LECTURE A1 – ROUTE DETERMINATION

CONTENTS

Introduction

Application

Background Considerations in Road Provision

Trip Purpose and Components

The Process of Route Determination

Route Prioritisation

Conclusion

INTRODUCTION

It may be said that the most durable aspect of a road is its location.

All possible factors that may influence the route choice must be considered. From this it follows that the systems analysis procedure, including goals, major and minor objectives and restraints, should be the basis of route determination.

The “paperwork” preceding the construction of a road generally covers three phases of planning and design. These are the Route Determination then the Preliminary Design and finally the Detail Design and working drawings.

INTRODUCTION

Thus in practice, Route Determination is concerned with the location of the corridor in which the road is to be designed and ultimately built.

APPLICATION

The outcome of route determination is a statement, usually in the form of a plan and longitudinal section showing the proposed alignment of one or more alternative routes.

Alternative answers to the problem have to be developed and compared, prior to the formulation of a recommendation concerning the route to be selected. If there is a real lack of alternative options this may reduce the level of detail to which the designer must investigate the problem for purposes of comparison, and it may become a feasibility investigation rather than route selection.

APPLICATION

If the terminals of the route are, say, only one kilometre apart there doesn't seem to be much reason for an elaborate comparative study.

In urban cases, alternative solutions have to be developed to establish the cost consequences of acquiring the road reserve along various corridors. As a rough rule of thumb, urban property acquisition can be anything up to 80 % of the total cost of the road with construction accounting for the other 20 %. In rural areas, the percentages reverse.

APPLICATION

To summarise, route determination typically applies to routes of extended length, and in the urban environment, the emphasis is often on factors other than purely geometric design considerations although, obviously, the requirements of the latter must be satisfied.

BACKGROUND CONSIDERARIONS

The process of route determination typically commences with the thought that a road should be provided between points A and B. It generally follows an initial sequence of network planning for the wider area or region of the road authority concerned.

A decision on the basic cross-section of the road (two-lane or multi-lane) and its class would stem from the network planning.

The designer would apply the geometric standards used by the road authority concerned.

BACKGROUND CONSIDERARIONS

The designer should establish early on, what the functional goals of the road are to be. Generally a road is proposed as an answer to a problem or a need, and its location is a separate problem whose solution must take account of the specific needs or goals.

Note that especially in developing territory, the goal may be to enhance the quality of life of people living in a certain area. Various options could then be considered, and transportation may be only one of several. For example, it may be more important to provide a guaranteed supply of potable water, or a decent system of sanitation, public health services or schools. Such competing needs could influence profoundly the funds available for a road, and thus also the design standards and route choice.

BACKGROUND CONSIDERARIONS

Economic analysis and the resulting demonstration of the economic benefits arising from providing the road could be very useful in arguing for more road-building funds in such a scenario.

TRIP PURPOSE AND COMPONENTS

The previous process would have given valuable input as to the broad function the road is intended to serve. Basically, a road is just a conduit along which trips can take place.

Most roads have a very general and mixed purpose, but a recent development is the occasional designation of specialised conduits as rapid bus or freight routes although the latter has yet to be applied in Southern Africa. Passenger transport is too often relegated to a subsidiary status.

TRIP PURPOSE AND COMPONENTS

With regard to people trips ("person trips"), function has two elements. The first is trip purpose and the second is trip component.

Regarding purpose, person trips are typically described as home-based work, home-based school or home-based recreation. The perceptions of the person undertaking a trip are going to vary according the purpose of the trip. Home-based work trips happen under conditions of heavy traffic flow under more or less severe time constraints and each driver just wants to reach his destination a.s.a.p.

TRIP PURPOSE AND COMPONENTS

Stopping sight distances calculated using this equation are given in Table 4-1, rounded up for design purposes.

A recreational trip can either be over a relatively short distance to the local gym or squash court, or perhaps a long distance trip as part of the annual holiday.

A purely recreational route can or, perhaps even should, have fairly low design standards but should focus the driver's attention on ever-changing natural vistas and should also, of itself, be an application of the principles of aesthetics.

