



Are dense residential neighborhoods liveable? A comparative analysis of old and new neighborhoods in Trondheim

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ABSTRACT: In Cities have been contesting liveability for generations. Modern theorists have advocated higher densities and mixed land use as the key parameters for cities sustenance. In this context, a brief study was conducted to understand the residential developments in Trondheim city, Norway. Two residential neighborhoods in Trondheim city were selected to make a comparative analysis to investigate the parameters linked to liveability. Mollenberg (Older development) is one of the neighborhoods that has high density population and Rosenborg (Newer development) the other has medium density. 30 respondents from each case area were considered to respond to a questionnaire focused on accessibility to public transport, safety, Universal accessibility and neighborhood experience. The scores were mapped on a Likert scale from 1 to 5. The average scores were then normalized and compared. It was found that the Rosenborg neighborhood with medium density was more liveable than the old neighborhood with high density. Hence, higher density theory cannot be universally applied and therewith not generally dealt with through generic valid measures

KEYWORDS: Cities, liveable cities, residential, neighborhood, population density, Floor space index

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I. INTRODUCTION

1.1 History and growth of Trondheim

A Trondheim city was found in 997 AD by King Olav Tryggvason and the city established as a permanent trading settlement adjacent to the river Nidelva. It was capital of Norway until 1217. During the 12th and 13th centuries, the city densified and there were timber houses, one or two stories height with small window openings. These were post and beam type of constructions and often would have workshops or stables at the lower floors. Porticos were a common feature where upper stories utilized the space above. The setbacks between the buildings were used as fenced-in courtyards, nowadays gardens.

After the reformation, the whole city experienced a catastrophic fire in the year 1681 because of the densely spaced timber buildings. New Baroque plan marked by General Cicignon created wide streets. The north-south axis was through Munkegata and the East west axis through the Kongens gate [11]. Later on, Carl Adolf Dahl, Trondheim's first city Engineer, pioneered building up the infrastructure for the city, especially to make the train surround the city center along an artificial piece of land in the sea (refer Figure 1). Later, the German Nazi control took over the city in 1940. During 1850 to 1914, a large number of buildings were constructed of stone and brick following the European architectural styles. Increased industrialization led to the usher of the Trondheim Technical School in 1870 and later the Norwegian parliament decided that Trondheim would house the Norwegian Institute of Technology. Soon Trondheim gained importance as engineering and architectural city. During early 2000, the city established itself as the educational city and promoted social housing. After world war-II, there was scarcity of materials and lack of housing. In 1975, a committee appointed by the Trondheim local authority, established three main principles.

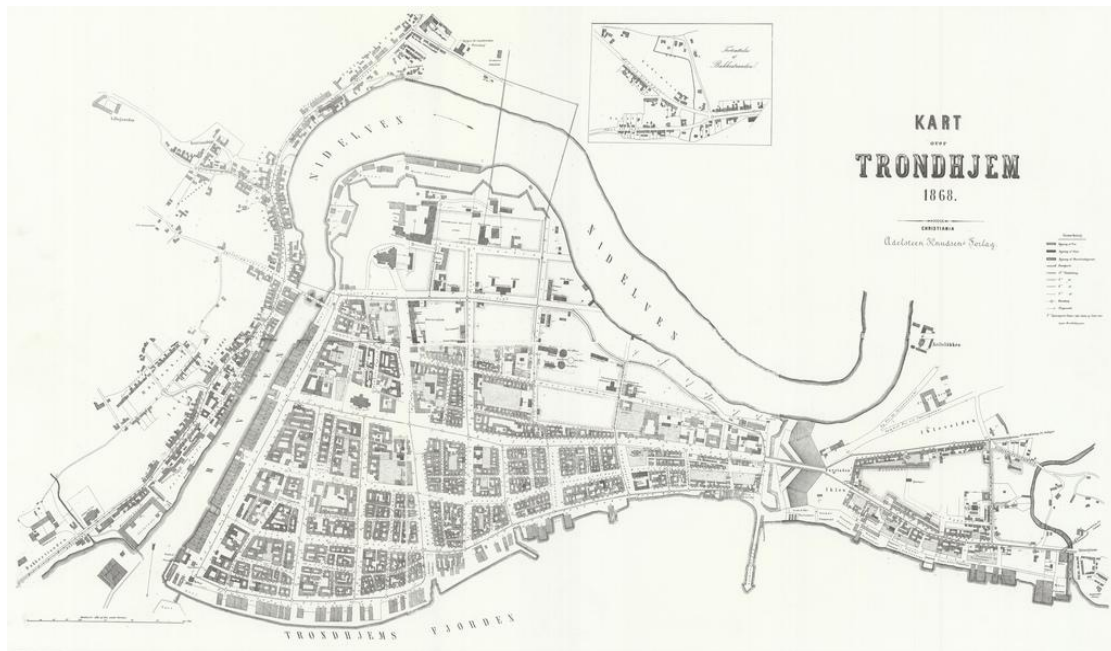


Figure 1 Map of ancient Trondheim city (with Nidelva river on the south), 1868
Source: http://www.strindahistorielag.no/wiki/index.php?title=Trondheim_1868

Firstly, to preserve Trondheim as a city of wooden buildings, Secondly- to define the city center as special area and Thirdly-to list or preserve the individual buildings. In continuation of this, building heights, extent of utilization, type of development and buildings of historic value were described [11]. Today, Trondheim city has a population of 1,87,353 as per 2016 data with an urban area of 342.3 sq.km. and has an urban density of 500 /sq.km. The Norwegian Institute for Cultural Research [6]. Oslo prepared the comprehensive plan for monitoring the medieval town of Trondheim. The plan includes the proposal for monitoring the environment by considering the knowledge of topographic ground conditions, historical circumstances, and state of conservation. The figure 2 shows the cultural footprints of the city of Trondheim.

Trondheim city is a growing city with a strong identity and great historical and architectural values. The guidelines for Urban design and Architecture for Trondheim (prepared by the Urban Agency in 2013) were based on the objectives of the Municipal Development Plan 2012-24 as shown in figure 3. The city shall be internationally recognized of technology and of knowledge, sustainable, inclusive and as diverse city. The city municipality shall be an active community developer for managing and contributing in the construction and development of city.

