Roads to Respect 2010
Azzurra Evangelisti Final Report

European Transport Safety Council

Name: Azzurra Evangelisti
University: University of Rome “Tor Vergata”
e-mail: azzurra.evangelisti@libero.it
Telephone: 339-7153541

1- Definition of the High risk site

1.1- Site description

The dangerous site which caught my attention is located within the area of the University of Rome “Tor Vergata”, on the eastern outskirts of Rome, where are mani roundabouts and signalized intersections. In particular it is situated at the junction of Viale della Sorbona and Via della Ricerca Scientifica, directly in front of the entrance of the “PP2” building complex (complex Property of the University).

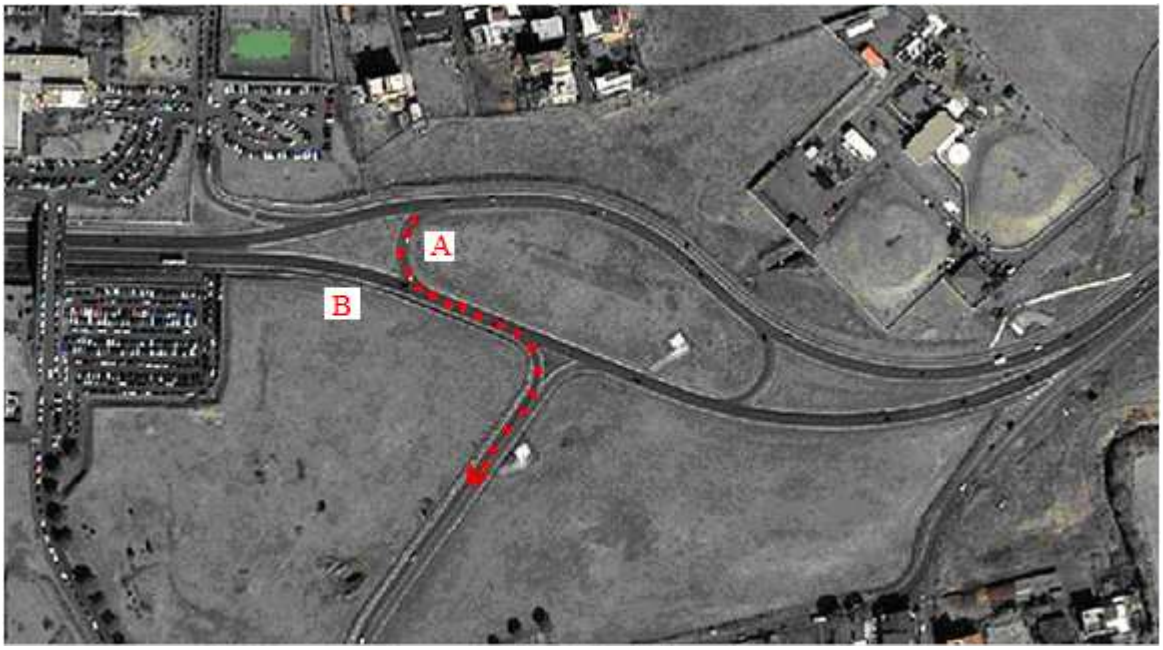
Viale della Sorbona is a two-way street, which consists of two lanes per each direction divided by a crash barrier. It is part of the so called “Corridoio della Viabilità” launched in 2009. This corridor has the task of make easier the passage that connects the last metro stop called “Anagnina” with two very important points of the district, that are the hospital “Policlinico Tor Vergata” and the “University of Tor Vergata”. It is easy to understand that via della Sorbona is a road with a large flow of traffic, also, being a very broad way and without obstructions inside, it traveled at great speed.

1 - Corridoio della viabilità

At the above mentioned junction (between Viale della Sorbona and Via della Ricerca Scientifica), there are two bus stops (one per each direction) without any pedestrian crosswalk connecting them.

2 - Bus Stops

The visibility there is very low because it is somewhat steep and cars often drive through at high speed. This causes many accidents, often lethal.
Below are the details of the intersection be examined:



3 - Junction that connects Viale della Sorbona in Stanford Street

4 - Particulars: A and B

The “Corridoio della Viabilità” is very important artery for traffic in the neighborhood. However, it is not subject only to the characteristics of ordinary traffic, but is also subject to individual characteristics. Constitutes the only access route to the Hospital and University, and this means that peak times are not only those of ordinary viability, but we must add those of the beginning and end of University lectures and sections of hospital visits.

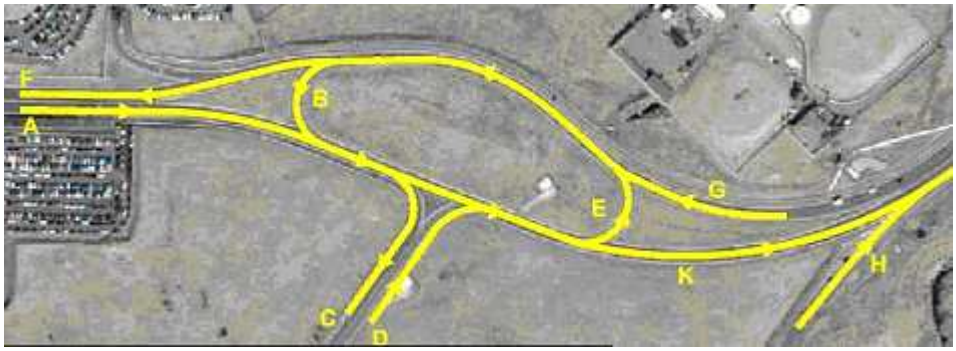
1.2- Count traffic volumes

The traffic count data was executed in two different ways: manual and automatic. The first was performed in person counting, by the roadside, vehicles and record the characteristics (type of vehicle and time of passage).

