On the Attendance Figure of the Sykehus til Alta March August 26th – 2017



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1 Introduction and Scope

On August 26th, 2017, a march was held in Alta, Norway in favour of establishing a hospital within the city of Alta. This study tries to find an answer on the question of how many people attended the march through the use of public resources.

2 Approach and scientific background

2.1 Sources, Measurements and Maps

The main resources for the study are:

1. Video 1 – Video_fra_Drone_Pos1
2. Video 2 – Video_fra_Drone_Pos2
3. Video 3 – Video_fra_Privatperson
4. Google Earth Pro
5. Google Maps
6. http://www.geodata.alta.no/
7. The “Sykehus til Alta” Facebook page

Plans and measurements are obtained from Google Maps, Google Earth Pro, the http://www.geodata.alta.no website and the provided video footage. It has proven difficult, given the available resources, to take detailed measurements on the geography.

2.2 Images and illustrations

As a support tool a Google My Map has been developed, containing all relevant information on the study and is referred to in the report as “the Google MyMap”. Below goes the link to the map. https://drive.google.com/open?id=1_tZrvMQ8HEczuMfXzwZh23WGhKY&usp=sharing

2.3 Crowd Dynamics

When people gather, there is a dynamic between the area they occupy, both as an individual and as a crowd, the actual number of people, their flow rate, and their physical environment. These Crowd Dynamics involve elements of risk assessment, emergency planning, information systems, human psychology and spatial awareness (Still, 2009). It is defined as the study of how and where crowds form and move above the critical density of more than one person per square meter (Still, 2013).

Crowd density and flow rates are key elements relating not only to the size of the crowd but also to facilities, site design and a moment in time. Crowd density must be considered separately for static or moving crowds as they each have their own limits. Effects of high density are not only physical (as in dense crowds); people are also forced to enter each other’s personal or even intimate zone (Hall, 1974). The flow rate is of importance for moving crowds. Crowd density and flow rates link to people per square meter, often leading to congestion and high crowd density (Still, 2013).

The study of Crowd Dynamics combined with crowd behaviour converges into Crowd Science.

2.4 Crowd Density

The crowd density scale in this report finds its origin in Fruin's Level of Service (LOS) for walkways (dynamic) areas (Fruin, 1987). Fruin expressed these Levels of Service (LOS) as feet per person. This is converted into the comprehensible "people per square meter." Every LOS is colour coded on the maps and illustrations.

Fruin assigns a fork of values per LOS; this implies that evenly coloured areas do not necessarily have the exact same density. The scale is shown below in figure 1.

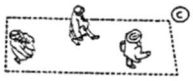
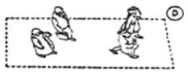
DENSITY LOS WALKWAYS		Conversion sq ft per person to people per sq m			
LOS	Image	ft²/p	ft²/p	p/m²	p/m²
A		0	35		0,31
B		35	25	0,31	0,43
C		25	15	0,43	0,72
D		15	10	0,72	1,08
E		10	5	1,08	2,15
F		5		2,15	

Figure 1 - Density Scale - LOS for walkways areas (p/m²)

It is important to understand that the densities are always expressed as an average for the entire area. Prof. Dr. G. Keith Still produced a series of comparable drawings (Still, 2014), which can be conveyed below. All drawings are obtained from Prof. Dr. Stills website; www.gkstill.com.

1 p/m²

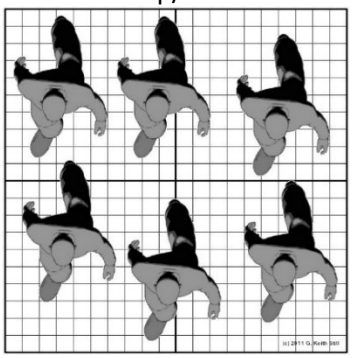


Figure 2 - One person per square meter (Prof. Dr. G. K. Still)

2 p/m²

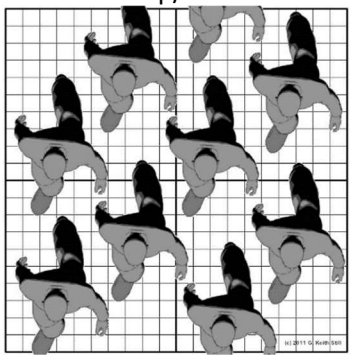


Figure 3 - Two persons per square meter (Prof. Dr. G. K. Still)

