THE CHANGING EMPHASIS IN TRANSPORTATION ENGINEERING

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INTRODUCTION

The following are some of my thoughts of the directions we may be heading in the field of ground transportation.

It may sound peculiar to have a representative of the Federal Highway Administration starting a discussion by referring to ground transportation rather than highways, but my purpose is two-fold:

1. To give an indication of the changing emphasis and changing national goals as they relate to highways, highway design, and program implementation; and
2. To set forth a very strong feeling that I have regarding the changing roles that will be faced by engineers—be they local, state, or federal.

In my opinion, it makes little difference who pays your salary. Whether you work for a city, county, university, or consultant, our basic responsibilities are the providing of professional services to the governing board, owner, or administrator who has engaged you to perform a specific function, operation, or task.

In your case it may be a governmental body or a private owner. In my case, it is the United States Congress acting by and through the executive branch of government, and executed through the secretary of transportation and federal highway administrator. In short, we both react to the desires or mandates of others who desire our services for specific performances. Few of us have the opportunity (or the financial resources) to go our independent ways. Certainly my bank account is not of a size to enable me to start my own federal-aid highway program.

SPECULATIONS ON NEW HIGHWAY ACT CONTENTS

The 1975, or should I say 1976, Highway Act is still being debated in Congress, but even though we don't have a new act, I believe we can predict some trends based on the House and Senate bills which were

passed. The conference committee has been meeting on and off for six weeks and as best I can guess—I stress the guess—here is some of what we may find in the final bill:

1. Two years worth of authorizations (probably 6.7 billion dollars per year).
2. Continued emphasis on interstate with some flexibility for the funding of routes of national significance versus strictly commuter routes.
3. A continuance of the highway trust fund as we know it for two years, along with a congressional promise to study it seriously in 1977.
4. Strong emphasis on highway safety.
5. Continued funding of the bridge replacement program, (although not at a level that we think is high enough).
6. Certification acceptance procedures made simpler, including a reestablishment of the secondary roads program.
7. Definition of construction changed to include resurfacing and restoration.
8. More local rather than state control of urban system funds.

Generally, Congress is saying that it sees a significant role for the highway and the automobile in transportation's future. However, and let me emphasize the however, the thrust of capital expenditures for highways in the coming years will be for tuning the system we have now, and in urban areas adjusting or adapting it for joint use by mass transit rather than building new freeways on new alignment.

ASSUMPTIONS ON FUTURE—AFFECT ON TRANSPORTATION AND ENGINEERS

The future of transportation, the future of federal transportation programs, and likewise the highway designer's role during the remainder of the twentieth century are affected by four assumptions (but I really believe they are facts of life):

1. The highway system will continue to be the primary form of transportation, for both rural and urban areas. This, therefore, dictates that other transportation systems (especially urban mass transit) be designed to supplement the highway system.
2. Funds will not be adequate to support the construction of major new systems. This is true for highways, mass transit, intercity rail, and perhaps even for other forms of transportation.

3. The major emphasis in all modes will be for finding ways to gain more effective utilization of existing systems.
4. The future challenges for engineers will be many—especially those problems requiring compromises between desired and possible. The days of cookbook engineering are gone and we will be back to doing some good, hard engineering.

HIGHWAY SYSTEMS DOMINATE ROLE IN FUTURE TRANSPORTATION

Secretary of Transportation Coleman has said in his September 17, 1975, Statement of National Transportation Policy: "The automobile is and will continue to be the most universally accepted form of transportation in America." His statement is supported by many facts. Predominant among the facts is the availability of autos. Since about 1917, there have been more autos in urban areas than transit seats. (And that's the year transit utilization began to decline). This desire for the auto has changed the shape of our cities from dense apartments to urban sprawl with its low-density housing. This, in turn, increased the demand for the auto so that today there are more vehicles than drivers. We now have a life style in which transit may never be able to return to its earlier role of being the primary mode of urban transportation.

Most of the growth in our cities has occurred during the automobile era. The urban form is compatible with the highway/auto system that is now the backbone of the urban transportation system. It will take, I suggest, at least 25 years for our cities to redevelop around any other forms of transportation. Hence, I contend that the private automobile operating on streets and highways will continue to be our primary form of urban transportation for the remainder of this century.

If this contention is true, then mass transportation systems of the near future must be designed to supplement the highway/auto system. At least, if they are to be effective, mass transportation systems must supplement the primary urban transportation system.