The emphasis on infill projects was more on density with the existing character to bring new qualities. The zoning defined a framework for integrated design of urban spaces, green compounds and traffic solutions in the area as a whole. The city is known for its landscape features like hills, city shoreline, river and stream valley, farmlands and striking trees. Hence high-rise buildings are allowed only in existing high-rise areas. Emphasis was also laid on form, universal design, correlation with existing and planned urban structure, public transit, historic buildings and green areas with shortest possible distances for pedestrians and cyclists. Urban spaces have to be formed with safety and attractiveness. It is also mentioned that the building massing need to emphasize and reinforce the street or space.

The Municipal Masterplan emphasized the need for densification and good quality housing for citizens. Areas that have a positive character had to be safeguarded and respected in the new developments. Higher densities and higher diversity of functions shall be encouraged to reduce the need to travel. The climate and energy plan for Trondheim aims to reduce the greenhouse emissions by 70 to 90% lower than what they were in 1991. Trondheim municipality has over 1,80,000 residents and over 30,000 students studying. City has adequate housing, schools and kindergartens, short transport distances, easy access to recreation and outdoor activities. The Housing programme 2011-14, is part of the building policy and the social housing policy. Building policy designates where and how people will live and the social policy targets the vulnerable groups who need public help to retain or obtain housing. The aim was to meet the housing needs in an efficient, social and equitable manner by enhancing zonal requirements that contribute to a proper housing market with diverse residential structure as envisioned in the Housing programme 2011-14. In the contemporary era, it is the role of the local government to be either facilitators or providers of housing for the city. And hence the role of local governments

was devising the form and fabric of the cities. According to the report on living conditions 2011 published by the Trondheim Kommune 2011 [14], there were about 89,690 registered housing in Trondheim. The strategy for current densification, targets to establish 80 % of the settlements within the existing urban structure. Often the diversity of the population structure also conflicts with densification. According to the SSB Building statistics 2011 [14], there were 44% houses in the city with 3 to 4 rooms and 31% with 1 to 2 rooms. It is pertinent to explore the concept of liveability in the context of Trondheim since there is a need for quality housing and housing environments in the city.

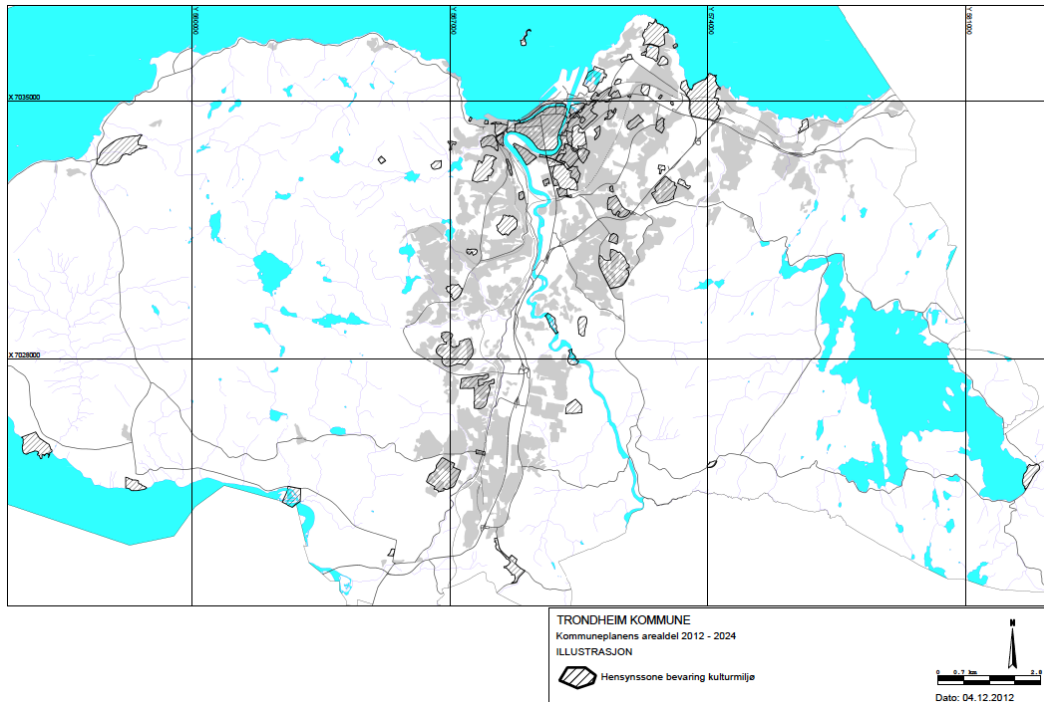


Figure 2 Cultural conservation zones, Source: Trondheim Kommune, 2012

Trondheim city is a growing city with a strong identity and great historical and architectural values. The guidelines for Urban design and Architecture for Trondheim, prepared by the Urban Agency in 2013 [15] were based on the objectives of the Municipal Development Plan 2012-24. The city shall be internationally recognized of technology and of knowledge, sustainable, inclusive and as diverse city. The city municipality shall be an active community developer for managing and contributing in the construction and development of city.