The second one was carried out by the ATAC (Agency of Transportation Autoferrotranviario the City of Rome), using detectors with memory chips located in the roadway, unable to count the passing vehicles and recording: the time of the passage, the length and the speed of vehicles.

In both cases, the peak times were: 7:30 to 9:30 and 17:30 to 19:30.

Traffic flows related to the junctions are shown in OD matrices, where O and D represent the start and end points of crossings of the examined exit.



5 – Intersection

Maneuvers: Peak hours in the morning: 7.30-9.30					
[Vehi.Eq./h]					
O/D	**C**	**E**	**K**	**F**	**Tot**
A	363	11	698	5	**1077**
D	0	41	205	19	**265**
B	627	0	21	0	**648**
G	627	0	21	789	**1437**
Tot	**1617**	**52**	**945**	**813**	

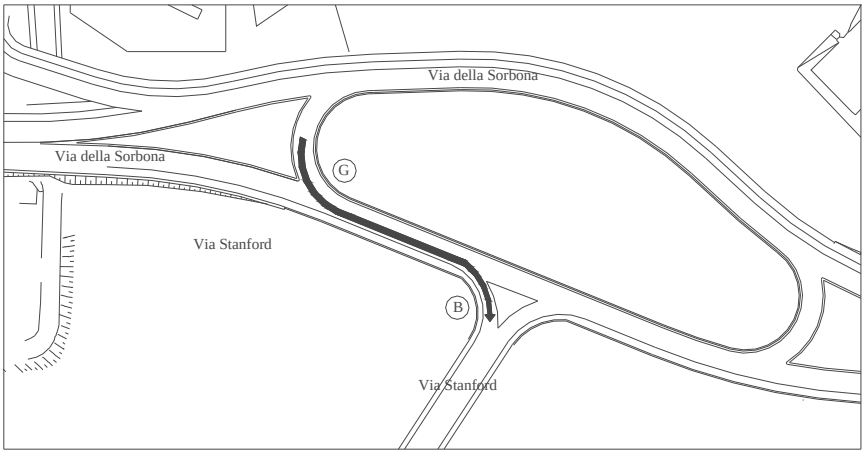
Maneuvers: Peak hours in the evening: 17.30-19.30					
[Vehi.Eq./h]					
O/D	**C**	**E**	**K**	**F**	**Tot**
A	451	61	1008	39	**1559**
D	0	39	204	38	**281**
B	616	0	13	0	**629**
G	616	0	13	873	**1502**
Tot	**1683**	**100**	**1238**	**950**	

6 - Sorce A.T.A.C.

1.3- Analysis of accidents

Was performed an analysis on incidents in the area of interest. The data were provided by the VII group of traffic police in Rome, but are related to the semester from January to June 2005, it must be added an annual increase generated by an increase of traffic at least 2%.

In only analyzed first semester 2005 were counted:



7 - Intersection

N° incidents	Via Stanford	(B)	16
	Junction in the direction of the Commercial	(G)	9
		tot	25
N° injured	Via della Sorbona	tot	51
N° seriously injured	Via della Sorbona	tot	20,91

25 accidents and 41% of the people involved was injured too seriously, resulting the intersection with the highest percentage of injuries per number of accidents.

There are several reasons:

- high-speed travel of the road
- sight distance for stopping insufficient
- a long time where the vehicles are at the point of conflict
- long waiting times for entries- poor visibility.

1.4- Analysis of visibility distances

Has been performed a thorough analysis of the distance of visibility of the intersection.

The visibility distance D is given by:

$$D \equiv V \cdot T$$

where:

V = reference speed [m / s], the value of traveling speed;

