT, from people that are using other transport modes.

By implementing a circulatory drive inside the arena, one should also consider the ideas of shared space. This will be an area that will be used by buses, pedestrians and bikers in an open environment, as it will be normal to move from the athletic halls up to the ski arena. Shared space will make the circulatory drive a natural part of the arena as separations between the travel modes will be removed and the safety is based upon low speeds and cooperation between the transport modes.

As the Superbuss may have an extension to Granåsen, the stop in Granåsen would be an end stop. Then a larger stop could be made to have capacity for more buses while they wait to start their route or wait for an event to end. The stop need in that situation to be moved away from Kongsvegen so that the buses have a possibility to wait there and there need to be a safe place for the bus to turn around. Today the civil defense camp has been used for this, as there are room for buses to wait and to turn around. A future solution could be using the new circulatory drive as a turnaround for the bus would provide safety and a lot of room for the buses to wait, as they could wait on the road nearest to the arena. As the extension would be used less than a normal bus route it is important to research if it is possible to make a stop that can be both an end stop for the Superbuss route and an efficient stop for the normal route.

Integration into the environment is a design aspect that is relevant to look at, and also mentioned in Table 5. The Superbuss design is developed so that it can be adjusted to the area where it is placed. In Granåsen the number of users today is low, but as there are kindergartens and schools in the area, there are times where there are a lot of passengers at once. The bus stop needs to be adapted to both scenarios, as well as fit into to the neighborhood. A big bus stop with no users would look out of place, while a small bus stop would not have room for school and kindergarten classes going on excursions. It is therefore important to place the bus stop at an area that can work as a natural expansion to the bus stop when there is a lot of passengers, and the bus stop itself can be small enough to become a natural part of the building structure as well as the rural environment.

It is important to consider where a bus stop would be most accessible. As the athlete's halls and the arena are on different levels of topography, there will be stair or a steep hill to get from the athlete's halls up to the road above which is closer to the arena. This can cause a challenge in universal design. If the bus stop is in Kongsvegen, the possibility is to make a road that takes a longer round trip but with an easier climb.

Summary of important aspects from this section:

- Provide accessibility by considering travel time to and from the bus stop.
- The location of the bus stop should be at a connecting point.

- The bus stop should be placed away from traffic, either in a side road or a circulatory drive.
- The bus stop should have several functionalities to meet the demand of events and weekdays.
- Consider the concept of shared space if bus stop is integrated in the arena.
- The bus stop should be integrated in the environment.

5.5 Which Facilities Can Increase the Use of Granåsen?

An increase in users of Granåsen is not directly connected to the utilization of PT. But with facilities and an outdoor environment that invites people to come to Granåsen, the demand for transport increases. This demand can be met by adapting for cars or PT. By adapting for PT, the new demand will create an increase in the utilization of PT. This again can be an incentive for further investments in improvement of PT to Granåsen.

Gehl (2010) says that people needs to be in focus for developing new cities, and with this, focus on how to invite people to public spaces and make the areas function as meeting places. As Gehl (2010) shows in his representation of outdoor activities and environment (Figure 18); the outdoor environment has a massive influence on optional activities. This represents all activities for all persons that uses or can use Granåsen to other activities than work and professional sports. This means that it is important to invite people to use the area by making a good and comfortable environment around the arena, as well as around the bus stop.

The survey showed that Granåsen could be improved by offering facilities such as toilets, cafes and a kiosk, see Figure 29. These facilities can make a community in Granåsen as well as getting people to come for a visit without having the main goal of exercise. Today, the respondents are using the arena primarily for skiing, exercise and outdoor activities, see Figure 27, which shows that the arena already has a good basis for exercise, therefore it is important to attract people that are interested in other organized outdoor activities. This could be zip line, tree climbing park, Frisbee golf and arranged flight of steps. Activities like this can be used in team building, birthdays and private events. Holmenkollen has implemented a

lot of these activities to get various kinds of people to get familiar with the arena so that it is a lower threshold for them to return on other occasions.

A sports hall is planned as part of the new development in Granåsen. It is important to get the users of this new hall to also get a knowledge of the area. The sports hall can also be used to arrange indoor concerts, competitions and other organized activities. This can improve Granåsen to be a sports hub for the close areas but also for the rest of the city. Proximity to the sports hall and offices will also reflect well on the bus stop as this will be a connection point to this area, as well as a connection point to other places.

In Holmenkollen a lot of investment have gone into attracting tourists, and tourist buses come every day to get a view of the ski jump, the museum and the view over the city. Hurtigruten is a tourist ship that comes to harbor in Trondheim every day and stays in Trondheim for three and a half hours (Hurtigruten, 2017). By implementing tourist attractions that tourists could visit in 20 min, then buses could be arranged to come to Granåsen and give a short impression of the ski jump arena and its history. It is also a possibility to include attracting local tourism by making larger attractions as a museum and a connecting playground which could attract families to Granåsen to do something else and have an interactive experience. Suggestions in the survey of a museum and playground in Granåsen got positive responses, which proves that it is already an interest in the idea of these future attractions.

Holmenkollen has added a lot of new facilities to spark the interest of other users or existing users to come to see and get know the possibilities of activities in Holmenkollen. This is based on the main vision of the arena that Holmenkollen is open for everyone. Granåsen have had their main focus on top-level athletes and adapting the environment to ski sports. So, the important aspect is to choose facilities that reflects the goal of the arena, and facilities that are inviting to people that can fulfill these goals.

From the existing data in this study, it is difficult to say if increase in use of Granåsen would provide a higher utilization of PT. Many of the respondents commented on the poor communication to Granåsen with PT, as a lot of people needs to switch between bus routes because of lack of access to the route and also uses long time waiting for the bus route

because its low frequency of departures. With higher utilization of the facilities Granåsen, it is possible to invest in higher frequency on routes, that again can cause a higher utilization, but at the same time, higher use is not likely to come without higher frequency. The best solution is to combine the investment in new facilities in Granåsen with an investment in PT, so that more people have the possibility to visit Granåsen when they would like.

Summary of most important aspects from this section:

- Facilities as cafes, toilets and kiosk can create a community.
- Arranged outdoor activities can invite a variety of people.
- Implementing activities and facilities as a museum and playground can cause a demand among foreign and local tourists.
- Local industry and new sports halls can create synergies for PT.

5.6 Weaknesses and Limitations Within the Study

A weakness with the analysis is the limited data collection. The survey only provided answers from 100 respondents, of which 3 were not qualified and 19% have never visited Granåsen. The survey was sent out to the offices at Granåsen, as well as offices, stores, kindergartens and schools in the area close to Granåsen, but with little response. The survey was also sent out to students and professors at the Institute for Civil Engineering at NTNU. It was attempted given to The Norwegian Trekking Association (DNT), which is an active user of the area in and around Granåsen, and also AtB's users, but this was hindered by their internal rules of distribution. With a low response in the survey it is difficult to say if the results are representative for the population in Trondheim. There were also insufficient documents about the existing bus service. However, as the results were almost unanimous, they still give an inclination to what the answers of a larger survey would be.