2.5 p/m²

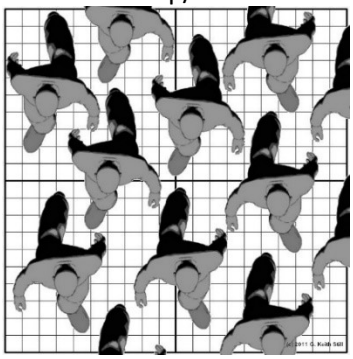


Figure 4 - Two and a half person per square meter (Prof. Dr. G. K. Still)

2.5 Approach

The study consists of three main parts:

1. Study of the characteristics of the march:
    - Study of the available video footage
    - RAMP Analysis
2. Crowd Size definition
    - Based on density and flow
    - Simulation, reconstruction
3. Conclusion

3 RAMP Analysis

A RAMP Analysis allows research, understanding and analysis into the four main aspects of Crowd Science; Routes, Area, Movement and Profile. When combined, all four of these elements allow a comprehensive study on how the crowds will form, what space is used and how, the movement within these routes and areas and how the crowd will react, behave and act regarding influential environmental factors. This is significant within the study to highlight density, flow rates and the overall crowd capacity.

3.1 Points of interest

The table below shows the points of interest, based upon the sources as mentioned above. All these points can be found on the Google My Map.

Name	Description
Start	City Hall (Radhus) - Sandfallveien 1, 9510 Alta, Norway
Roundabout 1	Roundabout E6 Altaveien/Skolevien/Komsaveien
Roundabout 2	Roundabout E6 Altaveien/Skolevien/Bossekopveien
Roundabout 3	Roundabout E6 Altaveien/Markveien/Maskinsvingen
End	Sentrum Markedsgata
Viewpoint 1	Location of the drone that shot Video 1
Viewpoint 2	Location of the person that shot Video 2
Viewpoint 3	Location of the drone that shot Video 3
Viewpoint 4	View from Roundabout 1 to Roundabout 2
Viewpoint 5	View from Roundabout 2 to Roundabout 3
Viewpoint 6	View on the E6 between Roundabout 2 and 3
Viewpoint 7	View on Roundabout 3
Viewpoint 8	View towards Section 6

3.2 Route

The march was foreseen to start at the Radhus, City Hall, and end in the City Centre, Sentrum. Based upon the footage from Video 2, the endpoint is set at the square at Markedsgata.

The figures below show the start and end point.



Figure 5 - Start point – Radhus

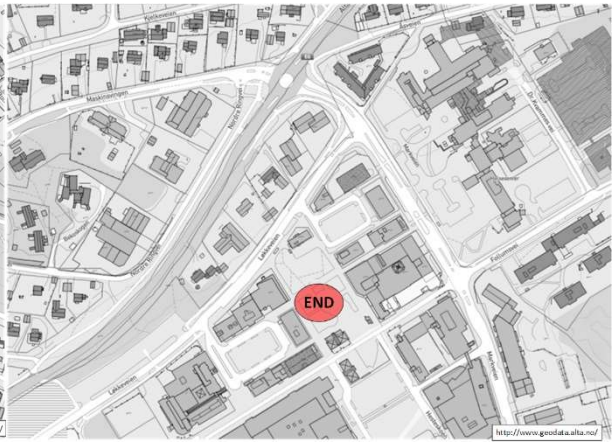


Figure 6 - End point - Sentrum

The main route as seen on the video footage is:

Sandvallveien – Skoleveien – Altaveien (E6) – Markeien – Markedsgata

The whole route can be seen on the Google My Map and the figure below.



Figure 7 - The Route from Radhus to Sentrum

The Route can be broken up into seven sections with the total distance approximately 1.770 meter. The sections are highlighted below.

