THE INFLUENCE OF DEVELOPMENT PLANNING ON HIGHWAY ENGINEERING IN GUYANA

By

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SYNOPSIS

A new Development Programme for Guyana is being planned by a team of economists and engineers. In order to give full effect to the proposals it will be necessary to improve and extend the highway system. The paper discusses the ways in which highway administration, planning, design, construction and research are being affected by the demands of the programme.

INTRODUCTION

In order to understand the manner in which highway engineering is being influenced by development planning it is important to examine the real character and underlying motives of the Development Programme in Guyana. Viewed through the eyes of different professional men our development planning could be seen to have a different significance; the educationist may see it in the promotion of intellectual levels among people, and medical men may recognise in it a stimulus to the growth of a healthier and more mentally alert people, whatever may be the immediate intentions of the principal planners. The engineer, however, is in a different position from his professional colleagues who may be associated with the Development Plan; he is very much involved in the preliminary stage, the execution of the plan and with its sustenance. Because of his complete involvement he is influenced in a broader manner and such influence is reflected in the practice of his profession as applied to the Development Plan. Highway improvement and construction will form a very important part of this Development plan and for this reason highway engineering will be affected to a greater extent than other branches of civil engineering.

There may be a difference of opinion as to the broad objects of a Development Programme but in the particular context of Guyana today they may be defined as the improvement of living standards to a point where most people are usefully employed, healthy and reasonably well educated. This concept of the objectives of this Development Plan would lead to the conclusion that no country could really be regarded as being fully developed, and this in fact is true, but the difference in the case of most developing territories is that the need for speed and the all embracing character of the plan produce influences which would otherwise be absent. In Guyana the Development Programme is charged with urgency and quite apart from the ultimate objectives there are certain needs to be met throughout its progress. Unemployment relief and reduction in living costs are two needs which im-

mediately come to mind but there should also be plans for external trade and interests which would affect the internal economy. Consideration should also be given to the manner in which development planning in neighbouring territories could be related to ours and to our highway system.

In every country, whether considered to be developed or not, highways can be shown to be a strong influence on economic well being, but in this particular study of the way in which highway engineering has to adjust to the requirements of an economic plan it is important to understand the special nature of the relationship between the highway and the national economy in Guyana. There are areas of the country with a partially subsistence economy, that is to say the needs of separate communities are provided, or left unprovided for, locally; if it is accepted that an appreciable rise in living standards is one of the main objectives of the Development Programme then it is necessary that in such communities it should effect a transition from a subsistence to a cash economy in which money for goods from other areas is required. This is only possible with reasonably low cost communications, hence the role of the highway. Not only would the farmer get better prices for his produce and so receive encouragement for further development of cash crops but the money prices of the goods brought into the area would fall. At the same time that the movement from a subsistence to a monetary economy is taking place there are also the accompanying benefits of better education and new human interests stimulated by the highway which is inseparably bound up with the overall economic plan. The analysis of this change is important not only because it would provide the highway engineer with an indication of his true role in promoting a developing economy but also because it would show that development planning is not merely a matter of national progress which can be measured in terms of economic prosperity but is a factor in stimulating research, fresh fields of endeavour and even new concepts in highway engineering.

PLACE OF ROADS IN THE DEVELOPMENT PLAN

At the moment the Development Programme is under review and the detailed plan for roads has not yet been finalised. However, fig. 1 shows an outline map of British Guiana indicating the principal undertakings proposed. Rehabilitation of the coastal road system and construction of a new highway to Mackenzie City are certainties in the programme. Presently the Roads Division of the Ministry of Works and Hydraulics undertakes maintenance and rehabilitation of roads; there is no highway contract work except for bridges and culverts. Until recently there was limited mechanisation of processes but a large volume of manual labour. There has been very limited use of Consulting Engineers.