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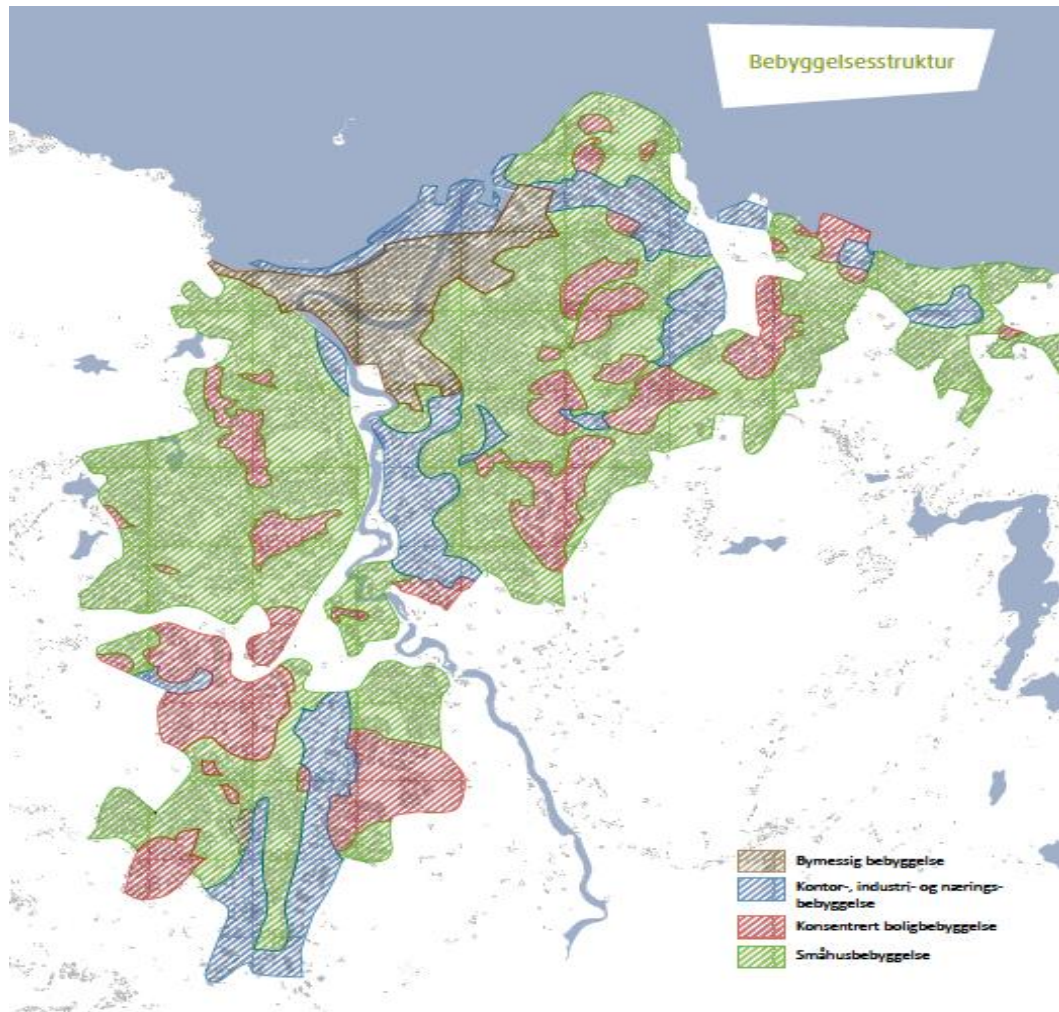


Figure 3 Building structure map (1.Urban settlements, 2. Office,Industrial and commercial buildings 3. Concentrated residential buildings 4. Small houses settlements),
Source: Veileder or byformogarkitektur, Trondheim Kommune, 2013

II. CONCEPT OF LIVEABILITY

2.1 Liveability

A liveable community is one that is safe and secure, has affordable and appropriate housing and transportation options, and supportive community features and services [5]. Economic Intelligence Unit (EIU) defines liveability as one of the aspects that could contribute to a high quality of living [12]. However, there is no standard framework for defining the measure of liveability. Liveability can be referred to as range of issues in a living environment that are associated with the quality of life and wellbeing [2]. The measure of these indicators, as found from the empirical studies, may help ranking of cities in different contexts. In another way, the 'desirable' construct representing set of characteristics can also be understood as liveability [2]. Often people have different choices while deciding upon the place to live, which makes it livable for them. Parameters that define the livability might vary accordingly, but many common platforms with diverse parameters are created to measure and compare the livability of different regions through livability index. Low density urban forms are often considered more liveable than high dense urban forms. Theoretical and empirical studies suggested that the negative effects of high density living attributed to the common perception of high densities being detrimental to liveability [8][9]. However, some studies of European cities suggest that high density doesn't have negative impact on neighborhood satisfaction that can be considered key to the livability of a neighbourhood [1].

2.2 Density and Liveability

The relationship between high density urban forms and liveability doesn't take into consideration the importance of public transport, accessibility, mix of land uses along with high densities. In each neighbourhood safety, quietness, neighbourhood ties (social and civic engagement) and attractiveness play a major role in resident satisfaction [4] while public transport, open spaces and accessibility to facilities are considered as important factors in high dense neighbourhoods [1]. Employing the combination of these factors that have significant importance in the liveability of low dense and high dense areas will help in understanding the liveability of neighbourhoods as a holistic concept with varying densities.

III. RATIONAL FOR SELECTING CASE AREAS

As the above literature indicates, Liveability is directly linked to the urban form and the density pattern of a city. Hence, it was important to select case areas of study, which qualify to be considered as suitable for analyzing the liveability parameters. Hence, the identification of the case areas was based on following factors- density pattern, character of the urban form, structure and location.