FUNDS FOR TRANSPORTATION ARE LIMITED

During the last two decades, our highway construction programs have been supported through user's charges. The four cent federal and about seven cent per gallon state gasoline tax (along with some other user fees) provided a bountiful revenue source. However, inflation started eroding the dollar's impact in the mid 1960's and now the energy crisis has restructured fuel consumption trends. Several states in this region have significantly reduced their construction programs with

only the highest priority projects being funded. Some state highway agencies project that in less than five years the maintenance budget could consume all the highway revenues.

The cost spiral is impacting all modes—not just highways. Let's look at mass transit. In 1966, the Montreal System was constructed at a cost of $14 million per mile. Today, it is expected that the Metro in Washington will cost over $45 million per mile and MARTA in Atlanta over $35 million per mile. In the face of these figures, UMTA is looking away from funding massive new fixed facilities and is looking to using buses on highways.

In short, we will face mounting traffic congestion and related transportation problems during the next 25 years, but we will not have funds available to construct massive new systems to relieve these problems. We must search for ways to more effectively utilize our existing facilities if we are to solve these urban transportation problems.

A NEED FOR EFFECTIVE USE OF EXISTING SYSTEMS

The earlier discussion points to the need for less capital intensive projects that are aimed at making use of the latent capacity within our existing systems. In 1968, we called this type of project TOPICS. Today, one of the top emphasis areas within the FHWA is projects related to better management of the highway system; that is, low-cost transportation improvements that will loosen the bottlenecks on our existing systems.

Let me give you examples of the kind of ideas we have in mind. One is priority treatments for high-occupancy vehicles. Today the typical auto occupancy during the rush hour is about 1.5 persons per auto. Another way of looking at that is one bus equals 13 carpool cars or 40 typical autos. It is obvious that better use of the existing highway vehicle capacity can extend the effectiveness of our present system. Another area we support is an active professional traffic operations staff which can insure better traffic flow by fine tuning the highway system with special lane assignments, adding or closing ramps, extending merge lanes, coordinating signal timing, developing urban bus distribution patterns, and so on.

Better use of our existing system is true in our rural areas as well as in urban areas. The connecting of cities has generally been done, so future decisions on new routes between cities and towns must consider the existing highway alternative; that is, can we fix it up rather than build a new road? In this time of growing maintenance costs and

limited resources (both monetary and natural) we must look twice (maybe even three or four times) at any decision to build a new facility while still maintaining the old. I believe Congress, in their redefining of "construction," is pointing us all in this direction.

One final example of an innovative approach that the Federal Highway Administration believes may be beneficial to not only relieving urban traffic congestion but also to improving the quality of life in our cities is the concept of auto-free zones. I'm speaking of perhaps a 25-30 square block area where autos are restricted (buses, taxis, delivery, and emergency vehicles would still be permitted to enter the zone). This concept has met with much success in Europe and really it is not unlike the philosophy behind suburban shopping centers. We are hopeful that two or three cities in this country will try the concept. We are still looking for volunteers.

FROM COOKBOOK ENGINEERING TO HARD ENGINEERING

As I look to the immediate future, I see the engineer as not pushing a template across the plains but rather tailoring a sophisticated existing system to serve the new needs and desires of mobile Americans.

My first three assumptions:

1. Highways and autos will be the backbone of our transportation system for the rest of the century;
2. Funds for major new transportation systems will be scarce;
3. There is a need to better use our existing systems

all point to my fourth point—that the engineer's role has changed. We no longer can rely on our engineering handbooks, but rather on creative engineering judgment—what is sometimes called good old "down home" engineering.

Because of strong social, environmental, and economic constraints, we can no longer look at removing a row of houses to widen or build a new street. But, rather, an intensive study, analysis, and testing approach to better use the existing street with less severe consequences is needed. Engineers will be forced to swallow the bitter pill of compromise between ideal and possible. When we decide to restore a rural highway we must also decide on whether or not we should widen lanes or shoulders which forces us to decide whether or not we should flatten slopes or use guardrails, remove trees or not, widen bridges or use special markings. The "cookbook" does not have an answer; rather we need to use the best information available on safety and

capacity, then mesh this with solid design principles, consider the environment, count our pennies, figure the maintenance costs, and then rank this project with all others before we decide what to do. Gentlemen, it won't be easy—the "cookbook" doesn't have the answer.

When we talk of exclusive bus lanes in the medians of urban freeways (like the San Bernardino Freeway in Los Angeles) we are forced to compromise—buses and freeway traffic must share a shoulder or else we can't build. Or just think of the hair pulling that we will have to do to fit a contra-flow bus lane on an urban street or freeway with compromises on turning traffic, signal sequences, loading areas, on- and off-ramp designs, weaving sections, and so on.