ECONOMIC ASSESSMENTS AND FEASIBILITY STUDIES

Reasons for highway improvement or construction were formerly based on relatively narrow considerations and while some thought was given to the

ffect which the job would have on life and business in the immediate area it as not often that a study was made of its place in the economy of the country nd its relation to an integrated transportation system. Now, however, the high- ay engineer is required to play his part in the assessment of economic feasi- ility of a highway job. Roads are seen to be part of the entire system of com- unications which includes rivers, canals, railways, air transport and telecom- unications; a communication problem is considered to have several possible olutions of which the highway is only one. The engineer is now required to xamine the feasibility of his highway project as an economist would; he has o look at it in terms of return for money to be spent, and has to consider factors ich as land use and traffic generation at the planning stage and may even ecide, as a result of his considerations, that the highway is not the best solu- on to a transportation problem.

This new demand on the highway engineer has given rise to the necessity or a Highway Needs Study so that the true position of the highway could be ssessed. This study which, it is hoped will soon be conducted, will try to deter- ine the standards to which highways should be built or improved so that ere would be a correct balance between their function and available finances ithin the country. It is a wide study and will place the highway engineer new roles both during its conduct and in the implementation of its re- ommendations.

The measurement of highway needs has never before been attempted Guyana and it will have an effect on planning and policy at the dministrative level in highway matters. The study will bring into clear focus e economic and physical relationships between the different transportation ystems and will embrace all the different aspects of highway engineering and eir effects on highway planning, organisation and financing.

It will have many important applications in development planning over e next few years but what is significant in this discussion of its influence highway engineering is that the highway will be seen as an investment hich could produce money in return; so that highway engineering will be en as something more than a public utility as it is now regarded. The re- tionship between highway needs and the cost of living is diagrammatically lustrated on fig. (ii). It shows how, when highway needs are determined, it the highway engineer's skill which produces economy in transport with its ffect on living standards. Another very important point to note is that the onduct of a highway needs study provides the best way of reviewing in etail the entire highway system, administration, financing organisation and gislation. It is therefore certain to reveal weaknesses and point to means rectifying them. Three obvious weaknesses which will be revealed and hich the Development Plan will require to be strengthened are high- ay legislation, traffic engineering and planning studies.

LEGISLATION

Apart from the fact that a study of Highway Needs would include nsideration of the function of the law in highway management and ad-

ministration, development planning itself, by the emphasis which it places on the value of the highway as an investment which produces returns, brings with it the need to protect the life and insure the expansion of the highway facility. This is most effectively accomplished by adequate and appropriate highway legislation. In the case of Guyana the Roads Ordinance, which was introduced in 1909, has remained virtually unchanged since then and many of its provisions are outmoded and restrictive insofar as effective management is concerned. Such barriers must be removed in order to facilitate development planning.

The Roads Ordinance has been revised in draft form almost entirely by engineers and is presently under scrutiny by the Law Officers. The revised version has clauses which embrace the concept of limited access and prevention of ribbon development; it defines clearly the procedures for acquisition and compensation of land, and introduces the idea of the road reserve or right-of-way for convenient usage and future development. Clauses have also been introduced to insure the safety of road users and to prevent the road from damage and indiscriminate use.

The fact that it was the highway engineers who were the prime movers in effecting this revised legislation is an illustration of one way in which the Development Plan has expanded their areas of responsibility.

TRAFFIC ENGINEERING

A highway resulting from a Development Plan always has initially as its prime motive the fostering of traffic growth - the other benefits follow as a result of this. At a later stage it is necessary to accommodate the further growth which must result if the plan is well conceived. In Guyana, therefore, traffic engineering must be given a boost as a result of development planning, and even now in the initial stages of the plan the lack of essential traffic data is an embarrassment to the engineers who are being called upon to estimate travel trends and capacities in rural and urban areas.

There is at the moment little traffic engineering and this is restricted to traffic counts and attempts at forecasting traffic growth by engineers of the Ministry of Works and Hydraulics, while the Police, who by tradition have always been responsible for the traffic control and enforcement of traffic law, have undertaken the installation and upkeep of traffic control devices.