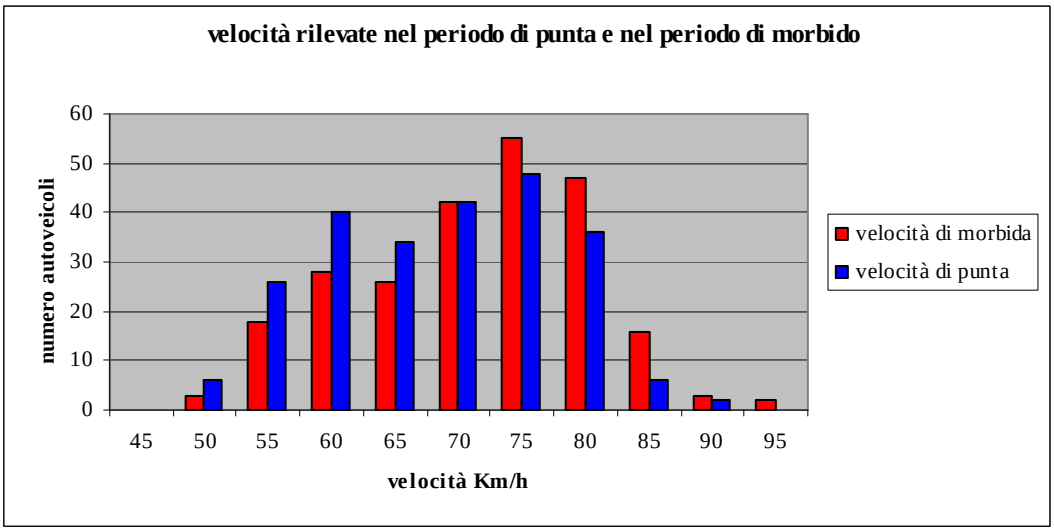
T = operating time equal to:

- 12 s in the presence of previously regulated by maneuvers
- 6 s in the presence of operations regulated by Stop

The design speed of Avenue of the Sorbonne is 60-80 km / h, but the limit is 50 km / h, so users are taken to overcome it.

In particular, have been recorded traveling speed of the users: the period chosen was between 16 and 17, for measures of the soft period and between 18 and 19 for the peak period. The velocities detected are referred to 240 vehicles during the period of soft and as many in the peak period. Furthermore, the distinction was made between the two lanes to one (overtaking) lane and B (running).

Velocity Km/h	*45*	*50*	*55*	*60*	*65*	*70*	*75*	*80*	*85*	*90*	*95*	TOT vehicles
N° vehicles Peak hours	0	6	26	40	34	42	48	36	6	2	0	240
N° vehicles Period of soft	0	3	18	28	26	42	55	47	16	3	2	240
N° vehicles Lane A(overtaking) Period of soft	0	0	0	2	2	12	53	44	16	3	2	134
N° vehicles Lane B(walking) Period of soft	0	3	18	26	24	30	2	3	0	0	0	106
N° vehicles Lane A(overtaking) Peak hours	0	0	0	8	8	16	46	35	6	2	0	121
N° vehicles Lane B(walking) Peak hours	0	6	26	32	26	26	2	1	0	0	0	119



8 - Number of vehicles divided by the traveling speed and lane (overtaking) and B (running).

Near the intersaction the sight distance is 133 meters calculated for speeds of 80 km /h, and 83 for a speed of 50 km / h.

Were taken several photographs, driver's height, to observe the visibility at various distances of approach the intersection.

9 - The view of a motorist at 133 meters from the intersection at grade.

10 - The view of a motorist at 83 meters from the intersection at grade.

11 - The view of a motorist at 133 meters at the stop intersection at grade.

The vehicles traveling at a speed greater than or equal to 80 km / h was 29.2% of vehicles monitored in the hour of soft and 18.4% during rush hour. This means that, although in theory there are no problems, because when the vehicles come at 50 km/h the distance is sufficient, in practice few people respect the speed limit, then there are questions of safety.

2- Project proposal to treat the selected high risk site

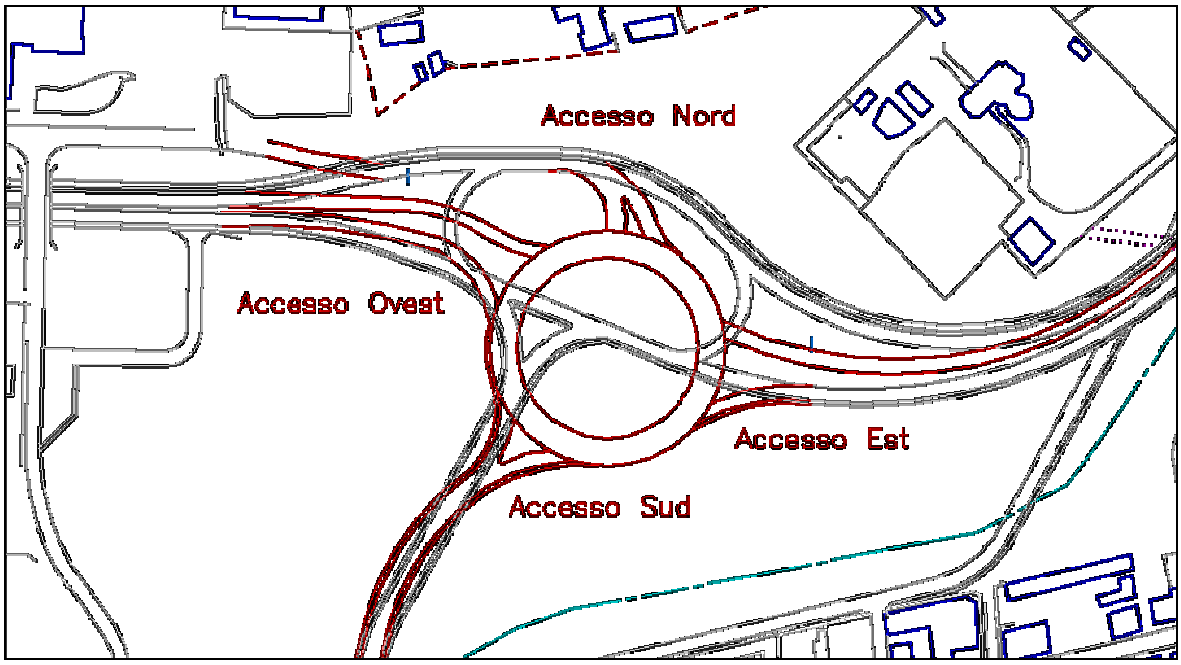
At this point it is necessary take action in order to reduce speed and thus the accident of the site. It is possible with the introduction of a roundabout or intersection with traffic lights. Have been proposed two scenarios for action that differ in the type of construction and development cost.

