Paper No. 103

PLANNING OF HIGHWAYS FOR NATIONAL OBJECTIVES

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INTRODUCTION

Highway Planning on one hand is the orderly and continued collection of information and data about highway use, its historical background regarding physical development and traffic growth, operating cost of vehicles, cost of maintenance and improvement, on the other hand its utilization for the efficient and economic development of the highway system. It is a never-ending process as it keeps on reviewing the basic social and environmental trends and the economic needs in order to meet the demand through short and long range planning. The objective of highway planning is the establishment of a highway network capable of accommodating the basic transport needs in an orderly, safe, efficient and economical manner. Planning has now become the prime activity of every major highway agency. Data assembled by planning units are utilized almost for all design matters and administrative decisions. New planning procedures are therefore kept under continuous advancement. The data required for good highway planning falls into several classes : road inventory; rural traffic service and forecasting; urban travel study; road life studies; research and investigation on soils to determine the sub-grade characteristics; investigations and research on road building materials for economical pavement designs; highway financing; vehicle ownership and use; and other special studies.

The need for highway planning arises on account of the diversity of demands which include renovation and improvement of the existing facility, expansion required on account of the needs of developing economy and changes in the pattern of other modes of transport. Careful planning minimizes the mistakes in the improvement and betterment of the existing facilities. In a nutshell proper planning provides for a wiser programme of construction and maintenance of the highway system in the country.

Good highway planning embraces the concepts of long range, comprehensive and co-ordinated planning so as to derive maximum benefits out of the investments. The long range planning implies determination of and

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providing for the long term need of a facility to be constructed or improved. Usually, the period counted ranges from 15 to 25 years depending upon the life of the facility. Such planning enables us to obtain the following advantages :—

(1) To use the physical resources more effectively and to acquire the right of way ahead of construction.

(2) It facilitates an orderly development of the surrounding areas by private agencies and to achieve the participation of the people in the highway improvement programme.

(3) Allocation of the required finances are also ensured as its requirements based on priority, are made known well in advance.

(4) Comprehensive planning means drawing up of a master plan for the development of a highway system considering all the needs and desires of the area. Thus it ensures an orderly future growth and a regional balance for the economic prosperity within the framework of financial resources of the community.

(5) Co-ordinated advance planning achieves much better results as it determines whether the highway plans are well combined with other plans of development in the area with its special relation to other modes of transport to make optimum use of the available financial resources.

When a highway planning agency uses the required techniques of planning and is properly staffed and organized and works with all other connected agencies to develop a long range, comprehensive and co-ordinated plan, it meets the demands of the growing population and developing economy in a most rational and orderly manner.

Planning of individual highway projects with parallel research data also forms a good basis for many decisions of importance regarding such projects. The availability of road inventory, accident experience, maintenance cost and other characteristics of the existing road, coupled with traffic estimates, provide the foundation for basic studies or other procedures for setting priorities for improvement. Predictions of peak-hour traffic volumes and its character govern decisions as to the location and design standards with respect to the number of lanes, standards for alignment and grade, and the geometry of intersections and interchanges. The expected number of trucks, classified in terms of axle numbers and loads, control the choice among pavement types and thicknesses. In summary, it is the knowledge of past, present and expected future conditions of all kinds, as developed through the planning surveys and special studies, that has brought modern and rational highway design in place of the rule-of-thumb methods of earlier years.

Initial Policy followed after Independence for the construction of roads

On Independence in 1947, we inherited a road network which was too inadequate and burdened with heavy arrears of maintenance and replacement and was therefore, a major drag on the development needs of the country. The West Pakistan, for example, inherited only 5,050 miles of metalled and black top roads, indicating the immediate need of developing the network of road length to connect the district headquarters, tehsils and the main market centres. Hence, there seemed a little need for "Planning" of Highways. Attention was primarily focussed on establishing a system of main roads with least possible delay. But this required huge sums of money. The financial resources were limited and it was not possible to invest on a good highway system. A policy was therefore, adopted to develop maximum length of roads at minimum cost within the available finances. Although the concepts of "Highway Planning" started engaging attention and were successively developed during the various plan periods, studies were made and some projects executed which promoted the development and adoption of these concepts, yet, by and large, the mentioned policy of developing maximum length of roads at minimum cost was generally followed, especially upto the middle of Third Five Year Plan period. Accordingly single lane pavements mostly ten feet wide were constructed with only 6" to 8" thickness of its pavement. During the past, this policy generally helped in increasing the mileage of road length having a single lane pavement of very low quality, which only served the desired objective of opening to vehicular traffic, a great part of the province and connecting important centres of population. Most of these roads were fit to take a traffic upto the order of 500 motorised vehicles per day whereas the present far exceeds this limit. According to the traffic data collected by the Highway Department in 1969, the position of the total road length with respect to the intensity of traffic roughly seems as under :—