The Development Plan makes provision for sub-urban housing areas and a University campus, near to Georgetown; there are plans for improvement of highways leading to the city, and even beyond to the relatively densely populated area of Mackenzie City. Such projected development would have a considerable effect on the traffic pattern within Georgetown itself and there is bound to be accompanying traffic engineering to meet the demands. There will be problems induced by mass transportation by buses, and Georgetown will soon be faced with a parking problem in the business areas - a problem which

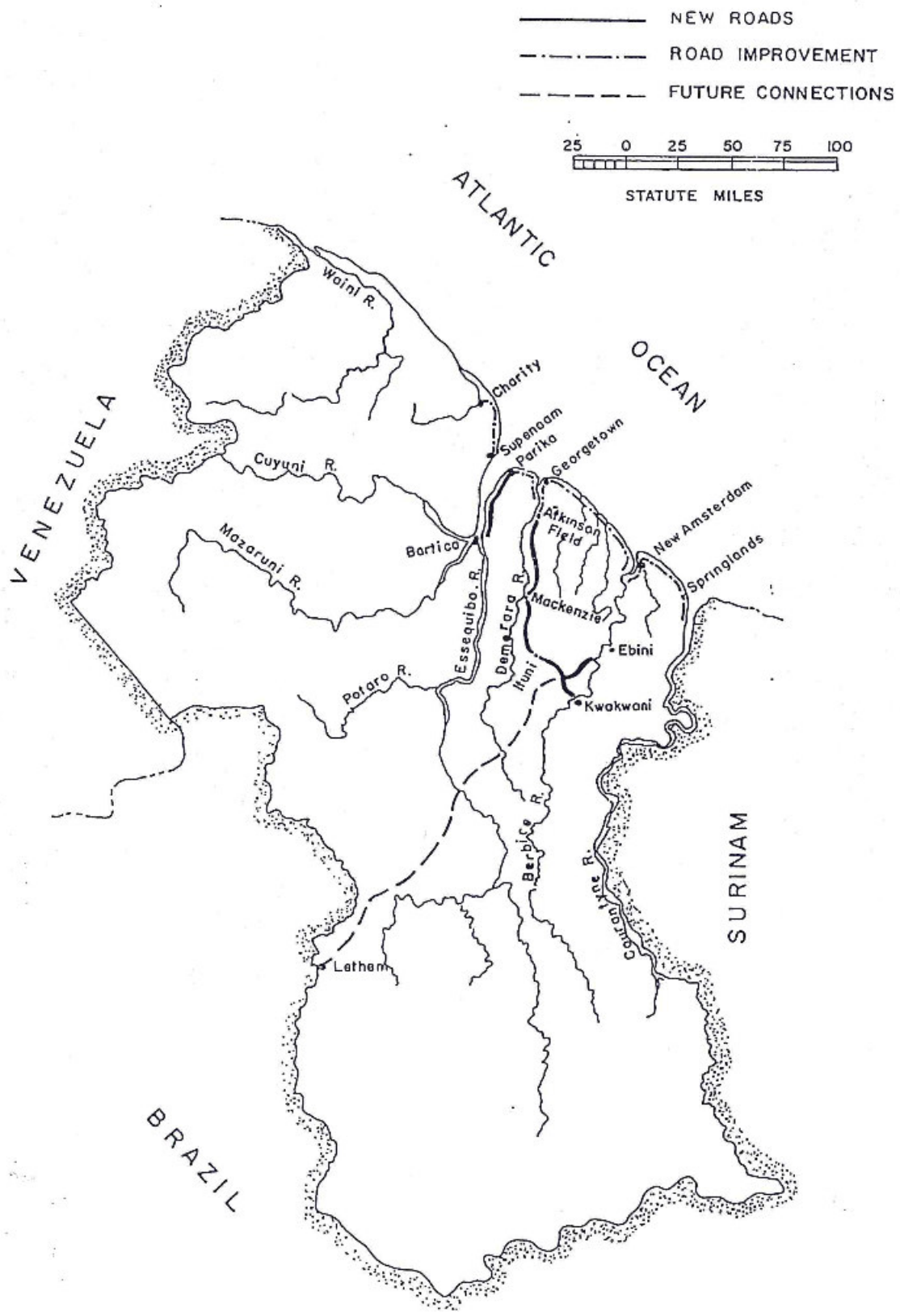

FIG. 1 — MAIN HIGHWAY PROJECTS IN DEVELOPMENT PROGRAMME

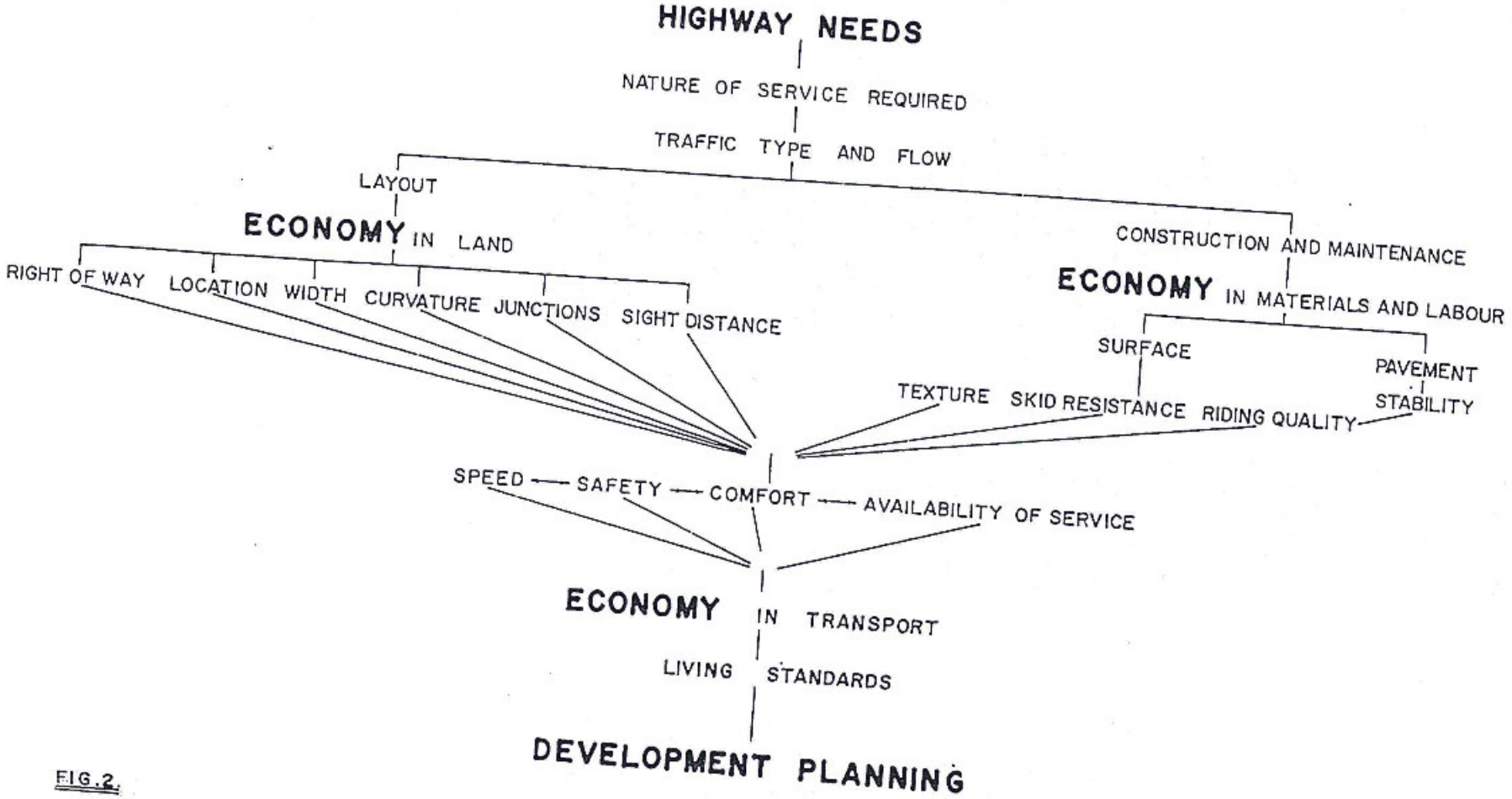
HIGHWAY NEEDS
NATURE OF SERVICE REQUIRED
TRAFFIC TYPE AND FLOW
LAYOUT
ECONOMY IN LAND
RIGHT OF WAY
LOCATION
WIDTH
CURVATURE
JUNCTIONS
SIGHT DISTANCE
CONSTRUCTION AND MAINTENANCE
ECONOMY IN MATERIALS AND LABOUR
SURFACE
PAVEMENT
TEXTURE
SKID RESISTANCE
RIDING QUALITY
STABILITY
SPEED
SAFETY
COMFORT
AVAILABILITY OF SERVICE
ECONOMY IN TRANSPORT
LIVING STANDARDS
DEVELOPMENT PLANNING