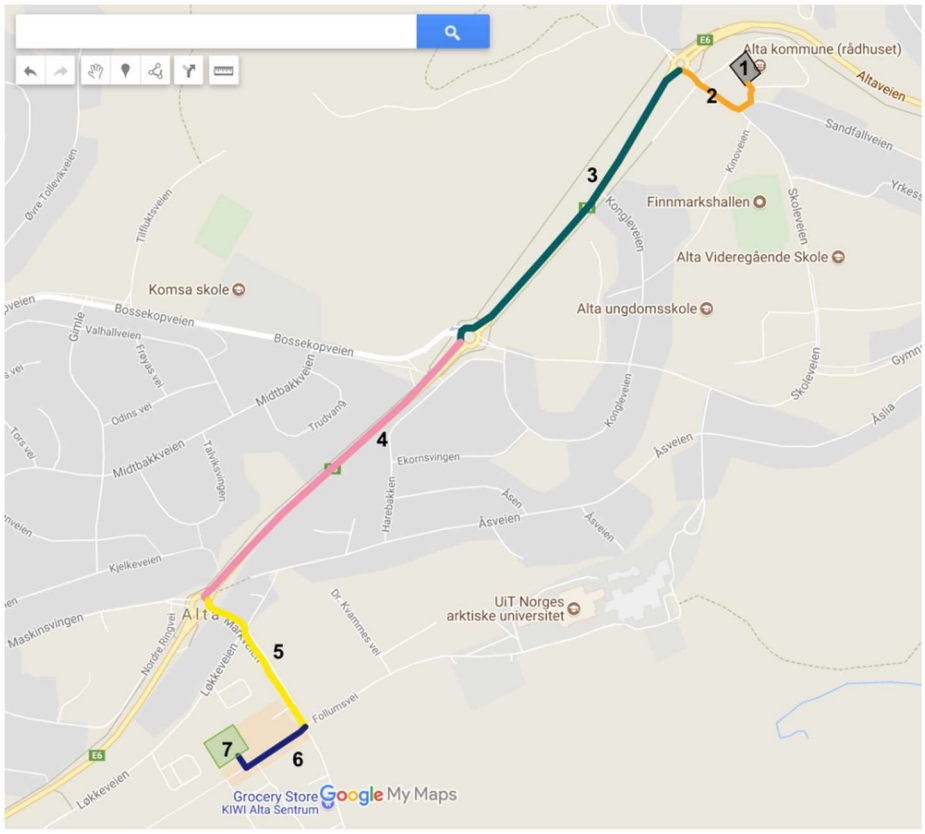


Figure 8 – 7 Sections of the Route

Section	Description	Distance (m)
Section 1	City Hall	0
Section 2	City Hall to Roundabout 1 (E6 Altaveien / Skoleveien	177
Section 3	Roundabout 1 to Roundabout 2	580
Section 4	Roundabout 2 to Roundabout 3	601
Section 5	Markveien	270
Section 6	Markedsgate	140
Section 7	Sentrum	0
Total		**1,768**

The video footage shows that the majority occupied the roads with small minority making use of the pavements.

3.3 Areas

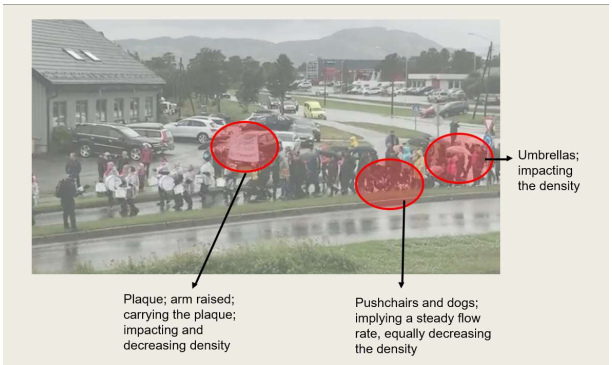
For each section the area is defined and determined whether the area holds dynamic or static crowds. Given the nature of a march, the areas in question contained dynamic movement.

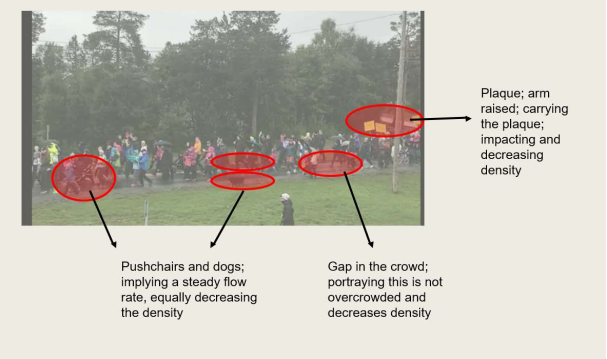
Section	Description	Distance (m)	Area (m²)	Static Dynamic
1	City Hall			Static
2	to Roundabout 1 (E6 Altaveien / Skoleveien)			Dynamic
3	Roundabout 1 to Roundabout 2 (E6)	577		Dynamic
4	Roundabout 2 to Roundabout 3 (E6)	601		Dynamic
5	Markveien	270		Dynamic
6	Markedsgate	160		Dynamic
7	Sentrum			Static
Total				