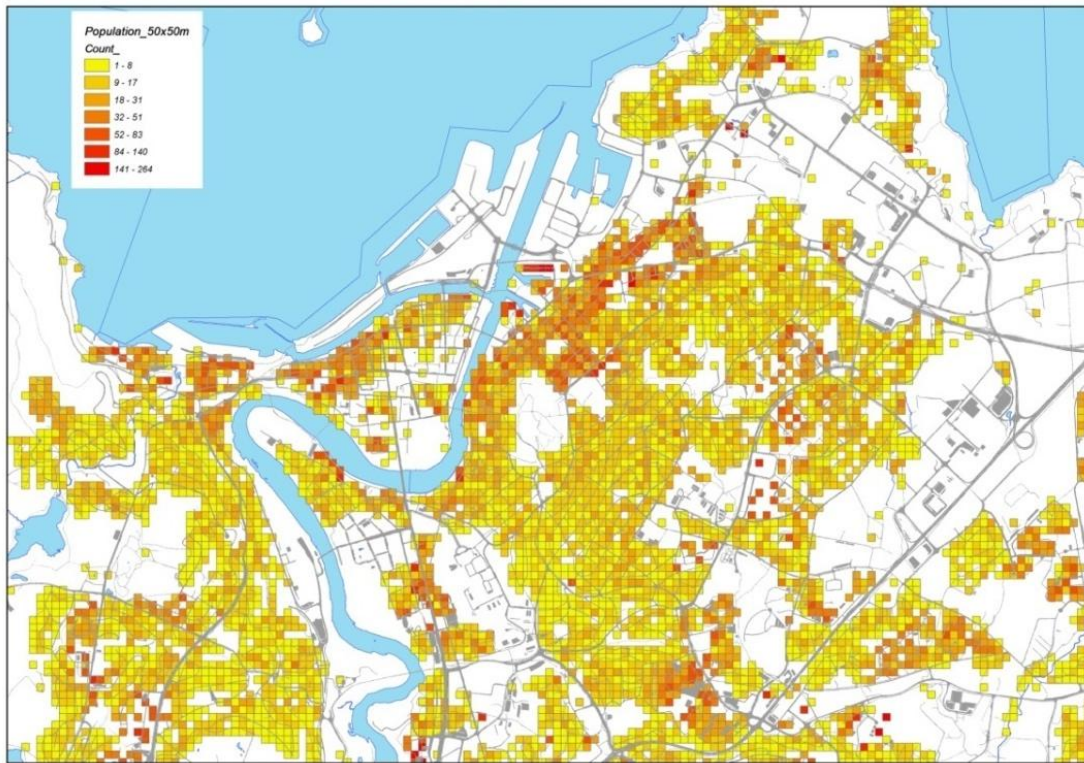


Figure 4 Trondheim density map,
Source: Norwegian mapping authority, Trondheim Kommune, 2016

The city has predominantly low dense areas ranging up to 68 pph. But in few areas an average density of 204 pph can be observed. The density gradient as per figure 4, shows a variation of high and medium density ranges from 208 to 1056 pph in very few portions of the city.



Figure 5 Trondheim residential areas near the city center,
Source: Map source Google and layers by Author

Upon further investigation it was found that the residential areas Ila, some areas in Midtbyen, Mollenberg and Rosenberg were comparatively high and moderately dense than rest of the areas of the city, which are close to the city center. Two residential areas in Trondheim- Mollenberg and Rosenberg park as shown in figure 5, are selected considering the density pattern, proximity from the city center, character of the urban fabric, access to public transportation and mix of activities around. Mollenberg is a part of the Old town area with high population density and Low building density and on the other hand, Rosenberg park is part of the redevelopment with moderate population density and high building density.

3.1 Mollenberg

Mollenberg area is a part of the old town with most of the buildings ageing between 100 to 150 years since this this area was directly connected to the shipyard and was constructed for the shipyard workers. Location of Mollenberg is close to the earlier harbor (Nedre Elvehavn) at the lower river and warehouses known as 'Solsiden', which means the sunny side. This is about 20 minutes by walk from the city centre 'Midtbyen'. This area is characterized with predominantly low rise buildings and high density population as seen from the density map above. It is an area with fine grain fine texture identified by grid pattern road network and clearly distinguishable in the satellite images.

Mollenberg occupies significantly large area close to the city center. Most of the houses and the clusters in Mollenberg are typical. The area was identified as conservation area to protect the old wooden houses once constructed. Below is the map (figure 6) showing the boundaries of the Mollenberg conservation area dated 08-04-1983 (Trondheim Kommune, 1986). According to the report on living conditions 2011 (2.1.9 Building types) published by the Trondheim Kommune [14], it is learnt that about 23% houses in Mollenberg

and 59 % of the houses in Rosenborg are small houses¹. Here there are predominantly one and two bedroom homes and also less number of families resides here and mostly there are young students staying alone [14].

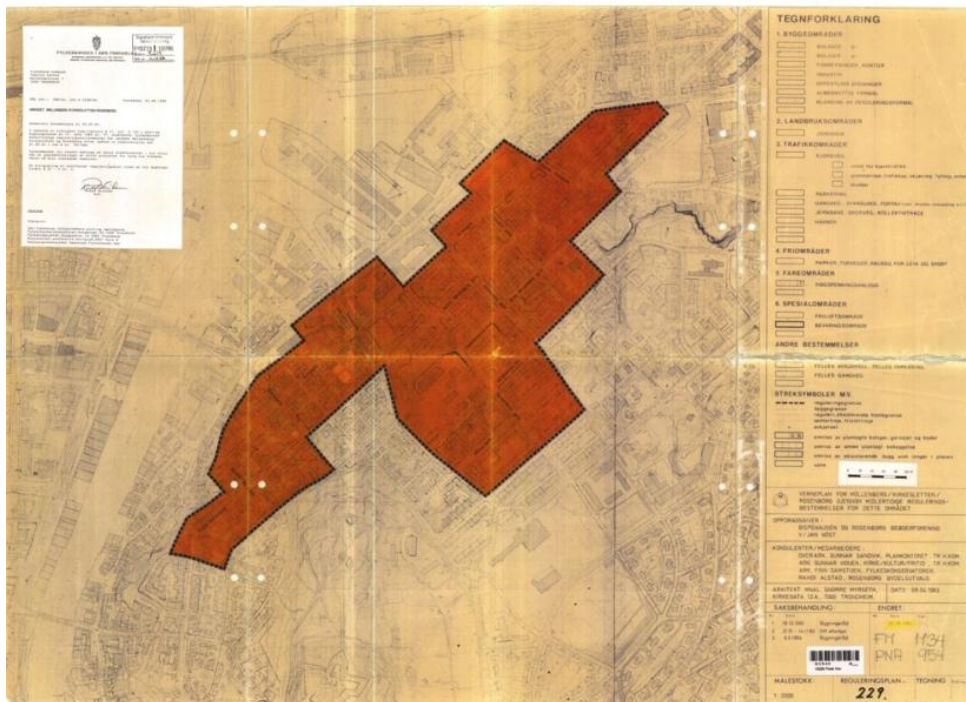


Figure 6 Mollenberg residential area property map
Source: Trondheim Kommune-1986

Figure 7 shows the similar urban character of Mollenberg residential district. In a city, which has a very low crime rate, Mollenberg area records a relatively high proportion of crime rate (2.2.8 Crimes by scene, Report on living conditions, 2011, Trondheim Kommune) [14]. This means the area is vulnerable to security and crime issues as compared to other areas of the city and also comparatively unsafe since most of the houses now have a different ownership and occupation. Some of the houses here are rented by students, who do not live here for the entire year and also don't use the surrounding areas much.