FIG. 2.

hould be tackled before it arises. There will have to be fresh concepts of unction design, there will be the need to consider the lighting of the high- ways outside of the city and the relationship between traffic generation and ighway planning studies will point to the development of a traffic engineering establishment in the country.

Improved and newly constructed highways will inevitably result in higher traffic speeds, regardless of any attempts at speed control by the imposition of low speed limits. The traffic engineer must design with this in mind; adequate road markings for centre lines, side lines and 'no-passing' zones will have to become a common feature of the country's highways. The new access routes to Georgetown would give rise to consideratians of replacing level crossings at railway junctions with overpasses and to planning for dual carriageways in close proximity to the city.

EFFECT OF HIGHWAY PLANNING

Development planning is a continuing process and even though an initial plan may be prepared for as short a period as five years it often has to be renewed and altered at the end of two or three years and the plan itself is often extended for another few years. A highway programme proposed now is therefore certain to be changed somewhat in two or three years' time but the extent to which this is done and the value of the changes will depend on proper planning by the highway engineer.

There is at the moment no planning section within the Roads Division but one will have to be formed. It is necessary for the highway planning engineer to assemble and analyse information on population growth and trends, agriculture, industry, trade, travel patterns and land use, if he is to locate and build his highways to meet the requirements of the national economy and not conflict with other media of transportation. Such planning has a particular bias towards highway use and capacity; it must not be confused with the function of the department of Town and Country Planning which is concerned principally with the development of communities. The highway planner will be a new breed of engineer in Guyana; he would have to combine the functions of a highway engineer with the specialised disciplines of regional planning and transportation economics.

There is need for an accurate inventory of all roads classified as rural, urban or private with information on surface types, width, condition and geometric characteristics. Unless this information is collected it would be impossible to give value and effect to a Highway Needs Study, which is in itself another continuing process.

Highway planning studies also include an examination of the financing of highways and consequently equips the engineer to advise on an equitable basis for assessing taxation on highway users in a direct or indirect way. In an

ordered system of communications such taxation is common, at the moment the highways in Guyana is not part of an ordered system and highway user taxes do not seem to have a logical basis. When the Needs Study fixes the highway in its proper place within the national economy such planning functions of the highway engineer will become obvious.

The zoning of areas for the acquisition of right-of-way and control of land use is a step which has already been taken with regard to one highway in the development programme and this is the first time that such action has been taken in the country. Prior even to the advertisement of the route located for the new highway from Atkinson Field to Mackenzie City, a zone was put under the control of a committee for appropriate development of the area to be serviced by the highway.

Utilisation of human and material resources

The highways are inadequate in themselves to meet the demands of traffic imposed on them and furthermore, there are not enough highways to form a properly integrated system of communications to meet the country's transportation needs. These defects in standards and needs have to be met as quickly as possible in the Development Plan. One quick way to achieve this is to have foreign consultants and contractors do the work for us, another is to mechanise our processes so completely that rapid progress would be achieved with the minimum of dependence on the human factor. But neither is suited to the solution which the highway engineer is expected to provide in the particular context of the development programme. The Development Plan has come with a formula for relief to the unemployed, particularly the unskilled; and this must be constantly considered when solutions are being devised.

The programme of improvement of the coastal roads provides a good illustration of how the highway engineer has responded to the need for utilising human and material resources without forgetting the importance of speed or economy. At the stage at which he was designing the road structure the highway engineer had to consider the degree of mechanisation that would be necessary to effect speed of construction while maintaining a balance between mechanisation and manual labour. The design was conceived with the process of soil stabilisation in mind and this involved the use of nearby materials. Extraction, loading and transportation of such materials make use of manual labour to a large extent while the stabilisation process is mechanised but still requires some attendant unskilled labour. Dependence on the human factor requires meticulous scheduling of work so that the operations are properly phased to permit of continuity of processes; this kind of construction planning has not been much in evidence in highway work locally prior to the development programme.