TRIP PURPOSE AND COMPONENTS

Trip component refers to the fact that a trip invariably involves departing from a terminal, say the home, moving up the hierarchy of roads from a residential street to a collector and then to an arterial for the major length of the trip; this followed by the reverse sequence, working down through a distributor system to the far terminal, say a parking garage in the business area. A driver will have varying expectations according to the segment or component of the trip being undertaken.

TRIP PURPOSE AND COMPONENTS

The underlying network plan should see to it that the "local street" component has only a short length, and that an arterial road is available nearby for the longer-distance and hopefully faster component of the trip.

It virtually never happens that a road serves only one trip purpose. The designer is thus required to have a clear idea of what the predominant type of trip on the road is.

TRIP PURPOSE AND COMPONENTS

Very often the characteristics most affected by trip purpose are the cross-section, gradients and intersection design.

As an illustration, it is not advisable to include a median island in the cross-section of a road that principally provides access to adjacent properties if a steady stream of traffic crossing the median at random is to be avoided.

THE PROCESS OF ROUTE DETERMINATION

1. Starting up

It is assumed that the stages of: -

- Deciding that a road should be provided;
- Determination of trip purpose and trip component;
- Selection of design hourly flow;
- Selection of design vehicle;

Have been completed.

THE PROCESS OF ROUTE DETERMINATION

The designer thus has a preliminary feel for the type of cross-section that he should be aiming at and also the order of design speed appropriate to the facility to be provided.

The designer must also acquire all the information he needs on the location of services that may be affected by his design, the land use, existing development and committed plans for land use that may either impinge on or be affected by the route.

THE PROCESS OF ROUTE DETERMINATION

In rural areas, preliminary route determination may possibly be done on plans with a scale of 1:50 000. The level of detail required in urban areas will necessitate a larger more appropriate scale.

The designer must thus select the scale of plan appropriate to the intended exercise and acquire the plans defining the area of interest. They should show contours, surface detail, cadastral and co-ordinate information. From these, a base plan is produced for further work.

THE PROCESS OF ROUTE DETERMINATION

The base plan is then marked up with all the information that has been acquired regarding services and land use. One feature of rural land use is that a single farming unit actually may comprise more than one registered property. Such agricultural business units must be respected just as much as cadastral boundaries may be.

Simply following a cadastral boundary to minimise the problem of alienation and fragmentation of property may actually result in adversely affecting the whole farming business operation.

THE PROCESS OF ROUTE DETERMINATION

Contact with the Extension Officers of the Department of Agriculture is thus essential to establish the true consequences of selection of a specific location. They can provide useful information on what is actually happening in terms of farming operations that are current or planned and also provide a very shrewd estimate of what a road located on any particular part of a farming unit will mean to that unit. They should also be consulted on drainage planning.

THE PROCESS OF ROUTE DETERMINATION

2. Tie points and No-Go areas

In designing vertical alignment, reference is also made to tie points, but the meaning attached to the word in that context is totally different. There, the tie point is a level that cannot be exceeded.

In the case of route determination, a tie point can either be a point through which the route must pass, for example a nek (in English, a cwm or coomb!) or an area or specific location towards which the road is attracted somewhere between its terminals.

THE PROCESS OF ROUTE DETERMINATION

The availability of construction material may also serve as a tie point of sorts in the sense that overhaul of material can be a costly exercise and, by judicious location of the road, it may be possible to reduce construction costs without imposing any penalty in terms of road user cost or other damage to the environment.

No-go areas are simply areas where road location is impossible or prohibitively costly in comparison to the alternatives. Mountaintops and swamps, burial sites or developed areas are cases in point.

THE PROCESS OF ROUTE DETERMINATION

A pure design example is the case of a corridor where the longitudinal ground slope is greater than the maximum gradient selected for the route for a substantial distance. This has an economic consequence in that cut or fill quantities would become excessive.

No-go areas also include all areas that it is best to avoid if possible. Areas with complicated drainage patterns can also create problems in terms of protecting the road against flooding. Staying away from a wetland is always sound engineering, and these days generally seen as essential for environmental reasons.