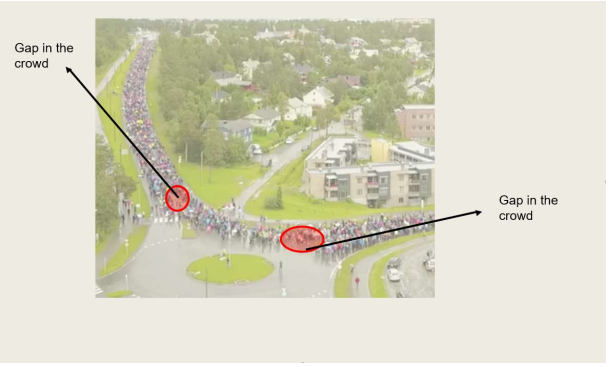
3.4 Movement

The movement of the crowd is synchronised and follows the same pattern; all heading to the same destination. The video footage conveys the crowd to have steady flow rates, all moving in the same direction and can be described as.:

- Ordered crowd
- Not overcrowded
- Pauses in the crowd (individuals waiting)
- Gaps in the crowd
- Pushchairs, children/toddlers and umbrellas
- Animals; Dogs
- Holding plaques







The images demonstrate the influential elements relating to movement and density. This includes; gaps in the crowd, umbrellas, dogs and pushchairs; all of which can impact on the movement of the crowd.

From the video footage, the crowd remain to the route without introducing short cut behaviour. This allows the study into movement to become accessible and enables an overview of the crowd profile.

3.5 Profile

The profile of the participants, as displayed on the footage, includes:

- Adults and Children; prams and toddlers
- Community movement
- United and cohesive as it is a march for protest to build a hospital in the city.

This highlights reasoning into the compliant movement of the crowd.

Momboisse (1967), created categories based on purpose of gathering, to aid with the understanding the behavioural patterns of a crowd. (Challenger Clegg and Robinson, 2009) The Alta March crowd complements characteristics of a Conventional, Expressive and Demonstrative Crowd.

Conventional Crowd	*'ones which are gathered for a specific purpose or to observe a specific event, with crowd members who share common interests.'* (Challenger, Clegg and Robinson, 2009, Page 70)
Expressive Crowd	*'ones with members who are involved in some form of expressive behaviour, although not in a destructive way, for instance, dancing or singing.'* (Challenger, Clegg and Robinson, 2009, Page 70)
Demonstrative Crowd	*'A crowd, often with a recognized leader, organized for a specific reason or event, to picket, demonstrate,* *march, or chant.'* (Challenger, Clegg and Robinson, 2009, Page 72)

This aids with identifying the purpose of which the crowd are assembling, allowing further assessment into the dynamics, flow rates and potential behaviours of the crowd. The use of a 'Demonstrative Crowd' can be seen within the video footage through the use of plaques. This alters the mood of the crowd and can have an impact when assessing density and the overall crowd count.

The weather can have an impact on the mood of the crowd, sharing a strong relationship to the way in which individuals will move. On the day of the march the weather is portrayed as rainy; (video footage and use of umbrellas). This could have an impact on the flow rates, density and morale within the crowd and is a considerable variable within the study.

4 Crowd Size based on Density and flow

4.1 Useful image and Sections?

The video footage shows a guy in an orange high visibility vest on point of the march, the back of the march is marked with a police car and there is a blue bus behind the march.

For this approach, an image showing the whole march is needed or a series of images showing the whole of the march at the same moment in time.

The image of Video 1, on minute 2:16 shows the whole of the march between Roundabout 2 and the beginning of Markveien. This is Section 4 and partly Section 5. When we zoom onto Roundabout 2, we see a blue bus. This blue bus is later seen behind the march. The bus in the view on 2:16 is clearly orientated right to left, implying that the bus is on Roundabout 2, behind the march. Therefore, the back of the march has left Section 3 and is entering Section 5. The gross of the march is in section 4.