As I see it, we are not going to be able to use a "cookbook" to develop the designs of the future. We will need to go back to the operational characteristics and behavioral assumptions that lay behind the standards, and, with this understanding, develop solutions that answer our particular problems. After all, we are getting paid as engineers for our creative minds, not to look up answers in a handbook. The transportation design decisions of the future will need to consider a myriad of social and environmental data as well as physical and operation input and then develop a solution that will work, that is relatively economical, and can be expeditiously implemented. That, gentlemen, is a challenge. But it is a challenge I am sure our profession can meet head-on and win.

REDUCED DESIGN STANDARDS SUGGESTED FOR REDUCED COST

There is one other area I would like to touch on—reduced design standards. This is a period of austerity in the highway program and we hear a clamoring for reduced standards. Neither AASHTO nor the FHWA have prescribed any set of so-called "Reduced Standards." The decision has been made to retain the standards, which we know to be sound, and to permit our division and regional offices to allow deviation from them as the situation permits on a project-by-project basis. This decision will require highway and traffic engineers to understand the engineering and operational principles which form the basis of our existing standards. I trust you can see how my feelings about cookbook engineering mesh with the FHWA/AASHTO philosophy on reduced standards.

Another area of suggested reduction is a desire to lower the design standard because of the 55 mph speed limit. The Federal Highway Administration again has taken the position: ". . . that even though

operational traffic speeds and speed limits have been reduced, design speeds and other design standards are not to be reduced."

Seldom, except on very low-volume highways, are conditions such that geometric features govern. Other vehicles, weather conditions, etc., combine to force drivers to restrict their speeds to well below the highway design speed. For instance, the average running speed, under low-volume conditions, of a highway with a 70 mph design speed is only 58 mph; for a highway with a 60 mph design speed it is 52 mph.

There are certain benefits derived from providing higher design speeds and certain disadvantages to providing lower design speeds. The benefits that are derived from higher design speeds are increased safety, a more comfortable driving environment, increased capacity, and provision for future growth. Fuel consumption and operating costs are also reduced when highways are constructed to higher design standards. The disadvantages to providing lower design speeds are more horizontal and vertical curves which prohibit passing on two-lane highways; this increases the likelihood that drivers will pass where sight distances are too restricted for safe passing maneuvers and also decreases the driver's ease of operation. Highways with lower design speeds invariably have poorer safety records.

The factors that should determine design speed are the terrain, economic considerations, type of highway, and volumes of traffic expected to use the highway. Design speed, the speed for which a highway is designed, should be as high as practicable, and the expected speed limit should be only one of the factors in the determination of design speed.

SAFETY CANNOT BE COMPROMISED

Inherent in all of the above is that no matter how we must compromise between the reasonable, feasible, and ideal, there is one area that cannot be compromised—and that is safety. There are certain things that can be done for economy, but only if it does not reduce our safety requirements. Further, there must be a continuous vigilance in the area of safety design and you will discover—if you haven't already —that reduction of generally accepted standards will cause appurtenant items to become unsafe because of the proximity (i.e., unyielding objects not touched due to lesser construction widths—signs, posts, headwalls, etc.) that must be considered along with your overall project design consideration.

OTHER PROBLEMS FOR ENGINEERS

This will require much more engineering ingenuity than before. Further, other problems will plague you, such as:

- Bridge reconstruction
- Passenger and pedestrian access between modes
- Bus operating characteristics
- Highway-railroad grade crossings
- Parking capabilities
- Exclusive transit ways
- Rail abandonments and related increase in rural highway loadings
- Accommodation of maintenance operations.

There are other areas that I've not spent a lot of time on, such as environmental concerns, people relocation, tax base, and so forth. Certainly, these will also be factors in your design, construction, and maintenance operations.

MORE COUNTY INPUT NEEDED FOR POLICY DECISIONS

Finally, I want to mention one activity we are pursuing in this FHWA Region that I believe the county engineers may be interested in. We are working very closely with Howard Schwark, the county engineer in Kankakee County, Illinois, to get more county input into our policy decisions. Howard has sent all county engineers in Region 5 his newsletters (I believe four to date) and he is interested in hearing from you. We are pleased to be working closely with Howard and other local engineers throughout our region, and we trust that this close working relationship will improve the highway programs in all our states.

CONCLUSION

I want to thank you for letting me share some of my ideas and concerns with you, and trust that we all can look forward to many years of challenging engineering.