

University of Groningen
Faculty of Spatial Science
International School of Spatial Sciences
Spatial Planning Group Project

Conflicts between Street Users in Vismarkt, Groningen

Group 8
Supervisor: Paul van Steen

Jan-Marc Joost - jan-marcjoost@web.de
Paulo Magalhaes Tarmamade - pvtarmamade@gmail.com
Gabriel Nobre de Souza - gabriel_ns@live.com
Lior Steinberg - lior.steinberg@gmail.com

20.01.2015

Table of Contents

1. Introduction	3
1.1 The Topic in Brief	3
1.2 Research Problem Definition	3
1.3 Research Goal Definition	3
1.4 Research question definition.....	3
2. Theoretical Framework	4
2.1 Background to the topic	4
2.2 Desire Lines	7
3. Methods	8
3.1 Organization of Fieldwork	8
3.2 Data Analysis	9
4. Results.....	10
4.1 Cyclists	10
4.2 Pedestrians	10
5. Analysis	14
5.1 Traffic Flows	14
5.2 Potential Conflicts.....	16
5.2.1 Cyclists and Pedestrians	18
5.2.2 Cyclists and Cyclists	21
5.2.3 Cyclists and Vehicles	22
6. Discussion	22
6.1 Elevated Zebra Crosswalk	23
6.2 Additional Zebra Crosswalk	24
6.3 Roundabout.....	25
7. References	27
Appendixes	28
Appendix 1	28
Appendix 2	38

1. Introduction

1.1 The Topic in Brief

The city of Groningen with a population of 195,418 inhabitants has a bicycle use of 37% being the highest in the Netherlands (Statistics Netherlands CBS, 2014; Fietsberaad, 2005). This shows the overwhelming presence of bicycles in the city, shaping the cityscape in a profound way. Groningen is internationally known as one of the most bicycle friendly cities in the world and has the first place in bicycle usage among the main cities in Europe (Ligtermoet, 2009). Thus Groningen serves as a pioneer in bicycle related topics and its successes and challenges can serve as examples for other cities that have the goal of promoting bicycle use. Cycling has been fostered extensively by local authorities, resulting in a bicycle-orientated traffic policy, giving cycling development priority over other means of transportation (Ligtermoet, 2009). However, this focus on cycling in urban transportation can also result in conflicts between different actors. "We are very proud of our high share of bicycles, but the success has also caused problems," said Groningen's bicycle commissioner Jaap Valkema in a panel discussion at the Velo-City urban cycling conference in Vienna (2013).

1.2 Research Problem Definition

In popular areas for cyclists and pedestrians conflicts between different public space users are bound to happen. The aim of this research is to analyze conflicts between pedestrians and cyclists in a popular intersection in Groningen. The intersection of Stoeldraaierstraat and Vismarkt in the city center of Groningen, which accommodates passing traffic and also serves as a destination point, has a high potential for conflicts, thus being the perfect scenario for this research.

1.3 Research Goal Definition

Our goal is to analyze the intersection of Vismarkt and Stoeldraaierstraat in terms of movements of cyclists and pedestrians, and identify potential conflicts between the two actors in the intersection of Vismarkt in Groningen, in addition to other street users such as merchants, public vehicles etc. Concluding, we would like to propose design solutions to the problem.

1.4 Research question definition

In order to fulfill the research goal, the following research questions have been defined:

1. Which are the main traffic flows and desire lines of the different actors in the intersection of Stoeldraaierstraat and Vismarkt in Groningen, focusing on cyclists and pedestrians?
2. What kind of conflicts between the street actors can be observed in the intersection, focusing on cyclists and pedestrians?

3. Which design change could improve the traffic flow and minimize the conflict potential, in emphasis between cyclists and pedestrians?

2. Theoretical Framework

2.1 Background to the topic

The use of bicycles is a healthy and environmentally friendly mode of transportation. As the risk of accidents to individual cyclists decreases when the level of cycling within an area increases (Pucher & Buehler, 2012), Groningen can be considered a comparably safe place for cyclists. Indeed, the Netherlands have one of the lowest ratios of cyclists involved in traffic accidents. Furthermore, even in Dutch municipalities differences in the safety of cyclists can be spotted. In municipalities with a high bicycle use, such as Groningen, the risk of a cyclist being involved in a traffic accident is on average 35 % lower than in municipalities with a lower share of cycling (Fruianu, 2009).

However, conflicts between the different traffic actors can lead to accidents. About 50% of traffic accidents with seriously injured persons in 2011 in the Netherlands resulted from bicycle accidents (OECD, 2014). Therefore, special attention needs to be paid to this group of traffic actors. The most dangerous place, where 80% of the more serious accidents happen is at crossings, proving that just safe bicycle paths are not enough if the crossings are not made safer too (Garder *et al.*, 1994). One common but usually not so lethal type of accidents related to crossings is the conflicts between cyclists and pedestrians. As a result, studies have come up with solutions for the different situations, usually focusing in the relation between bicycles and cars and bringing solutions like different types of roundabouts (Fortuijn, 2003). However, there is a lack of studies focusing in the interactions between pedestrians and bicycles. Therefore, it would be interesting to analyze situations with conflict potential between these actors in order to understand what causes the accidents and how these can be prevented.

Vismarkt, physically located in the heart of Groningen's old city (See Figure 1), is acting as a central point for traffic and commerce. Until the 1970's the square was functioning mainly as a parking lot and was heavily used by cars, but since the implementation of the circulation plan (Verkeerscirculatieplan) in 1977, it mostly accommodates cyclists and pedestrians (Tsubohara, 2010). The Vismarkt is used by many cyclists passing the city center on their way on the radial cycle-routes leading through the city center (Ligtermoet, 2009).

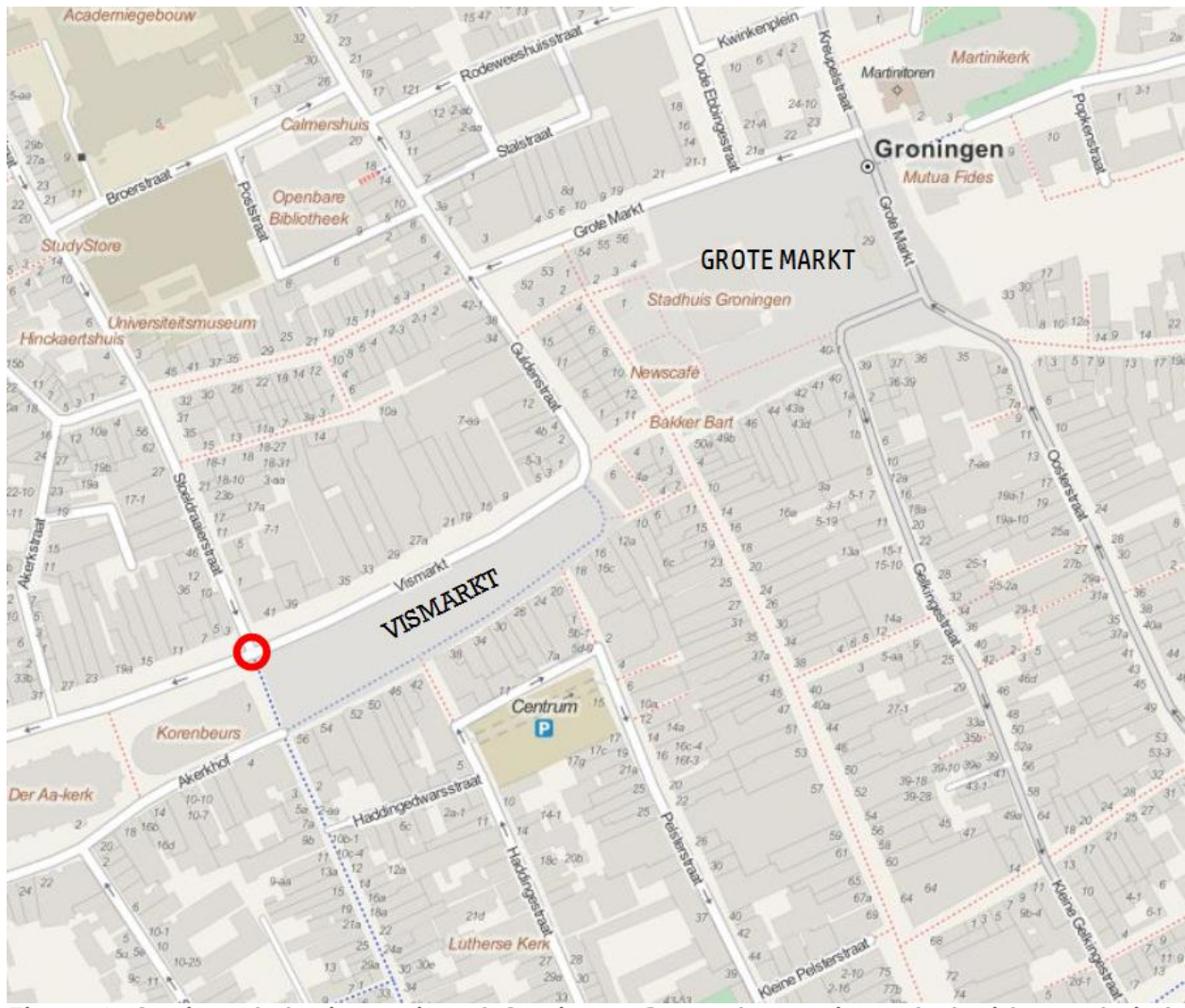


Figure 1. Section of the inner city of Groningen. Research area is marked with a red circle (Source: Mapquest, 2014)

The square is also a destination point. On Tuesdays, Fridays and Saturdays between 09:00 and 17:00 the Vismarkt is hosting a popular food market (Gemeente Groningen, 2014). Moreover, many stores are located at Vismarkt or close to it. In addition, the Korenbeurs building at the western end of the Vismarkt hosts a big supermarket. This strong accumulation of shopping facilities leads to great numbers of visitors. Due to its car-restricted location, these visitors are mainly arriving by foot or by bicycle (Tsubohara, 2010).

The intersection of Stoeldraaijerstraat and Vismarkt at the eastern part of the square poses many of the conflict potentials presented above. To begin with, cyclists arriving from four directions cross the intersection, and may turn to both directions (See Figure 2 and 3). Coming from the Stoeldraaijerstraat or going that direction, cyclists have to cross an intensively used sidewalk. The Akerkhof/Vismarkt street, going from East to West is the main-street, meaning

that street users going on this street have priority over street users coming from Stoeldraaierstraat and the cycle path on Vismarkt.



Figure 2. The intersection of Stoeldraaierstraat and Vismarkt. Cycling directions are marked in red (Source: Google Maps, 2014).

Furthermore, the intersection is a popular meeting point right by a big supermarket and the food market hosted in the square. Moreover, service vehicles (for example to supply the fresh food market three days per week, but also delivery vehicles in general) are occasionally crossing the intersection or temporarily park at the middle of it. Lastly, ambulances and police cars may also use the intersection from time to time.



Figure 3. The intersection from the view of observation

In conclusion, the Vismarkt in general, and the selected intersection in particular, is a location of diverse traffic, both in terms of actors as well as destinations. This makes it on the one hand a location with a high conflict potential between cyclists, pedestrians and other actors but on the other side a preferential spot for analyzing traffic patterns of these actors.

2.2 Desire Lines

Desire lines are the paths made by people and reflect the shortest or the easiest way between two points. The idea is based on observations made by philosopher Gaston Bachelard in the book *The Poetics of Space* (1958). Gaston observed that people would sometimes take unintended paths when moving in space. The first use of the concept in relation to cycling behavior was developed by the *Copenhagenized design Co.* (2012). Desire lines visualize the chosen way of every actor and provide a helpful tool in visualizing and understanding traffic flows of actors.

3. Methods

3.1 Organization of Fieldwork

In order to answer the research questions presented above, the research method of observation was chosen. By the means of observing the intersection both, quantitative as well as qualitative data can be gathered and generated. The observation was done by filming the intersection and evaluating the filmed material afterwards. The camera used was provided by us.

To gather a significant amount of data, observations were conducted on three different days, covering different possibilities and situations in the market: workdays and the weekend, and when the market is open or closed. Figure 4 demonstrates the different days, situations and combinations. This has allowed us to gather diverse data on the different intensities of traffic flows ranging from what was expected to be the lowest (Monday), medium (Friday) and highest amount of traffic (Saturday)

	Market		Day type	
	Open	Closed	Workday	Weekend
Friday December 5th, 2014	X		X	
Saturday December 6th, 2014	X			X
Monday December 8th, 2014		X	X	

Figure 4. Days on which observations were conducted (different situations and combinations).

To cover each day accurately, three observations were done during each day. The first one was in the morning rush hour, second in the noon, and the last one in the afternoon rush hour. Although the morning and afternoon rush hour does not occur on Saturday, observations on that day took place at the same times, to ensure the comparability of the data. The filming sessions were done by two people: one person was filming while the other took notes on potential conflict situations. This method helped to make sure that no potential conflict in the intersection was missed. In addition, climate, general condition and any unusual events were recorded to allow reliable further examination.

Each filmed observation were of 30 minutes in two sessions of 15 minutes, to allow the the observers to stay focused and well aware of the events in the intersection. The sessions were conducted between 8:45-9:30, 12:30-13:15 and 16:15-17:05, including the break between the sessions. The total amount of video-recorded material was four and a half hours in nine sessions.

3.2 Data Analysis

The movement of every single pedestrians and cyclists was counted and recorded. The videos were watched three times: one time to count pedestrians, the second time for cyclists and the third time to especially focus on potential conflict moments. While counting and analyzing the movements of pedestrians and cyclists, two people analyzed the movement of the street users using electronic counters. Another person was observing conflicts and noted any special event. The intersection was divided into all possible destination points (for cyclists see Figure 5; for pedestrians Figure 6). By recording the start-point and end-point of each street user's movement, the movements in the intersections could be analyzed in detail. Results of the analysis were recorded in Excel-sheets, with a total number of 35 possible ways for cyclists and 12 for pedestrians at the intersection respectively.

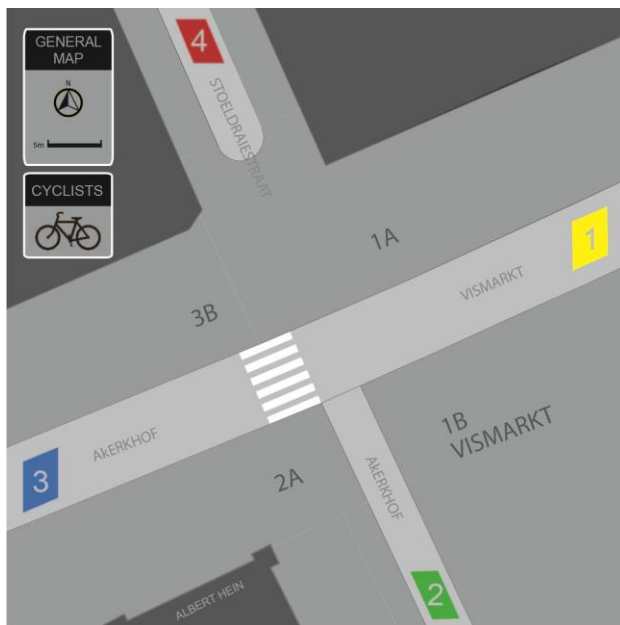


Figure 5. Directions for cyclists

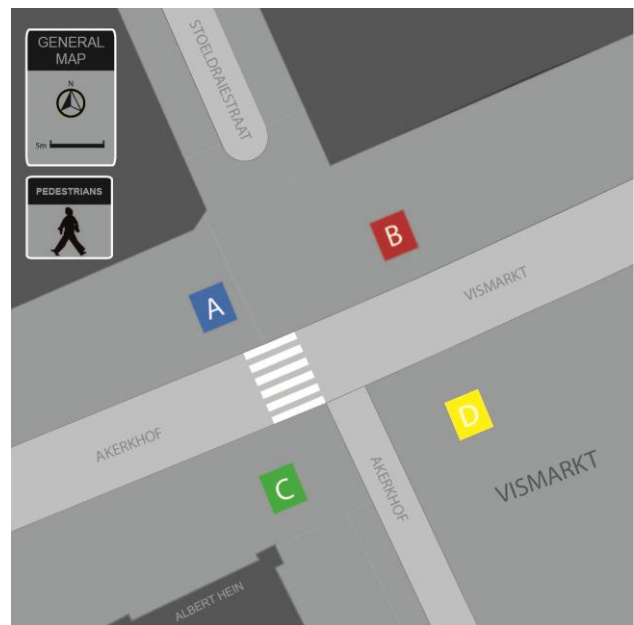


Figure 6. Directions for pedestrians

Afterwards, this data of traffic flows was transformed into desire lines for these two actors. The use of the methodology developed by Copenhagenized design Co. (2012) helped us to identify and visualize the main traffic flows of cyclists and pedestrians at the crossing and furthermore reveal how these actors interact with the given infrastructure and if this infrastructure fits the needs of traffic flows as well as the behavior of the different kind of actors.

As mentioned above, for a further understanding of the conflict potential at the intersection, the filmed material was evaluated in regards of specific moments of conflicts. These conflicts were analyzed individually in terms of the involved actors and the cause of the conflict. This qualitative data was intended to help us to identify the main sources of conflict potential. During

the research, a conflict was defined as a potential accident, meaning an accident that was prevented since at least one of the involved actors had to avert their natural movement in order to prevent an actual accident.

A combination of the quantitative data, which indicates main traffic flows and the desire lines which can reveal if the given infrastructure fits the needs of traffic flows, and the qualitative data, that helps the understanding of the specific causes for conflict moments, helped us to develop the proposals of design changes to minimize conflict potential at the intersection.

4. Results

In total, 8,106 pedestrians and 7,211 cyclists were recorded during the nine sessions. See figure 7 for detailed summary of the results. For comprehensive details of all recorded data, see Appendix 1.

Date	Day	Session	Degrees	Weather	Cyclists	Pedestrians	Conflicts
5.12	Friday	Morning	2°C	Cloudy	722	302	5
5.12	Friday	Noon	3°C	Cloudy	1034	1375	5
5.12	Friday	Evening	0°C	Clear	1100	1180	2
6.12	Saturday	Morning	3°C	Cloudy	246	174	2
6.12	Saturday	Noon	5°C	Clear	736	1546	3
6.12	Saturday	Evening	2°C	Cloudy	803	2081	1
8.12	Monday	Morning	2°C	Cloudy	766	161	2
8.12	Monday	Noon	2°C	Cloudy	743	607	1
8.12	Monday	Evening	2°C	Cloudy	1061	680	1

Figure 7. Summary of observation results

4.1 Cyclists

In total numbers, on Friday and Monday similar amounts of cyclists were counted (2,856 and 2,570, respectively), while only 1,785 cyclists were recorded on Saturday.