Traffic Count Motor Vehicles per day		Length Miles	Percentage of Total
Upto 500	..	7,200	52%
500 to 1,000	..	4,500	32%
1,000 to 2,000	..	1,800	13%
Above 2,000	..	500	3%
Total :	..	14,000	100%

SOURCE : Highway Department Traffic Counts.

It is apparent that a large length of the newly added roads has given impact to traffic increase by providing the essential needs which therefore establish that these investments have been very useful. But since the roads have been running over capacity, at present there is not only a problem of congestion and accidents but also of the fast deterioration of its pavement. The heavy traffic now threatens to break down the surface of the established network. The roads in some of the areas have further been damaged by waterlogging and floods. The situation calls for immediate steps to first widen, recondition and strengthen the existing roads. Timely strengthening is essential because total breakdown of the road surface is very expensive to repair as compared to strengthening. Widening alone, in most of the cases, is sufficient to result in an appreciable investment gains in terms of vehicle operating costs, capacity and safety. Similarly a large number of road bridges including some major river bridges are too narrow, unsafe and old. Hence, widening, replacement and upgrading of these bridges is also a must for the easy and safe flow of traffic.

Road planning concepts as reflected in the first four-five year plan periods

First Five Year Plan Period.—During the First Plan period high priority was given to the completion of the incomplete roads and to new roads in the under-developed areas. In addition, the provision of the improvement of the West Pakistan Highway *i.e.* from Karachi to Peshawar *via* Lahore, was urgently felt.

The programme for linking villages together and connecting them with the main road system was also proposed. As these roads were to be built mainly with local labour by local communities under the Village Aid Programme or the programme for local development outside the Village Aid areas, so no specific provision was made for this type of roads under the "Transport" allocation.

Regarding Road Research it was proposed that the existing Buildings and Roads Research Laboratory at Lahore, which was intended for the former Punjab, be expanded to serve the whole of West Pakistan.

Second Five Year Plan Period.—During the Second Plan period it was felt that there has been a general tendency in the past to build high type surfaces or none at all. To economize, resources available for roads, it was felt preferable to use low type all-weather surfaces especially soil stabilized or gravel types. The Plan, therefore, proposed the development of experimental stretches of low type all-weather surfaces as a basis for building an efficient system of feader roads. It was also programmed that important roads should be developed on the basis of stage construction. In the first stage a low cost surface should be used with culverts and bridges, unless traffic density justifies the immediate construction of a high type construction. The surface can be improved to higher specifications at later stages as necessary.

As regards rural roads, the previous idea of handling these roads on self-help basis was further carried and efforts to use voluntary local labour were proposed to be enhanced. It was also decided that the Public Works Department would only provide necessary technical assistance and thus collaboration between the technically qualified personnel and the Village Aid Organization with its roots in Basic Democracies should prove an instrument of vigorous development of roads, particularly in rural areas.

It was also brought out that the country is lacking in research in road construction and is following specifications which are out-dated and costly. To make best use of the limited resources, research and investigations were proposed to be carried out on various types of local soils and materials to discover better and cheaper methods of road construction in the different topographical regions of the country. The task of revision of the existing road specifications was entrusted to an expert body of Road Engineers in collaboration with the Roads and Building Research Laboratories to evolve the suitable specifications in view of rapid improvement in techniques of road construction and maintenance.

Third Five-Year Plan Period.—It was felt that utmost emphasis will have to be placed on measures directed towards deriving maximum benefits from the existing facilities. The following measures were therefore pointed out :—

(*i*) a careful classification or categorization of roads is essentially needed to avoid over-investment in relation to traffic density;

(*ii*) evolution and use of low cost road-building techniques be adopted which should be based on local materials;

(*iii*) development of effective organizational, institutional and financial arrangements be made to ensure efficient construction and proper maintenance of different categories of roads;

(*iv*) concentration of effort be made on the completion within the plan period, of individual projects, or parts thereof, so that benefits from investments are realized quickly; and

(*v*) execution of highway projects in stages, in conformity with prescribed geometric standards and specifications be carried out so that each stage conforms to the anticipated volume of traffic in the short run, and the highway is developed in gradual stages to take higher volumes and loads of traffic.