Despite having piloted the survey, the survey contained some mistakes. The logical jumps made the ones that answered that they used bikes or walked to Granåsen, jump to questions about car use. These result about car use where excluded in the result. As the master developed there were also questions that surfaced that should have been asked to get a clearer

understanding of the respondents view on PT and the importance of comfort. Examples of this was the importance of lighting and safety aspects of a bus stop. Some questions in the stated choice survey the survey was also misunderstood and this may have affected the result of the survey. The survey should also have asked the respondents if they own a car, since this would give an understanding if some people chose the bus over the car.

There have also been a lot of uncertainty around some of the basic data that should be provided for the master. As there are no actual plans about the Superbuss going to Granåsen there is a lot of uncertainty tied to if there will be a Superbuss to Granåsen or if one will continue according the same plans and design that is presented as of now. This has however not affected the study much as the study is based on the basic ideas of Superbuss and these ideas are fulfilling a lot of the goals for PT in Granåsen. The plans for the development of Granåsen is also in the idea phase so it is not certain that the alternatives shown for future development actually will be the ones that are established. Even so, the recommendations for Granåsen will still be valid.

The original plan for the interviews was to interview representatives from the police and Ruter in Oslo to get a greater understanding of the transportation to and from Holmenkollen. This was not done because of limited access to the relevant persons and limitations in time. This causes for a missing angle, but information given from the interviews that were held will still give relevant data to the thesis. The two persons that were interviewed may be biased and will not necessary reflect the opinions of the whole of the two organizations.

A limitation with the master thesis is its generalization. The main hypothesis is asked based on the transportation to and from Granåsen, which is a rural area, and therefore the study can have a different result in a more central area. The climate in Trondheim has also an impact as it changes a lot during the year. Granåsen was elected as a case study because of ÅF's connection to the development of Granåsen. This might not have been the best place as it is far away from the city center and there are not so many people living in the area. The bus stop fulfilled the criteria of having one bus route, placed in a rural area with a lot of car users. As travel time is so important for utilization, the location of the bus stop might have affected study negatively as the respondents were mostly occupied with the idea of decreasing travel

time. The frequency of the bus route may also have affected the results as some results were extremely positive on the basis of a higher frequency in combination with a change in bus stop design. A better location for a similar study would be a stop with one bus route with a higher frequency which is placed closer to the city center.

Other limitations are that the thesis focused only on the design and location of the bus stop and did not further consider the other aspects of PT which constitute a part of the holistic PT service, when considering the utilization. When discussing the bus stop the AADT have not been considered, and the study found no data on the exact number of users at Granåsen or of the bus stop.

Even though the study holds the weaknesses mentioned above, they will not have any mentionable impact on the result as the study have used existing literature and research to compare and underline the results. The research and literature have given the understanding of the aspects that were lacking in the study.

6 Conclusion and Suggestions for Further Research

The objective of this research was to see how location and design could influence the use of PT. This was done by collecting data from interviews, survey and observations, and by comparing these result with existing research and data. The conclusion of the study was reached by discussing four research questions that provided a basis to state if the hypothesis were correct or wrong.

The analysis done in this master proves the hypothesis “*It is possible to attract users to public transport by improving the design and location of a bus stop*” to be wrong. This means that improvement of design and location will not have a direct influence on getting a higher utilization of PT. It can, however, lead to higher comfort and passenger satisfaction which can be a goal in development of future PT. The discussions showed that there are many aspects that can improve a bus stop which the public is interested in. But in the end the study shows that increasing the comfort level by location and design is not enough to get people to use public transport. This is also reflected in previous studies done in other cities (Balcombe et al., 2004, Redman et al., 2013).

This result is still relevant as it gives an understanding of the outcome when investing in bus stop design. As development of PT is a large investment, it is important to get an outcome that reflects the goal, so as the goal is higher utilization of PT, one should research the other quality attributes and see how the public in Trondheim will be affected.

It is possible to assume that the level of utilization in PT will improve as a direct consequence of increasing offers of facilities and activities to the public in Granåsen. As well as making the area attractive for sports and industry. However, it is a large investment, as it may demand new buildings and development of an area. Thus, the development of new facilities cannot only be based on a wish to increase utilization of PT. It needs to be relevant to the future goals of the arena and surroundings, as it needs commitment and investment.

This study has been a small study with a small data collection. To get more exact results, a bigger study should be done which may also include a revealed choice study. This is to see if

the actions of the public are the same as they envision. The study has shown people to not understand the importance of comfort and some have not been able to imagine that it could have an impact, which is reflected in the results. This is why a revealed choice study may have a different outcome than a stated choice study. If the revealed choice study would prove something different is difficult to say, but as the respondents have not experienced a bus stop with all possible applications, the respondents may reply differently in the future. It would also be interesting to see if the outcome could be different in Norway compared to other countries that have researched similar problems.

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Appendix

Appendix 1	Task Description
Appendix 2	Information Letter to Respondents of the Survey
Appendix 3	The Survey
Appendix 4	Observations
Appendix 5	Interviews

The survey is added in appendix 3, but it is without the logic jumps that were sent out to respondents.

Appendix 1 Task Description

MASTER DEGREE THESIS
(TBA 4940 Veg)

SPRING 2017

for

Karine Gjersø**Granåsen Case Study: How can location and design of a bus stop influence the use of public transport?****BACKGROUND**

The increase in Norway's population will provide an increase in daily trips estimated to about two million travels a day. This will result in a 300 billion NOK investment if handled by cars, as well as an increase in greenhouse gas emissions. The Norwegian government has decided that further growth in transport should be handled with walking, biking or public transport. Public transport (PT) needs to be efficient and environmentally friendly, but also comfortable and accessible, to promote a higher utilization. Thus, it is important to consider both design and location of the stops when designing a PT service.

TASK**Task description**

Do a case study of a bus stop in Granåsen, Trondheim. See if the study confirms or rejects the hypothesis "*It is possible to attract users to public transport by improving the design and location of a bus stop*" by answering four research questions related to the hypothesis.

Objective and purpose

The aim of the study is to research if location and design of a bus stop can influence the willingness to use public transport.

Subtasks and research questions

1. What are the most important design facilities at a bus stop?
2. Which aspects of a bus service must be present to reach a higher utilization?
3. How can the bus stop be located so it provides good mobility for vehicles and people through the space, both on a normal day and during events?
4. Which facilities, connected to the bus stop, can increase the use of Granåsen?

General about content, work and presentation

The text for the master thesis is meant as a framework for the work of the candidate. Adjustments might be done as the work progresses. Tentative changes must be done in cooperation and agreement with the professor in charge at the Department.

In the evaluation thoroughness in the work will be emphasized, as will be documentation of independence in assessments and conclusions. Furthermore the presentation (report) should be well organized and edited; providing clear, precise and orderly descriptions without being unnecessary voluminous.

The report shall include:

- Standard report front page (from DAIM, <http://daim.idi.ntnu.no/>)
- Title page with abstract and keywords.(template on: [wiki page for students at CEE Departement](#))
- Preface
- Summary and acknowledgement. The summary shall include the objectives of the work, explain how the work has been conducted, present the main results achieved and give the main conclusions of the work.
- The main text.
- Text of the Thesis (these pages) signed by professor in charge as Attachment 1.