2.1- First case: Roundabout

It 'was the first choice because it appears to have a higher security level than other types of intersections; this aspect is mainly due to the following reasons:

- The roundabouts have fewer conflict points than conventional intersections. With the use of roundabouts, in fact, eliminate bumps on the right side of vehicles and frontal impacts related to the direct left turn. A single lane approach provides better security than multi-lane approaches as there are fewer points of conflict between road users and also crossings cover shorter distances;
- The low speeds associated with roundabouts give way to drivers to have more time to react in dangerous situations;
- The vehicles travel at speeds similar at roundabouts, thus having the relatively low speeds, which leads to less severity of collisions compared to traditional signalized intersections;
- The pedestrians have the opportunity to cross one direction of traffic at a time in each approach, also the speed of two-wheeled vehicles, incoming and outgoing calls are reduced by a good design of the roundabout itself.

Before proceeding with the definitive design of the geometry of the roundabout was carried out a study on the “Capacity” of the roundabout. It is a parameter that allows to define whether the roundabout fulfills well the task of flow traffic or if its implementation would lead to an increase in the traffic itself.

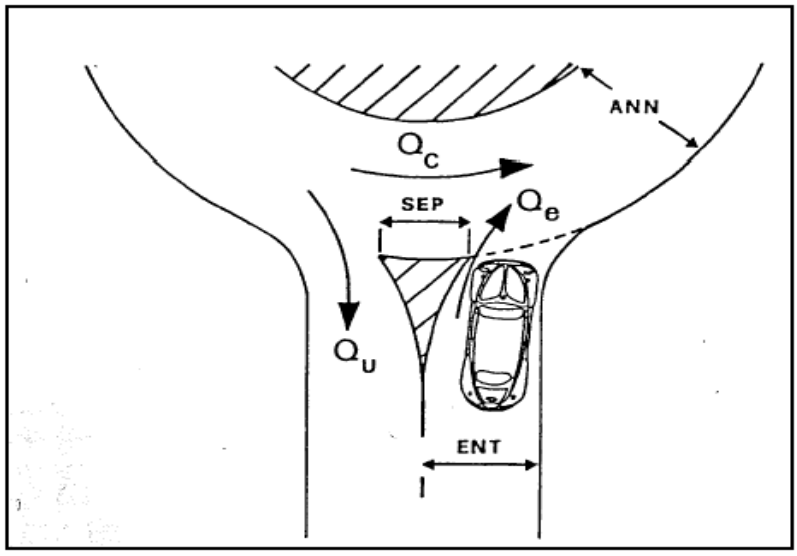


12 – First case: Roundabout.

The method used is the French SETRA That has the following characteristics: both the capacity and flows are measured in equivalent passenger cars per hour (EPH). To transform the flow of vehicles other than passenger cars in the eph will exploit the conversion factors proposed by Swiss standards:

Tipo di veicolo	**Coefficiente di conversione**
1 ciclo o motociclo sull'anello	0.8 autovetture
1 ciclo o motociclo in ingresso	0.2 autovetture
1 veicolo pesante	2.0 autovetture
1 autobus	2.0 autovetture

13 – Conversion coefficients.



It calculates the capacity Qe of the boom by the relation:

$$Q_e = (1330 - 0{,}7 * Q_d) * [1 + 0{,}1 * (ENT - 3{,}5)] \quad \text{[uvp]}$$

$$Q_e^{'} = \frac{Q_e}{1 + 0{,}1 * (ENT - 3{,}5)}$$

Q_c , Stream that runs through the ring at placing [uvp]

Q_e, Inflow [uvp]

Q_u , Outflow [uvp]

SEP, wide median island at the end of the arm [m]

ANN, ring width [m]

ENT, width of the seeds carriageway of the arm, measured behind the first vehicle stopped at the line of "give way" [m]

The method SETRA led to the following results:

7:30-9:30		nord	sud	est	ovest
SEP	[m]	14	14	18	18
ENT	[m]	4	4	7	7
ANN	[m]	8	8	8	8
Qc	[uvp/h]	1489	735	52	648
Qe	[uvp/h]	0	265	1437	1077
Qu	[uvp/h]	488	990	924	1301
Qu'	[uvp/h]	33	66	0	0
Qd	[uvp/h]	1511	779	52	648
C	[uvp/h]	273	785	1746	1183
Cp	[uvp/h]	123	635	1596	1033
Qe'	[uvp/h]	0	265	1064	798
RC	[%]	100	58	10	-4
	analysis:	ok	ok	ok	saturated