It was also brought out clearly that the following factors in the past have mainly tended to inhibit the growth of road network on sound lines :—

(*i*) construction effort was diffused over a number of projects ;

(*ii*) maintenance and improvement of existing road network suffered due to lack of adequate finances;

(*iii*) programmes were based on inadequate standards and specifications; and

(*iv*) research activities for evolving suitable techniques of construction based on local conditions and materials could not be adequately developed.

The road programme under the Third Plan, which seeks to rectify the situation aimed at an optimum expansion of the network in keeping with the growing need for mobility. It provided for :

(*i*) strengthening and expansion of the existing road network;

(*ii*) developing a system of super highways;

(*iii*) construction of secondary and feeder roads to meet the needs of the short distance, light traffic in rural areas and newly developing regions of the country; and

(*iv*) expansion of research facilities.

In addition it was felt that while railways and inland water transport continue to bear the main burden in the movement of mineral and agricultural products involving bulk transportation, the road transport, especially in West Pakistan, has been assuming an increasingly important role in the movement of short-haul traffic in particular manufactured goods and perishables.

Certain inter-modal studies initiated by the Govrnments had suggested the guidline for the promotion of an adequate, economical and efficient transport system wherein each form of transport will play the role for which it is best suited. The most essential requirement would thus be to ensure that the development of the transport system is conceived as an integrated unit and handled on the basis of a well established comprehensive national transport policy that should devise adequate machinery to enforce it.

Fourth Five-Year Plan Period.—Ir was emphasized that during the Fourth Plan a major stress will be placed on the following :—

(*a*) the On-going Aided schemes will be completed as quickly as possible;

(*b*) Peshawar (Torkham) to Karachi road will be built to high standard as a 2-lane facility;

(*c*) priority will be given to such roads as provide connections from villages to markets; and

(*d*) A Master Plan for roads for the period 1970-85 will be prepared.

It has further been conceived that effective transport co-ordination requires that the various transport agencies apply common investment criteria. Unless this is done, railway investments, for example, might be undertaken where road transport would serve more economically or *vice versa.* These common investment criteria will be applied not only to new investments but also to the maintenance, expansion and continued operation of existing investments.

The existing efficiency levels, the future traffic growth and the level of traffic likely to be handled by each mode is reflected below :—

(*i*) the rail freight and passenger traffic will grow but at a slow rate during the Fourth Plan;

(*ii*) the road transport has grown considerably in the past and will grow still faster during the next five years;

(*iii*) the level of productivity in the utilization of capital stock in the Pakistan Western Railway is deteriorating and requires to be improved;

(*iv*) the road network is in need for urgent rehabilitation and improvement; and

(*v*) the buses and trucks are being utilized very intensively and there is practically little improvement possible in this regard.

This, therefore, provides broad guideline for resource distribution between the two modes.

The basic criteria to allocate funds within each mode will be based on the highest rate of return to the economy. The return on an investment in transport is heavily dependent on the amount of traffic using the facilities and the condition of the facilities. An investment in widening a heavily travelled narrow road may also yield a good return. In some cases the existing traffic levels may justify an investment without even speculating on future growth.

Feeder roads obviously need greater attention particularly those leading to existing rail heads and trunk roads. Development of an integrated road network of a high standard, which is the ultimate objective, would spill-over into the Fifth Plan but the beginning made in the Third Plan has to be pursued vigorously in the Fourth Plan.

Other road planning aspects requiring immediate attention

Statistics.—Statistics on roads and road transport were not available adequately. A start in this direction had since been made and the programme of the compilation of road inventory and the traffic count has been established which requires further strengthening on modern lines.

Classification of Roads.—It will be worthwhile for the Provincial Governments to attempt a clear classification of roads and then assign responsibility. A one for the Punjab had since been presented in a draft form for approval.

Specifications for rural roads.—Minimum specifications for rural roads will be laid down by Highways Department in consultation with Basic Democracies and Local Self Government Departments and the rural roads will be made according to those specifications.

Co-ordination of road specifications.—The ultimate objective of the Transport Surveys will be the preparation of co-ordinated land use and transportation plans for the country. The transport sector allocation will ultimately be based on this co-ordinated transport plan and not on the individual Master Plans prodcued by each sub-sector (*i.e.* Highways Department, Railways, Water-ways). This co-ordinated transport plan will in fact be a consolidated and product of technical, economical, strategic, physical social and political analysis of each individual Master Plan produced by each transport sub-sector.

