Potential usefulness of Continuous flow intersections in greater Philadelphia

Final Proposal

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Abstract

For my Engineering 90 project I intend to study continuous flow intersections (CFI), and ultimately propose and design a CFI for a busy intersection in the Philadelphia area.

Introduction

When two roads intersect, it is ideal to design the intersection so as to minimize the aggregate waiting time for all cars using the intersection. Across the United States, the number of congested intersections is rapidly increasing. Intersections where there are a large number of stopped cars waiting to get through is a major problem. Oftentimes, cars may have to wait through several traffic light cycles in order to go through. The stopped cars increase pollution, contribute to economic losses through time spent in traffic, and increase people's overall stress level. The best option to ease congestion in an at-grade intersection would be to convert it into a grade separated intersection. However, this is often cost-prohibitive, and can disrupt businesses that are located at these intersections.

Technical Discussion

An alternative to grade-separated road crossings that greatly improves traffic flow is the continuous flow intersection, abbreviated CFI from here on. A CFI changes the way people make left hand turns. Whenever someone wishes to make a left-hand turn at a busy intersection, they must first wait for the light to turn green, and then wait for oncoming traffic before they can turn, meaning people making left hand turns have to wait an additional length of time. Another option that is sometimes employed is to have a phase in the light cycle dedicated to people making left hand turns. However, this latter option requires all drivers at the intersection to wait longer for the green light, since the cycle contains many more phases, although this cycle might be necessary because drivers wishing to make a left hand turn may have no opportunity to turn due to continuous oncoming traffic. With CFI's, drivers wishing to make a left-hand turn cross the

oncoming traffic lanes a couple of hundred feet before arriving at the intersection. The following diagrams illustrate how the procedure takes place

Figure 1- Those wishing to make a left hand turn are directed into a bay between the two main lines of traffic, as seen in the middle of the figure.

Figure 2- The drivers then cross the oncoming lanes of traffic into a bay that is located to the left of the oncoming traffic lanes.

Figure 3- The drivers then proceed to the intersection, where they make their left hand turn without having to wait for oncoming traffic to pass. The lights are timed so that soon after the green light is given to cross oncoming traffic, the light at the intersection turns green, allowing only one waiting period for left-hand turning traffic.

For this project, I will need to consult publications on signalized intersection theory. There are many parameters that govern traffic flow through signalized intersections, such as cycle length, average wait time, arrival rate of cars, flow rate

through intersection, displayed and effective red time, and others. One of the advantages of continuous flow intersections is that they cut down effective red time for drivers wishing to make left-hand turns, making it closer to the displayed red time in an intersection. Measurements that would need to be taken at intersections would include cycle length, the average flow rates from all directions, where they go, how long each direction has to wait, including, at the busiest times, how many cycles cars going certain directions have to wait. Particularly for cars making left hand turns, they may have to wait a number of cycles before they can make their turn. Intersections where such situations exist would definitely need to be redesigned. Determining whether or not an intersection would need to be reconfigured into a continuous flow intersection would be an objective of this project.

Project Plan

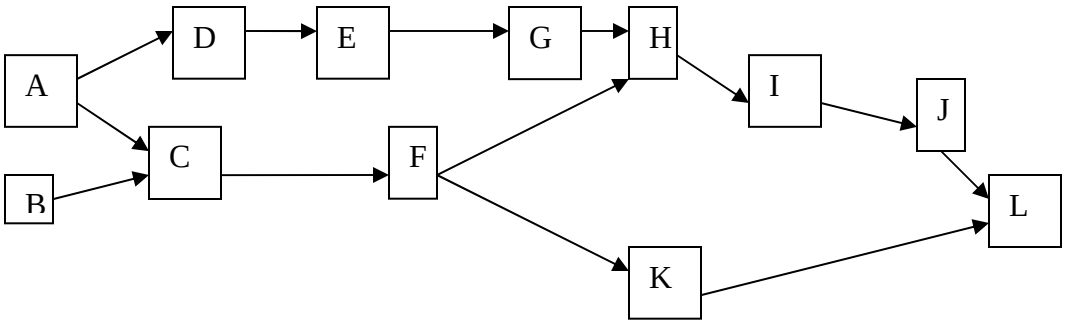
At first, my project will involve doing as much research as possible in traffic engineering, particular intersection design. Then, I will attempt to do as much research as possible on continuous flow intersections. I will attempt to speak to one of the designers of the three CFIs in the United States and acquire the design reports for the construction of these intersections. A number of the articles that I have read have presented calculations made by these transportation engineering firms indicating the time savings at each of the CFIs in the United States. Hopefully, I could be able to get a copy and gain a full understanding of these calculations, so I could apply them to other intersections that are not CFIs. The goal of this phase is to determine which conditions present at an intersection are ideal for it to be converted into a CFI. In any intersection, it must be demonstrated that the benefits of conversion outweigh the costs of construction and delays caused by construction, which usually takes around 6 months in length.