Figure 9 - Shot at 2:16 of Video 1

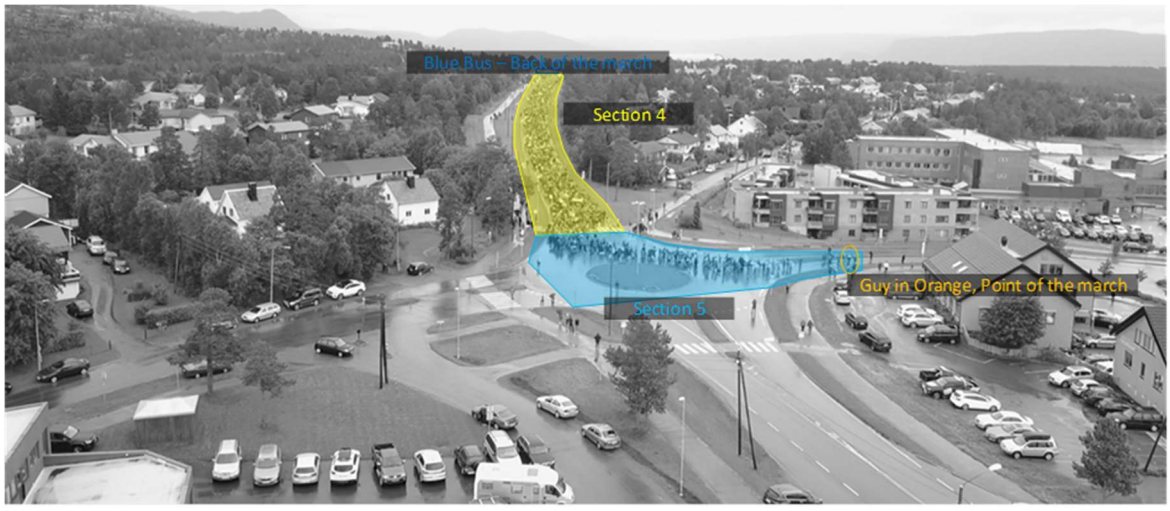


Figure 10 - Shot at 2:16 of Video 1 with indication of Section

The shot above, taken from Video 1 at 2:16 minutes, is the base of the crowd count influenced by density and areas in Section 4 and Section 5.

4.2 Speed and Density

The distance and angle of the videos limit perception and a detailed study. Open areas or gaps in the crowd cannot be seen towards Roundabout 2 due to the low angle and limiting sharp imagery towards the back.

As density is related to speed, the speed of some individuals in Section 4 is determined.

The image on minute 2:16 shows Person 1 (marked in red), carrying a yellow plaque. Person one is located at the sixth lamppost; the distance towards the pedestrian crossing at the end of Section 5 is 228 meters. It takes Person 1 184 seconds to reach the end of Section 4.

At minute 6:39 we have a clear visual of the blue bus which is right behind the march and travels at the same speed. At that time, the bus is at the ninth lamppost. The video stops before the bus reaches the end of Section 4. It takes the bus 418 seconds to cover the 408 meters to the lamppost.

