Traffic Engineering in Small Communities Under 50,000 Population

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TRAFFIC ENGINEERING—A BIG AND RESPONSIBLE JOB

This discussion concerns traffic engineering in a small community, particularly those communities under 50,000 population. In most cases, the cities with populations in this category cannot afford a full-time traffic engineer on the city staff. However, this does not mean that a traffic engineer or the services of a traffic engineer is not needed in some fashion or another. All cities have traffic problems, regardless of their size.

Following are some of my experiences encountered in working with smaller cities in traffic engineering. Some of the ideas that I have, although they may not be earthshaking, may be of assistance in the traffic engineering program in your community.

Definition of Traffic Engineering

In order to set the stage, consider the purpose of traffic engineering and the constitution of the Institute of Traffic Engineers. In the ITE Constitution traffic engineering is defined as, “That phase of engineering which deals with the planning, geometric design and traffic operations of roads, streets and highways, their networks, terminals, abutting lands, and relationships with other modes of transportation for the achievement of safe, efficient and convenient movement of persons and goods.”

Numerous Tasks—Technical and Complex

It is obvious that a great deal of responsibility is vested in the traffic engineer. A considerable amount of work needs to be done when we talk about planning, geometric design, traffic operation of our roads and streets, and not only that, but how they interface with one
another, the terminals, and the abutting land and its access. Not too often in the smaller communities are we concerned with other modes of transportation such as mass transit, but we may have to consider taxis to some degree and perhaps bicycles. So I think that the purpose of the definition given here applies to both large and small cities and sets the stage for this discussion.

**Must Deal with Both Engineering and People**

We also know that traffic engineering is unlike most engineering disciplines when we think of engineering as dealing with problems which depend primarily on physical factors. We can set down a formula for an electrical engineering problem or a mechanical engineering problem and come up with a solution. In traffic engineering one can do this to a point, but the human element must be considered. The human element involving the driver, and the pedestrian and their relationship with each other and with the road complex. Therefore, the traffic engineer or the traffic technician is in a unique position. He must be sensitive to many disciplines because what he does, or more importantly, what he fails to do, affects very large numbers of people. Often the people don’t know that they are being affected by the traffic engineer, the traffic officer, or the traffic technician, because they don’t realize what is being done to them.

**Traffic Engineering Dates Back to Early Romans**

If we were to look back into history, we would find that traffic engineering as it is known today has evolved with the automobile. Actually, many of the precedents that were established are grounded in ancient history. For example, one-way streets were known in ancient Rome along with special off-street parking facilities which were provided to remove the chariots from the roadway or the travelled way. Vehicles were prohibited from entering the business districts of large cities in the Roman empire during certain hours of the day because of traffic or chariot congestion. One of the first no parking regulations was invoked in England at a neighborhood tavern which prohibited the parking of horses and buggies on the roadway.

**Traffic Engineering and Rights and Privileges**

At this point, I would like to distinguish between a privilege and a right. In my opinion, a privilege is something that is granted for use, such as parking or a drivers license, which can be taken away if needed for the welfare of the general public, such as parking, or revoked if misused as in the case of the drivers license. A right is something that is guaranteed by the constitution or bill of rights, such as the freedom
of speech. This analogy might be helpful in your deliberations of parking removal or other traffic regulations.

HOW TO SELL TRAFFIC ENGINEERING TO CITY OFFICIALS

Show the Needs

Following are some ideas on how to sell a traffic engineering program to your supervisors, whether it be the mayor, board of works, city council, chief of police, city engineer, or whoever your responsibility falls under. If a particular city administration is not cognizant of the traffic problems, it is difficult to sell them on the idea that something needs to be done, and that something can be done to improve the flow of traffic. The job can be done, but it will take money and time and cooperation. Results will not be overnight but they will come if the proper effort is put forth. With these thoughts in mind as our purpose, and as your purpose in the traffic engineering or traffic work in your community, consider how we can establish a need.

Hazardous Index Formula for Intersection Accidents

Some of the ideas are not exactly new ideas, but as I indicated, the talk is designed to gather together these ideas into one paper that can be used as a reference in establishing a traffic engineering program for a smaller community. One of the first things in establishing a need for a traffic program is to look at the number of accidents and the accident rates in a community. This is a relatively easy job. By locating the number of accidents on a city map, an Accident Spot Map is formed. The map should be on a large enough scale so that the intersections can be distinguished easily. As the pattern of accidents is established at a particular intersection or on a section of city street, the accident reports can be reviewed in detail to determine the type of accidents which are occurring. The Collision Diagram (Figure 1) is a convenient format for studying the pattern and types of accidents at a particular location. A useful tool for comparing the relative hazard of intersections in a community is the intersection accident rate. It could also be termed a Hazardous Index. This is a relatively simple computation providing sufficient data are available. The formula is:

\[
\frac{\text{No. of accidents}}{\text{Year}} \times \frac{1}{365 \text{ Days}} \times \frac{1}{\text{ADT}} \times \frac{100,000}{100,000} = \frac{\text{No. of Accidents}}{100,000 \text{ Vehicles using the intersection}}
\]
After the computations have been completed, a ranking of the intersections can be made. This places all the high accident locations on the same basis—just because a particular location in your community has a high number of accidents does not mean that location is the most hazardous—a location with a smaller number of accidents with a low volume could be more hazardous. If this location had more traffic it could very well have more accidents.

**Existing Traffic Control Versus Manual Requirements**

The second way to point out need would be to compare the traffic control devices, signs, signals and markings that are installed in your community with the state manual on Uniform Traffic Control Devices or the federal manual. I understand the State Highway Commission will be promulgating the new Indiana manual probably some time in July of this year. We know the purposes of the manuals and standards. However, this again is a public relations job or a selling job with community officials to convince them of the need that our signs should be similar to the signs and signals in neighboring communities. Perhaps a theme of “keeping up with the Joneses” could be used.

**Review Congestion During Peak Hours**

The third way of showing the need for traffic improvement would be to review the congested locations in your community during the peak hour. This should be done on site with comments recorded of some ideas on how the flow of traffic might be improved. It could be improved signage, channelization, or revised signal phasing or timing. The old adage that a picture is worth a thousand words can prove helpful to the traffic administrator also. A timely picture of a con-
gested location can be very descriptive to the decision makers. The need can be shown in many ways. We will be covering the methods of showing the need later.

*Local Ordinances and the Traffic Engineer*

An area that should not be overlooked is that proper legislation is provided for the traffic engineer or the traffic administrator to function. The model traffic ordinance provides wording that could be included in your local traffic ordinance to provide the position of traffic engineer or traffic administrator. I think this is important. The ordinance outlines the individuals' duties and gives some legal groundwork for this job to be established.

*An Organization Chart*

An organization chart could be very helpful in outlining your proposed personnel to function as a traffic engineering department or division in your city administration. The organization chart (Figure 2) is a functional type and merely outlines the specific areas that should be considered.

![Organization Chart by Function](image)

*Figure 2*

*A Manpower Chart*

A manpower chart (Figure 3) is shown here for your consideration. The traffic director should have a police or engineering background with a desire to conscientiously serve the public. Some might say broad shoulders (physical or mental) are necessary to bear the brunt of complaints from motorists, pedestrians, etc. In the small community a
full-time secretary-receptionist cannot be justified. Ideally the secretary could do the necessary drafting. A consulting traffic engineer on a retainer or per diem basis should be utilized for technical guidance of your community’s traffic program. A minimum crew would consist of a foreman and helper for your signing and painting operation. Part-time summer help (students) could supplement the painting program. Signal maintenance requires the services of a specially trained individual with a knowledge of electricity, mechanical devices and traffic flow. Your community may not have a sufficient number of signals to warrant a full-time staff member. However, it is imperative that a preventive maintenance program be utilized for your signals. This can prevent most of your signal malfunctions through early detection.

Traffic Studies and Use of Tailored Personnel

Last but not least by any means, is the study portion of your staff. The traffic counts, speed checks and other studies need to be accomplished on a regular basis. If not done regularly, they will probably not get done. Retired persons are excellent for this function. As mentioned previously, this chart is a guide. The number of personnel must be tailored to fit each community’s needs, finances and qualified personnel available.
EQUIPMENT AND BUILDING REQUIREMENTS

Equipment and building requirements must be “custom-fitted” to each community also. As a minimum, a truck with sign and post racks is needed for the sign crew. Racks are necessary to keep the signs from “wearing out” due to transporting around town. A ladder truck or bucket truck may be necessary if you have a number of overhead sign and signal installations. Spray paint equipment is recommended for a more economical, faster and better looking job.

As for the building, consideration must be given for sign, post and hardware storage, sign shop, equipment storage, paint storage, signal storage and controller repair, and office area.

INVENTORIES AND STUDIES

Street Inventories

The area of inventories and studies is an important area. As I mentioned before, data and facts, information of all types, are important for you to indicate your program to the decision-makers. Some of the items that definitely need to be considered in addition to the previously mentioned accidents and the accident spot map are the miles of streets that you have in your community. These should be classified by functions, such as state highways, arterial streets, collector streets and local streets. The street conditions (which should be reviewed annually, at least, with your city engineer and street commissioner), the width of right-of-way, and the pavement width should be included in the inventory. If a problem were to arise you would not have to go out to the field to measure the width of a particular approach or street. You would have this in your file and you can immediately get a picture of the physical conditions as they exist and immediately begin your planning for additional lanes, wider lanes, removal of parking without having lost time in the decision making process due to the lack of field work. Railroad crossing protection should be given special consideration during this inventory phase.