Traffic and Transport Plan for Major Urban Areas.—By the end of the Fourth Plan period most of our big urban areas should each have a traffic and transport plan. The preparation of such a plan will be the responsibility of a well organised body in each of the major urban areas, who will have qualified persons to do this. The Traffic Police Department who are responsible for enforcement and implementation of the plan will also be kept in the picture when finalising the plan.

Ribbon Development.—Ribbon development will not be allowed so that sufficient land is available on both sides for further widening of the road. The law in this connection must be rigidly enforced.

Road construction industry.—The road construction industry should be ncluded in the industrial schedule and steps be taken to strengthen it in the country by allowing credit facilities, encouraging formation of consulting firms having their own engineering and technical personnel and by providing equipment and machinery in the contract work.

Equipment Industries.—To reduce our dependence on imported transport equipment which is obtained at the cost of our meagre foreign exchange, some immediate action shall be taken to set up transport equipment industries locally to manufacture bus and truck chassis, marine engines, auto-rickshaw engines, spare parts and accessories and some of the railway equipment and material.

Organizational Improvements

The pursuit of these policies will require organizational improvements to assure more effective co-ordination of the various transport modes, especially railways and roads.

The planning capability of the Highway Department will be greatly improved during the Fourth Plan. Local engineers with appropriate training for planning, designing of highways and bridges are available within the Highway Department, but the present organizational arangement does not ensure development of expertise which can eventually replace that of the consultants. The Highway Department should, therefore, pay considerable attention to developing their own planning and design organizations, among other things, by providing incentives (special pay etc.) which will attract qualified men to the design jobs and may keep them there.

Important extracts from CENTO Seminar on Highway Planning and Administration held at Lahore in August, 1972

Some extracts from the above Seminar are reproduced below, as these are of value in the development of planning concepts applicable to the conditions of our country :

1. L. L. Waters (U.S.A.)

It is suggested that ample right of way be acquired at the time of construction of a new facility because of the subsequent enhancement of land values contiguous to new or improved roads.

During discussion it came out that the balanced approach to highway planning be adopted to start with farm to market roads rather than super highways are developed first. While planning toll roads the amounts of toll should be minimum possible, especially for commercial vehicles because the latter affect the regional or national prices of commodities along with transportation cost.

2. Dr. Louis Berger (U.S.A.)

He emphasised that there has been revolution in highway planning during past five years. Study team once composed almost entirely of engineers now includes developmental economist, demographer, geographer, manpower specialist, system analyst and sociologist. The team thus consists of three engineers and five non-engineers.

During discussions author emphasised that in developing countries stress should be laid on variable design standard which can be improved on incremental basis.

3. Turkish Delegate

Impact of highway construction in Turkey indicated that about 1,000 job opportunities are indirectly created with the construction of 1 kilometer of road.

It was also experienced that further increase of population in big cities can only be reduced by providing adequate transport system in hinterland.

Brief Appraisal of Some Important Studies made on Highway Planning in Pakistan

Some important studies have been made in the recent past which paved-way towards the proper approach to Highway Planning. A brief appraisal of these studies would be valuable in understanding the present and future requirement of the Highway Planning as well as the role played by the studies in helping the planning activities.

1. Manual for the Economic Appraisal of Transport Projects

This Manual was prepared in the Planning Commission by Mr. Hans A. Adler, Adviser to the Planning Commission and issued in June, 1969.

It explains that in view of the strategic role of transportation, the large investments required, and the heavy foreign exchange costs frequently involved, a careful economic appraisal of these investments is particularly important. It is, therefore, the purpose of this Manual to serve as a guideline to all agencies in Pakistan responsible for planning in the transportation sector. The emphasis in this Manual is on the practical application of economic analyses. It is particularly important to stress that the analytical methods suggested in this Manual are of course not a substitute for the exercise of judgement, but are an additional tool for the more disciplined and systematic formulation of such judgement as the appraisal of projects is not a mechanical process but requires a high degree of analytical ability and a broad imagination. The consequences of the project being appraised must be clearly understood and formulated and the feasible alternatives must be fully considered. The most serious mistakes in project appraisal do not arise from the application of mistaken statistical techniques, but from inadequate analyses of alternatives and results.