Mollenberg has a good mix of activities where some of the residences at the lower floor have been converted into shops and groceries. The student population in Mollenberg makes it one of the densest areas in the city but most have the families in search for newer houses in other locations. Most of the houses are typical and do not offer much choice for the residents as compared to the newer developments. 43-B is one house as shown below is located in upper Mollenberg for two families (Refer figure 8). It has a total of six bedrooms with a gross area of 216 sqm. and has an FSI of 0.7. As the old houses do not have flexibility of use of space and universal accessibility, it is difficult for old people and disabled to continue living in these areas.

¹The study area defined in the report is a larger area and does not correspond to the similar area of the study in this research as marked in Figure 7. Mollenberg and Baklandet are part of one area and Rosenborg is another larger area, which also includes Rosenborg park.

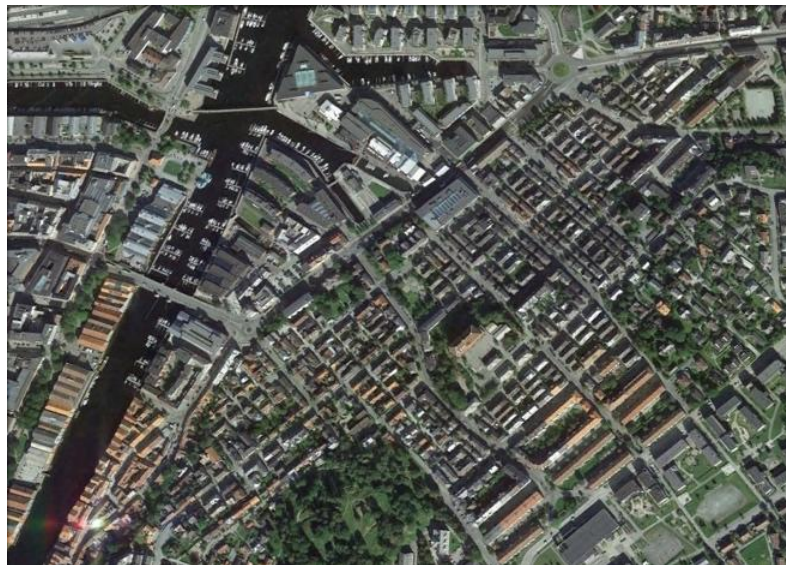


Figure 7 Mollenberg residential areas near the city center, Source: Map source Google Earth

Mollenberg also doesn't have enough open spaces or parks for old people and children to spend time. Even views to greens/open spaces are scarce.



Figure 8 Plan of a house 43-B in Mollenberg with gross area 216 sqm. and plot areas of 305 sqm., Source: TAKST-Forum, <https://hem.no/80442989>

3.2 ROSENBERG PARK

The Rosenberg park is a new residential development, as evident from the character of urban form as shown in figure 9, which was developed on a site of old University of Trondheim, built around a central green area Kristiansten Festningsom and Island forest. The location of the development is close to Kristiansten fortress and an island forest.



Figure 9 Rosenberg Park, Source: Google Earth

There are about 400 dwelling units altogether with a range of 36 sqm to 200 sqm. of unit areas. The development plan made a special provision that minimum 20 % homes will be adapted by the disabled people and also open space shall be designed to create universal access for all based on the Universal Design in Planning and Construction (Trondheim Municipality, 2006). The overall building heights are mid-rise structures with some grocery shops at the lower floor along the main road.

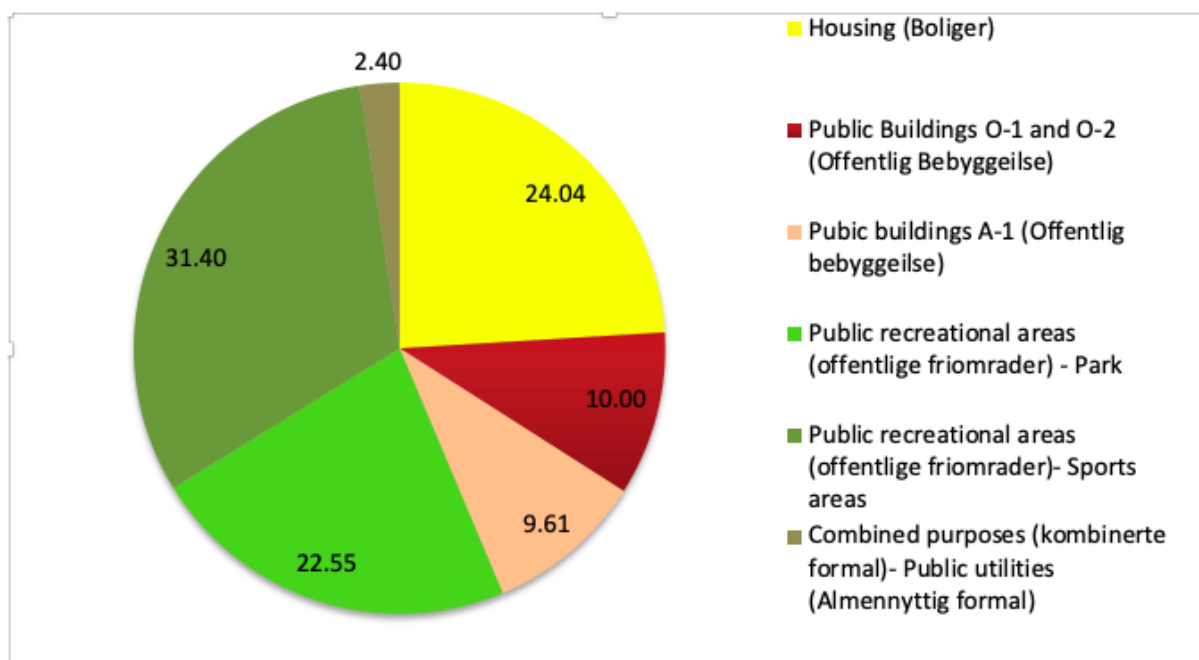


Figure 10 Rosenberg land use distribution, Source: Trondheim Kommune and Author

Significant effort is put into the planning and design of recreational areas to benefit the wheelchair users, walkers and mother's using prams. The percentage distribution of land uses in Rosenberg park shows that the major land about 54 % is reserved for public recreational areas i.e. parks and sports areas and next major land about 24 % is earmarked for residential development graphically shown in figure 10 above.