	Distance (m)	Time (s)	Speed (m/s)
Person One	228	184	1,24
Blue Bus	408	418	0,98

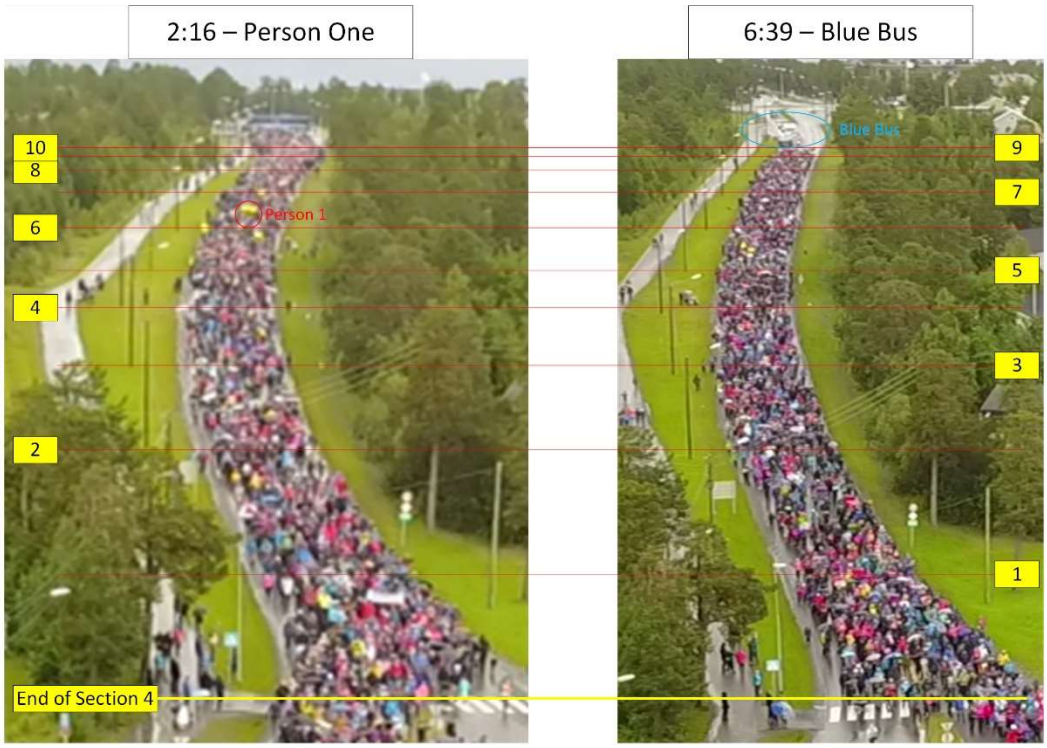


Figure 8 - Determination of speed on Section 4

If we compare both speeds with the data in the LOS Table, this concludes to:

1. For Person One, the speed of 1.24 meter per second corresponds with the upper boundary of Fruin's LOS. This calculates the density to be approximately 0.72 people per square meter.
2. The bus speed of 0.98 meter per second corresponds with the upper boundary of Fruin's LOS 2.17 people per square meter.

Fruin's Level of service was developed in respect to people moving on footpaths in urban areas and did not embed influential impacts such as umbrellas, prams and plaques.