Inventory of Traffic Control Devices

An inventory of traffic control devices is important, particularly traffic signals. The inventory should consist of the design of the intersection indicating the location of heads, the location of conduit, poles, etc. The inventory should also include the phasing of the intersection, the timing of the intersection, the type of equipment, manufacturer’s name and brand number or catalog number, etc. A most important record is that of traffic signal trouble calls that you have had.
or may have at a particular location. You never know when an accident might occur which could go to court because someone has the idea that a signal malfunctioned. Therefore, records on these mechanical devices are important. The records need to be continuously updated to reflect the conditions that presently exist. Forms for reporting trouble calls (Figure 4) and for recording signal maintenance work (Figure 5) are suggested in the Traffic Signal Manual of the International Municipal Signal Association.

**Inventory of Signs and Markings**

An inventory of signs and markings does not have to be as detailed as the signal inventory but it is important to program the number of signs that need to be replaced each year. As in most cases, the markings probably need to be repainted annually and at some locations, more often.

**Inventory of Traffic Volumes—ADT**

A fifth area of inventories that would be helpful is traffic volumes or an ADT on the major streets. At the main intersections a turning movement count should be made once a year or at least once every two years. The intersection turning movement counts at traffic signalized intersections can be an instant check on the phasing and time split of the signal cycle. This should be checked frequently to determine that the signal is properly handling the traffic and assigning the right-of-way

![Traffic Light Out Template](image)
at the intersection. The Intersection Flow Diagram (Figure 6) can be used to summarize these counts. These traffic counts can also be used in determining the capacity and the volume to capacity ratio which is an indication of the serviceability of an approach to an intersection.

Inventory of Parking Facilities

In regards to an inventory of parking facilities the number of on-street facilities should be known, the type (angle or parallel) should be a part of the inventory. The off-street facilities should be inventoried as
to number and location. Most small towns have a demand surplus and a supply deficit.

**Speed Studies**

Fast speeds being driven is the cause of many complaints. The speed check can be used to indicate the magnitude of the problem. Figure 7 can be helpful in showing the range, the pace, and the 85th percentile speed.
Substandard Intersection Studies

Condition diagrams are helpful in detailing substandard intersection design. As a minimum, these diagrams should indicate pavement width, curbs, lane lines, drive location, corner radii, right-of-way lines, sidewalks, trees, buildings, etc. The diagram could form a basis for design if revisions are warranted. Depending on the detail necessary, the scale should be between 1 in. = 20 ft. and 1 in. = 50 ft.

Congested Intersection Studies

Aerial photographs can be helpful in the initial analysis of a congested intersection that is complicated geometrically. A scale of 1 in. = 20 ft.
provides sufficient detail. This is a quick and economical way of reviewing a problem location.

*Data Used in Decision Making*

These data or facts can be used in providing answers to your decision makers when they ask why you need $10,000 for new signs, $5,000 for paint and glass beads for the coming season, or $5,000 for a new signal installation. This information can be provided on simple forms, some of which you have seen here, to help the decision-makers understand the problem.

**OTHER SERVICES OF TRAFFIC ENGINEER OR DIRECTOR**

*Safer School Crossings*

Remembering some of the other functions listed on the organization chart, we come down to one that is near and dear to the hearts of many parents. That is school crossings and crossing guards. Certainly the subject of school crossings should not be taken lightly. Several books and pamphlets have been written to demonstrate ways of providing safer school crossings. Perhaps this can become a PTA project in a particular school to provide adequate and proper markings or signs, school patrol vests, or maybe salaries for adult school crossing guards. Certainly this is an area that should not be neglected.

*Parking Meter Responsibility*

Some communities that still have parking meters, the enforcement, collection, and repair of the parking meters is sometimes assigned to the traffic division. Since the parking meters involve the traffic function of street use in regards to storage of the vehicle or even the off-street storage of the vehicle, the responsibility for maintenance and repair of the parking meters should fall under the traffic administrator. Collection of coins in the meters should also be here. This would consolidate the operation all under one department. On many occasions the parking meters are under the police department and we see officers collecting the money when they could be out enforcing traffic and other laws.