Quantitative analysis of Rosenberg park as per Table 1, shows that the overall ground coverage of the residential development is about 33% and overall FSI is 1.5 making it high dense with high built-up area as compared to Mollenberg and the surrounding existing development around Rosenberg park. The development has a good mix of single bedroom, double bedroom and triple bedroom units of 68 sqm.,97sqm. and 154 sqm. They are all distributed almost like 1/3rd of the total each.

Table 1 Rosenberg park residential area quantifiable characteristics

| S.No. | Zone | Zone area in sq.m. | No. of blocks | Blocks | Ground coverage | Total ground coverage | Percentage ground coverage | Building Heights | Total Built up area | FSI |
|-------|---------|--------------------|---------------|--------|-----------------|-----------------------|----------------------------|------------------|---------------------|------|
| 1 | B-1 | 1308 | 2 | B1-a | 232.62 | 514.14 | 39.3 | G+4 | 2570.7 | 1.97 |
| | | | | B1-b | 281.52 | | | G+4 | | |
| 2 | B-2 | 4841.27 | 4 | B2-a | 585.25 | 1472.52 | 30.4 | G+4 | 7362.6 | 1.52 |
| | | | | B2-b | 291.25 | | | G+4 | | |
| | | | | B2-c | 243.77 | | | G+4 | | |
| | | | | B2-d | 352.25 | | | G+4 | | |
| 3 | B-3 | 4275.16 | 4 | B3-a | 260 | 1211.25 | 28.33 | G+4 | 6056.25 | 1.42 |
| | | | | B3-b | 342.86 | | | G+4 | | |
| | | | | B3-c | 407 | | | G+4 | | |
| | | | | B3-d | 201.39 | | | G+4 | | |
| 4 | B-4 | 4410 | 4 | B4-a | 542.6 | 1561.3 | 28.33 | G+4 | 7806.5 | 1.77 |
| | | | | B4-b | 545.55 | | | G+4 | | |
| | | | | B4-c | 234.33 | | | G+4 | | |
| | | | | B4-d | 238.82 | | | G+4 | | |
| 5 | B-5 | 3049.66 | 5 | B5-a | 297.6 | 1161.08 | 38 | G+2 | 3713.64 | 1.22 |
| | | | | B5-b | 297.6 | | | G+2 | | |
| | | | | B5-c | 187.31 | | | G+2 | | |
| | | | | B5-d | 148.17 | | | G+2 | | |
| | | | | B5-e | 230.4 | | | G+3 | | |
| 6 | B-6 | 2609.62 | 2 | B6-a | 290.13 | 853.95 | 32.72 | G+3 | 2851.98 | 1.09 |
| | | | | B6-b | 563.82 | | | G+2 | | |
| 7 | Overall | 20493.7 | | | | 6774.24 | 33.06 | | 30361.6 | 1.50 |

IV. COMPARITIVE ANALYSIS

4.2 QUANTITATIVE ANALYSIS

The quantitative data gathered from various sources was tabulated for comparison as detailed out in the Table 2 below.

Table 2 Quantitative data

| Quantitative Parameters | Mollenberg | Rosenberg Park |
|--|-----------------------------|------------------------|
| Total Study Area | 58.59 acres (2,37,127 sqm.) | 21 acres (84,984 sqm.) |
| Population | 3,000 | 1,249 |
| Population Density | 300 pph | 147 pph |
| Resident profile | Mostly Tenants (Students) | Mostly owners |
| Distance to city center by private vehicle | 15 minutes | 12 minutes |
| Distance to city center by walk | 22 minutes | 20 minutes |
| Distance to city center by bicycle | 5 minutes | 5 minutes |
| Overall Building density (FSI) | 0.75 | 1.5 |
| Open spaces (Visual resources) | 25% | 31.4 % |
| Recreational spaces (Physical resource) | 10% | 22.5 % |
| Diversity and Mix of uses | 12% | 22 % |
| Equity (Universal design) | None | Considered |

The above data shown in table 2 shows that though Mollenberg possess higher densities, the diversity and mix of uses is lower than that of Rosenberg. In terms of distance to the city center either by walk or by

vehicle both the neighborhoods are close to the city center within half an hour. Rosenberg area allows for higher Floor space as compared to Mollenberg as the later is an old area and conserved. Any new development is restricted to the guidelines framed earlier and hence the building allowable floor spaces are restricted.

4.2 QUALITATIVE ANALYSIS

In view of obtaining perceptual opinion of people on the two neighborhoods, 30 respondents from each case area were selected. Diversity of the sample was required to achieve the response, which is not biased. Based on the theory of Purposive or Subjective Sampling Method [10], the maximum variation sampling method was used with the following below variations in the samples –

- Age (varying from 15 to 75 years)
- Gender (Male, female and transgender)
- Location of residence within the neighborhood
- Occupation or level of education (Employees, Businessmen and housewives)

Respondents were asked the questions to assess their opinion on four qualitative parameters of research –

- a) Accessibility to public transport
- b) Safety of public areas/streets
- c) Universal access to public spaces
- d) Neighborhood experience

The questions asked to the respondents are shown in the table 3 below and the responses were recorded on a Likert scale of 1 to 5, in which 1 being the lowest and 5 being the highest. The responses from the survey were then mapped on graphic scales to understand the variation in the people’s opinion in the two neighborhoods.