4.3 Section 4

Based on the finding from the RAMP Analysis, with the combination of a moving crowd (inclusion of pushchairs, children/toddlers, umbrellas and holding plaques) and the weather, this shows a relationship between speed and density. From this, we could set the density for this area between 1 and 1.5 people per square meter.

The image below shows Section 4 between Roundabout 2 and Roundabout 3. The yellow area is the zone occupied by the march with the area of 4,346 square meter. As mentioned before, the distance and angle of the video did not allow for a detailed study as open areas or gaps in the crowd cannot be seen towards Roundabout 2.

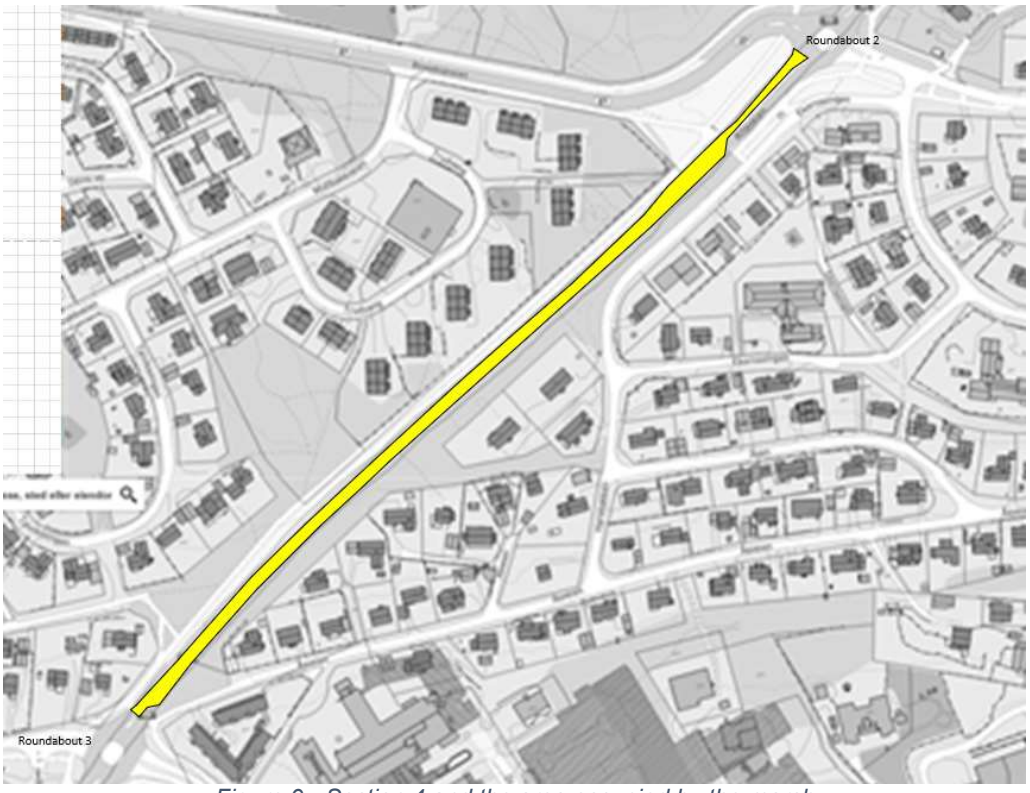
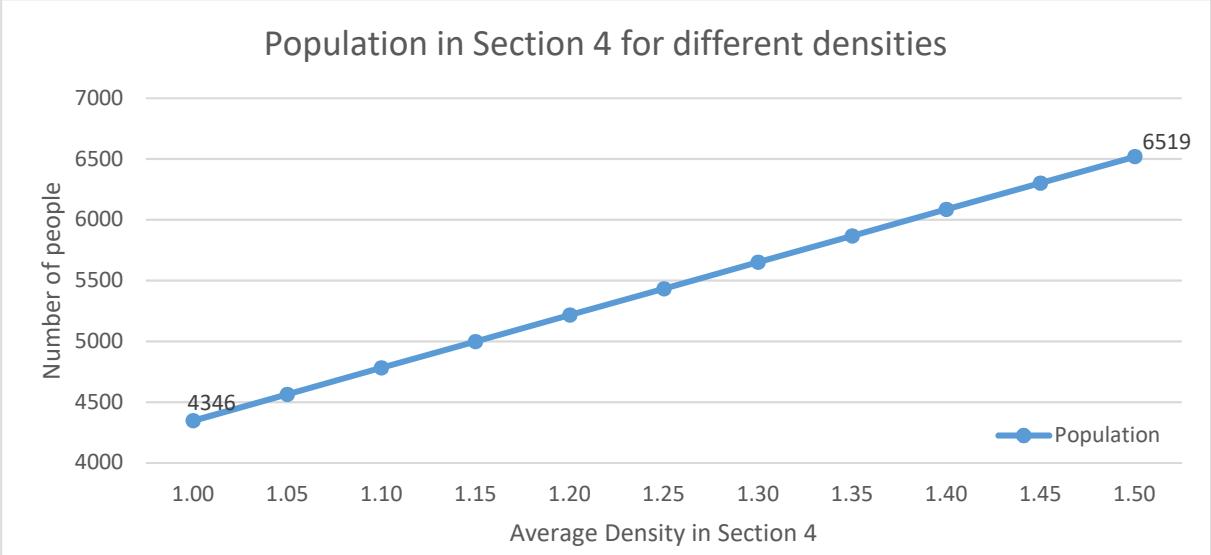