*Bus Service Operation Responsibility*

Some communities in this particular population class could have a mini-bus service of some type. The responsibility for the operation of this should fall under the traffic engineer or the traffic director. He can coordinate the routing and the scheduling on the streets that are
capable of handling this type of service. Also he can project the needs between generators to best serve the public.

**Public Relations**

The area of public relations is not listed on the organization chart, but is something that the director of traffic must certainly be involved in. The improvement of the flow of traffic is of concern to almost everyone in the community. Just about everyone has a driver's license once they reach 16 years of age and as a result the movement of traffic affects the majority of the population in your community. The traffic engineer or traffic director must be publicly oriented. He must have his ear to what the public is saying. This does not mean that he will bow to what the public wants in all instances, but he can project the needs for the good flow of traffic in his community on the basis of the information that he has gathered. He certainly must have liaison with the city engineering department, the street maintenance department, the police department, the courts to a certain degree, and the driver education teachers in the school system. This is referred to as the three E's—engineering, education, enforcement—equally balanced responsibility between functions. He can publicize the need for the improved flow of traffic through contacts with these people. Certainly he must not hesitate to speak to PTA's, civic clubs, religious groups, etc. in regards to these needs for traffic improvements in the community. One area that some communities have maybe shied away from because of previously poor experience is the traffic safety commission. However, if the traffic safety commission is composed of individuals that have a direct association with the traffic field, such as the courts, police, driver education, trucking firms, etc. I am of the opinion that the traffic safety commission or committee can be very beneficial to a community.

**Assist Other Engineering Departments**

The director of traffic should be willing to assist the planning and engineering departments of local government in regards to the flow of traffic on present streets and future improvements and planned streets that are being developed in the community. In many cases the location of an intersection with poor sight distance can be detected before it is constructed, thereby eliminating a potential future hazard.

**METHODS OF FINANCING OFFICE OF TRAFFIC DIRECTOR**

We have outlined a rather extensive program for the traffic director for the smaller community. Let's look at perhaps how this function
might be financed. Each community, I am sure, will have their own ideas on this and I merely point out areas that might be considered for financing. This could include a tax levy, perhaps from a thoroughfare fund, parking meter collections, or the motor vehicle account. The use of federal programs is possible, particularly in the study line through the Indiana Office of Traffic Safety. The 1973 Highway Act re-defines the term construction and includes those items originally included under TOPICS funding. I understand that obligational authority for the use of these funds for cities between 5,000 and 50,000 population has not been authorized at this time. This could be a possible source for traffic improvement projects when this authority is granted.

IN-HOUSE TRAINING FOR STAFF

In order to function properly it takes money, but really it takes more than money, it takes staff. People that are qualified to do the job are necessary and we just don’t find these people that easily. So, we may have to establish an in-house training program. Training sessions should cover the placement of traffic control devices. As you are aware, the manual dictates the height of the signs and the distance behind the curb, the type of sign and the size of sign. The traffic director must train his personnel so that he does not have to spend time in the field. The director should issue a work order to his supervisor or your field supervisor that a sign needs to be installed at such and such a location. The supervisor checks out the sign from the inventory and places it in the proper manner. In-house training is very important. Other methods of training is by attendance at the traffic engineering conference sponsored by Purdue and the Indiana section of ITE, usually in November. This last year’s conference where the Indiana Office of Traffic Safety also participated by providing the majority of the funds was quite successful. Perhaps in the future some of your staff can be in attendance at these conferences. On occasions, traffic signal manufacturers sponsor training sessions for the maintenance of equipment. I certainly don’t propose that the manufacturers and their representatives be taken advantage of, but the training that they do offer can be very valuable in your signal maintenance program.

DIRECTOR OF TRAFFIC—DEPARTMENT HEAD STATUS AND AUTHORITY

The director of traffic should have a department head status within your local city administration. His responsibility and authority should include signs, signals and markings, the location of street lights, on and
off-street parking facilities, and the installation and maintenance of parking meters. Traffic accident prevention in conjunction with the police department should be his responsibility. The other modes of transportation, as a mini-bus service or bicycle routes, should fall under his responsibility. He should also assist in an advisory capacity towards street and land use planning, transportation planning, and street construction and maintenance in the community. A big job has been outlined here for the director of traffic. The director of traffic should seek professional traffic engineering advice from a consultant and perhaps from the state highway commission particularly on traffic problems involving the state highways through the community.

SUMMARY

In summary, I would then suggest that your organization and improvements be based on facts and data. The inventories spoken of earlier should be utilized in promoting the traffic engineering program in your community. The advice of state highway traffic engineers and the advice of consulting traffic engineers along with these facts and information certainly can go a long way toward providing the traffic engineering and traffic flow program that you desire for your community.