While discussing the aspects of project appraisal, the Manul states that :

(*i*) The appraisal of a transport project involves engineering, managerial, financial and economic considerations. The engineering aspects deal primarily with the technical construction process and the operation of the project after it is completed, as well as with the estimates of capital and operating costs. The managerial appraisal deals with the multitude of management and staffing problems involved in construction and operation of the project. The purpose of the financial analysis is to determine whether the enterprise is likely to be financially viable *i.e.* to meet its financial obligations, to produce a reasonable return on the capital invested

and in appropriate cases to make a contribution from earnings towards the cost of future investments.

The basic purpose of the economic appraisal of a project is to measure its economic costs and benefits from the point of view of the country as a whole. There are, of course, many costs and benefits other than economic ones, such as the cultural opportunities from greater travel and the military and administrative advantages, and sometimes disadvantages, from greater mobility. These are not considered here explicitly, because they are not directly related to economic development. On the other hand, to the extent that these purposes reflect themselves in greater demand for transportation, they do become an effective part of the economic appraisal.

Therefore these four elements of project appraisal are closely interrelated. If the engineer over-estimates costs, the financial situation will be worse and the project may also no longer be economically justified. If the project is mismanaged, its costs will be higher and its revenue and benefits may be less. The forecast of revenues and benefits is closely related since consumers will not be willing to pay more than the benefits they receive and thus revenues are one important indication of benefits.

2. West Pakistan Transport Co-ordination Study

A Transport Co-ordination Study for West Pakistan was undertaken in the year 1969-70. Its first phase was completed on 30th June, 1971. In this phase, the quantitative part of the study is concentrated mainly on the most important parts of railway and highway transport systems, working out careful traffic forecasts, assessing the long term requirements of each sub-section, reviewing transport policies and operation and making recommendation about an optimum investment programme keeping the long term requirements in view. The survey would also help in preparing a co-ordinated land-use and Transportation Plan for the country based on the requirements of its economy, other physical developments and on the comparative efficiency and economies of each mode of transport. The results of this study in respect of important system parts indicated that during the Third Plan period the rail traffic had been almost stagnant and the traffic increase due to growth of economy had gone to the roads. Similarly, the growth in the road traffic during the Fourth Plan period would also be great as compared to the rail. It is, therefore, uneconomic for the railway to continue carrying traffic on short haul which is expected to divert more and more on to the roads. On the road side, the

study recommends concentration of the investments on strengthening and widening of existing roads and bridges rather than on new super highways. This result of the study confirmed the earlier decisions taken by the Government to defer the projects of construction of super-highways from Lahore to Lyallpur, Sheikhupura to Sargodha and Lahore to Multan which were not found economically feasible at this stage and the schemes of widening and strengthening of existing roads network were favoured for reason of yielding much greater economic benefits.

It may, however, be commented here that the search for economically desirable road investments cannot leave aside the thorough invesigation of potential new roads which, among other benefits, offer substantial distance savings and connections to new areas of production. Some very important feeder roads and new links may therefore have to be constructed to improve the economy. The above-mentioned results of the TRACO study, therefore, did not mean that such potential in the future highway planning were to be ruled out.

3. Appraisal Report of the Punjab Highway Department regarding future improvement standards of the Lahore-Rawalpindi-Attock Highway

A mention of the above specific study is important on account of the fact that Lahore-Rawalpindi-Attock Highway is a part of the National Highway running from Karachi to Peshawar. In fact, the main system parts selected for economic analysis in the first phase of the TRACO Pilot Project embraced the whole of the National Highway splitted into six parts. Two of these parts are Lahore-Rawalpindi and Rawalpindi-Peshawar. It would, therefore, be incidentally important to discuss the corelationship of the recommendations made in the above-mentioned studies regarding the improvement of the highway from Lahore onwards. The appraisal report carried out by M/s. Howard Needles, Tamman & Bergendoff Int., Inc. General Highway Consultants of the Highway Department, dealt with the economic analyses of the improvement programme of the highway in following sections :—

(1) Lahore to Gujranwala.
(2) Gujranwala to Gujrat.
(3) Gujrat to Jhelum.
(4) Jhelum to Gujar Khan.
(5) Gujar Khan to Rawalpindi.
(6) Rawalpindi to Hasan Abdal.
(7) Hasan Abdal to Attock.

The recommendations of this report were to widen the road to provide a 2-lane facility before the year 1977 and then to go on successively strengthen-

ing it up to the year 1993. However, it has been further mentioned that some sections of the road would become congested within the next 5 to 10 years and further widening or a new highway will therefore be needed from Lahore to Jhelum and from Gujar Khan to Hasan Abdal before 1980.