Table 3 Questionnaire

| Questions | Qualitative parameters | Answers | Rating on Likert scale (1-5) |
|---|---|--|------------------------------|
| How accessible is the nearest public transport and the amenities? | Accessibility | Very much accessible | 5 |
| | | Accessible | 4 |
| | | Somewhat accessible | 3 |
| | | Few facilities are not accessible | 2 |
| | | Not accessible at all | 1 |
| Are the public spaces safe at all times? | Safety of public areas/streets | Safe at all times | 5 |
| | | Safe during day time, safe during night time | 4 |
| | | Safe during evening time | 3 |
| | | Safe during day time | 2 |
| | | Not at all safe | 1 |
| Do you feel that facilities in your neighborhood are universally accessible? (by people with all abilities, genders and age groups) | Universal Accessibility (Gender usage and equality) | Highly accessible | 5 |
| | | Good | 4 |
| | | Average | 3 |
| | | Low | 2 |
| | | None | 1 |
| How many times a week/month you generally access recreational areas in your neighborhood? | Recreation within neighborhood | More than thrice a week | 5 |
| | | Twice a week | 4 |
| | | Once a week | 3 |
| | | Once in a month | 2 |
| | | Not at all | 1 |

4.2.1 ACCESSIBILITY

The response on accessibility to public transport is shown in figure 11 where Mollenberg scores high in terms of accessibility. Rosenberg is situated slightly on the higher terrain, so this makes it less connected to public transport also because the public transport frequency is less along this route.

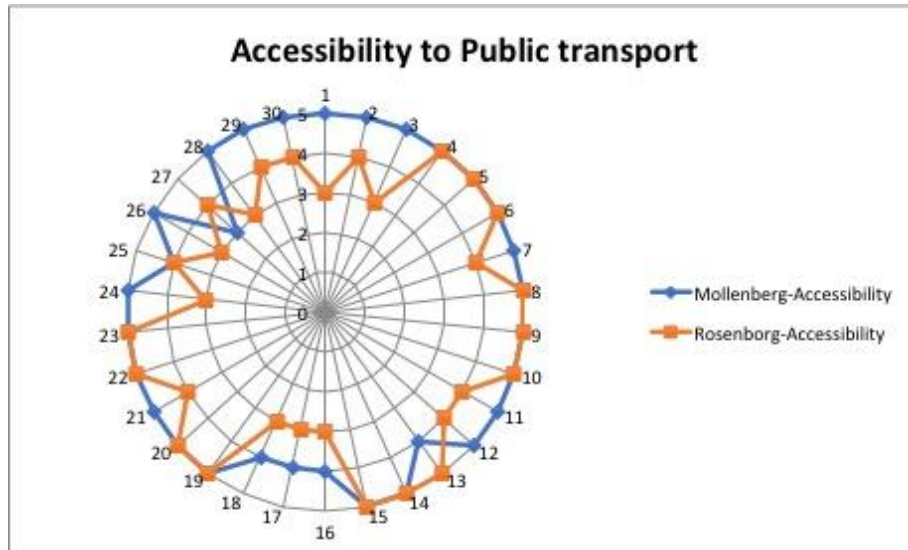


Figure 11 Accessibility to Public transport

4.2.2 SAFETY

The response on safety within the neighborhood as shown in figure 12 shows that Rosenberg scores high in terms of safety. The probable reason is primarily because of the typology of the neighborhood. In case of Rosenberg, the buildings form an edge along the outer periphery which are apartment type blocks with mix of units having commercial at the lower floors facing the road. The residential units are accessed from the open spaces within the neighborhood. But in case of Mollenberg, the neighborhood typology is having predominant independent plotted houses abutting the road along a row, making it totally exposed to any outsider. Also since, most of the houses are rented and occupied by students, there is a problem of theft within the neighborhood when the students are not staying in the neighborhood. And as per the living conditions study as discussed earlier, the area is unsafe and subjected to crime. Rosenberg, offers safe open spaces all throughout the day.

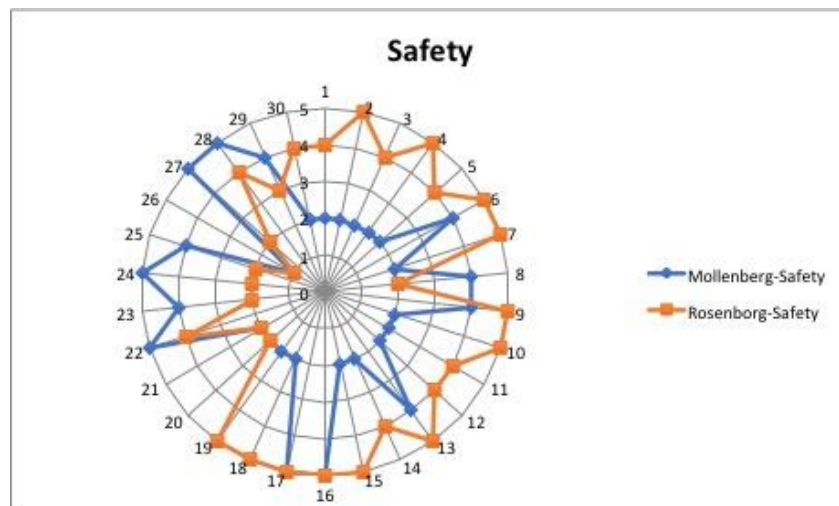


Figure 12 Safety of public areas

4.2.3 UNIVERSAL ACCESSIBILITY

One of the yardsticks to measure the liveability of neighborhood is to make sure that the neighborhood is equally accessible to all ages, abilities and sex of people within. Often after retirement, many neighborhoods fail to create universal access to old people or with disabilities. And this makes them to shift to comfortable housing.