The four most taken routes by cyclists are from west to east, east to west, north to south and south to north. In general, the west to east route on the Akerkhof/Vismarkt is the most used route in both directions.

When examining the routes according to time of days (morning, noon and evening), an interesting tendency is observed. While the amount of cyclists taking the most used route, west to east, is relatively stable during the day, there is a vast difference when it comes to the south to north, north to south and east to west routes.

As can be seen in Figure 8, during the mornings less than 200 cyclists took the east to west route. Later on, there is a growth in the number of cyclists taking this route, and during the

evenings 775 were using it. Secondly, there is more than a 50% drop in the number of cyclists using the south to north route during noon sessions, in comparison to those using it during morning sessions. During the evening sessions more cyclists are using the route again. Moreover, there is a stable growth of the number of cyclists taking the north to south route during the day, with less than 200 cyclists during the morning sessions to almost 400 cyclists during the evening sessions (see Figure 9).

It can be concluded that in the morning sessions the biggest traffic flows were from east to west and south to north. These flows reversed partially throughout the day. In the noon and evening sessions west to east and east to west traffic flows dominated. The routes with the lowest traffic in the mornings (east to west and north to south) showed the highest increase throughout the day, creating a different pattern of traffic flows in the evening.

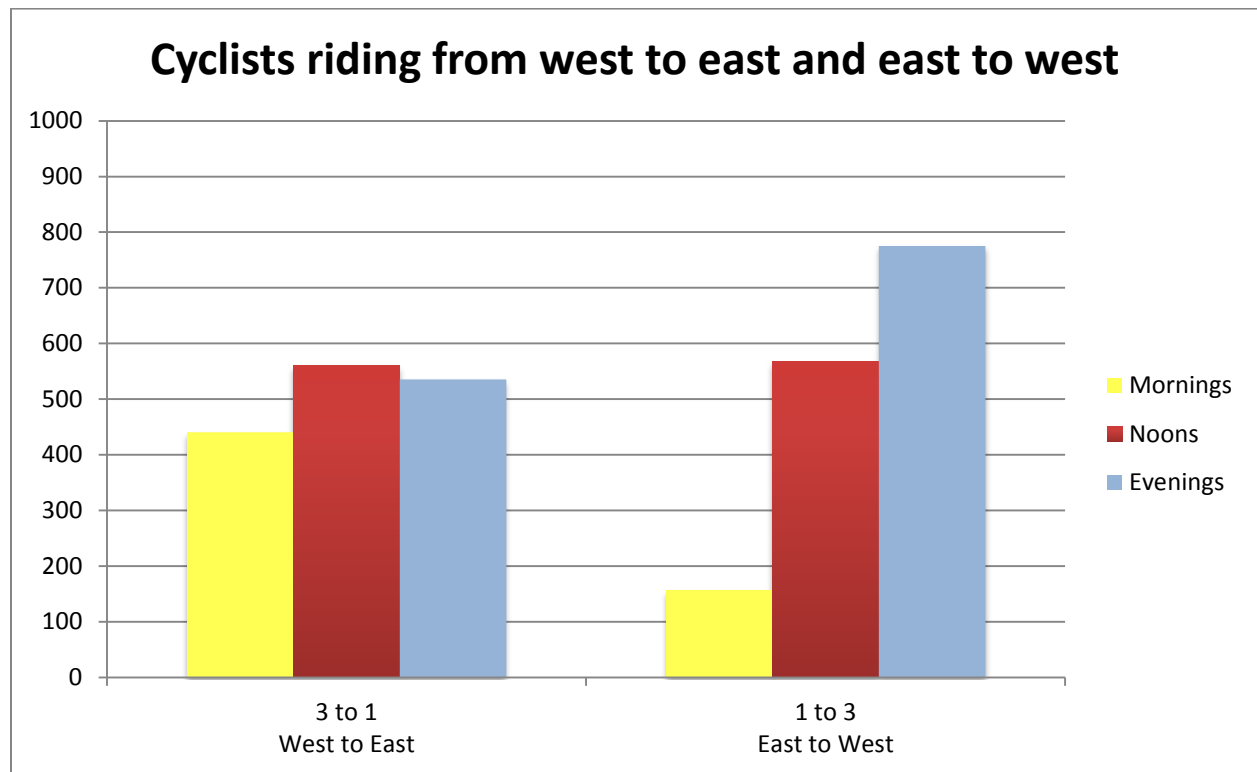


Figure 8. Cyclist flows from west to east and east to west

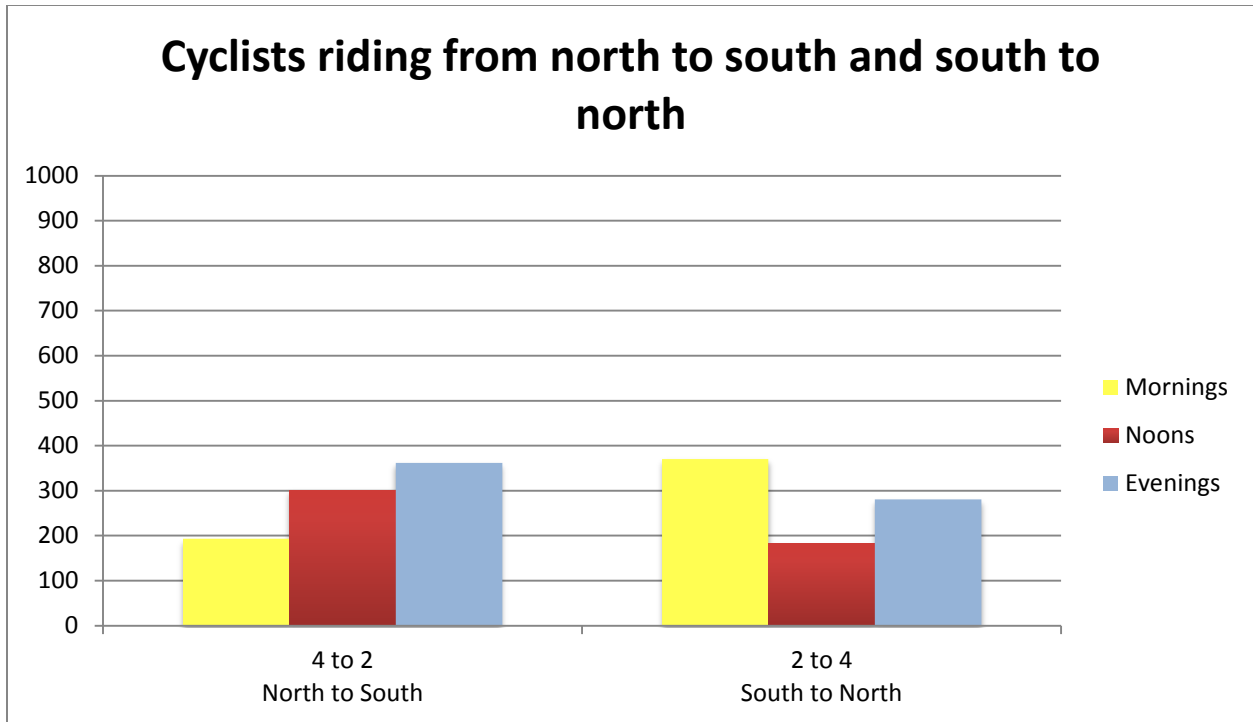


Figure 9. Cyclist flows from north to south and south to north

4.2 Pedestrians

In the following section the traffic flows of pedestrian will be presented. Figures 10 and 11 show that the pattern of pedestrian flows stays almost the same throughout the day, while numbers are rising intensively during the day. While in the mornings, the number of pedestrians was relatively low (637), the intersection was far more crowded with pedestrians in the noon and evening observations (3528 to 3941 pedestrians).

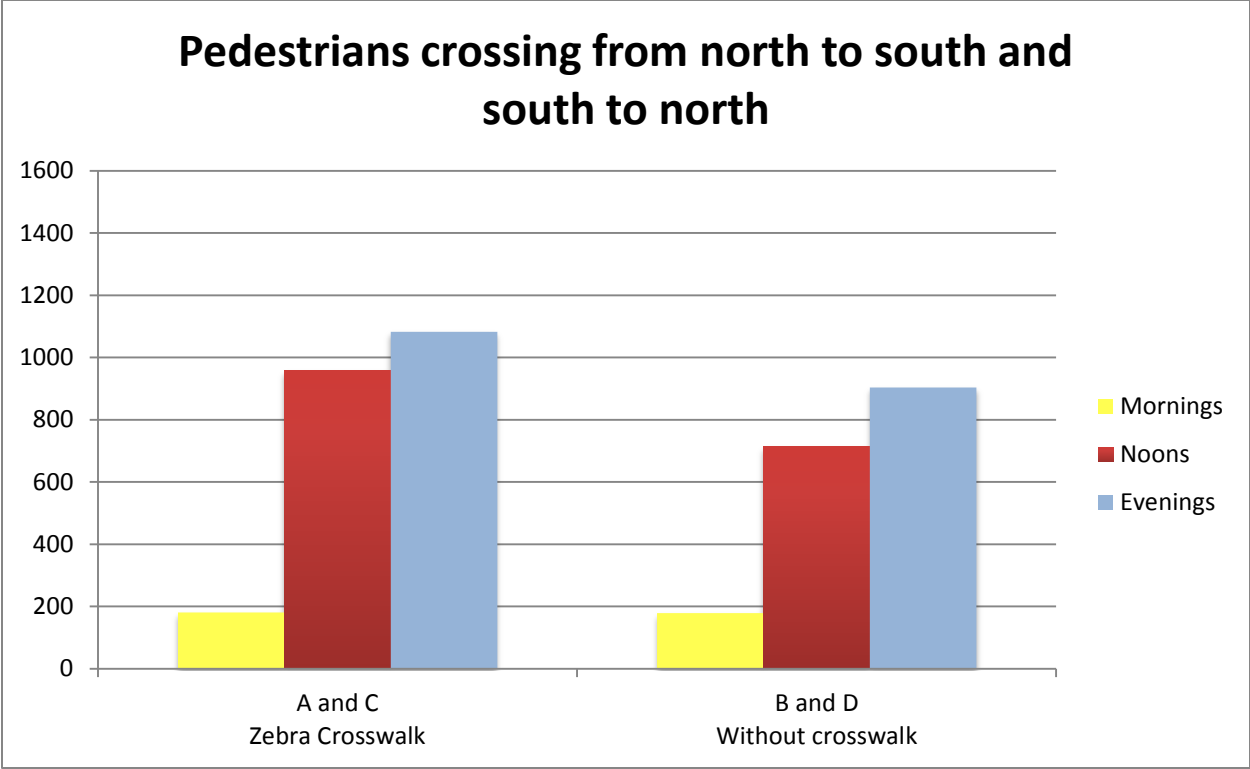


Figure 10. Pedestrian flows from north to south and south to north

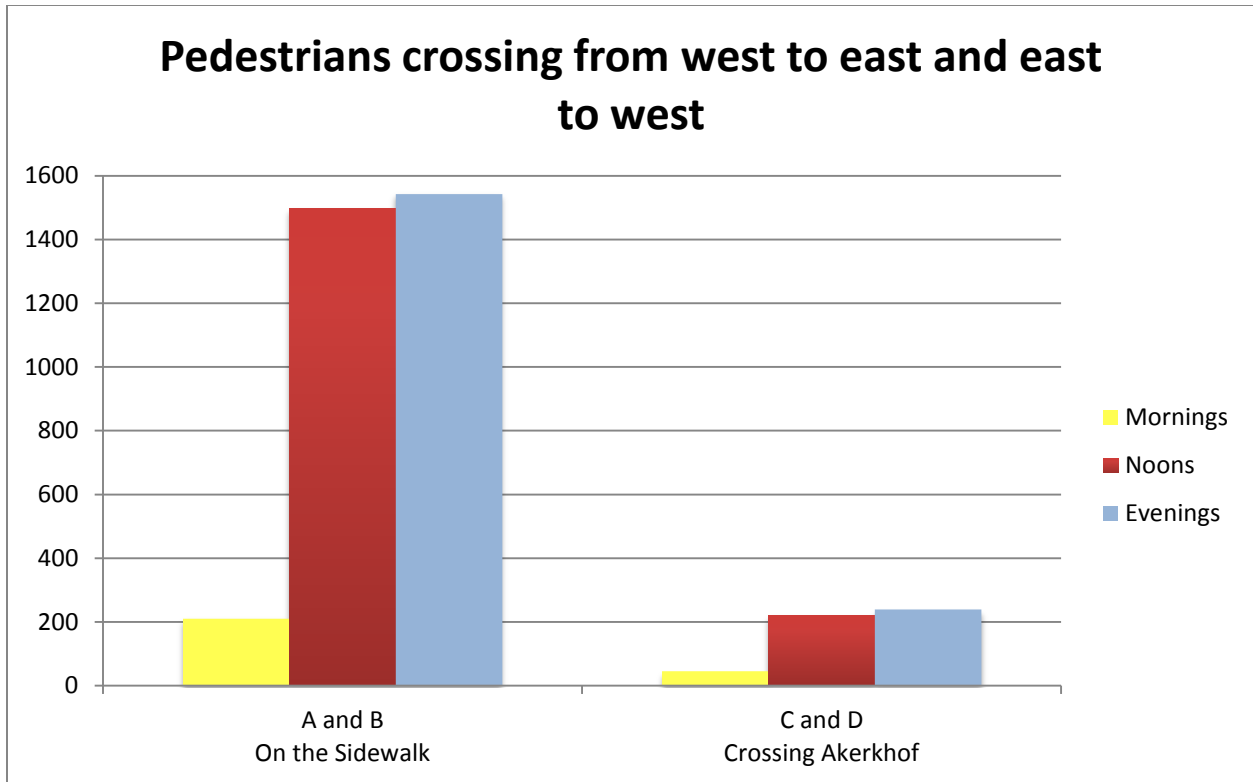


Figure 11. Pedestrian flows from west to east and east to west

When examining the different days, one can see that the strongest flows of pedestrians can be found on the sidewalk of the Akerkhof. Throughout all days these flows were above the largest ones. Diagonal crossings of the street were only observed in few numbers and did therefore did not play an important role in the traffic flow of pedestrians. Moreover, as it was expected, the highest number of pedestrians can be found on the market days Friday and Saturday (2857 and 3801 pedestrians) while the number was significantly lower on Monday (only 1448 pedestrians).

5. Analysis

5.1 Traffic Flows

The recorded data presented above was transformed into graphic visualizations in order to demonstrate the traffic flows of the actors in the intersections. The more pedestrians or cyclists used a certain path, the thicker the line in the graph is. At the end of each line, the number of users is presented. For the sake of simplicity, only paths with more than 1% of users used are presented. For each session two graphs were created: one for pedestrians and one for cyclists. For each path there is a line showing the direction and number of users. The thickness of each

line is determined by the quantity of street actors using it in relation to the total number of users in each session.

Figures 12 and 13 present the desire lines of pedestrians and cyclists on the Saturday's noon session. The rest of the figures can be found in the appendix (see Appendix 2).

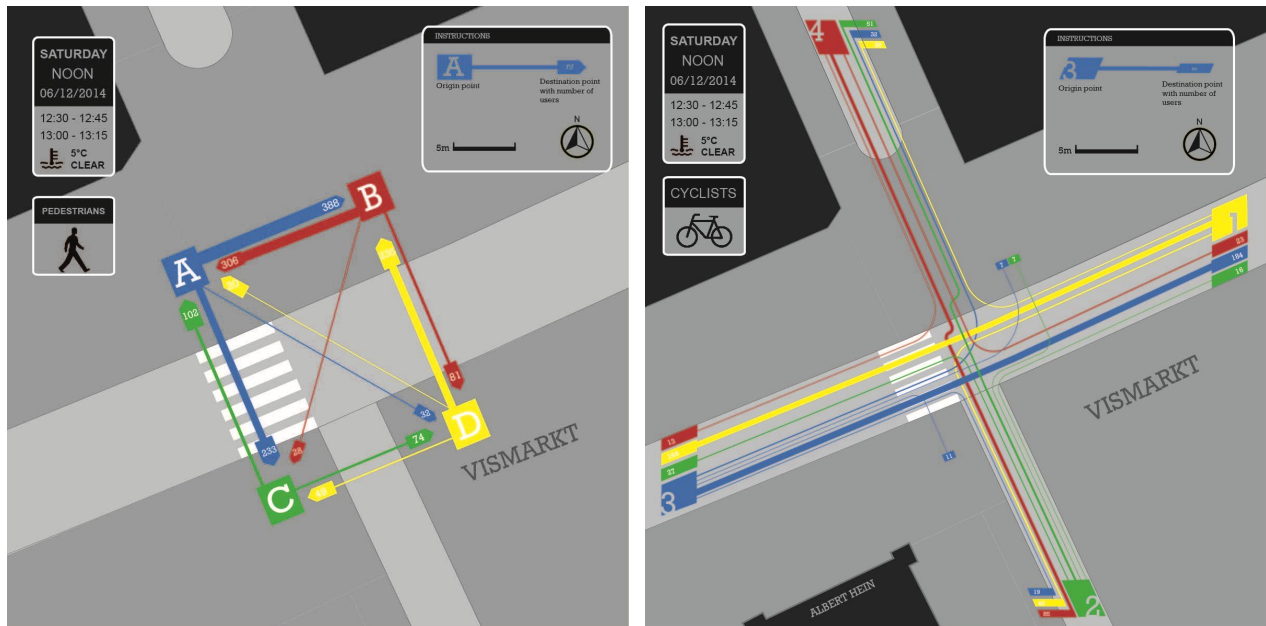


Figure 12. Desire lines for pedestrians, Saturday noon
Figure 13. Desire lines for cyclists, Saturday noon

The patterns of the 3 sessions in each day are similar as the number of cyclist and pedestrians grow throughout the day, having its lowest point in the morning and reaching its peak in the evening sessions (see Appendix 2). The exception for cyclists was on Monday when the morning session presented a higher number of cyclists than of noon (see Appendixes 2.7 and 2.8) and for pedestrians on Friday where the noon sessions had the highest count.

Friday was the day with highest total number of cyclists registered having the highest count in all noon and evening sessions (see Appendixes 2.2 and 2.3).

