Traffic Engineering Before The Operation of New Facilities

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What is traffic engineering? We must first determine what traffic engineering embraces before we can know for a certainty the scope of this paper. In other words, if we take the subject of this paper and analyze it in increments we should develop a fuller appreciation of our subject. For the purpose of this discussion we shall consider a “new facility” to be a new roadway, not previously opened for traffic or a reconstructed modernized roadway.

Now, the next portion of the topic, “before the operation of new facilities”, is in itself self-explanatory. Yet what phase of the “new facilities” do we want to consider? It is all those things that the traffic engineer or that traffic engineering principles are concerned with prior to the opening of a new facility to traffic usage. This then leaves us to concern ourselves with what “traffic engineering” embraces.

In its total context traffic engineering as defined by the Institute of Traffic Engineers is:

“Traffic engineering is that phase of engineering which deals with the planning and geometric design of streets, highways and abutting lands, and with traffic operation thereon, as their use is related to the safe, convenient and economic transportation of persons and goods.”

This definition is all-inclusive, and in many respects, is much broader than I wish to delve into in this paper. I will, therefore, confine my remarks not to the planning of streets, highways, and abutting lands in the same sense as highway planning survey transportation studies, or planning per se, but rather to the planning as it would affect the operational aspects of a completed facility.

Where Does the Traffic Engineer Begin?

With this further clarification of what phase of traffic engineering we are concerned with we might then delve into the question “where does the traffic engineer start”? Where does he fit into the chain
Fig. 1. Installation of the guardrail is essential prior to traffic usage.

of work production within an organization so that time and talents might be used to the utmost in the development of working relationships in the planning, construction, and operation of a highway so that the end product will be of optimum benefit to the road user?

In my opinion it behooves the traffic engineer to start his work at the planning stage. The planning stage, as I think of it, is advance planning before the location which deals with feasibility studies. Then he needs to further extend himself into the design stage, either being totally responsible in the first instance or, as a minimum, for the review and approval of the design if it is prepared by others. The traffic engineer needs to be concerned about those traffic control devices that are necessary for optimum operation of a facility. He needs to be concerned with the preparation of the plans and specifications for traffic control devices. He needs to be concerned with the planning aspects related to project completion, as well as with those things physical in project completion. These latter two items are those that would deal with speed regulations, parking restrictions, and access control, all handled in the planning of project completion. In the physical project completion we need to ask "when is a project complete"? This I will discuss in greater detail later in this paper.

Although the topic of this paper does not treat with the operation of the new facility, I nevertheless feel that I would be remiss if I did not touch on this important finalizing aspect of the new facility. How better could a traffic engineer be concerned and knowledgeable of those things necessary in planning before the operation of a new facility if he was not thoroughly cognizant of inherent facility operation problems.
Let us now review some of the different phases that the traffic engineer should be concerned with. So that my thinking would not be limited nor biased with regional or provincial experience, I contacted the traffic engineers in five of the states in this area and asked them the question—"What traffic engineering do you do before the operation of a new facility?" Almost invariably I received from them the same answer. There were varying degrees to the answer, but all seemed to fall in the pattern I outlined above. I was also quite surprised at the extent to which some states were, as well as were not, utilizing their traffic engineers.

All in all, those men charged with the administrative responsibility for operation of state highway departments, as well as in major cities, are on the whole utilizing their traffic engineers to advantage. I hope and trust that some of these thoughts may be of assistance in establishing guide lines for the utilization of the traffic engineer and for setting forth in part at least some areas in which the traffic engineer should be concerned.

Planning:

Where should the traffic engineer enter the planning phase? He needs to be cognizant of the work that is taking place in the highway planning aspects of new facilities, but he need not necessarily be embroiled in depth in these studies. He should be consulted at the location and the feasibility study stage of highways, for at this particular point, although decisions are preliminary and locations are tentative, the feasibility of a project can often be adjusted if the traffic engineer can interject certain thoughts with respect to the ultimate operational aspects of a new facility.