The choice of materials in highway design has a very considerable effect on maintaining the all-important balance between mechanised and manual processes. For instance, while it is true that reinforced or prestressed concrete and

steel are very durable materials for highway bridge construction yet timber bridges have been known to perform very well indeed, and if properly designed can give many years of service. Concrete and steel construction require importation of materials from abroad and the use of skills which are rarer in Guyana than such as would be required in the construction of a timber bridge of typical design. Moreover, timber is a locally produced material requiring local labour for its production. The economics of using local materials in highway and bridge design has therefore to be carefully studied. Timber piles could be used in place of reinforced concrete piles provided they are properly protected against rotting in the zone of variable water table, and if concrete construction is considered desirable for particular reasons, then consideration should be given to designs involving the use of pre-cast units. Pre-cast concrete should certainly be used much more in Guyana as it would be a means of obtaining good quality control under favourable conditions and employing more unskilled labour in the operations of assembly than do the present methods of construction. Furthermore, it could lead to mass production of units for rapid assembly in many parts of the country as the development programme may require. Such designing reflects the thinking of the engineer in fulfilling functional requirements, while meeting the needs of speed of construction and utilisation of human resources. This is, in fact, a kind of philosophy in engineering design in a developing community.

THE BUSINESS OF CONTRACTING

In the country there are no local contractors capable of executing all the construction phases of a highway contract and there are only a few who are able to undertake clearing and grading contracts. In such circumstances the bulk of the work is undertaken by the forces of the Ministry of Works and Hydraulics. With the Development Plan requiring a substantial and rapid increase in highway construction it is evident that the Ministry's forces would be inadequate to cope with such demands; if, therefore, the target is to be achieved, then foreign contractors would have to be invited to tender for work. In keeping with the objectives of the Development Plan, however, it is desirable that the local contracting business in highway construction should be assisted in attaining a standard which would enable the programme to be accomplished on time. If this is not done one of the objects of the Development Plan, namely the stimulating of local enterprise and industry, would be defeated, at least in this case.

It is intended to obtain the services of foreign contractors for construction of the highway between Atkinson Field and Mackenzie City. It is desirable that such contractors should achieve something more than a job faithfully executed and successfully completed - they should leave behind some expertise in contractual management and construction skill. This could be accomplished by requiring him, and indeed any other foreign contractors, to agree as a part of his contract to undertake to sub-contract to local contractors in all phases of the job. He would have to make arrangements

to be very closely supervised in processes with which they may be unfamiliar. This would, of course, mean that the contract would cost more than normally, but there would be the advantage of laying the foundations of a local contracting business in operations hitherto untouched by forces outside the Ministry of Works and Hydraulics. In the later stages of the development programme such contractors would be able to undertake work under the supervision of the Ministry's engineers, which would permit of more work being tackled simultaneously by the Ministry, thereby fostering the growth of the Development Programme.

It has been the experience in some countries that highway design and research are influenced considerably by close liaison between the men who design and plan and those who build; in short the contractor often influences the designer to improve techniques by virtue of his works experience and by pointing to the need for revision of specifications, the use of new materials and often by discovering techniques to meet particular site problems occasioned by the conditions under which he works. In the case of foreign contractors who may not spend much time in a country, such influences are likely to be insignificant but, on the other hand, a local contracting business would in time produce such desirable influences on highway design and research. Development planning, by virtue of the need which it has created for foreign contractors, has provided in them a means of giving a stimulus to the development of local contracting business which would in turn facilitate the execution of work and influence favourably highway design and research.