After I have assembled all of this information, I will attempt to identify busy at-grade intersections within the greater Philadelphia area. For this, I may need assistance form some transportation engineering firm in Philadelphia. Swat Alum Mark Handler ’05 should be an excellent resource as he works at a transportation firm in Philly. The next step would be to identify 4-6 intersections to be used in a comparison study. (This number range is very likely to change) For this study, I will examine conditions at these intersections and determine if a CFI would be helpful at that intersection. Hopefully, I

could do time saving calculations for each of these intersections, and be able to determine which intersection would experience the greatest time improvement for the implementation of a CFI. Once this is done, I can present the data as a proposal for building a CFI at this intersection. Also, I hope to design a continuous flow intersection

Critical Path/ Gantt Chart

Task	Task	Completed When
A	Research Traffic Engineering and intersection design	A collection of equations and parameters are obtained which detail intersection wait times.
B	Research Continuous Flow intersections	Have a complete understanding of how they work, traffic light phasing and wait times and places, where located, and who designed them,
C	Contact Designers of CFI's in the United States	Designs/Reports of CFI's are obtained for at least one CFI. Should have values for traffic flow measurements and signal lengths before and after construction.
D	Contact Traffic Engineering Firms in Philadelphia Area	A mentor relationship is established with someone who specializes in intersection theory.
E	Identify busy intersections in Philadelphia area where CFI's may be feasible	Have a preliminary list of 6-10 intersections, which may be narrowed down at future dates.
F	Identify conditions necessary for a CFI to be feasible	Have values for parameters for traffic flow through a busy intersection
G	Obtain preliminary data on these intersections, narrowing down list.	A list of 3-4 intersections is selected where measurements can be easily obtained.
H	Visit intersections and acquire data	Enough information is obtained to use as parameters for traffic flow equations.
I	Identify which intersections would benefit from a CFI, and which one would benefit most from a CFI	Have a single number which can indicate the potential improvements (or harm) a CFI would cause.
J	Design a CFI at that intersection	A detailed drawing is made of the intersection, using AutoCAD.
K	Write Report	Report Complete
L	Give Presentation	Presentation Made



Qualifications

I consider myself qualified to carry out this project because of my study of civil engineering throughout my career at Swarthmore. In particular, Geotechnical engineering will be helpful as I will have to learn about some pavement design when learning about the construction of roads. In addition, I am currently taking a course in Operations research, which deals with linear modeling and optimization techniques which will be especially helpful as I am in essence creating a model where I am attempting to minimize building costs and the time spent passing through the intersection. While I haven't taken any courses in transportation or traffic engineering, part of my E90 project will involve studying certain principles of traffic engineering, particular on signalized and non-signalized intersection theory.

Conclusions

I'm looking forward to studying continuous flow intersections and trying to determine transportation solutions for the greater Philadelphia area. When I was an intern working for Dan Honig between my sophomore and junior years, I frequently drove to many sites during rush hours, and got stuck in traffic at busy intersections. Since I'm somewhat familiar with these traffic issues, I believe that it is necessary to investigate transportation solutions that will improve the environment, the economy and the overall health of people's lives in the Philadelphia area. I believe that continuous flow intersections are part of that solution.

References

-ABMB Engineering Firm designed and implemented a continuous flow intersection in Baton Rouge, Louisiana. I will attempt to contact them and hopefully find someone who could be a mentor for my project.

-*Traffic Flow Theory, A State of the Art Report,* June 1992, written through a collaboration of engineers at Oak Ridge National Laboratory. http://www.tfhrc.gov/its/tft/tft.htm

-Pennsylvania Department of Transportation Bureau of design- http://www.dot.state.pa.us/Internet/Bureaus/pdDesign.nsf/DesignHomepage?OpenFrameSet.

-*Continuous Flow Intersections: Gaining Speed in the United States,* by Michael G. Bruce, P.E., and Paul W. Gruner, P.E., P.S. CE News feature, Jan. 2006.