Traffic assignment is sometimes made by the traffic engineer and sometimes by the planning survey engineer. In either instance, the traffic engineer should be responsible for checking the capacity aspects resulting from these traffic assignments to know if the facility will be operationally functional.

The traffic engineer should be cognizant of the highway project cost analysis phases of the preliminary project development. The traffic engineer can, through the interjection of traffic control measures, do much to change the speed characteristics of a facility, to change the safety of a facility and could many times interject many alternate methods which will have a direct bearing upon not only the road user, but non-road user benefits as would relate to the final completion of a new facility.
The traffic engineer could conceivably, in those areas where an existing facility is being planned for reconstruction, test the adequacy of existing traffic control devices and make recommendations for remedial measures which could be taken with a much less expenditure of capital funds than would be necessary for complete reconstruction.

I am reminded in this sense of the "Wisconsin Avenue Type Studies" conducted on Wisconsin Avenue in Washington, D. C., by the Bureau of Public Roads. Most of the states and many of the cities are now conducting pilot studies to determine, beyond a doubt, the many advantages that accrue from the application of sound traffic control measures and sound fundamental traffic engineering principles in street operation and highway operation. The application of many of these devices should be taken into consideration in a highway project cost analysis, for it is entirely possible that by the interjection of sound traffic engineering principles that the service life of an existing facility can be extended so that with a nominal expenditure of funds a major improvement to the road user will result therefrom.

Fig. 2. Paving of shoulders and installed signs prior to traffic usage.

**Design:**

Here is the first critical point at which the traffic engineer brings into play his knowledge of the geometrics of design, not only with respect to interchanges and channelization, but those things inherent in the operational characteristics of the motor vehicle so that the design of a facility will be functional and operational. The traffic engineer is not always responsible for the actual design; when this is true then
the traffic engineer must have authority for review and correction of non-functional design characteristics interjected by others.

The traffic engineer needs to check the operational aspects of the geometries of interchange design, the geometries of channelization and the geometries of roadway design so that it can be determined beyond all doubt that the road user can utilize this facility at the design speed contemplated and with optimum safety. There are several ways in which this can be accomplished—review over a drawing board of plans; construct scale models of proposed construction; and illustrative delineations can be made. From these, and especially the models, often geometric deficiencies are immediately apparent.

If the traffic engineer is not responsible for design in the first instance, it is imperative that he be one of those in the sequence of authority who must approve the plan for design before it is finalized and accepted.

*Traffic Control Device Planning:*

The traffic engineer must check all phases of the design of the roadway to ascertain the need for and application of traffic control devices. Operational layouts must and should be made at the design stage for signs, signals, and markings. This is one sequence in the development of a project before the letting of it to contract when minimal design deficiencies become evident. At this point adjustments can be made with an eraser and a pencil at no cost, whereas, if they are not checked at this stage they can only be corrected with a jackhammer and money.

The traffic engineer can assist in bringing about the checking of facilities as called for in Informational Memo #21-1-60, dated May 23, 1960, as issued by the Bureau of Public Roads. This memo relates to parking regulations and control of traffic on major street projects. It makes it mandatory that traffic control features are considered on every urban project and are made a part of an agreement worked out between the state and local government prior to project approval on the part of the Bureau of Public Roads. This means that those things operational with respect to traffic control devices need to be studied at the design stage. These devices need to be known when the project is programmed for federal aid participation.

A traffic engineer in the traffic control device planning stage needs to be cognizant of the detours that are necessary during project construction. These detours need to be integrated and studied with the whole of the project development. They must of necessity be planned,
so that the road user will not experience delays or unsafe operation in the development of the new facility.