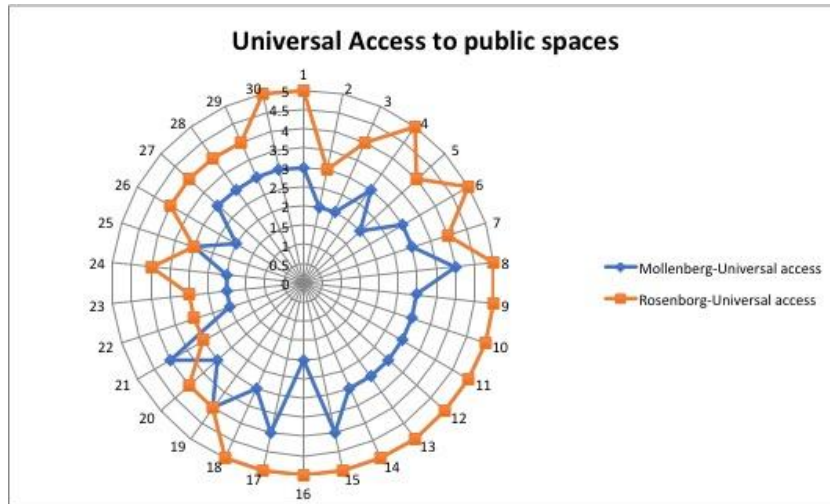


Figure 13 Universal accessibility

This may be the reason that many families shifted to comfortable neighborhoods which offered better comfort for older generations. Mollenberg neighborhood is quite an old neighborhood and most of the houses do not have lifts, or even ramps. This restricts people with disabilities and older generations to come out of the house to enjoy the open spaces. On the contrary, Rosenberg offers universally accessible open spaces, hence scores well as shown in figure 13.

4.2.4 NEIGHBORHOOD EXPERIENCE

Rosenborg offers great variety of open spaces which are both active environments and passive greens. This makes the residents to use the recreational areas very often. In addition to the open spaces, there are various play fields as shown earlier allowing different age groups to use them regularly for recreation. This makes Rosenberg a better neighborhood in terms of neighborhood experience as compared to Mollenberg as mapped in the figure 14.

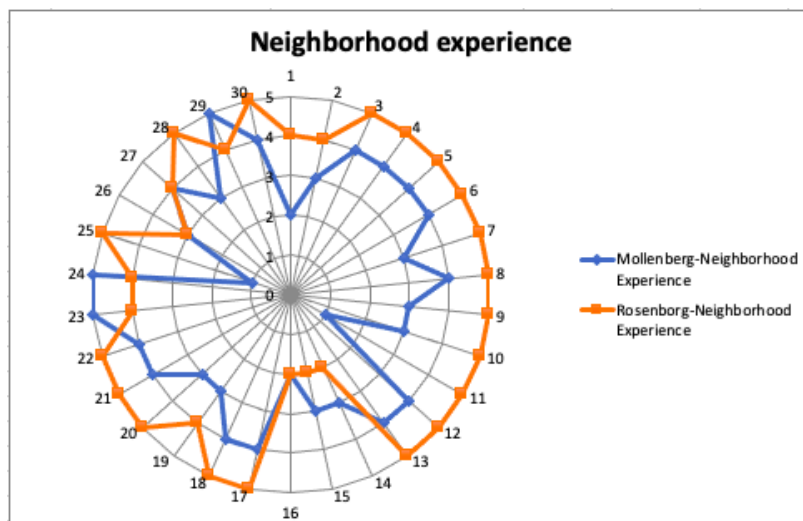


Figure 14 Neighborhood Experience

V. RESULTS

Figure 15 shows the consolidated average of scores of each resident on the above four parameters, shows that the Rosenberg scores high in terms of liveability parameters considered for the research. The comparison of average of the independent scores clearly indicate the variation of perception in the two neighborhoods with respect to the aspects considered. In most cases, the residents of Rosenberg have

significantly higher scores. And the fact is that most of the residents of the Mollenberg neighborhood being students who do not stay in the neighborhood during the vacations and during the college hours when the classes are running. This means the perception of students is predominant in the area and not like the generic population in any other neighborhood.

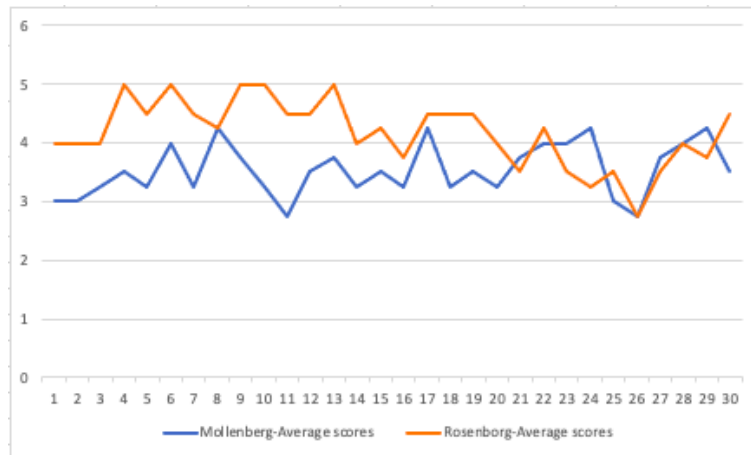


Figure 15 Consolidated average scores of each resident based on the survey

VI. CONCLUSION

The above research shows that not every high dense settlement is liveable like as is the case of Mollenberg since building densities and acceptability play a vital role. In case of Rosenberg, the development has mix of typologies, visual as well as physical access to open spaces, universal accessibility, community-based activities and self-sufficiency. The variety in housing typologies promote equity in the neighborhood with a good social mix which is not evident in Mollenberg since all housing units are more or less the same typology and similar areas giving lesser choice within the community. Though Mollenberg has high population density, it offers low building density i.e. FSI 0.7 which results in lesser per capita space for the individual, whereas Rosenberg has an FSI of 1.5 which allows for a better built up space per capita with a moderate density.

Since the access to the greens and city level open space is a good visual and physical resource for urban development, it makes the neighborhood much more liveable. In Rosenberg, only about 24% land is reserved for residential development whereas the rest are community level amenities, open spaces, recreational areas, playgrounds and public buildings with roads on the periphery unlike Mollenberg where roads are thoroughfare and essential part of the community leaving very less privacy for the people residing. Due to this, it is also observed that the crime rate is maximum in Mollenberg as compared to other parts of the city. The density studies therefore should consider the nature and mix of population residing in a neighborhood like age as an important factor. There can be neighborhoods where predominant population is either young or old. This may be because of the liveability factors that have influenced certain neighborhood to grow in that manner like Mollenberg. Hence, colloquial statement saying high density is liveable, is not true in every context.

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