The thesis can as an alternative be made as a scientific article for international publication, when this is agreed upon by the Professor in charge. Such a report will include the same points as given above, but where the main text includes both the scientific article and a process report.

Advice and guidelines for writing of the report is given in “Writing Reports” by Øivind Arntsen, and in the departments “Råd og retningslinjer for rapportskrivning ved prosjekt og masteroppgave” (In Norwegian) located at [wiki page for students at CEE Departement](#)

Submission procedure

Procedures relating to the submission of the thesis are described in DAIM (<http://daim.idi.ntnu.no/>). Printing of the thesis is ordered through DAIM directly to Skipnes Printing delivering the printed paper to the department office 2-4 days later. The department will pay for 3 copies, of which the institute retains two copies. Additional copies must be paid for by the candidate / external partner.

The master thesis will not be registered as delivered until the student has delivered the submission form (from DAIM) where both the Ark-Bibl in SBI and Public Services (Building Safety) of SB II has signed the form. The submission form including the appropriate signatures must be signed by the department office before the form is delivered Faculty Office.

Documentation collected during the work, with support from the Department, shall be handed in to the Department together with the report.

According to the current laws and regulations at NTNU, the report is the property of NTNU. The report and associated results can only be used following approval from NTNU (and external cooperation partner if applicable). The Department has the right to make use of the results from the work as if conducted by a Department employee, as long as other arrangements are not agreed upon beforehand.

Tentative agreement on external supervision, work outside NTNU, economic support etc.

Separate description is to be developed, if and when applicable. See [wiki page for students at CEE Departement](#) for agreement forms.

Health, environment and safety (HSE) <http://www.ntnu.edu/hse>

NTNU emphasizes the safety for the individual employee and student. The individual safety shall be in the forefront and no one shall take unnecessary chances in carrying out the work. In particular, if the student is to participate in field work, visits, field courses, excursions etc. during the Master Thesis work, he/she shall make himself/herself familiar with “Fieldwork HSE Guidelines”. NTNU student HSE policy is found here: <https://innsida.ntnu.no/hms-for-studenter>

If you are doing labwork for your project og master thesis, you have to take an online e-course in lab HSE. To get link, email kontakt@ibm.ntnu.no.

The students do not have a full insurance coverage as a student at NTNU. If you as a student want the same insurance coverage as the employees at the university, you must take out individual travel and personal injury insurance.

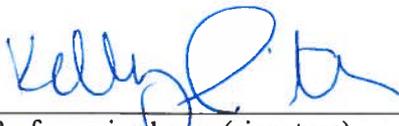
Startup and submission deadlines

Startup and submission deadlines are according to information found in DAIM.

Professor in charge: Kelly Pitera

Department of Civil and Transport Engineering, NTNU

Date: 27.06.2017



Professor in charge (signature)

Appendix 2
Information Letter to Respondents of the Survey

Forespørsel om deltakelse i forskningsprosjektet

”Undersøkelse for utvikling av bussholdeplass i Granåsen”

Bakgrunn og formål

Studien skal brukes i forbindelse med en masteroppgave med problemstillingen “How to get the public to take the bus by design of the bus station and surrounding areas?”. Formålet med studien er å finne ut om brukere av Granåsen er villige til å bruke kollektivmulighetene dersom bussholdeplassen og områdene i nærheten blir tilrettelagt etter brukernes behov. Masteroppgaven gjøres for NTNU i samarbeid med ÅF Engineering.

Utvalget blir valgt ut fra personer som bruker Granåsen og er over 18. Dette gjelder personer som bruker områdene både til fritid og jobb.

Hva innebærer deltakelse i studien?

Dette er en internettbasert spørreundersøkelse som gjennomføres ved bruk av Typeform, som er en spørreskjemaleleverandør. Opplysninger som hentes inn gjelder reise til Granåsen (transportmiddel og tid), bruk av området, preferanser i forbindelse med en bussholdeplass. I tillegg vil det bedt om å oppgi postnummer, kjønn, alder (i kategorier), inntekt, yrke. Spørreskjemaet innebærer registrering av e-post men dette vil trekkes ut og holdes separert fra innsamlede data. Samtykke gis ved å trykke på link. Dette blir informert om på forhånd.

Hva skjer med informasjonen om deg?

Alle personopplysninger vil bli behandlet konfidensielt. Alle data vil bli anonymisert i begynnelsen av analyseperioden. Ekstern oppdragsgiver vil kun få tilgang til analysen. Ingen av deltakerne vil kunne gjenkjennes i publikasjon av resultater. Prosjektet skal etter planen avsluttes 11.juni 2017. Datamaterialet vil deretter bli slettet da det ikke skal brukes videre.

Frivillig deltakelse

Det er frivillig å delta i studien, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn. Dersom du trekker deg, vil alle opplysninger om deg bli anonymisert. Samtykke gis ved å trykke på link til spørreundersøkelse. Ved å besvare spørreskjemaet vil du være med i trekninen av et gavekort.

Studien er meldt til Personvernombudet for forskning, NSD - Norsk senter for forskningsdata AS.

Vennlig hilsen

Karine Gjersø,
Masterstudent

Kelly Pitera,
Førsteamunesis

Norges Teknisk-Vitenskapelige Universitet (NTNU)
Institutt for Bygg- og Miljøteknikk
Høgskoleringen 7A/N -7491 Trondheim
Tel: 938 29 822
Epost: karinegj@stud.ntnu.no

Appendix 3 The Survey

Dette er undersøkelse om reisevaner til Granåsen og Granåsens bussholdeplass for å videre kunne utvikle denne til å bli et attraktivt sted å oppholde seg ved bruk av kollektivtransport. Undersøkelsen inngår som en del av en masteroppgave ved NTNU. Din deltagelse vil bidra til økt forståelse av transportvanene til Granåsen og også hvilke muligheter som foreligger for en utvikling av bussholdeplassen. Ved å delta kan du bli med i konkurransen om et gavekort på 500kr. Takk for din deltagelse.

(Deltakeren må være over 18 år)

Start

Granåsen er Trondheims hovedarena for all vinteridrett knyttet til hopp, langrenn og kombinert. Granåsen har også skiskytingsanlegg og rulleskiløype. Om sommeren brukes Granåsen til tur, rekreasjon og er inngangsport til marka. Arenaområdet blir også brukt som konsertarena og vert for ulike arrangementer i løpet av året.