The total number of pedestrians counted on all of Saturday sessions amounts to almost 4 times the total number of cyclists registered on the same sessions. Saturday, being the busiest day of the Vismarkt showed an extreme rise in the numbers of pedestrians. It showed the highest number of pedestrians and at the same time showed the lowest number of cyclists in all 3 days (see Appendixes 2.4, 2.5, 2.6, 2.13, 2.14, 2.15).

It was expected for weekends to present a lower number of cyclists as many businesses and the University are not on regular working day. Adding to this it was also observed that many people that come to the Vismarkt on Saturday come as cyclists, park their bicycles in the area and continue to explore the Vismarkt and surroundings by foot as it becomes the easiest way to

move in such crowded days. Others come only by foot. This factor helped the number of bicycles circulating in the area to drop while the number of pedestrians rose.

It was observed that during the peak times of pedestrians using the intersection, which was on Saturday noon and evening, the northern sidewalk of the Akerkhof tended to get overcrowded. This part of the sidewalk serves also as a shared space, as the Stoeldraaierstraat is not directly connected to the intersection but leads through the sidewalk of the Akerkhof. Therefore cyclists and vehicles have to cross this wider part of the sidewalk and need to pay closer attention to pedestrians when doing so.

When the number of pedestrians was highest, this part of the sidewalk was so crowded, that it was at times impossible for cyclists to cross it without getting off their bike and walk. Nevertheless there were no conflicts observed due to this overcrowded situations.

5.2 Potential Conflicts

The expected outcomes of observing the intersection were to find a considerable amount of accidents and more serious conflicts, however no accidents were observed. This contested the primary notion that the intersection was a chaotic and dangerous ambient for street users. It was observed that most street users, especially cyclists dealt well with the supposedly chaotic intersection and that they have very good response to the movement of other street users. Therefore one of the main findings was that even though chaotic and at times very crowded, traffic at the intersection is working in its very own dynamic way. Instead of accidents we registered several situations where potential accidents could occur.

In total, we have recorded 22 incidents that were identified as conflicts according to the standards presented above (See Section 3.2). None of these conflicts was an actual accident, but at least one of the involved actors in these conflicts had to avert their natural movement in order to prevent worse results. The conflicts that were witnessed can be divided into three categories, according to the involved actors: conflicts involving cyclists and pedestrians (10 times); conflicts involving only cyclists (5 times); and conflicts involving cyclists and vehicles (7 times). Figure 14 presents the distribution of conflicts according to actors involved.

Distribution of accidents by actors

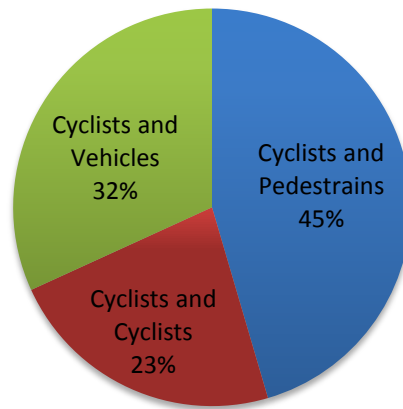


Figure 14. Distribution of conflicts according to actors involved

Figure 15 shows the exact locations of the conflicts. Almost all of the conflicts occurred in the intersection totaling to 18 out of 22 conflicts, making for about 82%. It can also be observed that there is a concentration of conflicts in front of the beginning of the cycle path between the Vismarkt and the Albert Hein. This section is narrower in comparison to the main section of the Akerkhof. This creates a "bottleneck" situation where cyclists tend to crowd the "entrance" of the section. Here conflicts between cyclists with pedestrians and/or vehicles were highest. Half of the conflicts between pedestrians and cyclists and 3 out of 5 conflicts between cyclists and vehicles happened in that location.

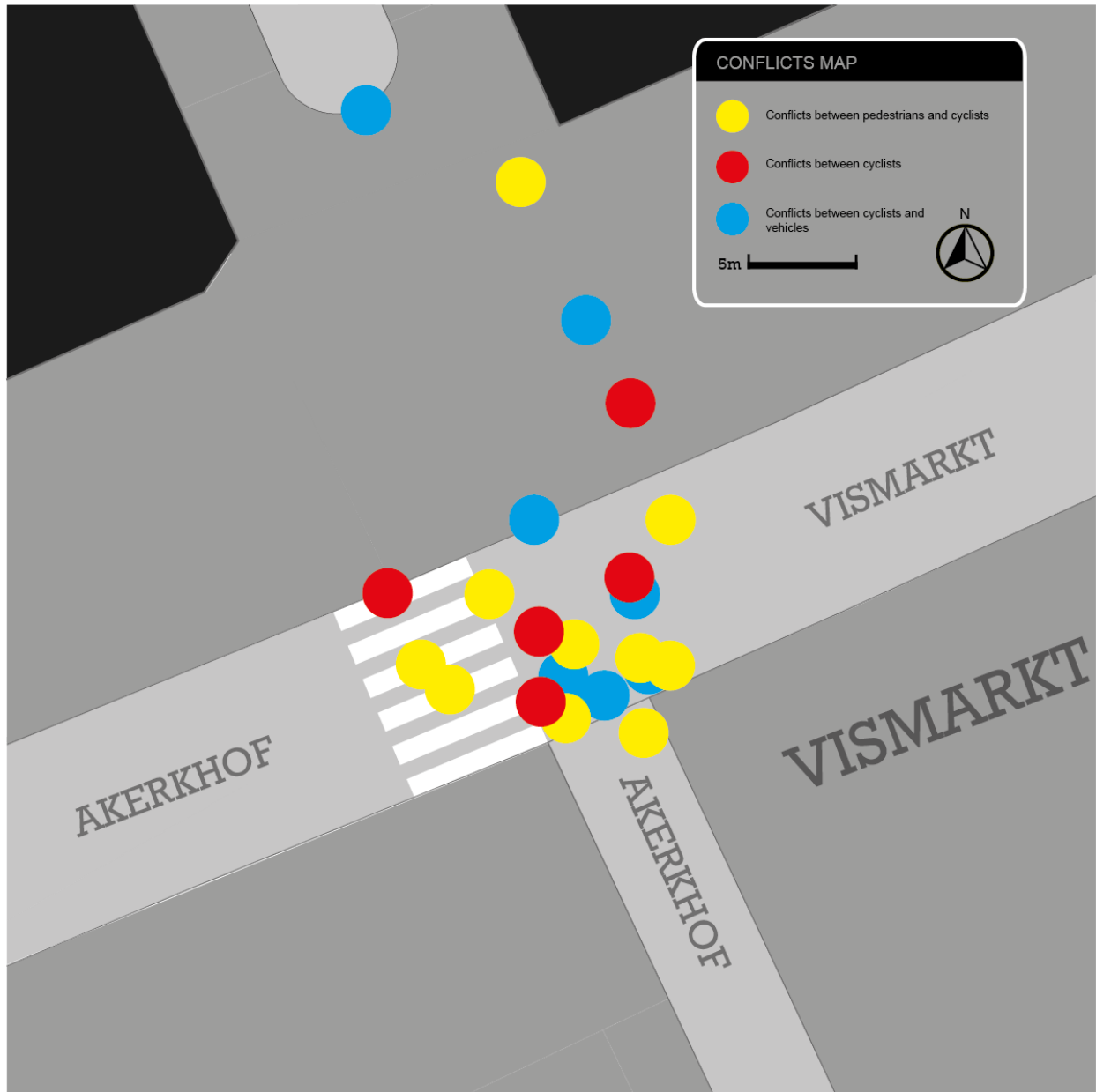


Figure 15. Conflict map that shows where conflicts occurred

Some of the conflicts happened either on the zebra crossing or in front of it. In total they account for 5 of the conflicts being 2 of them conflicts between cyclists and the other 3 between cyclists and pedestrians.

5.2.1 Cyclists and Pedestrians

In total there have been 10 conflict situations observed between pedestrians and cyclists. These conflicts can be divided into two general categories. The first category contains cyclists, not letting pedestrians pass, either on the zebra crossing or on the northern sidewalk of the

Akerkhof. The second consists of pedestrians, crossing the street without using the zebra crossing and not paying attention to cyclists on the Akerkhof. The number of conflicts in each category is equal with 5 conflicts.

Cyclists not giving way to pedestrians

Five conflicts happened due to cyclists not giving way to pedestrians. In three of these conflicts pedestrians were using the zebra crossing and on the other two pedestrians were walking on the sidewalk of Akerkhof when they were confronted with cyclists turning into Akerstraat. In all of these conflicts, according to the legal situation, the cyclists were obligated to give way to the pedestrians. Four of these conflicts occurred on Friday (one in the morning, one in the noon and two in the evening) and one on Monday (noon).

What all of these situations have in common, is that the cyclists either did not stop at all for pedestrians or stopped late and too sharply, so that the pedestrians were forced to make avoidance movements. Therefore the source of this conflict situation can be seen in the lack of attention that the involved cyclists were paying to the pedestrians.

It is one of the general observations of the recordings that cyclists tend not to stop for pedestrians on the zebra crossing. They rather curve around them and try not to stop on their way. Therefore using the zebra crossing for pedestrian's means that they have to pay extra attention to cyclists at all the time and that they might have to stop while crossing.

It can be said that due to the high number of people using the zebra crossing during the observations (in total: 2228 persons), a number of only three conflict situations at the zebra crossing seems to be quite small, especially as none of these situations resulted in an accident. But nevertheless it also implies that a lot of pedestrians have to stop at the zebra crossing and have to let cyclists pass, even if according to the legal situation they have the priority to go. Therefore it can be concluded that there is not enough attention paid by cyclists to pedestrians using the zebra crossing.

Pedestrians not paying attention to cyclists while crossing the Akerkhof

The second source of conflicts between pedestrians and cyclists is the lack of attention some pedestrians are paying to cyclists while crossing the Akerkhof without making use of the zebra crossing. This caused five conflicts during the observations, two on Friday (noon) and three on Saturday (two at noon and one on the evening). During these times, the total number of pedestrians crossing the Akerkhof without using the zebra crossing was the highest (see appendices).

In all of these situations, the pedestrians started crossing the street without paying enough attention to cyclists using the street. Therefore in all but one case, the pedestrians had to make

a sharp stop and avoidance movement when noticing the cyclists. In three out of five times, the cyclists as well had to stop to avoid a collision.

Within a total number of 1885 people crossing the Akerkhof not using the zebra crossing during the observations, again a number of five conflicts seems to be quite small. But it has to be realized, that this is the cause of potential conflicts that could easily be avoided by using the zebra crossing which is just a few meters away.

By comparing the findings of the pedestrian-counting, it becomes clear, that while the majority of pedestrians crossing the Akerkhof is using the pedestrian crossing (2228 pedestrians using the zebra crossing to 1885 not using it, see also Figure 10), there are different patterns for pedestrians crossing from north-to-south and in the opposite direction. Furthermore the market has an influence on these patterns too.

The majority of pedestrians crossing the Akerkhof in the south-to-north direction are not making use of the zebra crossing, but crossing the street departing from the Vismarktsquare (see Figure 16). This becomes especially visible when the food market takes place on this square. During the peak use times of the market (Friday noon and Saturday noon and evening) the number of pedestrians crossing the street in a north direction without making use of the zebra crossing exceeds the number of pedestrians using the zebra crossing by far.

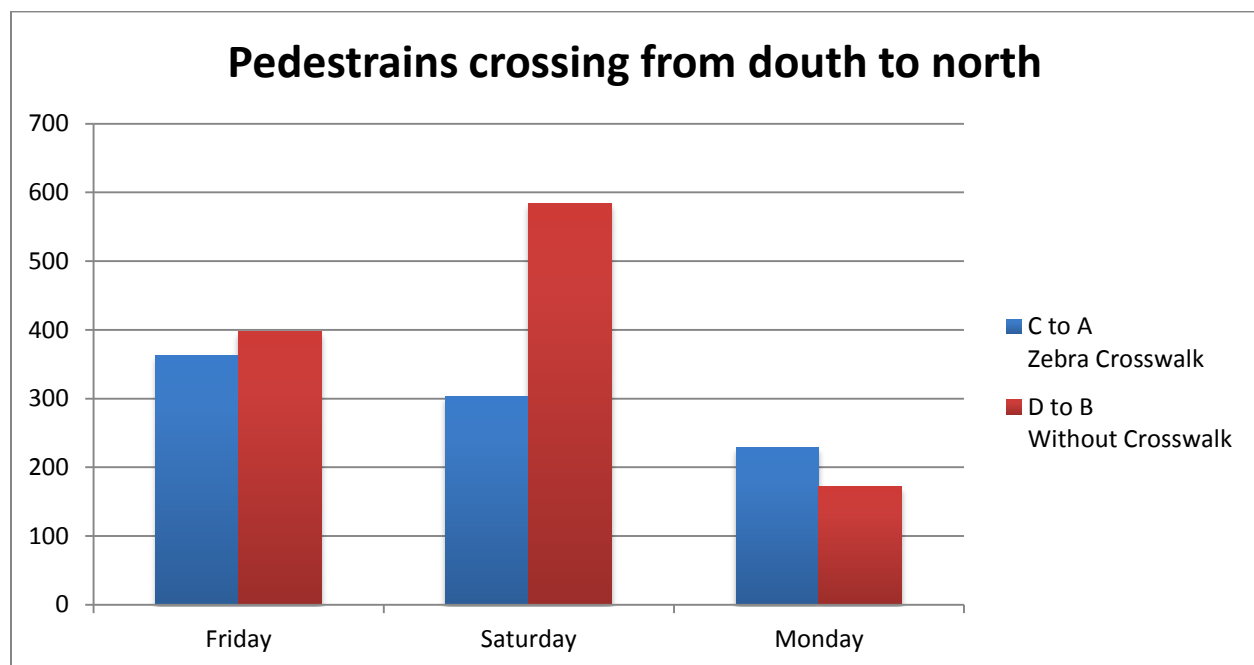


Figure 16. Pedestrian flows from south to north by day of the week

This suggests that the location of the zebra crossing is not perfect to match the desire lines of pedestrians leaving the Vismarkt-square in a north direction. If they wanted to cross the Akerkhof on the zebra crossing, they would first have to cross the heavily used cycle path,

dividing the Vismarkt-square from the Korenbeurs-building. Therefore most pedestrians decide not to make use of the zebra crossing creating a potential conflict situations with cyclists on the Akerkhof.

While this observation is made for pedestrians on a south-to-north direction, it was observed, that this is not the case for pedestrians head to the Vismarkt from the north. In these cases, the number of pedestrians using the zebra crossing was much higher and almost always exceeded those of not using the zebra crossing by far.

5.2.2 Cyclists and Cyclists

In total the number of conflicts between cyclists was five, surprisingly leaving it as the least frequent type of conflict that have occurred in the sessions analyzed, amounting to just about 23% of all conflicts. All of the conflicts happened in the intersection with cyclists coming from different directions. Except for one of the five conflicts, that happened because of a van was blocking the view from one side of the street, all the other conflicts happened due to one of the cyclists having difficulty to read the other cyclists movement and speed. This then results in the two cyclists heading in a colliding trajectory although none of the conflicts actually resulted in an accident, as the cyclists deviated from collision, sometimes at the last moment.

We can learn from the sessions analyzed that cyclists have a good response to the movement of other cyclist and are avoiding collisions in a more intuitive manner. Cyclist do most of the time respect the traffic flow hierarchy but will often deviate from the planned out paths in order to facilitate their movements. They will often take the shortest paths and will react intuitively to the traffic situations. An example of this is when cyclists, in crowded sections of the street, get off their bicycles and walk them for a short section to get past the crowd and then continue cycling. In most cases they would only do this if it would not create conflicts with other cyclists.

One problem that has been detected many times because of cyclists opting for shortest paths, is the use of sidewalk by cyclist coming from Akerkhof heading to Stoeldraaierstraat. This situation created one of the five conflicts registered. This conflict occurred when a cyclist coming from Akerkhof on the west of the intersection tried to go through the sidewalk to reach Stoeldraaierstraat on the north of the intersection passing through the opposite lane of the street. While passing though the opposite lane the cyclist almost collided with another cyclist coming from that opposite lane.

Three of the five conflicts were registered in morning sessions (Friday, Saturday and Monday) while the other two were at noon (Friday) and evening (Monday).

Although morning sessions not having the highest number of cyclists they still counted for the highest number of conflicts. This can happen due to the morning rush hour where many people cycle to work and especially a high number of students cycle to their classes, many in a rush.

Situations where students rush to get to classes in time at around 9 am can lead to more reckless cycling and generate conflict situations.

5.2.3 Cyclists and Vehicles

Even though there were no large numbers of vehicles circulating through this intersection, they were one of the main causes of conflicts. Around 30% of the conflicts (7/22) had a vehicle as the main source of the conflict situation. All of these conflicts were due to a large vehicle, including trucks, cars and vans, as the main cause. Also, as was observed, in all conflicts that big vehicles were part of, they were considered the cause of the conflict.

All of the conflicts involving vehicles as the main cause were during the Morning. And the usual scenario would include trucks and vans coming towards the Vismarkt for apparently unloading of products for the market. Usually, these trucks stop in the middle of the intersection with the conflicts happening around it because the most common situation includes a truck or van blocking the middle and conflicts happening around it with cyclists trying to go around or avoiding collisions with the vehicle.

Cyclists avoiding collision around/with large vehicles

As mentioned before, the conflicts involving vehicles as the main cause are related to large vehicles like trucks, cars and vans due to its proportion in relation to the crossing and how it affects the functioning of the latter by including this unexpected element in the location. The trucks and vans are too large for the crossing and causes problems as blocking the intersection and decreasing the visibility. This causes the cyclists to stop and wait or try to go around it, which can lead to conflicts due to the lack of visibility of what is behind the vehicle, this specific situation could be observed during the Monday morning.

Cyclists avoiding collision with small vehicles

The small vehicles were observed as being potential elements of conflicts during the filming sections, however they were not the cause of any conflict. One observation that was made watching the conflicts involving those small vehicles is the different notion of speed and space that comes along with them in relation to the bicycles. The cyclists are used to the speed and maneuvering abilities of bikes and when mopeds and electric vehicles are present, the notion of how fast the vehicle is coming, how long does it take to stop and to maneuver are different, thus being a potential cause of conflicts.

