EFFICIENT ARTERIAL MOUVEMENT ARRANGEMENTS TO REMOVE A MULTIPHASED SIGNAL IN LUCCA (Tuscany, Italy)

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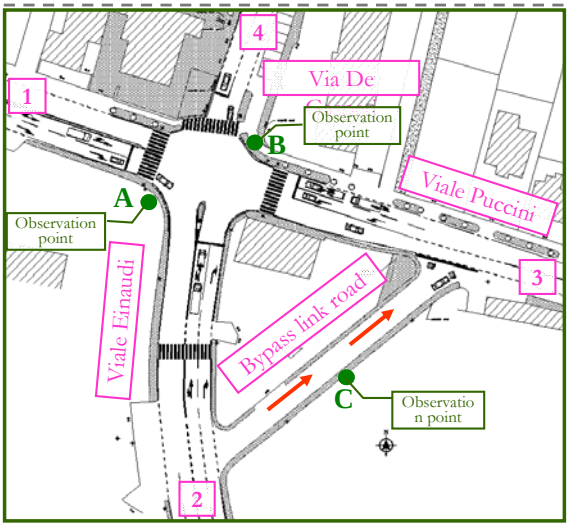
ABSTRACT

This planning idea is conceived into the framework of an existing research contract stipulated by the Municipality of Lucca with the Department of Civil Engineering for traffic analysis and task problem solving on the urban transport system.
The intersection is placed in Lucca, a small town placed in central Tuscany having about 90.000 inhabitant, and it is located in the north-west of the town at a critical at-grade junction between the center and a developing suburban area.
The main road is S.R. 439 "Sarzanese Valdera" – in its arterial urban track named Viale Puccini – that is the east-west direction. Other branches are Viale Einaudi, south bound connection with Motorways A11 and A12, and Via De Gasperi at north bound. Nowadays, the at-grade intersection is controlled by semi-actuated traffic signal and all the entries have two lanes, with the exception of Via De Gasperi which has single lane entry without flare.
In the Urban Traffic Master Plan is referred that such a road junction is charged by weekday high flows, usually producing long queues both on Via Sarzanese and on Viale Einaudi. A typical feature of the actual road configuration is the one way link connecting Viale Einaudi to Viale Puccini (westbound). This way allows the right turns of vehicles coming from Viale Einaudi. However, such bypass link road is scarcely used now.
Our main planning goal deals with the setting up of new movement arrangements introducing a self-regulated priority's system in order to remove the signal, and its related queues, improving efficiency and lowering traffic negative impacts. The proposed new layout goes beyond the mere intersection area. First, because it involves a larger block area. Second, because the limits of each existing facility are taken into account, in the respect of National standards on geometric, safety and economic requirements.
A traditional roundabout layout could not be suitable to the particular configuration of the intersection both because of actual difficulties to find the required spaces (subordinate to some expropriations) and to the imbalance among the different traffic flows (generally required for good performances of the roundabout).
Therefore we propose a design layout and evaluate both traffic performances and acoustic emissions as may as in the Present Condition and the Proposed Layout. The obtained results show that the proposed solution is able to improve at notable extents both traffic operations and circulation safety, while the environmental effects are reduced at the same time.



Present Condition

Performances

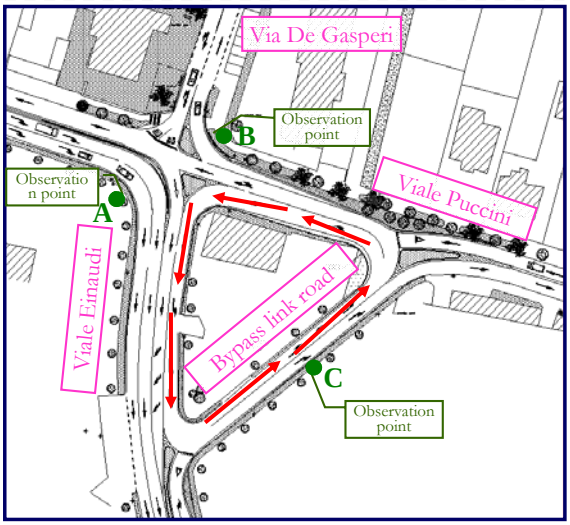
Performances are evaluated by L.o.S. for eachone of the two cases. The applied procedure is ***HCM 2000***.

Signalized intersection		
Method	Control Delay per vehicle (s/veic)	L.o.S.
HCM 2000 (chap. 16)	70,6	E

Acoustics

To acquire acustic data is used the sound level meter ***Larson Davis LD824***, an instrument that learn the resonant pressure and translate it into a counted electric signal.
This instrument had permitted to determinate the equivalent noise level L_{eq}.
The parameter Q_l (hourly volume of light vehicle) e Q_p (hourly volume of heavy vehicle) are evaluated directly in site.
Executing relief we have selected the model of Italian Council Research's (**C.N.R.**).

Observation point	Leq (dBA)	Q_l (vehic./h)	Q_p (vehic./h)
A	70,3	704	18
B	69,2	673	11
C	63,4	276	1



Proposed Layout

The new Proposed Layout takes a sorting tournament of triangular form with one way circulation; it is the roundabout's principle. The difference is that in such a case the approaches are designed to take into account the importance of traffic flows, related to the volumes entering the intersection.
Then, L.o.S. of Proposed Layout has been determined. This case has required to consider different capacity methods for the entries and the weaving area. The references are HCM2000 and S.E.T.R.A. methods.

Entry	Reference	Parameter	L.o.S.
Weaving Area	HCM 2000 (chap. 24)	4.45 vehic./km/line	A
Entry Viale Einaudi	S.E.T.R.A.	4 s	A
Entry Viale Puccini	S.E.T.R.A.	9 s	A
STOP Via De Gasperi	HCM 2000 (chap. 17)	13,6 s	B
Overall L.o.S.			A

The overall efficiency is very good. The delays are dropped down and the traffic operations become high efficiently (LoS A) from poor (LoS E).

C.N.R. Model

Calculation for the New Layout are performed applying the C.N.R. model (also called "Modello Corbino") which follows:

$$Leq = 35{,}1 + 10 \cdot \log(Q_L + 8 \cdot Q_P) + 10 \cdot \log(25/d) + \Delta L_v + \Delta L_f + \Delta L_h + \Delta L_s + \Delta L_g + \Delta L_{vb}$$

The different parameters are referred to corrective factors that vary according to the distance from the measure point, to the presence of close buildings, to layer level and to specific traffic conditions on the road.

Measure's point	Actual State	Project State
A	70,3	68,5
B	69,2	68,6
C	63,4	69,25

It is largely improved the **road safety**:
- Conflict points are reduced in number and kept at distance;
- All movements become right turns;
- Vehicle speeds are lowered due to reduced radius and shortened links, also conditioned by weaving;
- Pedestrian and cyclists are drove away from the intersection zone.