1 Hvor ofte besøker du Granåsen? *

- Aldri Noen ganger i året En gang i måneden Hver andre uke Hver uke
 2-4 ganger i uken 5-7 ganger i uken

2 Hva er bakgrunnen for besøket/besøkene? *

- Toppidrett Trening Ski/tur-gåing Jobb og næringsliv Arrangement
 Lek og friluftsliv Annet

3 Hvilket transportmiddel brukte du sist du dro til Granåsen? *

- Bil Buss Sykkel Gå Annet

4 Hvorfor velger du å ta bilen?

5 Vurderer du noen gang andre transportmidler? *

Ja Nei

6 Hvilke? *

Bil Buss Sykkel Gå Annet

7 Hvorfor ikke? *

8 Hvorfor velger du å ta buss?

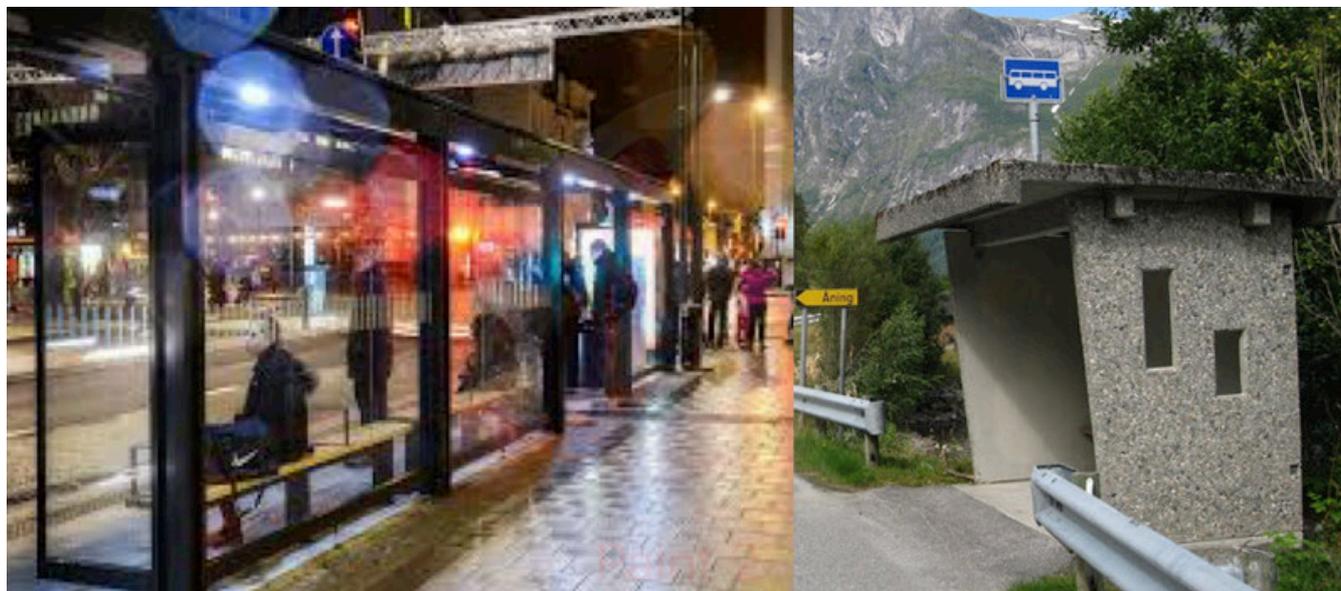
9 Hvor lang tid bruker du vanligvis fra avreisepunkt til Granåsen? *

< 5 min 5 - 10 min 11 - 20 min 21 - 30 min 31 - 40 min 41 - 50 min
 51 - 60 min > 60 min

Bussholdeplasser kan være utformet ulikt fra sted til sted. I sentrumsområder er det ofte større holdeplasser med tak, benker, søppelkasser, sanntidsinformasjon osv., mens det i mer gravgrendte strøk er mindre stopp med kun en overbygning og tidtabell.

De følgende spørsmålene omhandler attraktivitet til bussholdeplasser og området rundt.

Under til venstre kan du se en sentrumsholdeplass og til høyre kan du se en holdeplass som ofte ligger i ytre strøk.



10 Synes du denne bussholdeplassen er attraktiv med tanke på design?

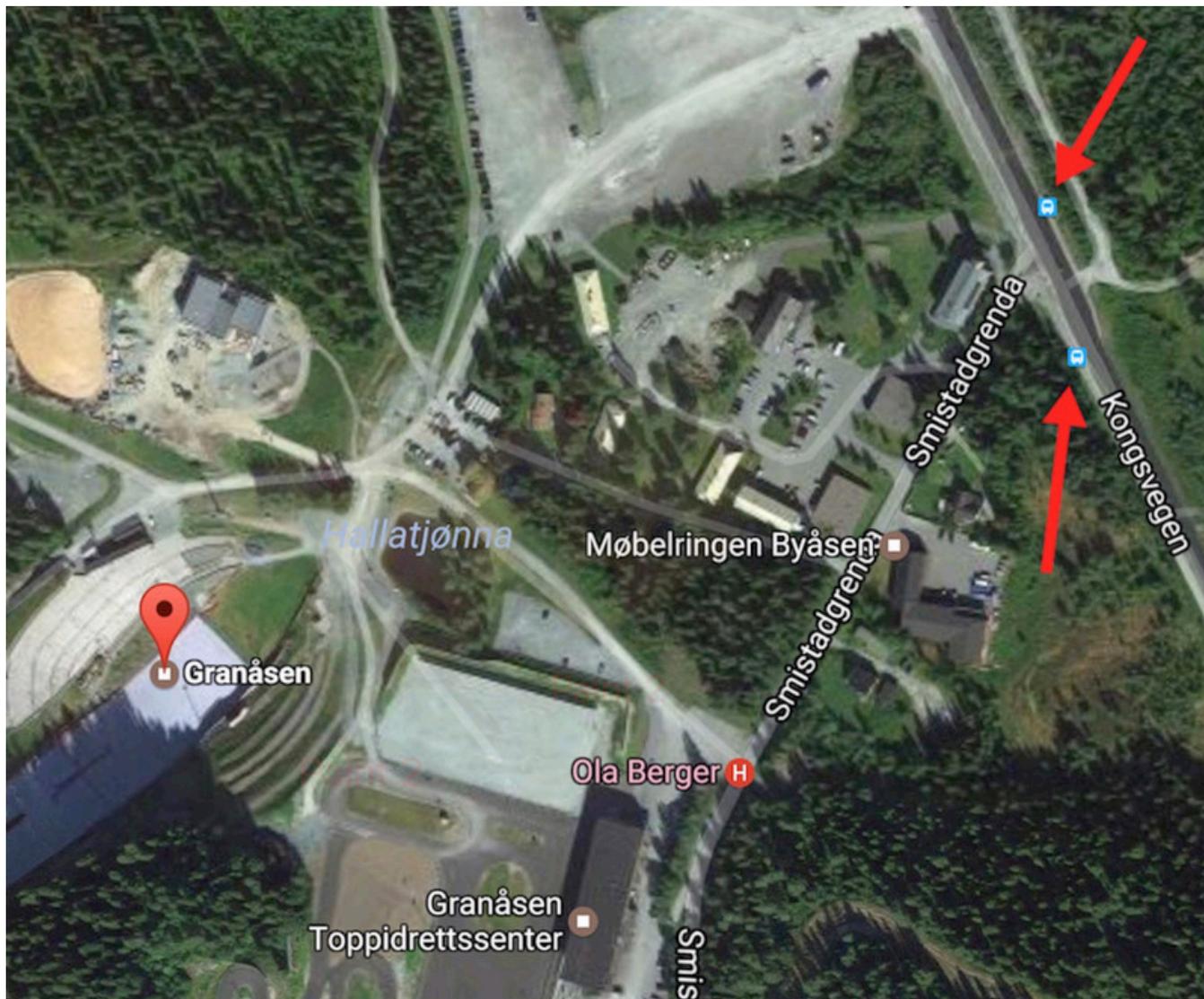
Dette er den eksisterende holdeplassen ved Granåsen.