6. Discussion

After analyzing nine sessions during three different days, we have not witnessed an actual accident in the intersection. Despite very high numbers of pedestrians and cyclists that

sometimes led to an overcrowded intersection, the traffic at the intersection was quite safe and led to less conflicts than was expected. Therefore, this research was able to conclude that the need for interventions into the infrastructure of the intersection is not as needed as first thought. It was observed that the "chaotic" environment created by the intersection works to keep users in an alert state that prevents accidents. The intersection is not perfect, but it is a lot safer than what was thought in the beginning of the research.

However, we did notice several causes for conflicts in the intersection that could be avoided:

- Many pedestrians are not making use of the existing zebra crossing, especially during market hours.
- Many cyclists do not stop at the existing zebra crossing.
- Large vehicles tend to block the entire intersection.
- Cyclists coming from the western part of the intersection and turning left to Stoeldraaierstraat tend to cut through the sidewalk.
- Small vehicles, such as mopeds, do not signal before turning.

Based on these findings, we have tried to come up with viable solutions to improve the intersection (see Figure 3 for current situation). We preferred to keep the solutions simple, since making small interventions might benefit the scene much more than a large makeover. Finally, we suggest three proposals, each based on the former one. None of the solutions can solve all the mentioned causes for conflicts, but only some of them. The following solutions are sorted by the extent of the interference into the existing infrastructure. The higher the level of interference, the more unpredictable are the results. Thus, we think that more subtle design proposals can be more effective.

6.1 Elevated Zebra Crosswalk

Since many cyclists do not stop for pedestrians at the existing zebra crossing, the first proposal is to simply elevate the crosswalk (see Figure 17). This would force cyclists to slow down when approaching the zebra crossing and due to that, there would be an increase in cyclists stopping for pedestrians at the crossing. As the use of the crosswalk would be improved, we believe that more pedestrians will choose to go through it rather than crossing in different places. This solution, besides being relatively simple for implementation, will solve the first two causes for conflicts presented above. It would provide pedestrians with a more safe option to cross the Akerkhof.



Figure 17. Design proposal 1: Elevated zebra crossing

6.2 Additional Zebra Crosswalk

The second proposal is based on the Elevated Zebra Crosswalk solution, with additional intervention. We offer to add another elevated crosswalk at the eastern side of the intersection (see Figure 18). By adding another zebra crosswalk, we insure that pedestrians will have a safe and legal place to cross the street at the side of Vismarkt. Additionally, the two crosswalks are elevated, forcing cyclists to slow down when approaching the intersection. Lastly, since another crosswalk was added, we made both of them narrower than the original crosswalk, as pedestrians would not be concentrated on a large crosswalk anymore and to make sure there is enough space between the two crossings.



Figure 18. Design proposal 2: Additional zebra crosswalk

6.3 Roundabout

The last proposal involves yet another intervention to the intersection. We offer to add, in addition to the pair of elevated crosswalks, a small roundabout (see Figure 19). In this solution, the area between the sidewalks will be transformed into a roundabout, but slightly elevating a circle with a radius of 2.5 meters. The entire area that includes the crosswalks and the roundabout will be elevated, in order to force cyclists to slow down. Additionally, the roundabout will make sure that cyclists do not make shortcuts through the intersections (the fourth cause for conflicts presented above). The space created would have a clear function of organizing the traffic flows and make them more efficient. Lastly, placing an elevated roundabout will hinder large vehicles from stopping in the middle of the intersection.



Figure 19. Design proposal 3: Roundabout

7. References

- Bachelard, G. (1958). *The Poetics of Space*. Beacon Press; Reprint edition (1994).
- Copenhagenize Design Co., (2012). *The Bicycle Choreography of an Urban Intersection*. [online] Frederiksberg. Available at: https://dl.dropboxusercontent.com/u/5661923/Bicycle_Choreography_Urban_Intersection_Copenhagenize.pdf [Accessed 2 Dec. 2014].
- Fietsberaad, (2005). Differences in bicycle use can be easily explained. [online] Available at: <http://www.fietsberaad.nl/?lang=en&repository=Differences+in+bicycle+use+can+be+easily+explained> [Accessed 18 Nov. 2014].
- Fortuijn, L.G.H., 2003. *Pedestrian and Bicycle-Friendly Roundabouts; Dilemma of Comfort and Safety*. Delft University of Technology, The Netherlands.
- Fruianu, M. (2009). *Cycling in the Netherlands*. Den Haag: Ministry of Transport, Public Works and Water Management, Directorate-General for Passenger Transport.
- Gårder, P., Leden, L. and Thedéen, T. (1994). Safety implications of bicycle paths at signalized intersections. *Accident Analysis & Prevention*, 26(4), pp.429-439.
- Gemeente Groningen, (2014). *Markt in Groningen*. [online] Available at: <http://gemeente.groningen.nl/markt/markt-in-groningen> [Accessed 17 Nov. 2014]. (Dutch).
- Google Maps, (2014). Map of the intersection of Stoeldraaijerstraat and Vismarkt, Groningen. [online] Available at: <https://www.google.com/maps/@53.2170855,6.5637143,73m/data=!3m1!1e3> [Accessed 27 Nov. 2014].
- Hellemeier, Clemens, (2010). *Implementation and Results of the TrafficCirculation Plan in the City of Groningen*. Stockholm University, Department of Human Geography, Urban andRegional Planning in Europe.
- Ligtermoet, D. (2009). *Continuous and integral: the cycling policies of Groningen and other European cycling cities*. Rotterdam: Fietsberaad.
- Mapquest, (2014). Map of inner city, Groningen. [online] Available at: <http://www.mapquest.com/maps?city=Groningen&country=NL>. [Accessed 27 Nov. 2014].
- OECD (2014). *Road Safety Annual Report 2014*, OECD Publishing.
- Pucher, J., & Buehler, R. (2012). *City cycling*. Cambridge, Mass.: MIT Press.
- Statistics Netherlands (CBS), (2014). *Population dynamics; birth, death and migration per region*. [online] Available at: <http://statline.cbs.nl/Statweb/publication/?DM=SLLEN&PA=37259eng&D1=0-1,3,8-9,14,16,21-22,24&D2=0&D3=0,2-5,121,137,254,356,428,438,933,1049,1072&D4=1&LA=EN&HDR=T&STB=G1,G2,G3&VW=T> [Accessed 18 Nov. 2014].
- Tsubohara, S., (2010). *Democracy through political parties and public participation the case of the planning history of Groningen, The Netherlands*. Rijksuniversiteit Groningen, Groningen, the Netherlands.

Appendixes

Appendix 1

1.1 Detailed data for cyclists counting

Date	Session	From	To	Name	Count
5,12	Morning	1	1B	1 to 1B	0
5,12	Morning	1	1A	1 to 1A	0
5,12	Morning	1	2	1 to 2	39
5,12	Morning	1	2A	1 to 2A	7
5,12	Morning	1	3	1 to 3	76
5,12	Morning	1	3A	1 to 3A	0
5,12	Morning	1	3B	1 to 3B	1
5,12	Morning	1	4	1 to 4	9
5,12	Morning	1	4A	1 to 4A	0
5,12	Morning	1	4B	1 to 4B	0
5,12	Morning	2	1	2 to 1	42
5,12	Morning	2	1A	2 to 1A	1
5,12	Morning	2	1B	2 to 1B	0
5,12	Morning	2	3	2 to 3	12
5,12	Morning	2	3A	2 to 3A	0
5,12	Morning	2	3B	2 to 3B	1
5,12	Morning	2	4	2 to 4	155
5,12	Morning	2	4A	2 to 4A	0
5,12	Morning	2	4B	2 to 4B	0
5,12	Morning	3	1	3 to 1	209
5,12	Morning	3	1A	3 to 1A	5
5,12	Morning	3	1B	3 to 1B	0
5,12	Morning	3	2	3 to 2	13
5,12	Morning	3	2A	3 to 2A	4
5,12	Morning	3	4	3 to 4	60
5,12	Morning	3	4A	3 to 4A	0
5,12	Morning	3	4B	3 to 4B	0
5,12	Morning	4	1	4 to 1	5
5,12	Morning	4	1A	4 to 1A	3
5,12	Morning	4	1B	4 to 1B	0
5,12	Morning	4	2	4 to 2	68
5,12	Morning	4	2A	4 to 2A	4
5,12	Morning	4	3	4 to 3	8
5,12	Morning	4	3A	4 to 3A	0
5,12	Morning	4	3B	4 to 3B	0
5,12	Noon	1	2	1 to 2	66

5,12	Noon	1	2A	1 to 2A	5
5,12	Noon	1	3	1 to 3	233
5,12	Noon	1	3A	1 to 3A	0
5,12	Noon	1	3B	1 to 3B	0
5,12	Noon	1	4	1 to 4	28
5,12	Noon	1	4A	1 to 4A	0
5,12	Noon	1	4B	1 to 4B	0
5,12	Noon	2	1	2 to 1	42
5,12	Noon	2	1A	2 to 1A	1
5,12	Noon	2	1B	2 to 1B	0
5,12	Noon	2	3	2 to 3	36
5,12	Noon	2	3A	2 to 3A	0
5,12	Noon	2	3B	2 to 3B	4
5,12	Noon	2	4	2 to 4	82
5,12	Noon	2	4A	2 to 4A	0
5,12	Noon	2	4B	2 to 4B	0
5,12	Noon	3	1	3 to 1	198
5,12	Noon	3	1A	3 to 1A	8
5,12	Noon	3	1B	3 to 1B	3
5,12	Noon	3	2	3 to 2	40
5,12	Noon	3	2A	3 to 2A	7
5,12	Noon	3	4	3 to 4	46
5,12	Noon	3	4A	3 to 4A	0
5,12	Noon	3	4B	3 to 4B	0
5,12	Noon	4	1	4 to 1	22
5,12	Noon	4	1A	4 to 1A	8
5,12	Noon	4	1B	4 to 1B	1
5,12	Noon	4	2	4 to 2	145
5,12	Noon	4	2A	4 to 2A	6
5,12	Noon	4	3	4 to 3	47
5,12	Noon	4	3A	4 to 3A	0
5,12	Noon	4	3B	4 to 3B	2
5,12	Noon	1	1B	1 to 1B	1
5,12	Noon	1	1A	1 to 1A	3
5,12	Evening	1	1B	1 to 1B	3
5,12	Evening	1	1A	1 to 1A	2
5,12	Evening	1	2	1 to 2	102
5,12	Evening	1	2A	1 to 2A	7
5,12	Evening	1	3	1 to 3	295
5,12	Evening	1	3A	1 to 3A	0
5,12	Evening	1	3B	1 to 3B	0
5,12	Evening	1	4	1 to 4	40
5,12	Evening	1	4A	1 to 4A	2
5,12	Evening	1	4B	1 to 4B	1
5,12	Evening	2	1	2 to 1	48
5,12	Evening	2	1A	2 to 1A	10
5,12	Evening	2	1B	2 to 1B	0
5,12	Evening	2	3	2 to 3	45

5,12	Evening	2	3A	2 to 3A	0
5,12	Evening	2	3B	2 to 3B	0
5,12	Evening	2	4	2 to 4	73
5,12	Evening	2	4A	2 to 4A	0
5,12	Evening	2	4B	2 to 4B	0
5,12	Evening	3	1	3 to 1	187
5,12	Evening	3	1A	3 to 1A	4
5,12	Evening	3	1B	3 to 1B	2
5,12	Evening	3	2	3 to 2	34
5,12	Evening	3	2A	3 to 2A	1
5,12	Evening	3	4	3 to 4	26
5,12	Evening	3	4A	3 to 4A	0
5,12	Evening	3	4B	3 to 4B	0
5,12	Evening	4	1	4 to 1	26
5,12	Evening	4	1A	4 to 1A	1
5,12	Evening	4	1B	4 to 1B	3
5,12	Evening	4	2	4 to 2	133
5,12	Evening	4	2A	4 to 2A	5
5,12	Evening	4	3	4 to 3	45
5,12	Evening	4	3A	4 to 3A	0
5,12	Evening	4	3B	4 to 3B	5
6,12	Morning	1	1B	1 to 1B	0
6,12	Morning	1	1A	1 to 1A	1
6,12	Morning	1	2	1 to 2	25
6,12	Morning	1	2A	1 to 2A	0
6,12	Morning	1	3	1 to 3	32
6,12	Morning	1	3A	1 to 3A	0
6,12	Morning	1	3B	1 to 3B	1
6,12	Morning	1	4	1 to 4	9
6,12	Morning	1	4A	1 to 4A	0
6,12	Morning	1	4B	1 to 4B	0
6,12	Morning	2	1	2 to 1	7
6,12	Morning	2	1A	2 to 1A	3
6,12	Morning	2	1B	2 to 1B	0
6,12	Morning	2	2A	2 to 2A	1
6,12	Morning	2	3	2 to 3	8
6,12	Morning	2	3A	2 to 3A	0
6,12	Morning	2	3B	2 to 3B	1
6,12	Morning	2	4	2 to 4	19
6,12	Morning	2	4A	2 to 4A	0
6,12	Morning	2	4B	2 to 4B	0
6,12	Morning	3	1	3 to 1	35
6,12	Morning	3	1A	3 to 1A	5
6,12	Morning	3	1B	3 to 1B	5
6,12	Morning	3	2	3 to 2	15
6,12	Morning	3	2A	3 to 2A	2
6,12	Morning	3	3b	3 to 3b	1
6,12	Morning	3	4	3 to 4	16

6,12	Morning	3	4A	3 to 4A	0
6,12	Morning	3	4B	3 to 4B	0
6,12	Morning	4	1	4 to 1	8
6,12	Morning	4	1A	4 to 1A	4
6,12	Morning	4	1B	4 to 1B	1
6,12	Morning	4	2	4 to 2	34
6,12	Morning	4	2A	4 to 2A	3
6,12	Morning	4	3	4 to 3	4
6,12	Morning	4	3A	4 to 3A	1
6,12	Morning	4	3B	4 to 3B	3
6,12	Morning	4	4b	4 to 4b	2
6,12	Noon	1	1B	1 to 1B	1
6,12	Noon	1	1A	1 to 1A	6
6,12	Noon	1	2	1 to 2	40
6,12	Noon	1	2A	1 to 2A	2
6,12	Noon	1	3	1 to 3	164
6,12	Noon	1	3A	1 to 3A	0
6,12	Noon	1	3B	1 to 3B	1
6,12	Noon	1	4	1 to 4	28
6,12	Noon	1	4A	1 to 4A	1
6,12	Noon	1	4B	1 to 4B	0
6,12	Noon	2	1	2 to 1	16
6,12	Noon	2	1A	2 to 1A	7
6,12	Noon	2	1B	2 to 1B	0
6,12	Noon	2	3	2 to 3	27
6,12	Noon	2	3A	2 to 3A	0
6,12	Noon	2	3B	2 to 3B	0
6,12	Noon	2	4	2 to 4	51
6,12	Noon	2	4A	2 to 4A	0
6,12	Noon	2	4B	2 to 4B	0
6,12	Noon	3	1	3 to 1	184
6,12	Noon	3	1A	3 to 1A	7
6,12	Noon	3	1B	3 to 1B	4
6,12	Noon	3	2	3 to 2	19
6,12	Noon	3	2A	3 to 2A	11
6,12	Noon	3	3B	3 to 3B	1
6,12	Noon	3	4	3 to 4	32
6,12	Noon	3	4A	3 to 4A	0
6,12	Noon	3	4B	3 to 4B	0
6,12	Noon	4	1	4 to 1	23
6,12	Noon	4	1A	4 to 1A	5
6,12	Noon	4	1B	4 to 1B	0
6,12	Noon	4	2	4 to 2	85
6,12	Noon	4	2A	4 to 2A	1
6,12	Noon	4	3	4 to 3	18
6,12	Noon	4	3A	4 to 3A	1
6,12	Noon	4	3B	4 to 3B	1
6,12	Evening	1	1B	1 to 1B	3

6,12	Evening	1	1A	1 to 1A	10
6,12	Evening	1	2	1 to 2	37
6,12	Evening	1	2A	1 to 2A	3
6,12	Evening	1	3	1 to 3	204
6,12	Evening	1	3A	1 to 3A	0
6,12	Evening	1	3B	1 to 3B	0
6,12	Evening	1	4	1 to 4	22
6,12	Evening	1	4A	1 to 4A	0
6,12	Evening	1	4B	1 to 4B	0
6,12	Evening	2	1	2 to 1	14
6,12	Evening	2	1A	2 to 1A	2
6,12	Evening	2	1B	2 to 1B	1
6,12	Evening	2	2A	2 to 2A	3
6,12	Evening	2	3	2 to 3	21
6,12	Evening	2	3A	2 to 3A	0
6,12	Evening	2	3B	2 to 3B	0
6,12	Evening	2	4	2 to 4	58
6,12	Evening	2	4A	2 to 4A	1
6,12	Evening	2	4B	2 to 4B	0
6,12	Evening	3	1	3 to 1	177
6,12	Evening	3	1A	3 to 1A	1
6,12	Evening	3	1B	3 to 1B	6
6,12	Evening	3	2	3 to 2	29
6,12	Evening	3	2A	3 to 2A	9
6,12	Evening	3	4	3 to 4	37
6,12	Evening	3	4A	3 to 4A	0
6,12	Evening	3	4B	3 to 4B	0
6,12	Evening	4	1	4 to 1	46
6,12	Evening	4	1A	4 to 1A	1
6,12	Evening	4	1B	4 to 1B	1
6,12	Evening	4	2	4 to 2	88
6,12	Evening	4	2A	4 to 2A	1
6,12	Evening	4	3	4 to 3	28
6,12	Evening	4	3A	4 to 3A	0
6,12	Evening	4	3B	4 to 3B	0
8,12	Morning	1	1B	1 to 1B	0
8,12	Morning	1	1A	1 to 1A	0
8,12	Morning	1	2	1 to 2	30
8,12	Morning	1	2A	1 to 2A	4
8,12	Morning	1	3	1 to 3	49
8,12	Morning	1	3A	1 to 3A	0
8,12	Morning	1	3B	1 to 3B	0
8,12	Morning	1	4	1 to 4	9
8,12	Morning	1	4A	1 to 4A	0
8,12	Morning	1	4B	1 to 4B	0
8,12	Morning	2	1	2 to 1	48
8,12	Morning	2	1A	2 to 1A	0
8,12	Morning	2	1B	2 to 1B	0