The recommendations of the TRACO Pilot Project are based on the economic analysis of the suggested improvements of the road from Lahore to Rawalpindi and from Rawalpindi to Peshawar as one system part each and recommend that apart from strengthening which should be carried out successively in various portions of road depening upon its present condition, subgrade characteristics traffic volume and intensity, it is essential that the road as a whole should be widened to a 4-lane facility during the 5th and 6th plan periods.

One point clearly emerges from the comparative study of the above recommendations that widening of the road to a 4-lane facility would be necessary up to 1982 or so and priority in this respect should be given to the portion from Lahore to Jhelum and Rawalpindi to Hasan Abdal. Further priority ratings in between various sub-sections of these portions can be determined after further study, but it is time to prepare for the implementation of this important task. Also for obvious reasons of ultimate economic advantage as well as the increase in the capacity of the road and safety of traffic, it would be advisable to go in for a divided 4-lane facility rather than an undivided one.

4. Classification of highway system and Design Criteria

This draft publication (for approval) has been issued by the Directorate of Planning and Design of the Punjab Highway Department in June, 1972. A clear classification of roads is essential in order to evolve a rational method for further improvement and to relate the investments for traffic density. This was long overdue because of tremendous increase in the volume and weight of vehicular traffic on the roads. The present highway network is, therefore, required to be integrated into a proper system so that each component route can be identified and defined. The highway system in the Punjab has therefore been classified into three categories of routes, Primary Highways, Secondary Highways and Feeder Roads. Route in each category has also been given a specified number.

Sections of primary or secondary highway and feeder road will be prepared for improvement or reconstruction depending on the volume of traffic into any of the three construction standards, *i.e.* Class I, Class II or Class III as described in the booklet.

The highway system as proposed along with the construction standards will rationalise the basis and procedure for the proper growth and development of road system in the province.

THE EXISTING ORGANIZATION AND ACTIVITIES OF THE HIGHWAY DEPARTMENT IN THE FIELD OF HIGHWAY PLANNING

As would be manifest from the perusal of the reaction from the various past Five-Year Plans, the thinking towards evolution of a well-organized Planning Activity for the Highway system did develop successively during the various plan periods. However, actually it started taking a concrete shape during the Third Five-Year Plan period. Incidentally in the year 1965, on the advise of the World Bank, the Government of West Pakistan also appointed General Highway Consultants to the West Pakistan Building and Roads Department with the main purpose of processing some schemes financed by the World Bank. These consultants apart from advising the department on individual projects, also made some contribution towards highway planning for preparing *proformas* for Road Inventory and initiating Traffic Count Programme. Their work relating to the individual projects mainly related to their assistance in the processing of the detailed design of the following schemes prepared by Specified Consultants and the Department :—

(1) Karachi-Hyderabad Super Highway	(Specified Consultants)
(2) Lahore-Multan Highway	(,,)
(3) Lahore-Sheikhupura-Lyallpur Highway	(,,)
(4) Sheikhupura-Sargodha Highway	(,,)
(5) Bridge over River Ravi near Lahore	(A toll facility designed by the Bridge Directorate of the Highway Department and vetted by the specified consultants).
(6) Bridge over River Jhelum near Jhelum	(,,)
(7) Bridge over River Sultej near Bahawalpur	(,,)

It may be mentioned here that the Projects mentioned at Serial Nos. 2, 3 and 4 were later on found to be non-feasible on their appraisal by the Government of West Pakistan itself and were thus deferred.

The General Highway Consultants had also recommended bifurcation of the B & R Department into two separate Highway and Building Departments. The bifurcation took place on the 30th September, 1967 with the object of streamlining operations, fostering efficiency increasing specialization and to provide for an effective structure for the introduction of operational improvements and better technical performance in both the sectors. After the revival of the former provinces on 30th June, 1970, this very step continued in the Province of Punjab and a Planning and Design Directorate was created on 30th June,

1971, by mobilizing the local engineering talants which replaced the consultants. This Directorate coupled with the already existing Directorate of Bridges, Road Research Institute and staff office of the Chief Engineer forms the basic planning unit of the Highway Department responsible for the long range comprehensive and co-ordinated planning as well as for the work involved in the planning of individual highway segments. A brief introduction of the functional responsibilities of each unit and their interrelationship in the framework of highway planning activities is described here.