Ja Nei

11 Synes du denne bussholdeplassen er attraktiv med tanke på beliggenhet?

Denne holdeplassen er plassert rett ved veien og det tar ca. 5 minutter å gå fra holdeplassen til hoppbakkene og skiløypene. Plasseringen av bussholdeplassen er markert med røde piler.



Ja Nei

12 Ville du vurdert å benytte bussholdeplassen dersom den var bedre tilrettelagt både med tanke på lokasjon og design? *

Ja Nei

13 Hva er viktig for deg å ha tilgang til på en bussholdeplass?

Rangér valgene fra 1 stjerne til 5 stjerner, hvor 1 stjerne er "lite viktig" og 5 stjerner er "veldig viktig".

a. Benk *

1 2 3 4 5

b. Sjøppelkasse *

1 2 3 4 5

c. Varme *

1 2 3 4 5

d. Tidstabell *

1 2 3 4 5

e. Sanntidsinformasjon *

1 2 3 4 5

f. Tak *

1 2 3 4 5

g. Wifi *

1 2 3 4 5

h. Reklame *

- 1 2 3 4 5

i. Musikk *

- 1 2 3 4 5

j. Lagring til ski-/turutstyr *

- 1 2 3 4 5

k. Ladestasjon for elektronisk utstyr *

- 1 2 3 4 5

l. TV/underholdning *

- 1 2 3 4 5

m. Annet?**14** Hvilke servicetjenester ønsker du deg i Granåsen? *

- Toaletter Kafé Daglivareforretning Kiosk Museum
 Arrangerte utendørsaktiviteter som f.eks zipline, klatring Lekeplass Annet

15 Hvis du skal ut i Bymarka fra Granåsen. Hvilket transportmiddel bruker du helst til Granåsen? *

Bil Buss Annet

16 Du valgte å ta buss til Granåsen for å komme deg til Bymarka. For å komme seg til Bymarka er det også mulig å ta buss til Skistua. Anta at du reiser fra Prinsenkrysset. Under vises de nye egenskapene ved buss til Granåsen og til Skistua. Hvor hadde du valgt å dra? *

Skistua	
Reisetid	17 min
Anganger	1 gang i timen
Komfort bussholdeplass	Tidtabell

Skistua

Granåsen	
Reisetid	22 min
Anganger	4 ganger i timen
Komfort bussholdeplass	Bank Sjapperkasse Tidtabell

Granåsen

17 Egenskapene på bussholdeplassen er nå endret. Hvor ville du dratt? *

Skistua	
Reisetid	17 min
Anganger	1 gang i timen
Komfort bussholdeplass	Tidtabell

Skistua

Granåsen	
Reisetid	22 min
Anganger	4 ganger i timen
Komfort bussholdeplass	Bank Sjapperkasse Tidtabell Tak Sjansid Reklame

Granåsen

18 Egenskapene på bussholdeplassen er igjen endret. Hvor ville du dratt? *

Skistua	
Reisetid	17 min
Anganger	1 gang i timen
Komfort bussholdeplass	Tidtabell

Skistua

Granåsen	
Reisetid	22 min
Anganger	4 ganger i timen
Komfort bussholdeplass	Bank Sjapperkasse Tidtabell Tak Sjansid Reklame WiFi

Granåsen

19 Egenskapene på bussholdeplassen er igjen endret. Hvor ville du dratt? *

Skistua	
Reisetid	17 min
Avganger	1 gang i timen
Komfort bussholdeplass	Tilbubel

Skistua

Granåsen	
Reisetid	22 min
Avganger	4 ganger i timen
Komfort bussholdeplass	Bank Separkasse Tilbubel Ta Sannid Reklame WiFi Musikk/TV/Underholdning Elektronisk ladestasjon

Granåsen

20 Egenskapene på bussholdeplassen er igjen endret. Hvor ville du dratt? *

Skistua	
Reisetid	17 min
Avganger	1 gang i timen
Komfort bussholdeplass	Tilbubel

Skistua

Granåsen	
Reisetid	22 min
Avganger	4 ganger i timen
Komfort bussholdeplass	Bank Separkasse Tilbubel Ta Sannid Reklame WiFi Musikk/TV/Underholdning Elektronisk ladestasjon Varmt lokale Ombordoppvarming for skihvulder

Granåsen

21 For å reise til Granåsen er det mulig å bruke bil og buss, i tillegg til å sykle og gå. Nedenfor er to situasjoner med bil og buss presentert. Hvilket av alternativene ville du valgt som reisemiddel til Granåsen? *

Bil	
Kostnad	100 kr
Reisetid	20 min
Avganger	Hele tiden
Komfort	Bil

Bil

Buss	
Kostnad	64 kr
Reisetid	26 min
Avganger	4 ganger i timen
Komfort bussholdeplass	Bank Separkasse Tilbubel

Buss

22 Egenskapene på bussholdeplassen er nå endret. Hvilket transportmiddel ville du nå brukt? *

Bil	
Kostnad	100 kr
Reisetid	20 min
Avganger	Hele tiden
Komfort	Bil

Buss	
Kostnad	64 kr
Reisetid	26 min
Avganger	4 ganger i timen
Komfort bussholdeplass	Bank Separkasse Tilbubel Ta Sannid Reklame

23 Egenskapene på bussholdeplassen er igjen endret. Hvilket transportmiddel ville du nå brukt? *

Bil	
Kostnad	120 kr
Reisetid	20 min
Avstand	Hele tånen
Komfort	Bil

Bil

Buss	
Kostnad	64 kr
Reisetid	28 min
Avstand	4 ganger i timen
Komfort bussholdeplass	Benk Sjoppkasse Tidabelt TAK Saniert Roklimate WiFi

Buss

24 Egenskapene på bussholdeplassen er igjen endret. Hvilket transportmiddel ville du brukt? *

Bil	
Kostnad	120 kr
Reisetid	20 min
Avstand	Hele tånen
Komfort	Bil

Bil

Buss	
Kostnad	64 kr
Reisetid	28 min
Avstand	4 ganger i timen
Komfort bussholdeplass	Benk Sjoppkasse Tidabelt TAK Saniert Roklimate WiFi Musikk/TV/Underholdning Elektronisk ledetast

Buss

25 Egenskapene på bussholdeplassen er igjen endret. Hvilket transportmiddel ville du brukt? *

Bil	
Kostnad	120 kr
Reisetid	20 min
Avstand	Hele tånen
Komfort	Bil

Bil

Buss	
Kostnad	64 kr
Reisetid	28 min
Avstand	4 ganger i timen
Komfort bussholdeplass	Benk Sjoppkasse Tidabelt TAK Saniert Roklimate WiFi Musikk/TV/Underholdning Elektronisk ledetast Oppladningsstasjon for skiforretter

Buss

26 Når du foretar denne reisen, hvor mange reiser du vanligvis med? Skriv inn antall personer i gruppen.

Under kommer noen generelle spørsmål om deg.