**Plans and Specifications for Traffic Control Devices:**

The traffic engineer prepares either for separate or integrated contracts plans for signs, signals, and markings. How these plans and specifications are prepared, that is, the depth or completeness of their preparation, will in some respects depend upon the manner in which the project is implemented. That is, is it to be done contract or state force? Here is the place where the traffic engineer is the man that knows where signs should be located, the messages contained thereon, where signal heads (vehicular and pedestrian) should be placed. This multiplicity of concern is for the viewing angle of signs, the manner in which the signal is to be operated, and the proper interrelation of the pavement markings to the signs and signals. This is of paramount importance if the facility is to operate safely and efficiently.

At the plan preparation stage the traffic engineer needs to be concerned with the coordination of traffic control devices with other work, that is, their availability for use with the completion of paving and other project considerations. This means that he has to integrate workday count on these projects with those of the prime contractor so that a logical operational sequence will be accomplished so that the facility will be ready for traffic at the prescribed moment.

**Planning Project Completion:**

The “paper work” incident to the project completion can and must be anticipated. There is much that the traffic engineer is concerned with and must take into consideration such as the assignment of route numbers, and the shifting of state, US or Interstate route numbers. This sometimes is a slow, tedious process to get all the legalistic paper work taken care of to process through the highway commission or the city council, the AASHO US Route Numbering Committee, or others. These take a considerable amount of lead time and need to be started in the development stages.

The traffic engineer needs to be sure that the legal implications of parking restrictions, whether part-time or full-time, are taken care of. For the enforcement officer to use parking restrictions the necessary legal paper work is essential. Enforcement without legal sanction is meaningless in a court of law. Likewise, speed control, the establishment of speed zoning, turn controls, resolutions involving through stop highways (for the placement of stop signs) and the like are all “in a day’s work.” These things should all be worked out prior to the open-
Fig. 3. Lane lines, edge lines and stabilized shoulders are desirable before traffic utilization.

ing of a project for traffic. If possible they should be conceived in the planning stage and executed during project development.

Physical Project Completion:

When is a project complete? This is one of the most controversial points in the whole of the sequence of development. Is a project complete when the paving of the roadway is finished? Is it complete when the paving of the shoulder is finished? Is it complete when the guardrail has been installed? Is it complete when the signs are in? Is it complete when the signals are in? Is it complete when the markings are in?

You can get as many different answers to the above questions as there are questions. In my opinion, and I feel strongly that it is the opinion of the road user, no project is complete until all of the points mentioned above are operational. Yet, one of the concerns of the administrator of an organization and his staff is the pressures, both internal and external, that are brought upon them and through them to the construction and the traffic engineer to make a project operational too soon. The withstanding of these internal and external pressures is
something over which the traffic engineer does not always have ultimate control, but he should do everything within his power to exert logic within his own organization to see that the projects are not operational until all aspects of the project are completed.

In their conservative concern for the expenditure of funds, many traffic engineers lose sight of the fact that certain traffic control devices are ultimately going to be necessary, but are not absolutely mandatory at the outset of project completion. Therefore, they often do not recommend or see that these things are installed at the outset. I think this is especially true of traffic signals. The traffic engineer should see that all traffic control devices are installed at the outset if they are at all going to be needed within a reasonable length of time. Do not procrastinate in an atmosphere of conservatism.

I know in my own state we have had two prime examples within the year. We have had a suburban section of a multiple lane expressway where we knew that within five years to ten years actuated signals would be necessary to properly protect and control cross traffic and turning traffic. In another instance at a ramp terminal, on a segment of interstate highway, within an urban area, we knew that ultimately we were going to need actuated traffic signals. In neither instance did
we insist nor recommend that they be installed at the outset; and yet, when both of these facilities were opened the public was concerned that there were not signals present. Public demand and influence caused the Department to immediately proceed to install signals.

The point to this is that the traffic engineer was the individual criticized for not being far sighted enough to have insisted on the installation of traffic signals at the outset. This, then, leads me to believe that the traffic engineer must be susceptible of properly evaluating the thinking and influence of the road user. If the traffic engineer is to "err" might it not have been better to have done it first instead of later. Throw off the mantle of conservatism on occasion and look forward to the "bold approach."