Figure 9 - Section 4 and the area occupied by the march

This sets the population in Section 4 between **4,346 and 6,519** people. The graph below shows the population for the fork of densities between 1 and 1.5 people per square meter.



4.4 Section 5

The view on Section 5 in the 2:16 image is clearer. The point of the march is also in the image. This implies that all of the march is either passing through Section 4 or in Section 5. The image below represents Roundabout 3 and the area occupied by the crowd in Section 5 at 2:16 on Video 1.

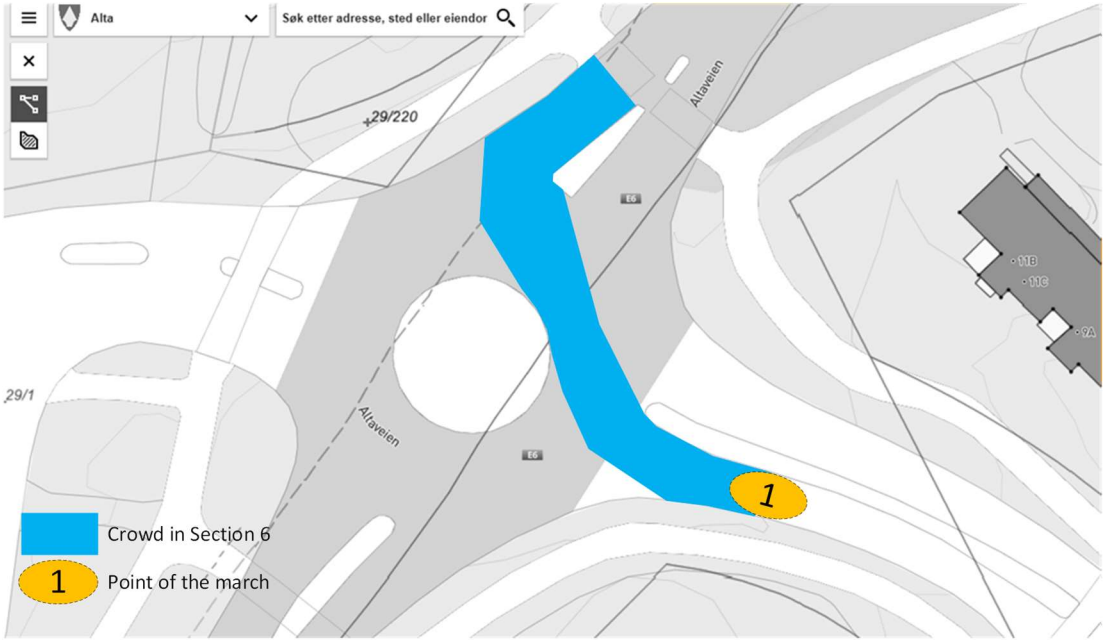


Figure 10 - Section 5 occupied space

Within the occupied area of Section 5, different densities occur. These are outlined in the table and image below.

Section	Zone	Area (m²)	Density p/m²	Population	Remarks
5	A	94	1	94	
5	B	115	0,5	58	
5	2			13	Marching Band
5	1			10	Point of march
TOTAL		**209**		**175**	

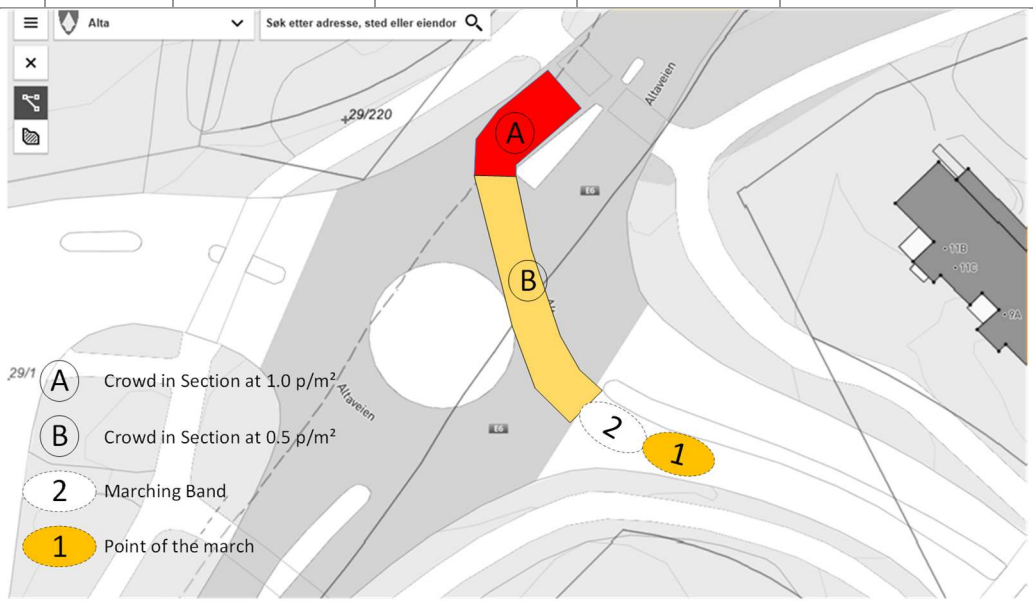


Figure 11 - Section 5 Crowd Density

4.5 Total Number

The table below summarizes the figures related to the image of 2:16 from Video 1.

Section	Description	Area (m²)	Density (p/m²)		Population	
			Lower	Upper	Lower	Upper
1	City Hall	Not in use				
2	to Roundabout 1	Not in use				
3	Roundabout 1 to Roundabout 2	Not in use				
4	Roundabout 2 to Roundabout 3	4,346	1	1.5	4,346	6,519
5	Markveien	209			175	175
6	Markedsgate	Not in use				
7	Sentrum	Not in use				
Total					**4,521**	**6,694**

The number if people that can be seen on the march sits between **4,521 and 6,695 with an average of 5,608.**

5 Conclusion

The overall outline was to assess the number of attendees present at the Alta, Sykehus March 2017. Based on the video footage and the referenced illustrations, the number of participants were assessed and estimated.

When breaking down the march into seven sections, this conveyed a structural and comprehensive analysis into the capacity of each section combined with density, to allow an estimation on the overall number of participants. Due to the available footage, this limited the definition of the study, resulting in a minimum and maximum configuration…;

Minimum: **4,521**

Maximum: **6,695**

Average**: 5,608**

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