27 Hva er din alder? *

28 Kjønn? *

Mann Kvinne

29 Hva er din yrkesstatus? *

Yrkesaktiv heltid Yrkesaktiv deltid Student Hjemmeværende/permisjon
 Arbeidsledig Arbeidsufør Pensjonist

30 Hva er husholdningens samlede bruttoinntekt? *

< 249 999 kr 250 000-499 999 kr 500 000-749 999 kr 750 000-999 999 kr
 1 000 000-1 500 000 kr > 1 500 000 kr Ønsker ikke å oppgi inntekt Vet ikke

31 Hvor mange bor i din husstand?

a. Over 18 år: *

0 1 2 3 Annet

b. Under 18 år: *

0 1 2 3 Annet

32 Bosted? (Postnummer) *

33 Har du noen kommentarer til undersøkelsen?

Send inn

Appendix 4 Observations

Observasjoner

Holmenkollen

Jeg dro opp torsdag 9.mars for å kartlegge området. Været var grått, men det var allerede satt i gang med opprigging til Skifest 11.-12.mars. De viktige områdene er T-banestasjon Holmenkollen, kryss 1, inngang A, inngang B og C. Tiden ble tatt til disse ulike områdene fra T-banen.

Tid til:

Kryss 1: 5 min

Inngang A: 7 min

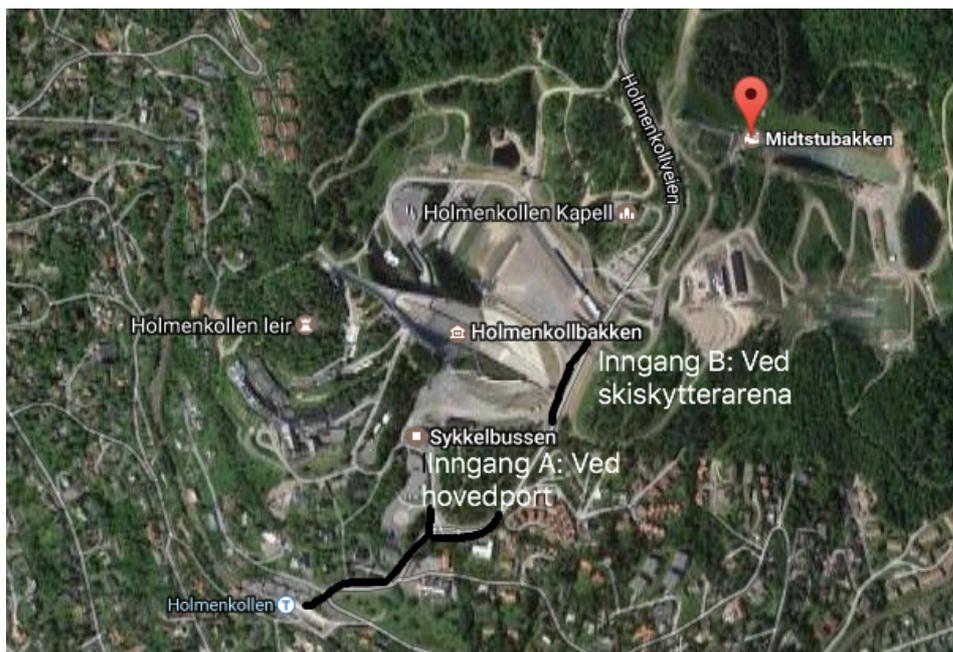
Inngang B: 9 min

Inngang C: 11 min

To større parkeringsplasser ved inngang A, kø inn mot disse. Parkeringsplass også ved inngang C, her også med HC-plass.

Ved dagen for skifest var det mye press på kollektivtilbudet. På Majorstuen ble det såpass kaotisk at politiet stengte av stasjonen og sluset personer ned til stasjonen når tbanen dukket opp. Ellers fulgte militærpolitiet opp trafikken oppe ved arenaen. Fortauene er gjerdet inn og deltakerne ble sluset oppover mot tribuneområdene. Ved avslutning av arrangementet ble alle deltakerne sluset inn i sponsorområdet. Her ble det mye kø da mange fordelte seg utover for å få tak i mat og merch. Dette førte til at presset nedover mot stasjonen minket og det derfor ble mindre press på t-banen. Likevel var det mange mennesker som kom med tbanen fra Frognerseteren. Dette førte til at få personer likevel kom på tbanen, men da det var midt i arrangementet var det også en del personer som ble igjen i kollen.

Appendix 4 – Observations



Granåsen

RAW air:

I forbindelse med eventet var det satt opp ekstra kollektivtilbud fra Trondheim S- Granåsen. Denne bussen tok samme rute som rutebussen 19. Avreise fra Prinsen P1 var 16:06.

Holdeplassen nærmest Granåsen var avstengt og man måtte stige av på holdeplassen før, på hver kjøreretning. Det medførte 13 min gange frem til stadion. Trafikken over Granåsen gikk skate da dette var midt i ettermiddagsrushet og bussen stoppet på alle holdeplasser. Vi ankom Leirbrua Gård 16:27. Holdeplassen nærmest Granåsen var stengt. Bussen ble ikke full på vei oppover.

Parkeringsplass i nærheten av hoppet som tar rundt 800 biler, koster 50kr å parkere. Mange politi og frivillige som organiserer. Større busser parkerer også på samme parkeringsplass. Personer som kommer gående og med kollektivt må gå gjennom samme parkeringsplass, men det er laget en gangsti på venstre side.

Etter rennet fordelte folkemengdene seg og gikk mot de åpne bussholdeplassene. Kom til holdeplassen 19:07 og da var det >200 pers på holdeplassen. Tre busser kom samtidig 19:23. Stoppet også denne veien på alle holdeplassene.

Appendix 4 – Observations

Observasjon Granåsen 22.feb 17:45-18:20

Observerte tre parkeringsplasser, A, B og C. A er den store parkeringsplassen, B er ved kafeen, C er ved Olympiatoppen. Iløpet av tiden jeg var der observerte jeg 9 biler som ankom på parkeringsplassene, disse gikk på ski, innendørs trening eller tur med hund. Det var 11 parkerte biler på parkering B, 16 på parkering A og 26 på parkering C. Iløpet av tiden kom kun én buss. Denne var 5 min forsinket og det var ingen av- eller påstigning.