The Three P’s:

I am often reminded that we in engineering are always saying we need to be conscious of the three "E’s." All of you know what these three "E’s" are, but let’s repeat them anyway—engineering, education, enforcement. With the proper interrelation of these three "E’s" we end up with a wholly operational facility. But I feel one of the things that the traffic engineer, and possibly the administrative engineer, is not as completely concerned with as he should be are the three "P’s." What are the three "P’s"? They are: people, politics, and policy.

Now, let me explain what I mean by this point. People are responsible for the election of politicians, and politicians make policy in light of their constituents' needs and demands. In this particular sense we in engineering need to be concerned with those policies that are an outgrowth of politics which are usually an expression of the desires and wants of the people. These demands are not always expressed with the logic that we in the technical phase of government feel that they should be; yet, we cannot long endure without being conscious of them. I am not recommending that the traffic engineer emasculate his principles, but he can and should on occasion temper them. Yet, he should never subjugate them to political whim.

Facility Operation:

After the facility has become operational the traffic engineer needs to, more than ever, be concerned with how this facility operates. I realize this is beyond the scope of this paper, but traffic engineers need to observe operational aspects of any facility and to continually strive to up-grade the safe, convenient, economic movement of people and goods.
The traffic engineer needs to continually observe operations, for how can he learn of the mistakes that he might have allowed to go through advance design when he was checking it to determine if it was operationally adequate. He needs to check for needed continuing changes in traffic control devices. He needs to be concerned for those things operational with respect to the legalistic aspect of enforcement—the placement of signs with respect to speed regulations, parking restrictions, turn prohibitions, etc. Are these signs functionally operational so that the road user cannot complain when the enforcement officer is trying to execute his phase of making this facility operational for the road user?

The traffic engineer must have at his disposal a ready, continuing file of high-accident locations. He must be allowed to make changes as needed which will improve the safety and operation of a facility. He must continually devote himself to the operational research for the improvement of devices and establishing functional standards.

Summary:
I have endeavored to cover what in my opinion have been some of the problems incident to the traffic engineering aspects of making a facility operational prior to its utilization by traffic. We can say that the traffic engineer needs to be involved to a lesser or greater extent in almost every phase of highway development. He needs to be in at the planning stage, at the location stage, at the design stage. He needs to be cognizant of the construction stage and he needs to be present in the development of the necessary rules and regulations which will make a facility operationally functional.

I also would be remiss in this summary if I did not say that I in no way am trying to point out that the traffic engineer is trying to, or should, usurp the privileges and the prerogatives of the other disciplines in the organization, but there are certain phases which relate to traffic operation that the other disciplines of the organization should not overlook the knowledge and ability of the traffic engineer to assist in their implementation.

There are probably as many divergent opinions on the actual extent to which a traffic engineer should be involved in the varying aspects of a new facility as there are people involved in the development of a new facility. But, I do feel as the traffic engineering profession grows, and as the traffic engineer exercises sound judgment in what he does, others will become cognizant of the ability of the traffic engineer to assist in facility operation, to make it functional, and to
make it safe for the road user. And yet, while the traffic engineer and others are concerned with interrelations within the internal framework of the organization in which they are operating they should not be unconcerned with the ultimate end result of their combined efforts.

The final judgment of success of this is “how is the facility accepted by the road user.” The road user is not cognizant of the many things that have gone on in the development of this new facility. He is not concerned as to whether one element of the engineering team is exercising control and the other one is advising and the like. He is only concerned with the end product.

The traffic engineer is by the nature of his work closer to the road user, his fellow man, than all other disciplines involved in road building. No other profession has such an intimacy with his fellow man. It is thus a challenge for the traffic engineer to present himself as one approved by overtly exercising his professional ability.