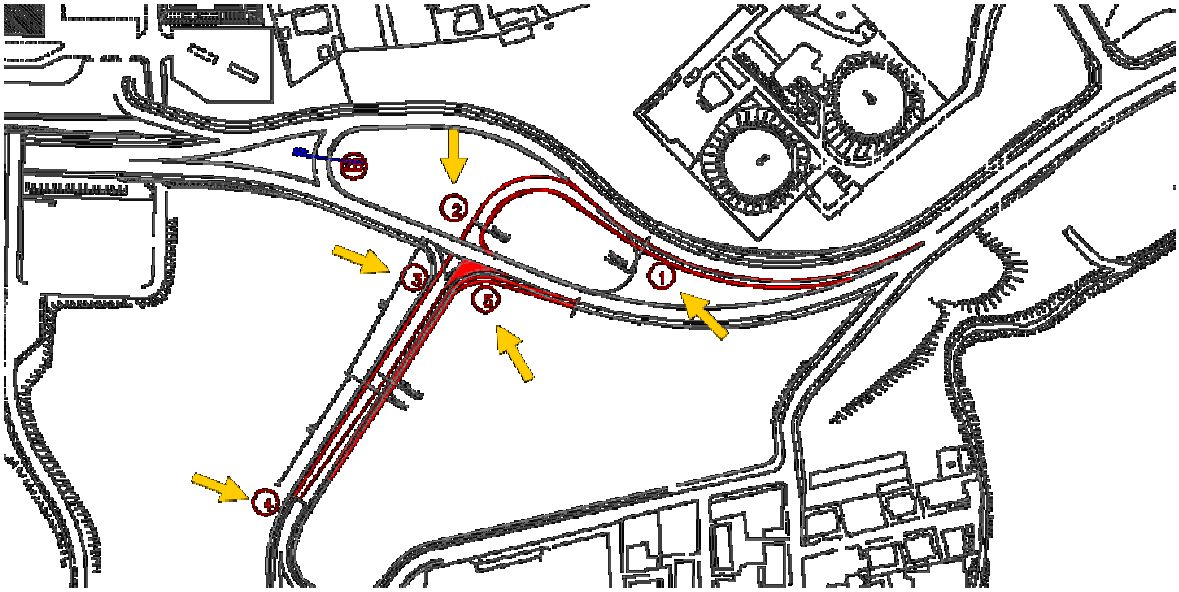
17:30-19:30		nord	sud	est	ovest
SEP	[m]	14	14	18	18
ENT	[m]	4	4	7	7
ANN	[m]	8	8	8	8
Qc	[uvp/h]	1602	1121	100	629
Qe	[uvp/h]	0	281	1502	1559
Qu	[uvp/h]	570	1067	1225	1520
Qu'	[uvp/h]	38	71	0	0
Qd	[uvp/h]	1627	1168	100	629
C	[uvp/h]	191	512	1701	1201
Cp	[uvp/h]	41	362	1551	1051
Qe'	[uvp/h]	0	281	1113	1155
RC	[%]	100	22	3	-48
	analysis:	ok	ok	ok	saturated

It is therefore inappropriate to introduce the roundabout as it would be saturated and would not be able to successfully dispose of the traffic.

2.2- Second case: Traffic light 1

This proposal involves the introduction of traffic light redesigning the geometry of the entire intersection, because the current geometry does not present the usual appearance of a four-arm intersection.

This results in higher costs which must not only provide for the inclusion of traffic lights, but also for the reconstruction of the geometry near the intersection, the gain is get in the efficiency of the intersection.



14 – Second case: Traffic light 1.

The sizing was performed with the classical method of Webster English: it determines the flow rate S from a base value Sb considering ideal conditions, to be later corrected by the coefficients Ki instead consider the differences with the real case of study.
It takes into account the geometry of the intersection and traffic conditions:

- The width of access L;
- inclination of the access i ;
- Scope or traffic volume of access q;
- Composition of traffic flow in various streams of traffic;
- Type of maneuvers;
- Interference with vehicular and pedestrian flows;
- Presence of any parked vehicles;
- dislocation of intersection in the urban area.

So we have that the flow S is given by:

$$S = S_b \cdot K_1 \cdot K_2 \cdot \ldots\ldots\ldots\ldots\ldots..K_n \qquad \text{[vehic/h]}$$

with:

$$S_b = 525 \cdot L \qquad \text{con } 5{,}5m < L < 18{,}5m \qquad [vehic/h]$$

$L = L_g - L_r$

L_g geometric width;

L_r reduced width:

$L_r = 1{,}65 - [\ 0{,}9 \cdot (\ D - 7{,}5\ ) / V\ ]$ if $D > 7{,}5$ m

$L_r = 1{,}65$ if $D < 7{,}5$ m

K_1 coeff. of Vehicle Composition:

$$K_1 = 1 / \Sigma\ a_i \cdot E_i$$

a_i is the fraction of vehicles of type i;

E_i is its coefficient of equivalence:

Vehicle type	Equivalence factors
Passenger cars and light goods vehicles	$E_a = 1.00$
Medium and large heavy vehicles	$E_p = 1.75$
bus	$E_b = 2.25$
Tram	$E_t = 2.50$
Motorcycles	$E_m = 0.33$
Bicycles	$E_c = 0.20$

K_2 coeff. of Slope of the access:

$$K_2 = 1 + 0.03 \cdot i \ ;$$

K_3 coeff. of Localization of the intersection:

Area	K_3
Suburban residential	1.00
Commercial	0.98
Industrial	0.93
Business center	0.85

K_4 coeff. of Type of operations:

$$K_4 = 1 / \Sigma\ a_i \cdot E_i$$

a_i are the villages of brought to access for the individual maneuvers;

E_i are the coefficients of equivalence.

Type of operation	Equivalence factors
Marcia direct	$E_d = 1.00$
Turn right	$E_{ds} = 1 \div 1.25$
Turn left	$E_{sn} = 1 \div 1.75$

K_5 coeff. of interaction with pedestrians:

$K_5 = 1 - \alpha$

α = 0.05 for low flow rates of pedestrian crossing (100/ora);

α = 0.15 for average flow rates to pedestrian (300/ora);

α = 0.25 for high values of pedestrian flow (500/ora).

The capacity C is :

$$\mathbf{C = S \cdot \lambda = S \cdot \frac{V_E}{C_I}}$$

$$V_E = V_E^{'} - \frac{q \cdot R_E}{(S - q)}$$

con: V_E' Effective green of opposite operation of the turn:

q that represents the scope of opposite access.

Below are the results for the study of the traffic light cycle (using the Webster's Method) and the estimated costs necessary for its implementation:

	7:30-9:30		
Road hubs	nord	sud	est
Cl[sec]	55	55	55
Giallo[sec]	3	3	3
Ared[sec]	2	2	4
Verde[sec]	16	16	26
Rosso[sec]	34	34	22
C [v/h]	1062,27	513,24	1002,14
degree of saturation	0,61	0,52	0,61
λ	0,31	0,31	0,55
Wdoherthy[sec]	13,1156	13,1160	5,6819
Service Level	B	B	A

	17:30-19:30		
Road hubs	nord	sud	est
Cl[sec]	55	55	55
Giallo[sec]	3	3	3
Ared[sec]	2	2	3
Verde[sec]	16	16	27
Rosso[sec]	34	34	22
C [v/h]	1042,19	503,53	983,19
degree of saturation	0,60	0,56	0,60
λ	0,30		0,55
Wdoherthy[sec]	13,3387	13,3393	5,5380
Service Level	B	B	A

As you can see, the level of service that is reached is very satisfactory, so the choice to insert an intersection traffic light is the right way to solve the problem of safety and disposal of traffic of the intersection.

The proposed work includes:

- Construction traffic light
- Make changes to the current traffic
- Maintenance

Costs were estimated based on the pricing of the Lazio Region:

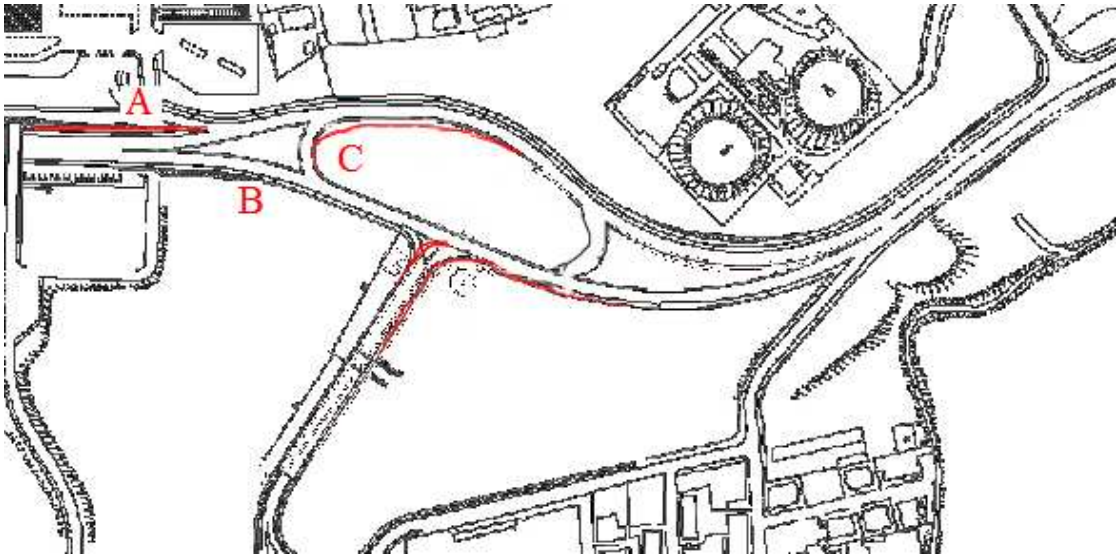
Electrical works		euro	17000
Masonry	excavation for electrical cables	euro	40000
	rebuilding lanes	euro	140000
Maintenance		euro/year	3500
TOTAL		euro	200500

Could seem that the proposed costs are very high, but in Italy the cost of an injured person is about € 22,000, while a victim is 1.2 million €. It is easily deduced that the investment is entirely beneficial.