8,12	Morning	2	2A	2 to 2A	1
8,12	Morning	2	3	2 to 3	9
8,12	Morning	2	3A	2 to 3A	0
8,12	Morning	2	3B	2 to 3B	0
8,12	Morning	2	4	2 to 4	196
8,12	Morning	2	4A	2 to 4A	0
8,12	Morning	2	4B	2 to 4B	0
8,12	Morning	3	1	3 to 1	196
8,12	Morning	3	1A	3 to 1A	0
8,12	Morning	3	1B	3 to 1B	0
8,12	Morning	3	2	3 to 2	11
8,12	Morning	3	2A	3 to 2A	2
8,12	Morning	3	4	3 to 4	88
8,12	Morning	3	4A	3 to 4A	0
8,12	Morning	3	4B	3 to 4B	0
8,12	Morning	4	1	4 to 1	9
8,12	Morning	4	1A	4 to 1A	0
8,12	Morning	4	1B	4 to 1B	0
8,12	Morning	4	2	4 to 2	91
8,12	Morning	4	2A	4 to 2A	1
8,12	Morning	4	3	4 to 3	21
8,12	Morning	4	3A	4 to 3A	0
8,12	Morning	4	3B	4 to 3B	1
8,12	Noon	1	11B	1 to 11B	2
8,12	Noon	1	11A	1 to 11A	8
8,12	Noon	1	2	1 to 2	39
8,12	Noon	1	2A	1 to 2A	2
8,12	Noon	1	3	1 to 3	170
8,12	Noon	1	3A	1 to 3A	0
8,12	Noon	1	3B	1 to 3B	0
8,12	Noon	1	4	1 to 4	32
8,12	Noon	1	4A	1 to 4A	2
8,12	Noon	1	4B	1 to 4B	1
8,12	Noon	2	1	2 to 1	14
8,12	Noon	2	1A	2 to 1A	6
8,12	Noon	2	1B	2 to 1B	3
8,12	Noon	2	3	2 to 3	30
8,12	Noon	2	3A	2 to 3A	0
8,12	Noon	2	3B	2 to 3B	0
8,12	Noon	2	4	2 to 4	49
8,12	Noon	2	4A	2 to 4A	0
8,12	Noon	2	4B	2 to 4B	0
8,12	Noon	3	1	3 to 1	178
8,12	Noon	3	1A	3 to 1A	9
8,12	Noon	3	1B	3 to 1B	3
8,12	Noon	3	2	3 to 2	20
8,12	Noon	3	2A	3 to 2A	12

8,12	Noon	3	4	3 to 4	28
8,12	Noon	3	4A	3 to 4A	0
8,12	Noon	3	4B	3 to 4B	0
8,12	Noon	4	1	4 to 1	19
8,12	Noon	4	1A	4 to 1A	12
8,12	Noon	4	1B	4 to 1B	2
8,12	Noon	4	2	4 to 2	71
8,12	Noon	4	2A	4 to 2A	1
8,12	Noon	4	3	4 to 3	26
8,12	Noon	4	3A	4 to 3A	0
8,12	Noon	4	3B	4 to 3B	1
8,12	Noon	4	4A	4 to 4A	3
8,12	Evening	1	1B	1 to 1B	2
8,12	Evening	1	1A	1 to 1A	0
8,12	Evening	1	2	1 to 2	55
8,12	Evening	1	2A	1 to 2A	8
8,12	Evening	1	3	1 to 3	276
8,12	Evening	1	3A	1 to 3A	0
8,12	Evening	1	3B	1 to 3B	4
8,12	Evening	1	4	1 to 4	20
8,12	Evening	1	4A	1 to 4A	0
8,12	Evening	1	4B	1 to 4B	0
8,12	Evening	2	1	2 to 1	55
8,12	Evening	2	1A	2 to 1A	7
8,12	Evening	2	1B	2 to 1B	0
8,12	Evening	2	3	2 to 3	24
8,12	Evening	2	3A	2 to 3A	0
8,12	Evening	2	3B	2 to 3B	0
8,12	Evening	2	4	2 to 4	150
8,12	Evening	2	4A	2 to 4A	0
8,12	Evening	2	4B	2 to 4B	0
8,12	Evening	3	1	3 to 1	171
8,12	Evening	3	1A	3 to 1A	1
8,12	Evening	3	1B	3 to 1B	12
8,12	Evening	3	2	3 to 2	20
8,12	Evening	3	2A	3 to 2A	3
8,12	Evening	3	4	3 to 4	35
8,12	Evening	3	4A	3 to 4A	0
8,12	Evening	3	4B	3 to 4B	0
8,12	Evening	4	1	4 to 1	29
8,12	Evening	4	1A	4 to 1A	0
8,12	Evening	4	1B	4 to 1B	1
8,12	Evening	4	2	4 to 2	141
8,12	Evening	4	2A	4 to 2A	8
8,12	Evening	4	3	4 to 3	38
8,12	Evening	4	3A	4 to 3A	0
8,12	Evening	4	3B	4 to 3B	1

1.2 Detailed data for pedestrians counting

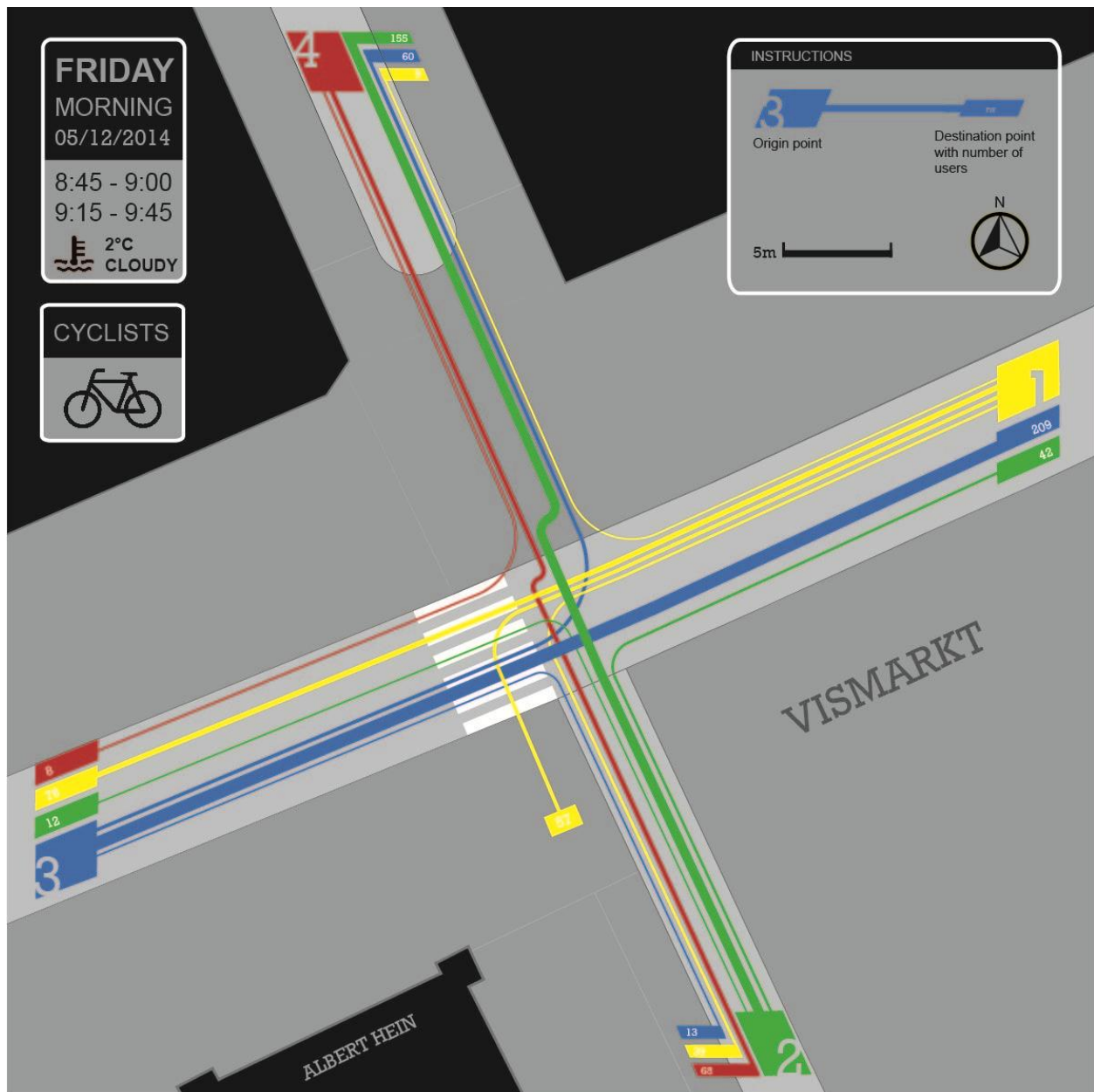
Date	Session	From	To	Count
5,12	Morning	A	B	79
5,12	Morning	B	A	40
5,12	Morning	C	D	9
5,12	Morning	D	C	9
5,12	Morning	A	C	22
5,12	Morning	C	A	65
5,12	Morning	B	D	3
5,12	Morning	D	B	66
5,12	Morning	A	D	1
5,12	Morning	D	A	1
5,12	Morning	B	C	2
5,12	Morning	C	B	5
5,12	Noon	A	B	281
5,12	Noon	B	A	267
5,12	Noon	C	D	40
5,12	Noon	D	C	34
5,12	Noon	A	C	268
5,12	Noon	C	A	143
5,12	Noon	B	D	132
5,12	Noon	D	B	181
5,12	Noon	A	D	10
5,12	Noon	D	A	13
5,12	Noon	B	C	6
5,12	Noon	C	B	
5,12	Evening	A	B	217
5,12	Evening	B	A	192
5,12	Evening	C	D	38
5,12	Evening	D	C	40
5,12	Evening	A	C	216
5,12	Evening	C	A	155
5,12	Evening	B	D	126
5,12	Evening	D	B	151
5,12	Evening	A	D	14
5,12	Evening	D	A	14
5,12	Evening	B	C	10
5,12	Evening	C	B	7
6,12	Morning	A	B	30
6,12	Morning	B	A	19
6,12	Morning	C	D	13
6,12	Morning	D	C	6
6,12	Morning	A	C	24

6,12	Morning	C	A	26
6,12	Morning	B	D	19
6,12	Morning	D	B	27
6,12	Morning	A	D	2
6,12	Morning	D	A	4
6,12	Morning	B	C	2
6,12	Morning	C	B	2
6,12	Noon	A	B	388
6,12	Noon	B	A	306
6,12	Noon	C	D	74
6,12	Noon	D	C	49
6,12	Noon	A	C	223
6,12	Noon	C	A	102
6,12	Noon	B	D	81
6,12	Noon	D	B	235
6,12	Noon	A	D	34
6,12	Noon	D	A	20
6,12	Noon	B	C	28
6,12	Noon	C	B	6
6,12	Evening	A	B	353
6,12	Evening	B	A	471
6,12	Evening	C	D	80
6,12	Evening	D	C	68
6,12	Evening	A	C	294
6,12	Evening	C	A	175
6,12	Evening	B	D	205
6,12	Evening	D	B	322
6,12	Evening	A	D	68
6,12	Evening	D	A	41
6,12	Evening	B	C	2
6,12	Evening	C	B	2
8,12	Morning	A	B	30
8,12	Morning	B	A	12
8,12	Morning	C	D	0
8,12	Morning	D	C	8
8,12	Morning	A	C	8
8,12	Morning	C	A	36
8,12	Morning	B	D	1
8,12	Morning	D	B	62
8,12	Morning	A	D	0
8,12	Morning	D	A	2
8,12	Morning	B	C	0
8,12	Morning	C	B	2
8,12	Noon	A	B	145
8,12	Noon	B	A	110
8,12	Noon	C	D	12
8,12	Noon	D	C	10
8,12	Noon	A	C	125

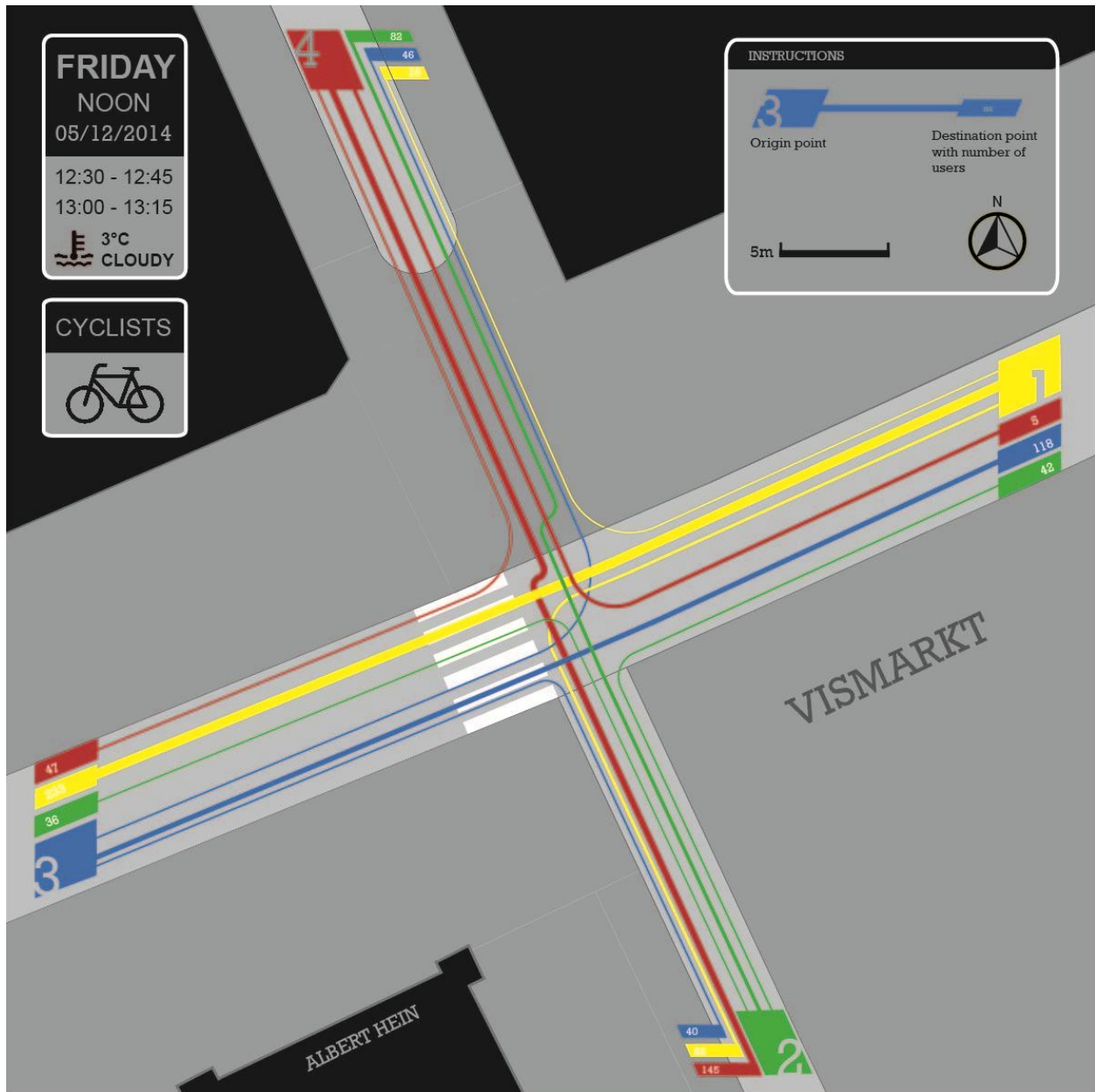
8,12	Noon	C	A	97
8,12	Noon	B	D	24
8,12	Noon	D	B	60
8,12	Noon	A	D	2
8,12	Noon	D	A	6
8,12	Noon	B	C	8
8,12	Noon	C	B	8
8,12	Evening	A	B	159
8,12	Evening	B	A	151
8,12	Evening	C	D	8
8,12	Evening	D	C	5
8,12	Evening	A	C	147
8,12	Evening	C	A	95
8,12	Evening	B	D	50
8,12	Evening	D	B	50
8,12	Evening	A	D	3
8,12	Evening	D	A	1
8,12	Evening	B	C	5
8,12	Evening	C	B	6