A NEW ROLE FOR THE CONSULTANT

Employment of consulting engineers for highway work has been limited. Some years ago there appeared to be the feeling that they would be more technically competent to solve highway problems in our difficult conditions; some of them produced answers which were not wholly acceptable for the reason that there did not appear to be full discussions at intermediate stages, as this would have enabled the client to satisfy himself on any questionable aspects. More recently, however, the consultant has appeared in a changing role. After work on the location and design of the Atkinson Field/Mackenzie City highway had been taken to an advanced stage by the Roads Division, a consultant was sent to review such work and check that its standard was acceptable for a loan application. The individual, sent from a reputable firm, worked, not in the usual manner of an independent consultant, but actually as one of our staff and succeeded not only in carrying out the necessary review but also in assisting in training whenever corrections had to be effected. This seems to be a most acceptable role for the consultant in our particular conditions, although it does not exclude his functioning as an independent designer and supervisor.

This new role of the consultant could best be appreciated when it is remembered that the development programme has among its aims not only the rapid completion of work but also the development of skills. The Roads Division, therefore, would release to consulting engineers only such works, the urgency of which would tax it beyond its physical capacity, but at the same time it is keen to develop the skills of its personnel by experience and association with consultants. A highway department must evaluate its capabilities and potential before determining the extent to which consultants are desirable to help develop its internal functioning and extend its activities without embarking on a temporary build-up of staff merely to accelerate a programme.

The study of our highway needs will probably indicate that the consultant will be necessary in Guyana for some time yet. Following the pattern of consulting work on the Atkinson Field/Mackenzie City highway, a consultant engaged by the United States Agency for International Development to assist in materials design and control, is operating almost in the same way; an individual from a reputable firm is working as an adviser in the Materials Laboratory. In this way there is close liaison between the consultant and his employer, and his work should have good value and effect.

Like the contractor from abroad, the consultant will be required to undertake training of local staff on the larger contracts. For instance, it is intended that whoever is the consultant engaged to supervise the contract for the Atkinson Field/Mackenzie City highway will be required, as a part of his contract, to undertake to give training and experience to local personnel at all levels of responsibility.

In the present climate of development there are likely to be more applications for loans from foreign governments or international agencies which would require economic justifications and feasibility studies to qualify the project as worthy of a loan. The foreign consultant will be required here, not merely because of his experience on an international scale in presenting information in the manner required by such agencies, but also because he would be regarded as an independent investigator whose opinion would be unbiased. Although experienced in this field the consultant has still to learn from his local colleagues, because the criteria accepted in feasibility studies in metropolitan countries are not necessarily applicable in developing territories. In the absence of adequate statistics the risk factor in assessing the economic justification of a highway project must be high in a developing territory, as there is no means of forecasting accurately the extent to which a facility will be used in an area which has hitherto had no experience of its use. In Guyana it is likely that new concepts would emerge in studies of economic justification and feasibility and the local engineer would contribute very much to these.

In view of the expense of engaging consulting engineers the question is often asked whether the influence they produce in the long run is really worth the expense. This cannot be thoroughly discussed here but it seems important to point out that one very good influence which they could produce is experience which local staff could derive from their introduction of modern

techniques, of the use of instruments and other equipment which a highway department would hardly wish to afford. For his own. econo consultant would use photogrammetric methods of location and des highways, electronic computers to give ready solutions to lengthy probl earthwork, curvature and superelevation, and geological sono-probes i sub-surface explorations. They would thereby bring the local engin contact with a broader spectrum of engineering experience and so in his thinking in highway administration and planning. The consultant however, be of greatest value by providing the individual adviser t within the framework of the department's organisation on particular r on which assistance is needed; if he does his job well he will not be re for long.

RESEARCH

Intensified planning has pointed to the need for research in order economical solutions to problems. It has already been explained w stabilisation methods were considered desirable in the improvement coastal roads but the heavy plastic clay forming the subgrade stil problems to the materials engineer. Research is being contemplated use of lime in stabilising such clay for base courses or to improve the su and so reduce pavement thickness. While this has been successfully c India, parts of Africa and the U.S.A., the problems in British Guia somewhat different because of the high water table condition which exists even in the dry season; furthermore, there is the problem of adn of lime into the clay which becomes very hard and lumpy in the dry when construction should take place.