Appendix 4 – Observations

22.feb
17:45-18:20
2 parkeringsplasser
Timetable 18:15 Passed at 18:20

# Car	# Persons in arriving car					Purpose	# Bus	# Leaving the bus	# Group Leaving				
	1	2	3	4	5				2	3	4	5	
1				x		S	1	0					
2	x					S	2						
3		x				W	3						
4	x					S	4						
5	x					S							
6	x					S	Waiting	# People					
7	x					S	30 min		2	3	4		5
8	x					T	25 min	0					
9		x				S	20 min	0					
10						S	15 min	0					
11							10 min	0					
12							5 min	0					
13							Parking	Parked cars					
14							1	11					
15							2	16					
16							3	29					
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													

S = ski
D = drop off
T = indoor training
J = job
R = recreation
W = dog walking/walking

Appendix 5 Interviews

Intervju Holmenkollen

Hvem: Bente Sjulstad

Dato: 24.april 2017, kl 13:00

Spørsmål	Svar
Hva er din stilling og rolle?	Jobbet fra høsten 89 med barneskiskole og barnas Holmenkolldag, jobbet videre med ulike arrangement, koordinator og leder av dette. Ansvar for World Cup i mange og jobbet i VM 2011, sittet i driftsavdelingen og sitter nå med ansvar for sport og event til hele anlegget.
Hvor mange større arrangement er det i kollen i løpet av et år? Vinter/sommer?	Foregår mye i anlegget både sommer og vinter. Over 50 arrangement på vinteren, over 250 arrangement i turistanlegget. I tillegg til riggdager. En blanding av små og store idrettsarrangement, trening, møtevirksomhet og private events. Har blitt mer aktivitet på sommeren etter rulleskibanen har kommet. Største arrangement transportmessig er WC i nordiske grener, og deretter Barnas Holmenkolldag og skiskyting som er likt nordisk men litt roligere enn nordiske grener.
Hvem er brukerne av Holmenkollen på hverdag og eventer?	Varies mye fra event til event, og alt fra skiskoler til profesjonelle i hverdagen, og turisme.
Tilbud om sommeren?	Mye trening, rulleskiløp, frisbeegolfbane, sommerskiskole, sommercamp, sommersamling for ulike idrettsforeninger. Diverse events med ulike eventbyrå, rappellering, teambuilding osv. Hopping i plast i Midtstuen. Bryllup og andre private arrangement.
Hvordan kommer de seg til arenaen?	Bil i hverdagen og tbane ved arrangementer
Promoterer dere området og hverdagsaktiviteter?	Jobber mye mot turister og dette har vært brukt lang tid på å opprette en strøm med turister. Skaper enkle aktiviteter for turister som er mulige å gjøre på kort tid. Opptatt av at folket skal komme og gi en følelse av pulsen” i kollen. Mye promotering av bakken gjennom ny utbygging. Zipline fungerer veldig bra og har mange besøkende. Må alltid jobbe med utvikling. Folk kommer til Holmenkollen for å se på utsikten. Jobber mye med utvikling for å folk til å komme til Kollen. Facebookside med informasjon. Jobber med mange arrangementer for at folk skal ha en kjennskap til Kollen slik at det er lettere å komme tilbake å bli kjent. Folk avler folk.

Appendix 5 – Interviews

Har dere sett en oppgang/nedgang i besøkende?	Økning i turisme. Må jobbe med lokal turisme. Mange områder rundt Holmenkollen arena hvor folk besøker.
Hvilke kollektivtilbud finnes?	Tbane ved hverdag, turistbusser som er organisert av turistbåtene. Disse turistbussene kjører ofte opp til hoppet og har bare 20 min før de må reise videre.
Hva brukes mest?	T-banen er en fordel her til kollen og man legger vekt på kollektivtransport for å unngå store køer. Før VM 2011 hadde t-banen kun kapasitet på 3000pers/t og etter ble det 9000pers/t. Det har reddet transporten til kollen. Før hadde man prosjekt ”gå til kollen”, men tiden hvor man kunne få store mengder til å gå til kollen er forbi. Det var lagt opp til salgsboder på veien oppover.
Hvor mange biler er det tilrettelagt for? Hverdag og event?	Ved mindre events der ikke hoppet er i bruk så brukes hele hoppsettla til parkering. Ved et stort WC arrangement er det mye infrastruktur og mange telt inne på området som hindrer bruk av områdene til parkering. Da er det kun støtteapparat, løpere, gjester og media som parkerer i området, mens publikum skal komme med offentlig transport. Ved større events er parkeringen inndelt i mange forskjellige fargekoder og man får ikke parkert inne på arenaen uten tillatelse.
Hvordan tilrettelegges kollektivbruk for større arrangement?	Større parkeringsplasser på Bogstad, Hovseter, Midstuen med tilhørende shuttletrafikk ved for eksempel Barnas Holmenkolldag. Selv med tbane så setter vi opp shuttletrafikk fra Majorstuen, men vi ser ofte ann på for eksempel været. Sponsorer bestiller egne busser og melder det inn. Busser blir også satt opp ved sosiale arrangement mellom eventene. Og bussing frem og tilbake til ulike tilholdssted for å hente utøvere, media osv.
Burde det vært vurdert andre løsninger for kollektivtransport? Har noe annet vært brukt før?	Rømningsvei til Midstuen med parkering og buss der.
Hva er bra og hva bør forbedres?	Viktig å tydeliggjøre at det ikke er parkering og informere om hva slags alternativer som finnes. Det bygges ut for skimuseet og andre bygg for å tilrettelegge for flere besøkende.
Hvor lang avstand bør det være fra en holdeplass til arena?	Bra å gå, dette skaper en deltagelsesfølelse. Ønsker man at publikum skal komme rett inn i arenaen og gå kortest mulig, eller ønsker man at man skal lage noe på vei fra der bussen stopper? Da er det viktig å gjøre noe på den veien. Egentlig kan man gjøre alt, men det må bare være en plan og en

Appendix 5 – Interviews

	helhetlig tankegang, og bygge noe rundt det. Ved at bussene er tettere på anlegget kan det motivere enda flere til å ta bussen. Kanskje man burde fokusere mer på miljø og at man går, med trim, konkurranser osv.
Hvem drifter anlegget?	Kommunen drifter anlegget og samarbeider tett med Skiforeningen. Det lages bredere løyper, rulleskiløype og bygges ut nye hus.
Hvordan kan kollektivholdeplasser tilrettelegges for både hverdagsbruk og større arrangementer?	Trenger ikke mange for å fylle Granåsen, ca 12 000, men det blir likevel mange busser. Kanskje man skulle bygget t-bane?
Hvordan samarbeider dere med Ruter?	En liten seksjon som heter publikumstransport koordinerer med t-banen
Hvor mange var i kollen? Lørdag/søndag?	Solgte total 39 000 billetter og det var totalt 60 000 i marka
Hvordan er tilgangen for HC?	Satt av noen plasser ut ifra erfaring. Under VM 2011 måtte man bestille på forhånd. Leder for seksjon trafikkparkering. Kan kontaktes?
	Systemet for trafikk ble utviklet til vm 2011. Deretter ble det nedskalert til WC.