THE PROCESS OF ROUTE DETERMINATION

Anyone who has ever tried to shift a cemetery will be able to confirm that it is far more convenient to go around it than across.

All information concerning tie points and no-goes is marked on the base plan. The information provided by the Agricultural Extension Officers may also suggest areas that should be considered as either tie points or no-go areas and these would also be marked on the plan.

As more and more information is added to the base map, certain corridors should start to reveal themselves as being worthy of consideration.

THE PROCESS OF ROUTE DETERMINATION

3. Corridor and Alignment Determination

This is a process of iteration, with successive trials and adjustments to develop a short-list of feasible routes from which a final selection is made. Obviously, the shortest route is the one that will offer the lowest construction cost and also the lowest road user cost, if all else is equal. Unfortunately all else is seldom equal.

Routes would then be drawn with a series of straights, points of intersection and circular curves fitted between the straights, to produce better lines that also skirt the no-go areas and including the tie points, and proceed as directly as possible to the far terminal.

THE PROCESS OF ROUTE DETERMINATION

Ultimately, a number of alignments in a generally directional corridor will have been identified.

The next step in the process is to consider which of all these possible candidates should become probable candidates. The re-evaluation of the tie points now come into play. One or other of the routes may serve a particular tie point better than do all the others and this would create an obvious bias towards the selection of that particular route

THE PROCESS OF ROUTE DETERMINATION

There is of course no compelling reason to follow the above sequence, which simply provides a systematic approach to a problem with too many variables for the average mind to deal with other than step by step.

It is generally possible and necessary to eliminate a number of the alternative corridors on the somewhat subjective basis of “engineering judgment”. In the end, it will still be necessary to make a motivated recommendation on the route choice. A process of prioritisation is used.

ROUTE PRIORITISATION

This is a major field of study in its own right and can only be briefly introduced here. *If the designer, in his capacity* as systems analyst, properly defined the objectives for the road and also set criteria and standards for these objectives, he could conduct a meaningful comparison of the various possible routes and hence make a recommendation.

There are two possible procedures for this comparison. They are utility analysis and economic analysis.

Economic analysis is a rigorous procedure which gives a ranking of the alternatives according to their capital and operating costs.

ROUTE PRIORITISATION

Utility analysis is a systematic method of assessing the properties of the alternatives that are less easily measured and quantified than the economic inputs. Greatly simplified, the process of utility analysis will select some set of characteristics of whatever objects or alternatives are to be compared. A panel of experts is then convened to deliberate on the extent to which the various alternatives or objects possess the desired characteristics – each expert scoring on a numbered scale from low to high. Calculation of the average and standard deviation of the ratings given by the panellists is a straight arithmetic manipulation.

ROUTE PRIORITISATION

Utility analysis is a useful tool in that it it provides a disciplined method of looking at parameters which are not readily quantifiable and also has the benefit of being relatively quick to perform.

Economic analysis is dealt with in some depth in Lecture T7 and is touched on only briefly here.

Three basic methods of analysis can be followed:

1. Benefir/Cost Ratio
2. Rate of Return
3. Nett Present Worth

ROUTE PRIORITISATION

The construction cost of each alternative design can be estimated with a certain amount of effort. Benefits are more difficult to estimate because these principally concern road user savings arising from using one route in preference to another. To quantify the expected savings requires projections of future traffic volumes, which may be problematic.

An important feature of economic analysis is that competing alternatives for a new project are often not compared just between themselves, but rather compared to a base value described as the Null (or Do-nothing) Alternative. The reduction in road user cost thus constitutes the benefit achieved by providing the link.

CONCLUSION

It would seem, (quite rightly), that route determination is the most difficult task that the designer can be asked to undertake. It may also be the most laborious. The fact of the matter is that it provides a true test of the designer's capabilities. Because of the wide range of factors which require sound answers, it is done most quickly and effectively by one with considerable experience.

The ability to successfully achieve all these objectives is the hallmark of the competent designer.