Appendix 2

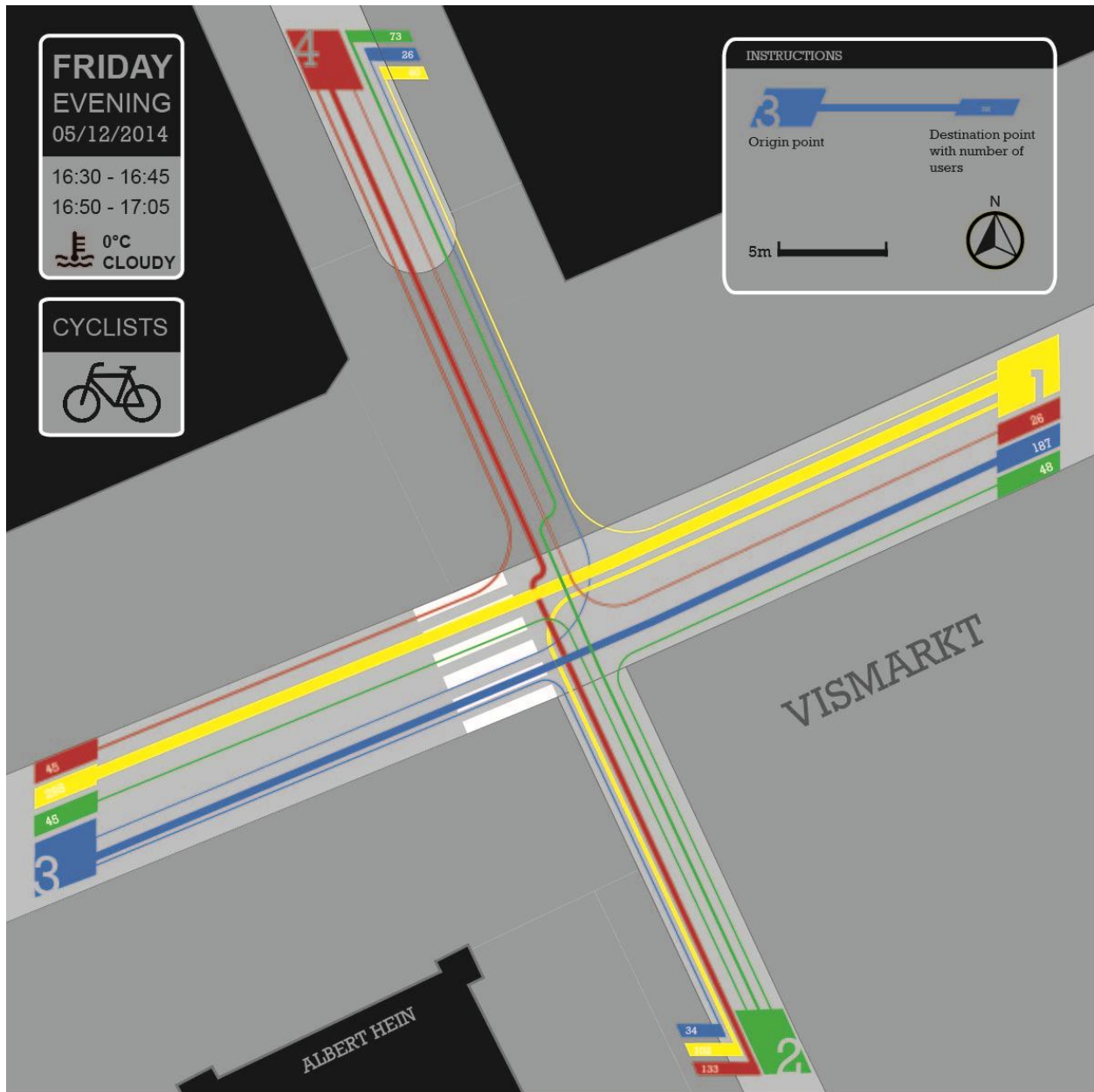
2.1 Cyclists on Friday morning



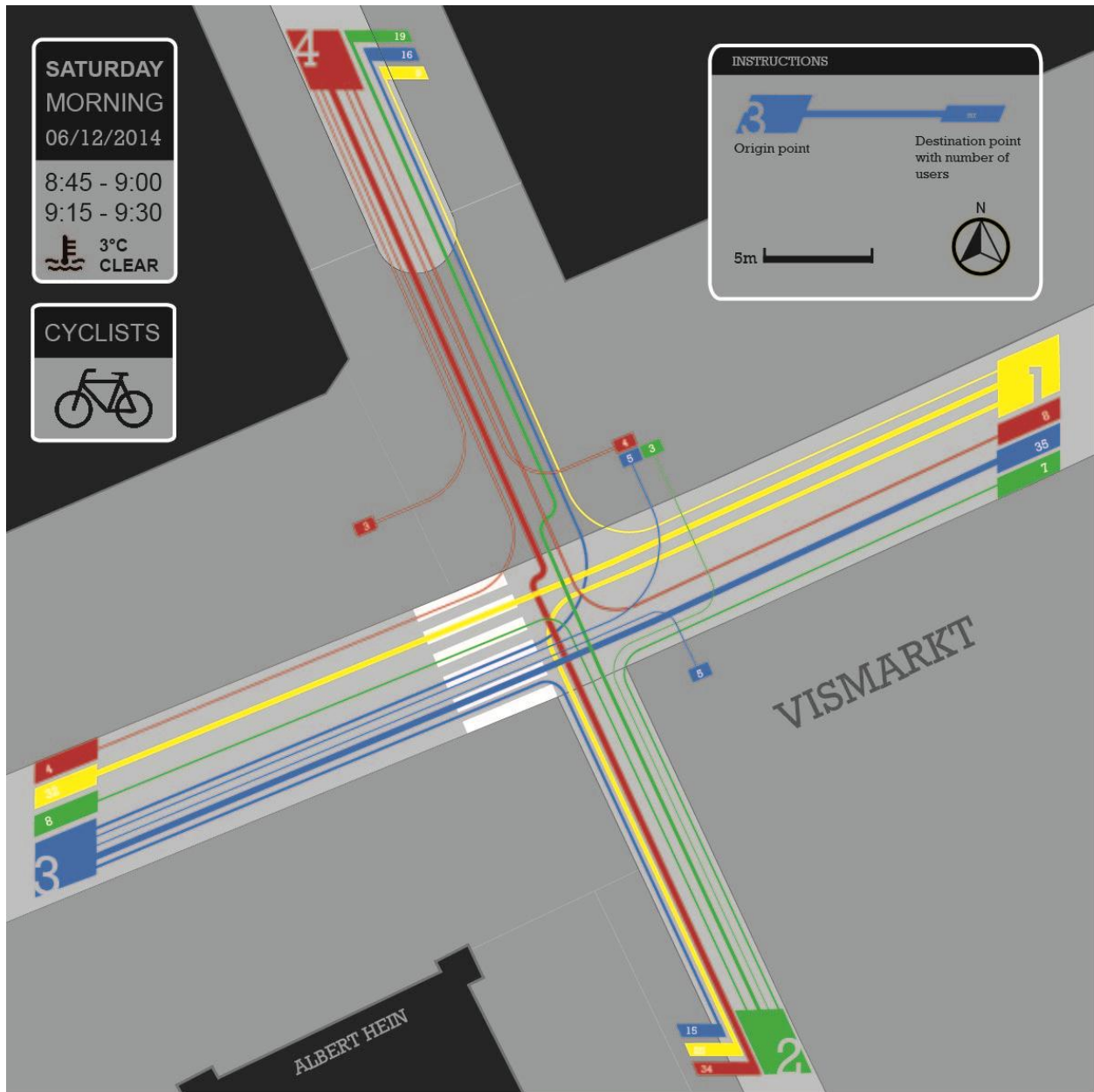
2.2 Cyclists on Friday noon



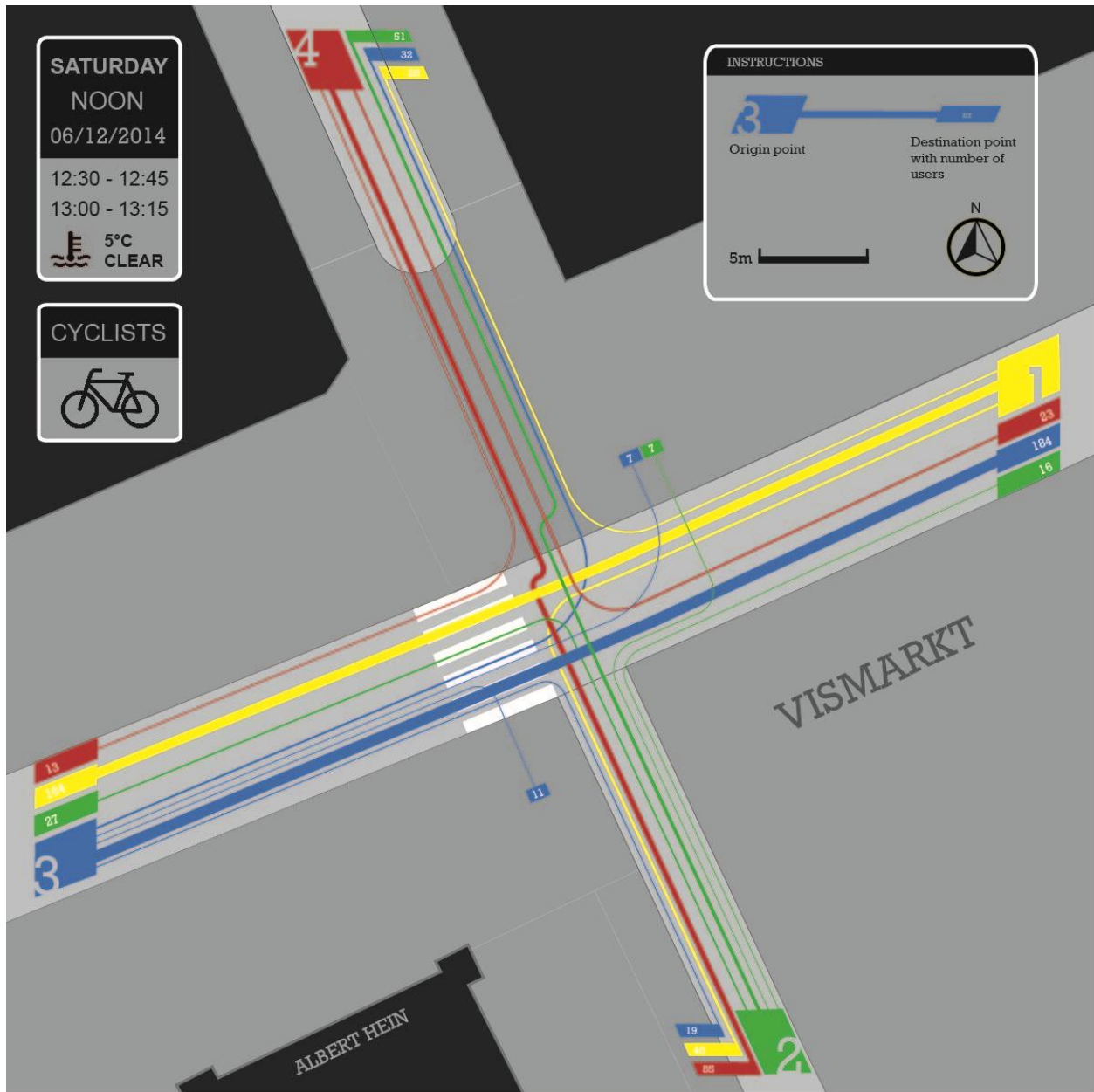
2.3 Cyclists on Friday evening



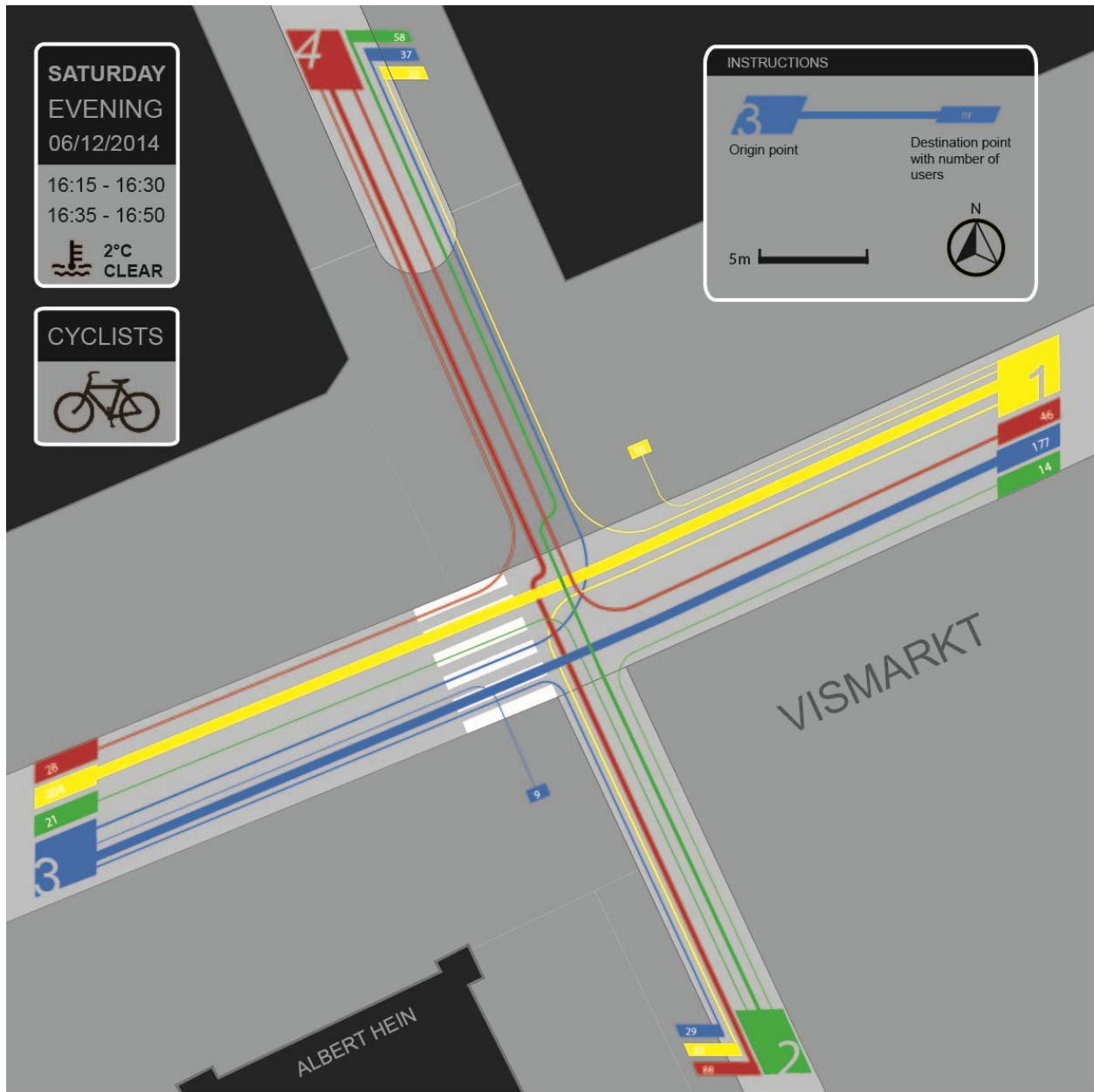
2.4 Cyclists on Saturday morning



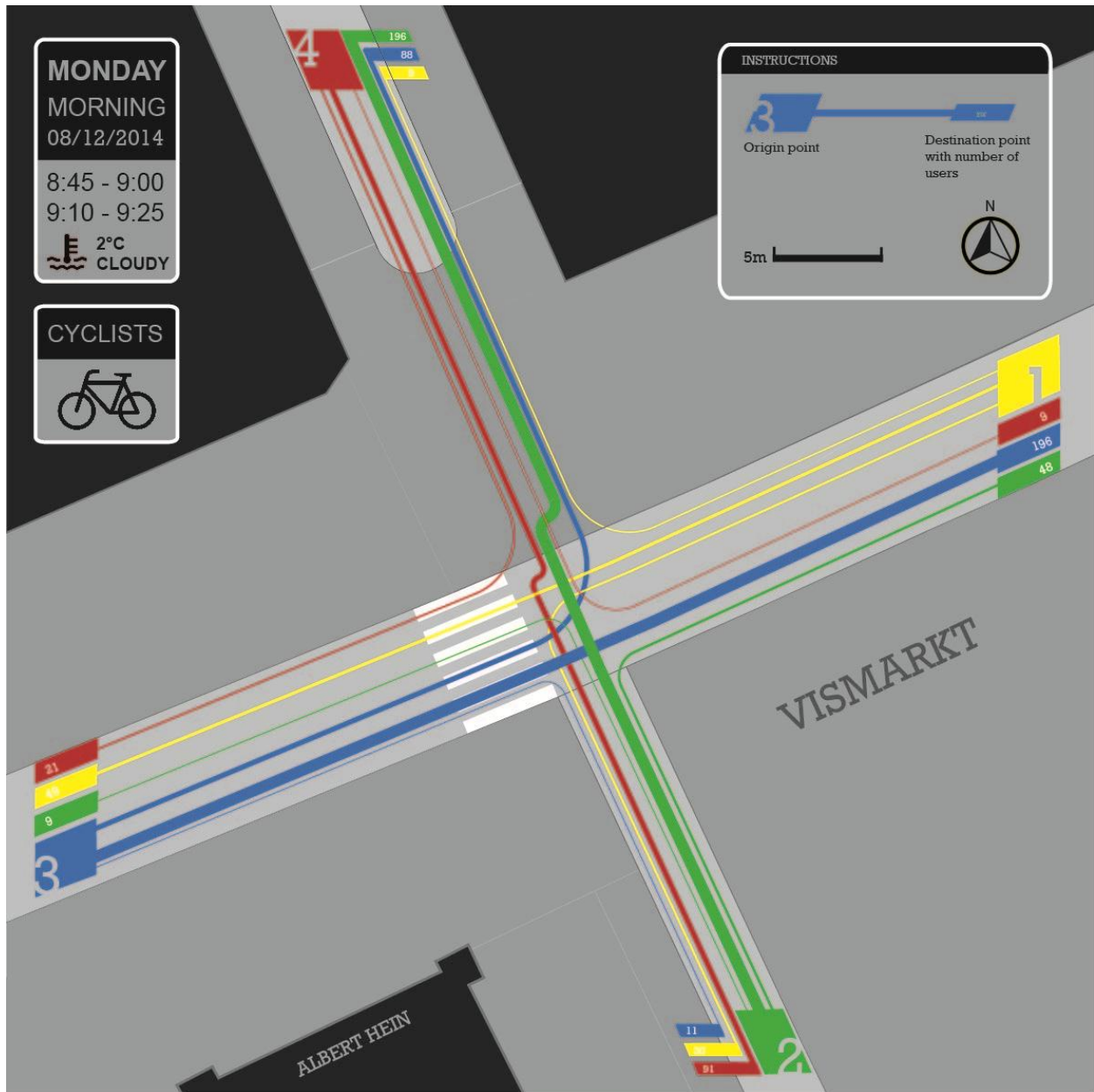
2.5 Cyclists on Saturday noon



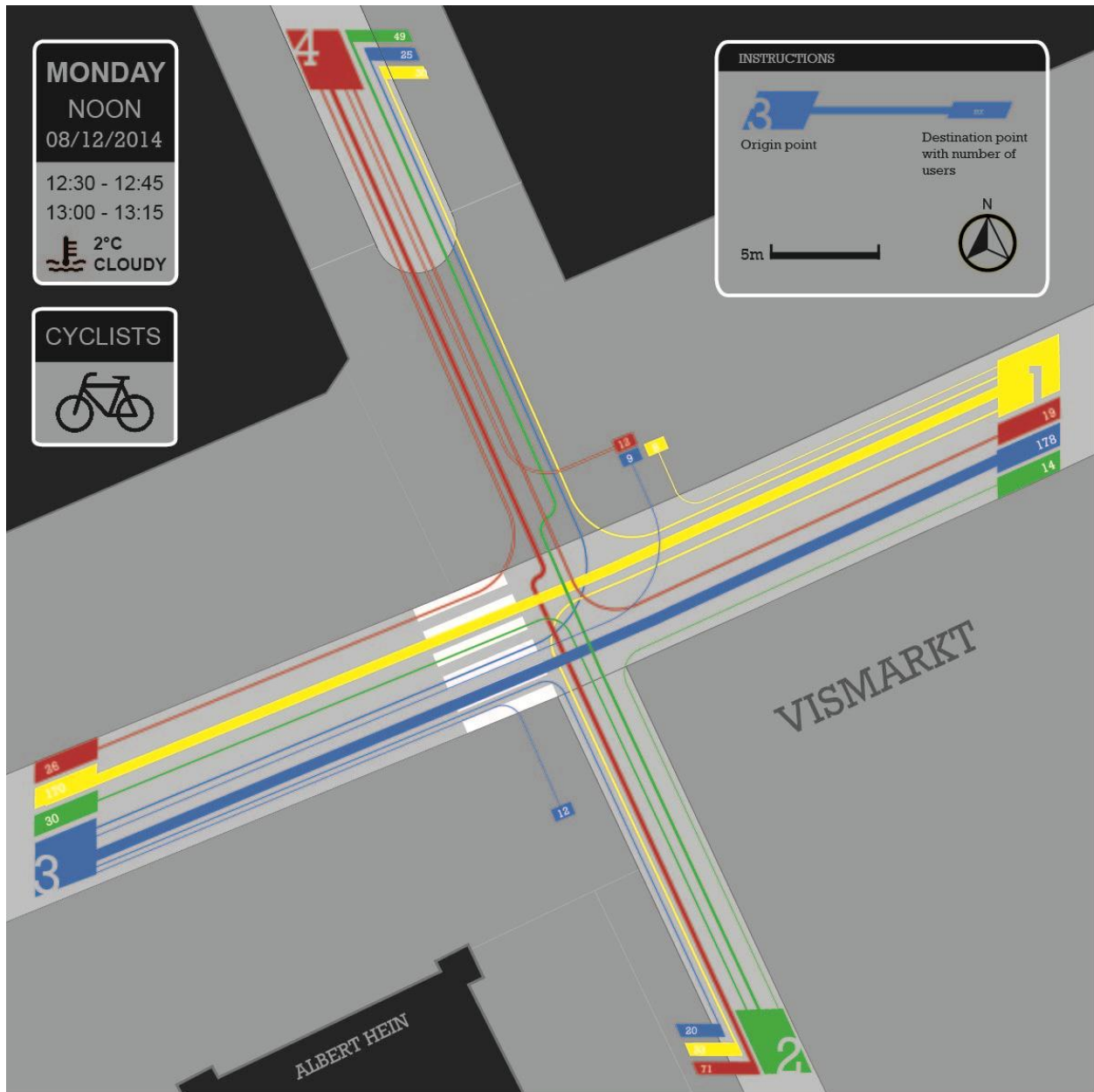