2.3- Third case: Traffic light 2

This proposal came after the estimate of cost, calculated previously. The intention is to lower costs further by introducing an intersection with traffic lights without disrupting the existing structure of the intersection.

This result not only savings in terms of cost but also reduces the processing time.



15 – Third case: Traffic light 2.

This solution is to place a pedestrian crossing in the outside lane of Route Sorbonne (A), insert an implant of traffic lights in the inside lane of the Sorbonne (B) and arm entry for Stanford Street (C). Below are some images with reconstructions of the project:

16 – Pedestrian Crossing (A).

17 – Traffic light (B).

18 – Traffic light (C).

It is a cost effective solution because it regulates only two flows (from west to east and from north to south), without having to intervene in the flow that goes from east to west that is not congested or subject to points of conflict.

Below are the results for the study of the traffic light cycle (using the Webster's Method) and the estimated costs necessary for its implementation:

7:30-9:30		
Road hubs	nord	est
Cl[sec]	60	60
Giallo[sec]	3	3
Ared[sec]	2	4
Verde[sec]	25	23
Rosso[sec]	30	30
C [v/h]	850	1403,47
degree of saturation	0,76	0,77
l	0,43	0,43
Wdoherthy[sec]	9,6355	9,6347
Service Level	A	A

17:30-19:30		
Road hubs	nord	est
Cl[sec]	60	60
Giallo[sec]	3	3
Ared[sec]	2	4
Verde[sec]	25	25
Rosso[sec]	30	28
C [v/h]	850	1403,47
degree of saturation	0,74	0,77
l	0,43	0,43
Wdoherthy[sec]	9,64	9,6347
Service Level	A	A

Electrical works		euro	17000
Masonry	excavation for electrical cables	euro	40000
	rebuilding lanes	euro	10000
Maintenance		euro/year	3500
TOTAL		euro	70500

3- Campaign to get the high risk site treated

My first step was to contact my professor at the university and I had many meetings with him, especially marked in the technical study of the intersection and in the best choice to solve the problem.

In fact, although the best choice is the second (presented in the previous chapter), we decided to propose the third because we thought it appropriate to have a chance of effectively and economically, in fact the authorities that I have contacted were more likely, especially for the lowest price!

Then I contacted two of the major newspapers of my country and also local newspaper and related to the student context:

il Giornale (Italian national newspaper) for the section dedicated to the city of Rome;

Il Messaggero (a historic national newspaper based in Rome);

Newspaper of the University of Rome;

Radio journalat University Tor Vergata;

GIROMA (Newspaper online information about Rome).

I asked them to have published an article about the activity that the ETSC and my university carry to raise awareness on road safety (I enclose the letter I sent them).

Mi chiamo Azzurra Evangelisti e sono una studentessa della facoltà di Ingegneria Civile Magistrale presso l'Università di Roma "Tor Vergata".

Vi scrivo perché ho il desiderio di pubblicare un breve articolo riguardante il lavoro di cui mi occupo da qualche mese, commissionato dalla ETSC (European Transport Safety Council).
Si tratta di individuare un sito stradale particolarmente pericoloso e studiarne in maniera dettagliata la bonifica, possibilmente proponendo più di una soluzione.
Il sito da me scelto è un'intersezione a raso che si trova nel "Corridoio della Viabilità" , nel nuovo quartiere universitario della seconda Università di Roma: precisamente si tratta dello svincolo che collega Viale della Sorbona a Via Standford. È un tratto che presenta un notevole traffico urbano in quanto è l'unica via di accesso all'Università e al Policlinico di Tor Vergata, e tuttavia conta numerosi incidenti, con più del 40% di feriti gravi e qualche decesso.
Sento una particolare responsabilità nello studio e nella campagna di sensibilizzazione verso l'intervento delle Autorità, per la bonifica di questo sito, in quanto le vittime degli incidenti sono quasi unicamente giovani studenti dell'università.

L'intervento che ho ipotizzato e che ridurrebbe in maniera drastica il numero di incidenti, consiste nell'introduzione di una semplice intersezione semaforizzata. Si tratta di un intervento relativamente economico e i cui costi verrebbero immediatamente assorbiti dal notevole risparmio che si otterrebbe dalla riduzione del numero di feriti e decessi.
Quello che chiedo a Voi , quindi, è semplicemente la possibilità di veder pubblicato un breve articolo che sottolinei come l'Europa per prima, le Università e gli studenti, siano sensibili al problema delle vittime stradali e propongano soluzioni per ridurne il numero.

Allego al seguente comunicato, la lettera di presentazione che la commissione Europea per la sicurezza stradale ha stilato per me.

Ringrazio anticipatamente per la collaborazione.

I asked to the Lazio region, the opportunity to have a meeting with the City Council to show my project. After four months I have been given permission to speak an engineer of the technical office of the municipality, that has reviewed the project and indicated an interest in the third project, as it represents the most economical solution.