I. Road Research Institute

The history of Road Research Institute dates back to 1944 when a small Soil Stabilization Laboratory was established in the former Punjab. With further developments, up to the year 1962 its activities mainly confined themselves to the testing of materials. In this very year, however, the laboratory was bifurcated into a Building Research Station and Road Research Laboratory. At present the activities stand expanded and the organization concerning roads is functioning as a Research and Material Testing Institute at Lahore. The Laboratories of the Institute comprise of the following four divisions :—

1. Foundation.
2. Pavement and Physical Testing Section.
3. Field Quality Control.
4. Administration and Training.

Generally speaking, research and routine work is carried out under the guidance of a Director.

In a nutshell, the role of institute is to serve as a centre for securing and disseminating knowledge leading to a scientific and improved method for highway construction and maintenance.

Routine work includes site investigation and pavement design covering soils and materials investigation for roads throughout Punjab. Testing of materials is performed either by following the B.S.S., the A.S.T.M., or the A.A.S.H.O. Specifications. Laboratory carries out investigations to determine soil bearing capacities for bridge foundations. It also makes detailed recommendations pertaining to modern airport design in connection with its foundation and pavements. Limited studies are undertaken in traffic engineering and economics and several other matters related to highway design, construction and maintenance. Research studies are concentrated on investigation and research of local problems rather than theoretical problems of a fundamental nature. The institute is presently engaged in testing the materials for road construction/ maintenance including aggregates, bitumen, cement and concrete. Testing of subgrade soil for pavement design and in-situ strength properties of subgrade

for highway and airfields are also done. The in-service training of field engineers and the supervisory staff of Highway Department to up-date their knowledge is also one of the objects of the institute. Facilities are also existing to train laboratory staff from other agencies although at a limited scale.

II. Directorate of Bridge Design

The Bridge Design Directorate was established in the year 1959 and has proved during the past years that such a colossal job can be handled by the Directorate if proper working conditions are provided to them.

During the past years the Highway Department remained very active in the field of Bridge Design and Construction. A number of major river bridges have been designed, constructed and opened to traffic along with a large number of other sizable span bridges.

A great number of our bridges are narrow, designed for light loading and have outlived their lives. Their replacement is going to be a major task which needs to be tackled during the Fourth and Fifth Five-Year Plans. A number of new bridges on new roads including major river bridges are planned for execution. Some of the railway level crossings are to be replaced by overhead bridges. The effort that will be required to tackle all these bridging problems will be colossal and will be a great challenge to us.

The Directorate is responsible for all stages of bridge design from initial review to final cost estimates. More specifically, the unit is responsible for the following :—

- Site location;
- Hydraulic studies;
- Type studies and cost economies;
- Detailed design and drawing;
- Bill of quantities;
- Detailed cost estimates; and
- Review contract documents.

The functions being performed by this Directorate are given below :

1. Specify requirements for survey to be carried out, either directly by survey unit or by contract and check these surveys on submissions of documents.
2. Establish terms of reference for hydraulic studies to be carried out by external agencies or the Irrigation Research Institute for the Highway Department.
3. In collaboration with the Highway Design Section, establish location of structures.

4. Prepare designs for highway structures.
5. Extract quantities and prepare estimates for technical sanction.
6. Prepare tender documents for highway structure projects, including plans, specifications, bills of quantities etc.
7. Provide technical advice during the construction period.
8. Formulate and review design standards and guide manuals.
9. Prepare typical and standard details.
10. Recommendations in the assessment and selection of design consultants for highway structure projects and prepare terms of reference for work to be carried out by them.
11. Review standard contract documents.
12. Review and comment on studies, reports and contract documents related to bridge design prepared for the Highway Department by external agencies.
13. Prepare reports on proposed projects or existing structures as required.
14. Periodic review and updating of Code of Practice for Bridges.

DIRECTORATE OF PLANNING AND DESIGN

The Directorate of Planning and Design is charged with the responsibilities of proforming the following functions :—

A. Traffic Surveys

1. Develop and implement annual traffic count programs.
2. Implement special traffic count programs as required.
3. Organize province-wide origin and destination traffic surveys to help fix project priorities.
4. Tabulate and document various types of basic highway data such as :
   (*a*) Highway traffic counts.
   (*b*) Vehicle origin and destination information.
   (*c*) Highway accidents data.
5. Collect traffic capacity-speed-operation data.
6. Assist in the collection of data for Highway Department sponsored by traffic research projects.

B. Road Inventory

Maintain and update road and bridge inventories depicting the existing pavement width, pavement condition, pavement thickness, roadway alignment, formation width, right-of-way and condition of bridges.