In some parts of the country low grade bauxite, sometimes termed l overburden, has been used as a base course and surface with satisf results. The material does not meet the normal specifications of gradati plasticity for base course or surfacing materials for roads, but neverthel performed well. Before it could be used on a larger scale, however, it be desirable to investigate its performance and verify that it would have qualities. Research is also contemplated on the use of this material as in sand-bituminous mixes instead of cement or limestone dust which h be imported.

The whole question of flexible pavement design in our tropica ditions needs to be reviewed as the standard methods have all beer rowed from the U.S.A. and are generally thought to give very conse thicknesses of pavement. There is no doubt that the adoption of sta set by the American Association of State Highway Officials, the A Institute, Highway Research Board and similar agencies in the U.S.A produced satisfactory results but it has not always been possible to such standards because of the nature of the materials used; sometim have varied the standards without adverse effect and this has given rise

question as to whether we should not attempt to fix our own standards for reasons of economy.

Extension of the highway system away from the coastal plain of alluvial clay has introduced different subgrade conditions and an unusual feature is the combination of heavy rainfall of about 100 inches per annum in areas of pure white sand; in short, a desert condition exists in the subgrade but in a climate typical of a wet region. This poses the problem of erosion control in highway design and it has not been possible so far to draw on the experience of any other country in this respect. Research has therefore to be conducted to determine economical methods of erosion control in view of the rapid run-off in predominantly sandy areas. The problem is immediately realised when such areas are cleared of vegetation prior to construction of the highway. Some research has been done on the sizing of drainage structures in predominantly sandy areas and a preliminary report released.

There is another problem connected with highway construction in sandy areas; it is the control of compaction density of the sand subgrade prior to laying the pavement. No satisfactory method has yet been devised to determine in the laboratory the density to which cohesionless materials should be compacted for best results when functioning as a subgrade. This means that control of compaction is likely to be uncertain unless there is a close co-ordination between field and laboratory studies. There is the danger that unless the sand subgrade is well compacted, there will be subsequent densification during the life of the highway resulting in deformation of the surface. In Guyana there is very little experience in this connection because paved roads have not been built on sand to any great extent. Where this has happened it would be useful to study the density attained by the sand after a few years and relate it to factors which could give significance to those methods which have been proposed.

Research is essential in any progressive organisation and it is to be expected that many different situations will arise demanding an original approach. Already a large-scale experiment has been conducted on the effect of surcharge loads in pegasse soil and the economics of total or partial excavation of pegasse in relation to the construction of highway embankments. It is no longer possible, as in the past, to avoid pegasse conditions by circumventing them; the development programme makes it necessary for such problems to be faced and for economical solutions to be found. Research in highway work has become a reality.

INTERNATIONAL CONSIDERATIONS

It has already been suggested that development planning should include considerations of international trade and whether this would affect the inter-highway system. So far, in the current Development Plan, much information on this is not available but it would be useful to examine how

the highway system in Guyana would be affected by trade links with other South American countries.

At a recent regional meeting of the International Road Federation held in Lima, plans for the 'Marginal Highway' or 'La Carretera Marginal de la Selva', as it is called, were discussed and it is now definite that this highway, which has been started, will be built on the eastern slopes of the Andes connecting Bolivia, Peru, Ecuador, Colombia and Venezuela. The first four countries have planned it in order to facilitate their development and relieve the pressure of expanding population but it will become a major factor in the economic development and integration of South America. Surinam has expressed a desire to be connected with this highway, preferably through Guyana and Venezuela. The latter country is interested in highway connections with Guyana for trading reasons, they say. The question arises as to how will Guyana react to these external stimuli in the light of its own interests in fostering external trade. The reaction may not be immediate but possibilities for trade would certainly be attractive and the mere passage of international traffic through the country would bring revenue and stimulate private enterprise. If is therefore very likely that the future would see an east-west highway through Guyana connecting Surinam and Venezuela. The Lima conference resolved to investigate the matter of extension of the Marginal Highway to the Guyanas; if this extension materialises this would be a case in which development planning on an international level has pointed the need for internal improvement of our highway system. Our thinking in the past has been directed across the Atlantic but there seems to be every advantage in also looking around towards the broad vista of the Amazon and the Andes and this would point to the need for better highway communications to international standards.

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