2.6 Cyclists on Saturday evening



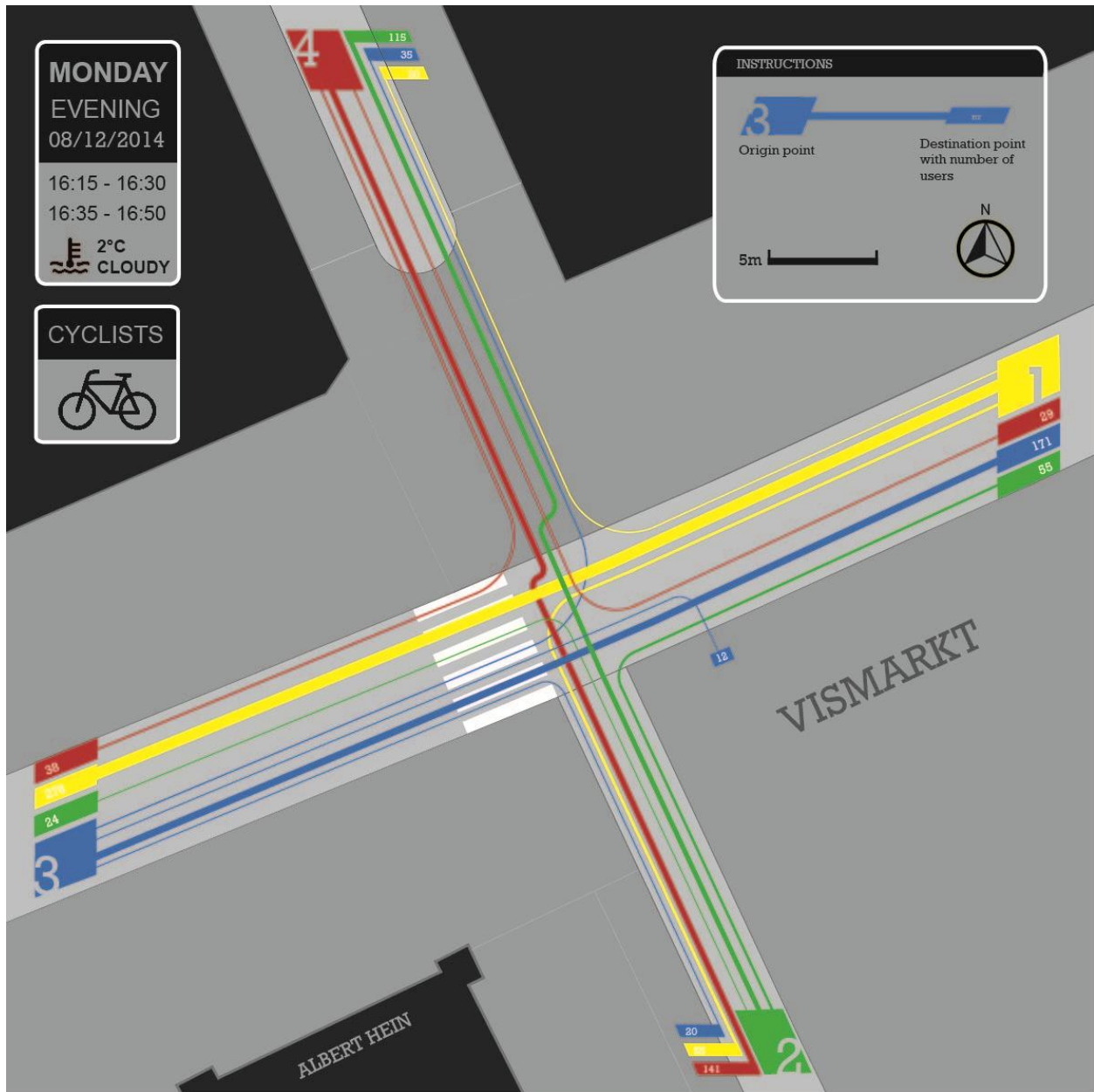
2.7 Cyclists on Monday morning



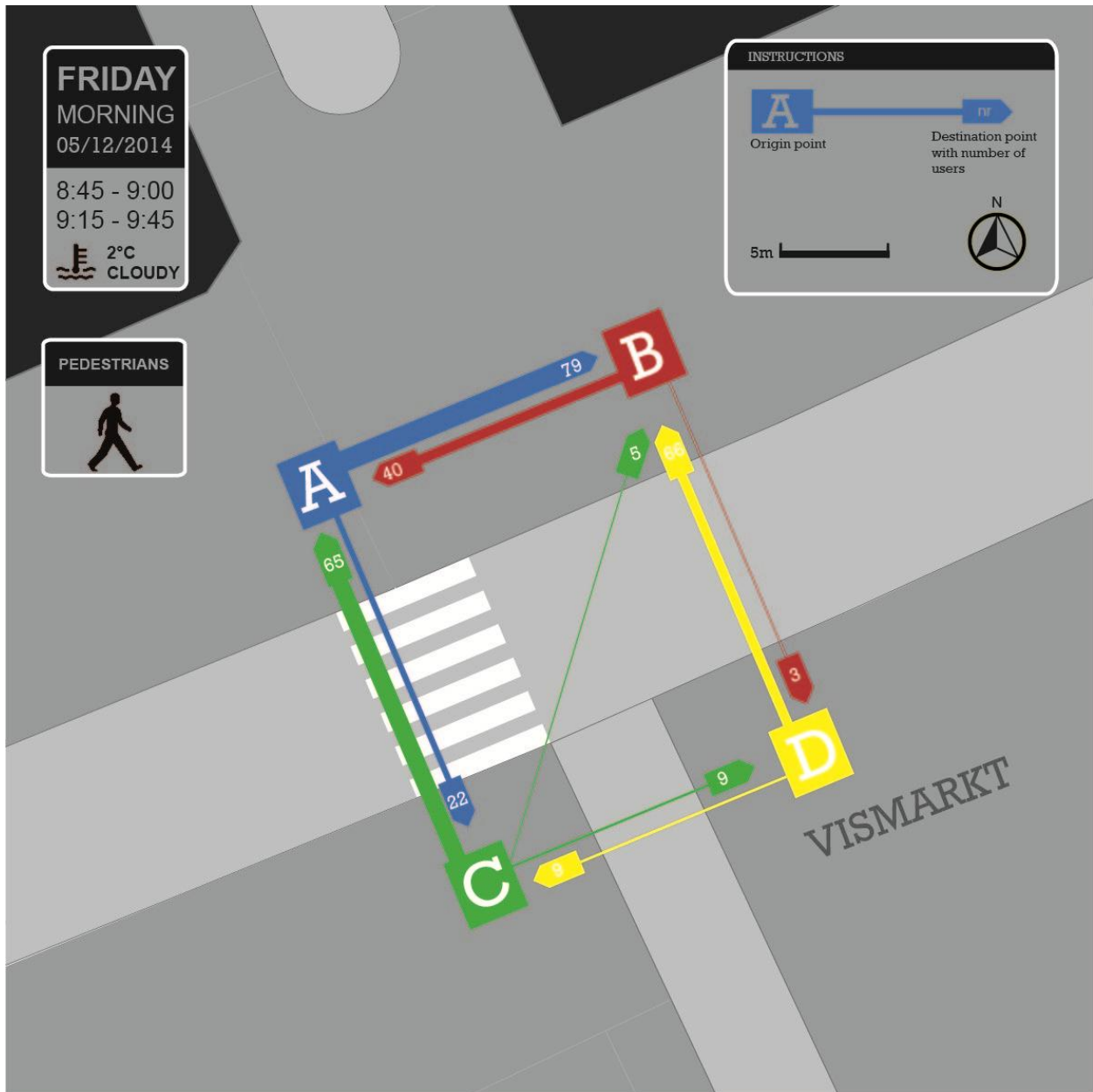
2.8 Cyclists on Monday noon



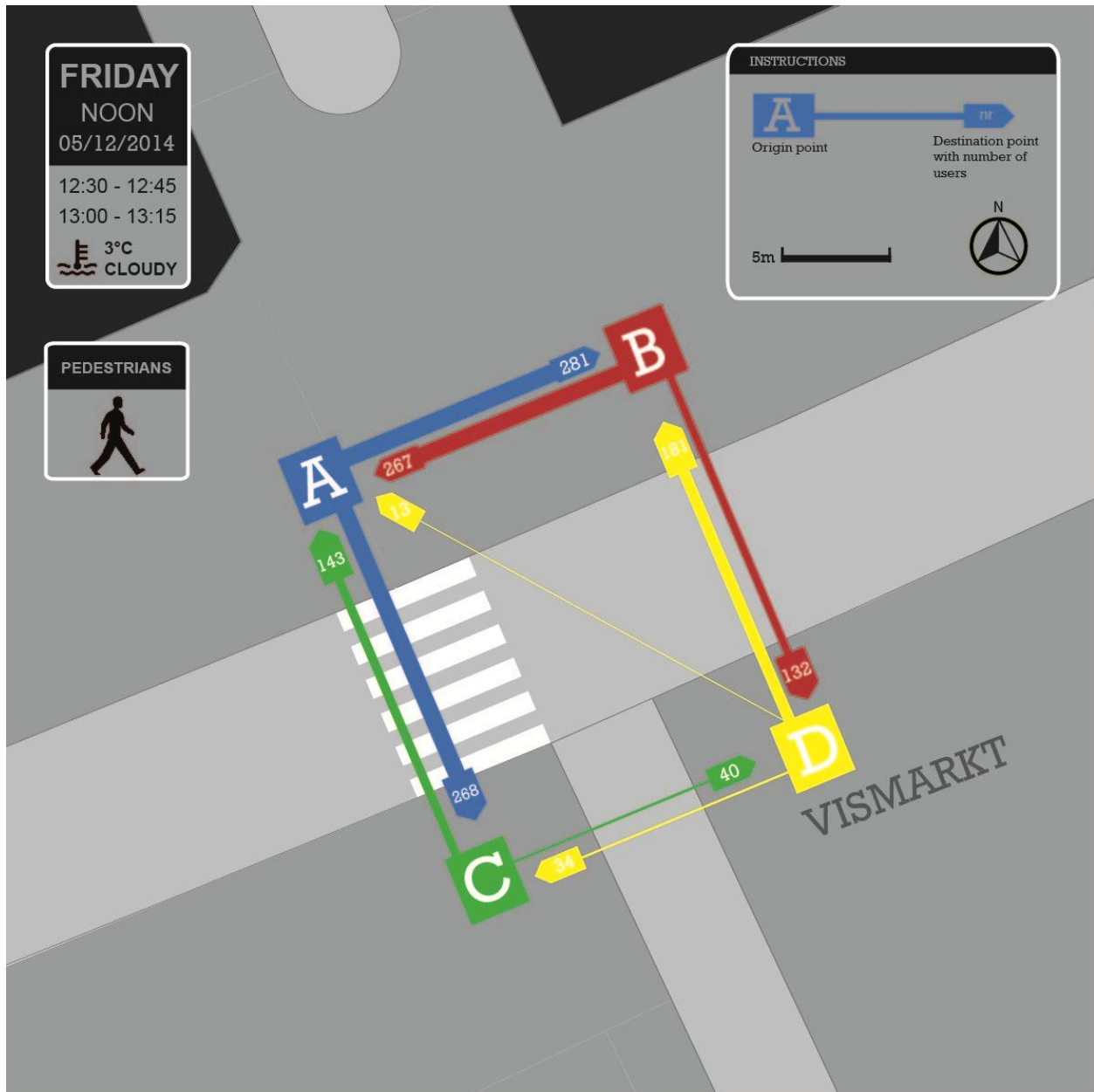
2.9 Cyclists on Monday evening



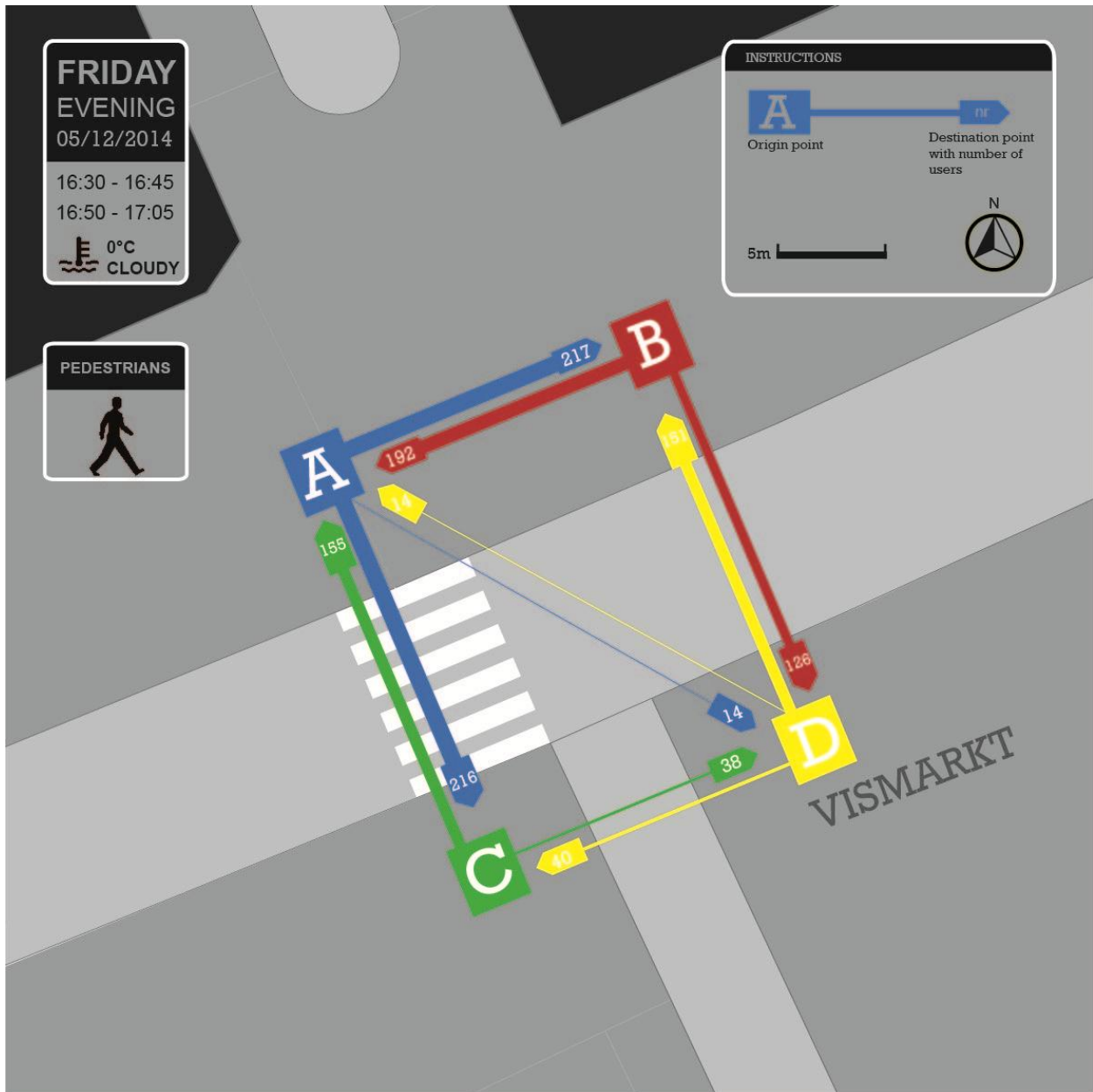
2.10 Pedestrians on Friday morning



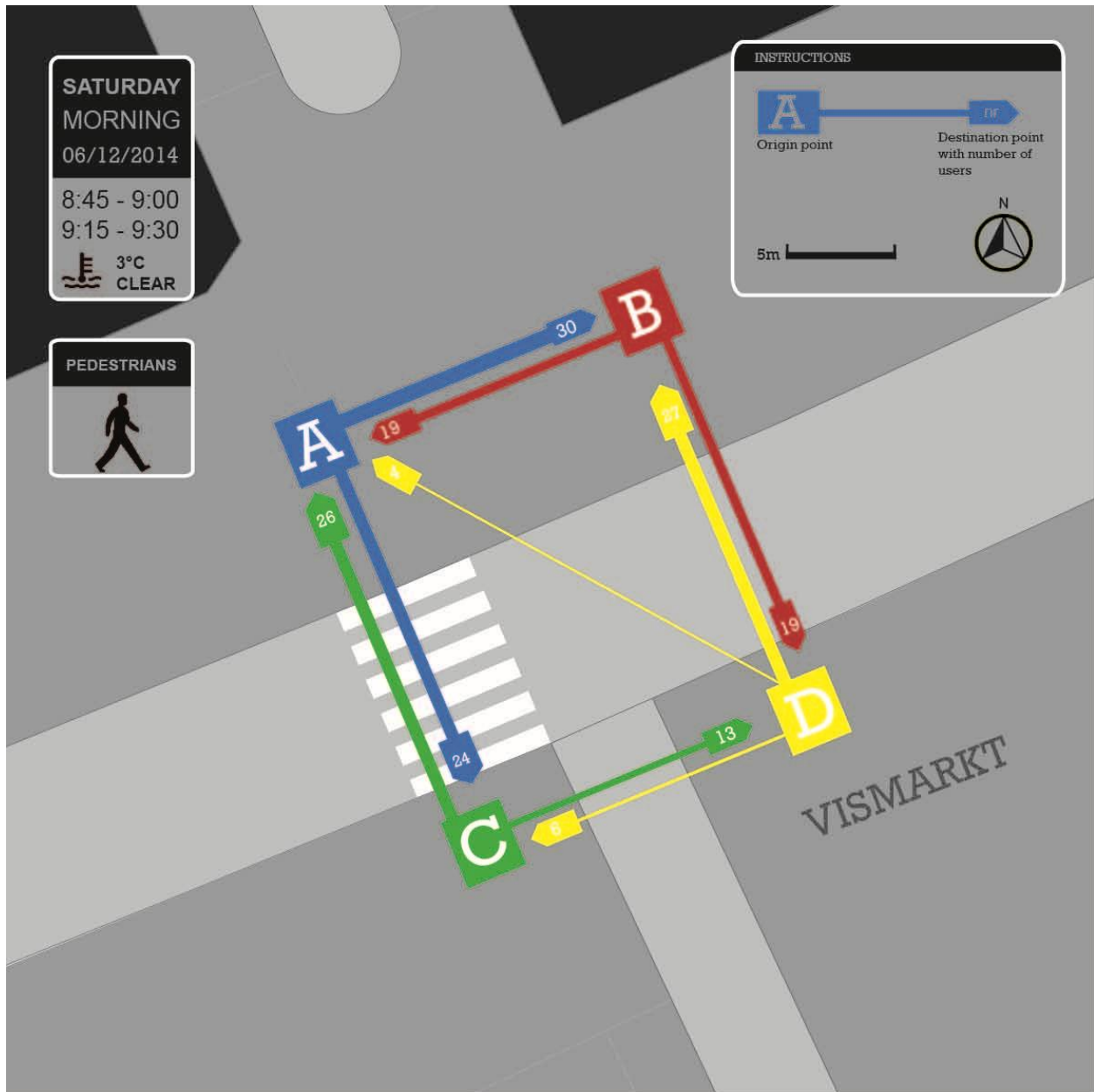
2.11 Pedestrians on Friday noon