In April there werw political problems within the City Council who presented entire the resignation. This caused the lock on future projects and only activities already funded by previous City Council have been implemented. I have so lost contact that I had.

I decided then groped the way of advertising "low level", involving only small municipal authorities, as the school which is located near the district.
I have had preliminary meetings with teachers, to whom I presented the R2R project, I described my project for the intersection and decided to make the meetings with the classes.
In these meetings we initially talked about road safety, the importance of good signage and driver education.
Then I also had an afternoon meeting with parents, to whom I presented my project to clean up the intersection and they were very interested in meeting with their children and the possible development of new activities to improve road safety in our neighborhood.

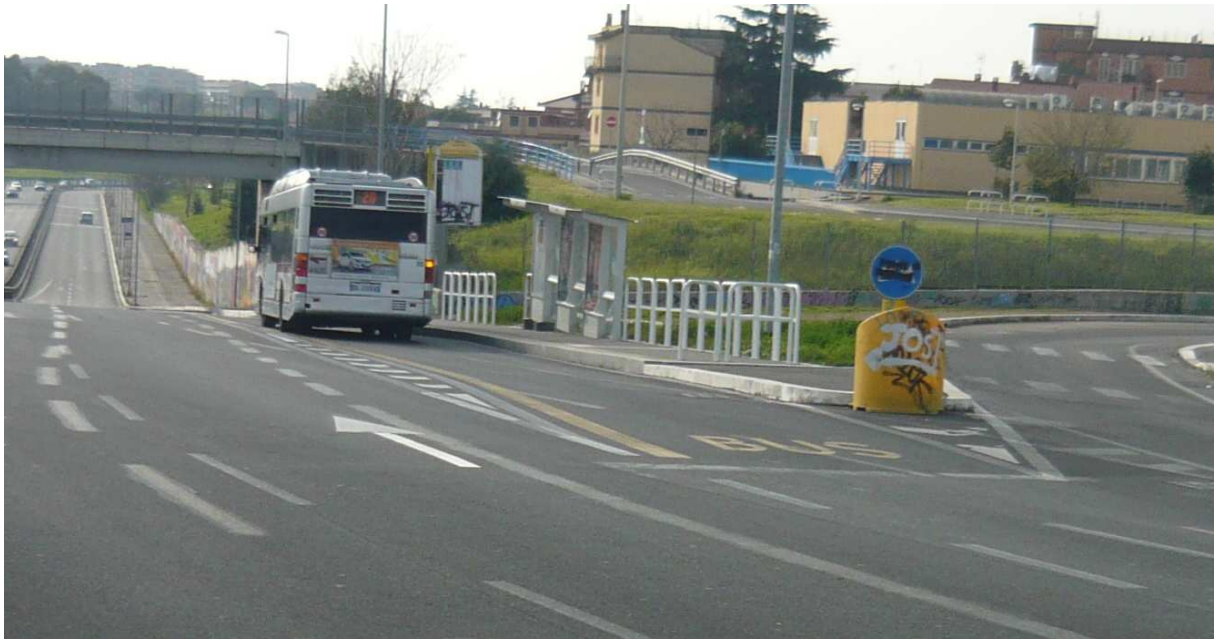
I had e chance, at the end of june, to show my project to a committee of the new City Council, but I have been given to understand that, for the moment, it is not possible put my project in the context of programming, because the priorities of the district are linked to the development of the subway line that was used for their election campaing.

The authorities were not inclined to help me, but individual citizens have shown very sensible to these issues, especially because it comes to the streets of our neighborhood.

The university newspapers have agreed to the publication of an article and a speech to the Radio to publicize the activity, but still it would not have entered in the steps of editing.

4- Achievements of the project

In these months of the campaign works were carried out near the intersection of that I'm studying. The intervention consisted in the enlargement of via della Sorbona from two to three lanes, only in the vicinity of the intersection with University entrance.



19-20 – Enlargement via della Sorbona.

The works of widening of the road, near the bus stop, were covered in the project to upgrade the efficiency of the “Corridoio della viabilità” inaugurated in 2009.
This is an advantage for the third case that I presented, because I really expected the expansion of traffic lanes near the intersection. In fact, the third proposal would not interrupt, with a traffic light intersection, the flow that goes from east to west, and this expansion allows the bus stop safely, without slowing the flow behind.
Expenses that I predicted is then further reduced:

Electrical works		euro	17000
Masonry	excavation for electrical cables	euro	35000
Maintenance		euro/year	3500
TOTAL		euro	55500

As I already mentioned in the previous paragraph, when I realized that the authorities would not have helped me, because they are apparently engaged in election campaigns, I decided to conduct my campaign trying to raise awareness among my fellow citizens, involving schools and parents of pupils.

These have proved very sensitive to the issue of road safety, especially because our neighborhood is peripheral, and many children spend time playing in the street. So by the parents themselves started the idea of making a large collection of signatures and to follow a constructive path that will last the entire next school year.

This means that, although this year has failed to get the proper attention, I do not give up and will resume meetings in September on road safety in classes of schools and to collect signatures for the remediation of the site chosen by me and other hazardous sites in our neighborhood.

I enclose a poster that can use the next year:


La sicurezza stradale nasce da lontano..