Intervju Granåsen

Hvem: Bjørn Morseth

Dato: 28.apr. 2017

Stilling og rolle?	Rådgiver for Trondheims Aktivum, juridisk arrangør av World Cup, eneste ansatte på prosjektet. Koordinator av arbeidsoppgaver.
Hvilke kollektivtilbud finnes?	Det er 19-bussen som går, ca to ganger i timen. Eller ta nr 8 til Stavset og gå derfra. Eller så er det 4 eller 7, hvor det også er 2,5 km å gå.
Hva brukes av kollektivtilbud?	Det er kun buss. Atb er de eneste med nok materiell til publikumstransport. Leier inn andre selskaper til å frakte skoler. Sponsoropplegg kjøres inn fra Steinkjer.
Hvor mange busser trenger man plass til?	Har brukt sivilforsvarsleiren for der kan de kjøre i en "rundkjøring" og få flyttet ungene vekk fra der alle andre oppholder seg.
Hva er viktigst: At folk bruker Granåsen eller at folk velger kollektivt når de gjør det?	Vi tjener billettinntekter på parkering så sånn sett ønsker vi at parkeringsplassen er full. Men jo flere biler som kommer, jo mer trafikkaos er det og det skaper negativ omtale. Vi har aldri gått ut med at vi ønsker at folk skal kjøre, vi bare vet at det er nok mennesker som gjør det slik at vi får fylt opp parkeringsplassen uansett. Vi går alltid ut med at vi ønsker at folk skal velge kollektivt. Ved et WC hvor det er 20 000 deltagere og alle skal ta kollektivt, blir det en utfordring da atb ikke har masse busser tilgjengelig da det er full trafikk på en ukedag og de ikke har en "pool" av busser. Hadde ikke vært mulig å få opp 20 000 i buss med det materialet atb har i dag. Sånn sett er vi avhengige av biltrafikken. Oppfordrer alle på Byåsen til å gå. Det skal være enkelt for barnefamilier å komme til Granåsen.
Hvordan stiller dere dere til superbuss? Tror dere det vil ha noen effekt?	Tror at det kan ha en positiv effekt. Vil ta tid før folk vil lære seg at den går opp til

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	Granåsen, men etter at det har satt seg så vil dette være positivt. Bussen til skistua blir jo mye brukt og er et godt eksempel på dette.
Med superbuss så trenger man større holdeplasser, hvis man legger denne på den store parkeringsplassen ville det vært en løsning med en shuttleløsning til andre parkeringsplasser?	Det er savnet. Det har vært prøvd med varierende suksess da det ikke er parkeringsplasser i nærheten som er store nok, slik at det ikke er kostnadseffektivt. Hvis man kan ha en stor bussholdeplass i nærheten av Granåsen som kan få unna folk og også ha en stor parkeringsplass med shuttle hvor man kan si med sikkerhet at folk kan få plass så blir det lettere at flere gjør det. Tidligere blitt brukt minibusser og da kan man noen ganger stå å vente lenge.
Hva er bra og hva bør forbedres?	Med alt som skjer i anlegget så er det ikke en holdbar infrastruktur, verken bilmessig eller kollektivt.
Hva arrangeres i Granåsen?	Årlig er det World Cup, hopp og kombinert, siden 2012. Rullerende avtale om COC og NM. Plastmesterskap årlig. Konserter, motbakkeløp. Skiskoler, barnehager, toppidrettsutøvere, aktivitetsdag for skoler, mosjonister. 2,5 km rulleskibane om sommeren, brukes også av scater og handicappede. Også tilrettelagt for hundekjøring. Stort hverdagsanlegg.
Hvor mange mennesker deltok på WC (World Cup) i år?	9000 personer, i fjor var det 16000, hadde et mål om 20 000.
Hvordan gikk menneskeflyten gjennom området?	Synes det fungerte bra. Prøver å sette opp arenaen slik at folk kommer seg enkelt til mat, toalett. Inngangspartiet er trangt med nødvendig trafikk av biler, men det får vi ikke gjort noe med. Hadde vært optimalt med flere innkjøringer til området, for eksempel til barnehagen og HC-parkering.
Dere hadde stengt av bussholdeplassen nærmest hoppet, hva var formålet? Hvordan fungerte tiltakene for kollektivtransport under WC? Hva var bra/dårlig?	Det var færre mennesker enn forventet så det gikk bra, har ikke hørt noe annet i hvert fall. Det var satt opp forsterket tilbud, flere avganger, men ingen ekspressbusser. Vi har en kjempegod dialog med atb, sammen med politiet og vegvesenet for å organisere vegbildet. Atb tok i bruk alt de har av busser.

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<p>Hvem var samarbeidspartnere for å gjennomføre transportløsningene? Hvordan transporteres handicappede inn på området?</p>	<p>De bli kjørt helt opp til hoppet. Andre har en sluse på parkeringsplassen hvor de kan slippes av.</p>
<p>Hvor mange biler parkerte under WC?</p>	<p>I underkant av 1000, rundt 800 biler. Kommer an på hvor flinke vi er til å “stable” og snølagringen tar også plass på parkeringsplassen.</p>
<p>Prisen på parkeringen var 50kr. Hva var tanken bak prisen på parkeringen?</p>	<p>Det skal være et rundt tall, så det er enkelt å betale med kontanter for de som bruker det. Har mange billetter som er ferdigprintet med ”50kr”. Burde egentlig økt det. Viktig at prisene er lave for å kunne være et familiearrangement.</p>
<p>Den ideelle bussholdeplassen i Granåsen, hvordan skulle den sett ut?</p>	<p>Viktigst med antall avganger. Hverdagsbehov og arrangementsbehov er to forskjellige ting. Ikke viktig å ha en bussholdeplass som passer til arrangementer for det vil bli et stort dødt område. Informasjon er viktig, helst sanntid.</p>
<p>Hvor skulle den plasseres?</p>	<p>Et sted hvor den ikke stopper biltrafikken. Det må også være mulig å gå forbi den.</p>
<p>Hvor lang avstand bør det være fra en holdeplass til arena?</p>	<p>Veldig positivt med å dele opp massene ved at holdeplass har en viss avstand til arenaen. Uten dette hadde det hopet seg opp med mennesker som ville sperret biltrafikk og ikke minst nødvendig biltrafikk. Ikke noe bra om også hopperne blir stående igjen i kø pga personer. Utfordrende å lage en bussholdeplass rett ved arenaen for da kan alle bli stående ved første punkt når man kommer ut “døra” som vil skape kø innover i anlegget.</p>
<p>Den eksisterende holdeplassen, hva synes du om design og plassering?</p>	<p>Plasseringen er god til daglig bruk. Problemet er antall avganger. Holdeplassene ligger ute i veibanen og er ved arrangement helt uaktuelle å bruke da de stopper all trafikk. Litt utrygt i Smistadveien da folk kjører fort. Ikke gunstig for barnehagen.</p>
<p>Ville en bussholdeplass på parkeringsplassen vært for langt unna?</p>	<p>Ikke for de som vanligvis bruker buss, men tror ikke at man får endret holdningen til de</p>

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	<p>som kjører. Folk er vant til å kjøre helt frem til dit man skal.</p>
<p>Hvis du kunne velge kollektivtilbud, hva skulle det være?</p>	<p>Spor. Superbussen står jo i den samme trafikken med alle bilene. Forutsigbarhet er viktig, så vet du at trikken tar 25 min så vet man det.</p>
<p><u>Fornyelse av Granåsen?</u> Hva inkluderer det? Hvilke fasiliteter burde lages?</p>	<p>Granåsen er stort og det handler mye om plassering. Vi som holder på med skiidrett synes det er viktig at utgangspunktet er at det skal holdes på med skiidrett. Unngå fasiliteter som hemmer kjerneaktiviteten. Så tidlig i fasen at det ikke er sikkert hva som kommer. Fokus på større tilbud i Granåsen.</p>
<p>Hvordan påvirker solforholdene Granåsen?</p>	<p>Det er veldig snøsikkert og ved at hopprennet er et kveldsrenn så påvirker ikke dette antall publikummere. Det er viktigere at det er skygge og stabile snøforhold. Under et VM vil det passe bra med sol midt på dagen.</p>