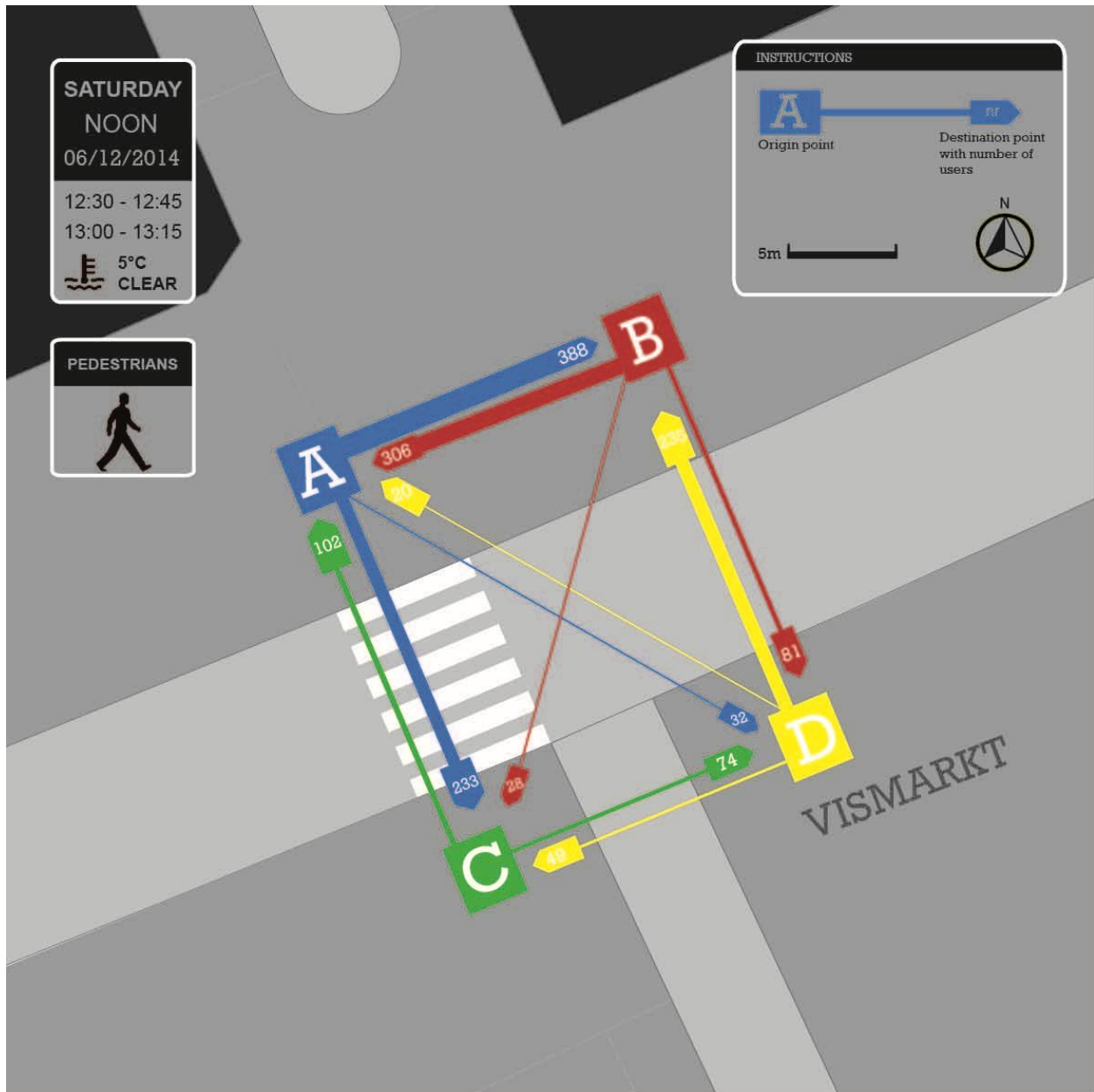
2.12 Pedestrians on Friday evening



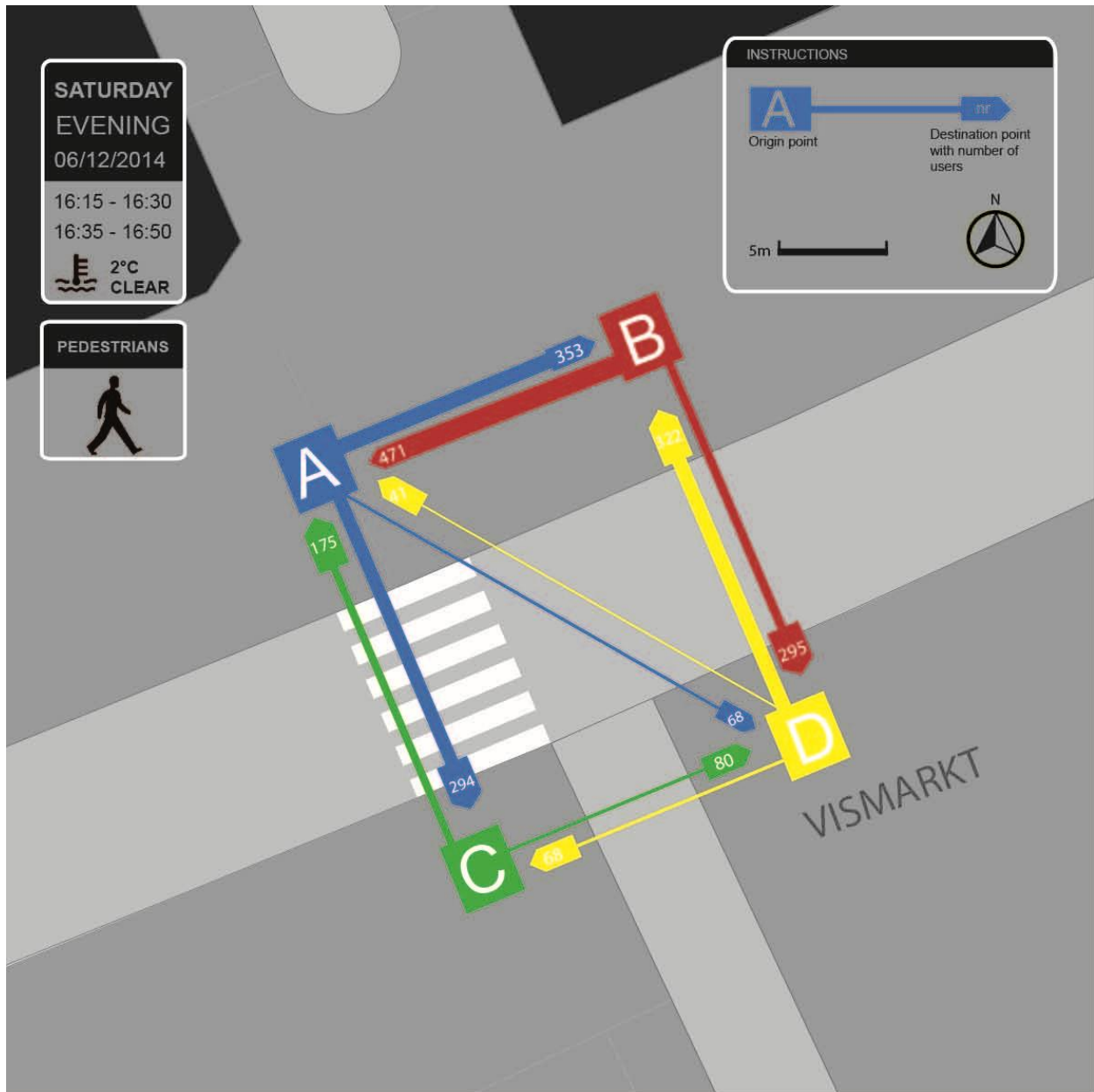
2.13 Pedestrians on Saturday morning



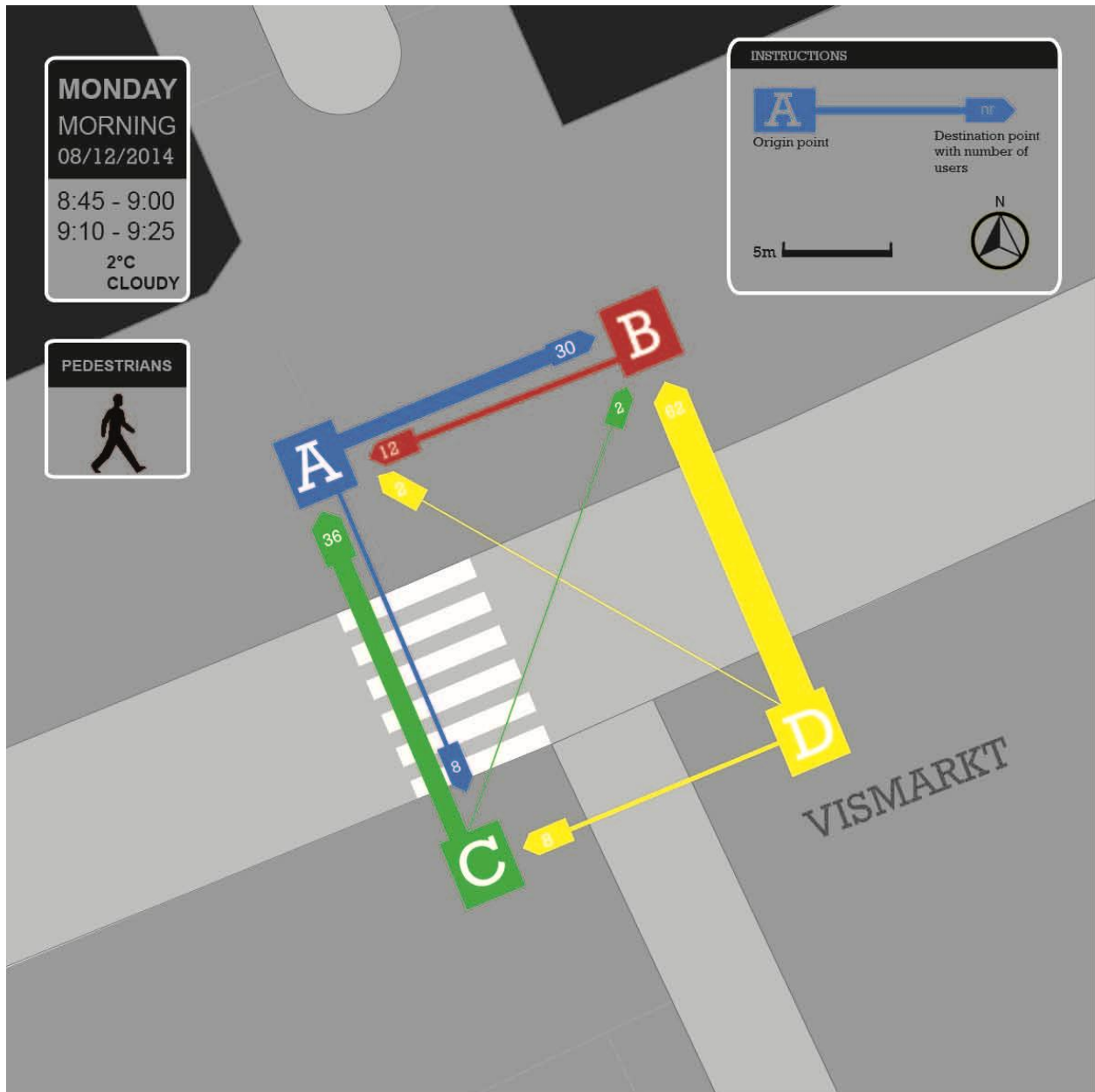
2.14 Pedestrians on Saturday noon



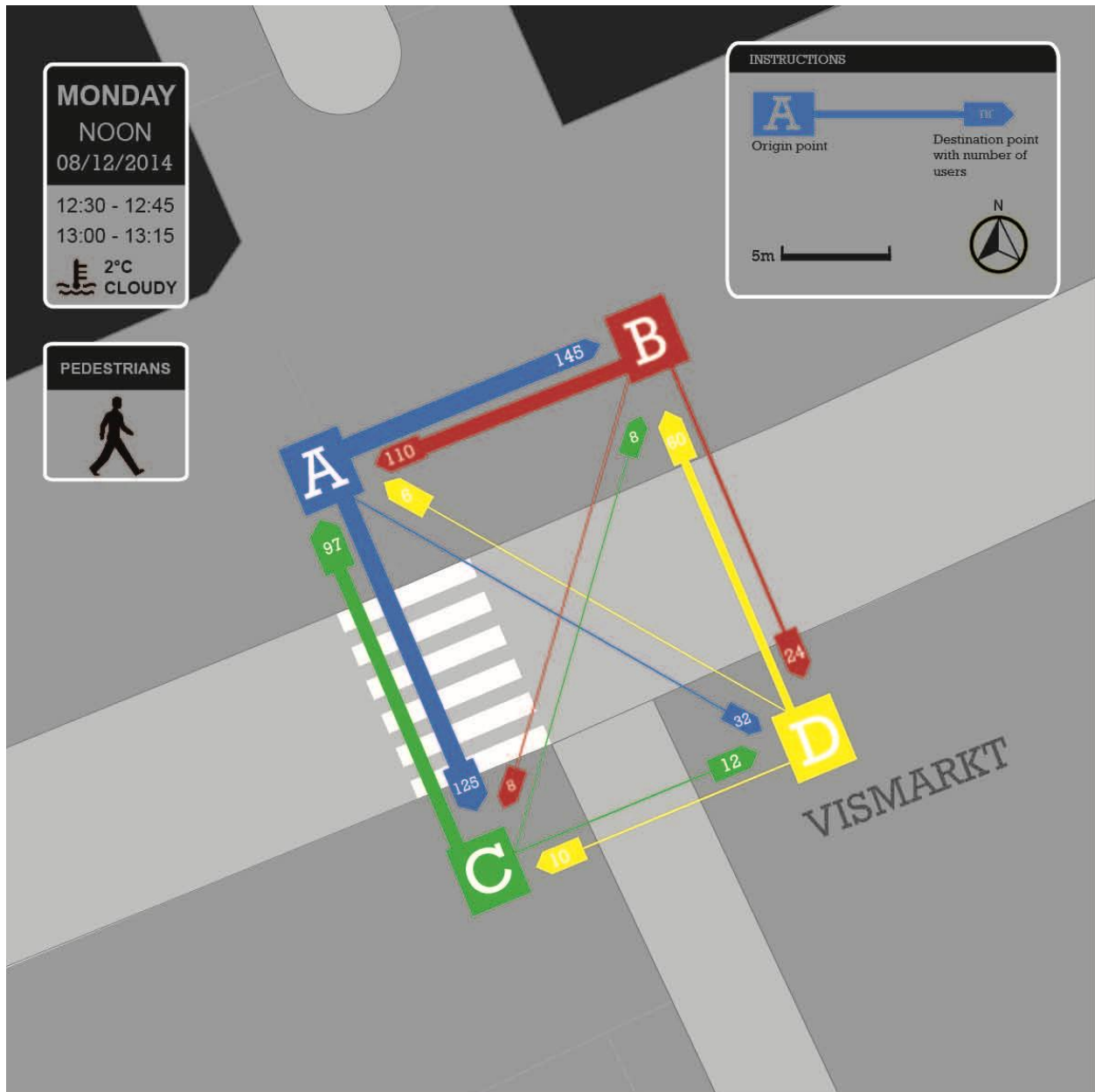
2.15 Pedestrians on Saturday evening



2.16 Pedestrians on Monday morning



2.17 Pedestrians on Monday noon



2.18 Pedestrians on Monday evening