C. Planning

1. Determine the adequacy of existing roads/bridges to handle present and projected traffic (sufficiency studies).
2. Evaluate traffic capacity-speed-operation data and develop empirical relationships between traffic capacity, speed and level of service of various types of existing roads and bridges in the province.
3. Estimate future traffic volumes from collected historical traffic data for use in feasibility studies and project programming.
4. Development of Highway classification and route numbering system.
5. Evaluate alternative alignment corridors for new highway projects with respect to right-of-way acquisitions and proximity to existing highways.
6. Final review of location studies, feasibility studies and cost benefit analysis.

D. Traffic Engineering

1. Develop policy and recommend legislation on signing, vehicle size, weight and speed limitation, commerical sign installations and highway safety.
2. Co-ordinate planning with other Government agencies and provide general assistance as required.
3. Evaluate collected highway accident data and recommend specific project improvement to improve highway safety.
4. Develop and implement research projects in the areas of traffic capacity, vehicle operation, etc.

E. Transportation Economics

1. Establish and improve methods of economic evaluation of highway investment projects.
2. Establish procedures and initiate programmes for the collection of statistical data required for economic evaluation of highway projects.

3. Document and analyse various types of basic highway data such as :
   (*a*) Vehicle operating costs.
   (*b*) Representative construction and maintenance costs.
4. Propose and initiate analysis of highway investment projects.
5. Study and review the economies of :
   (*a*) Individual highway projects.
   (*b*) Highway development and betterment programmes.
   (*c*) Road maintenance and construction methods.
   (*d*) Road standards.

F. Design

— Determine route locations for each new road.
— Specify land acquisition requirements,
— Evaluate relocation and improvement studies.
— Define structural requirements.
— Fix design standards.
— Prepare detailed working plans.
— Review and prepare specifications.
— Prepare quantity estimates and final cost.

A brief description of the work done/being done by the P & D Directorate is given here :

(1) *Road Inventory.*—The work is in progress on road inventory and nearly 80% mileage of existing road network in the Province under the Punjab Highway Department has been covered. A typical sheet of the road inventory is attached herewith in order to show the type of data which is being gathered and plotted on the road inventory maps.

(2) *Traffic Survey and Traffic Projections.*—The traffic surveys are being carried out year to year and the traffic maps have accordingly been prepared. The latest traffic map for the year 1971 is annexed to show the details of the present-day traffic and the location of traffic count stations etc. Traffic projections are made by extrapolation method for the next 15 years to form a basis for the design of the roads.

(3) One important step that has been covered by this Directorate to fulfil the basic requirements of long range planning is the classifiction of highways. This has already been explained under 'Appraisal of Studies'.

(4) The proposal containing the criteria and finalization of the schemes regarding upgrading of level crossings has been completed and is under approval. This will be a major steep towards improvement of the geometric standards of rail road crossings in the Province.

The work on the following individual projects has been completed, right from the route location up to detailed working drawings :—

(1) Muridke-Narowal Road.

(2) Kharian-Jalalpur Road.

(3) Badiana-Chawinda—Zafarwal Road.

The work on the following individual projects is in hand :—

(1) Kalar-Dubaran Road.

(2) Pind Dadan Khan-Lilla Road.

(3) Chund-Lalian Road.

Besides above, the work relating to improvement of curves, grades and intersections of the schemes of widening and strengthening of road network in the Province is being done by the Directorate according to the requests made by the field formations. A number of important intersections have been designed which is a notable contribution regarding raising of the geometric standards for safe and fast flow of traffic.

The highways passing through urban areas are also engaging attention of the Directorate because of the traffic problems of such portions of the roads. The design for the dual carriage-way within Sheikhupura Town has been done by the Directorate and a survey of traffic hold ups at rail road crossing has also been carried out in order to finalize the schemes for overcoming the traffic problems on some schemes of the roads passing through the rapidly developing urban area.

Last but not least a mention must be made of the important work which is being taken in hand for the planning and design of dual carriage-way from Lahore to Jhelum and from Lahore to Sheikhupura which are justified for the traffic requirements in the near future.

At the end it may be stated that the Transport Economic part of the P & D Directorate is yet to assume its shape because the services of the Transport Economist so necessary for this wing of the Directorate have yet to be made available. The Traffic Engineering Wing is also rather weak because of lack of Traffic Engineering Specialist. It is hoped that these needs of the Directorate would be fulfilled very soon in view of the urgency of the situation.

IV. Programming and Budgeting

The following functions relating to the programming and budgeting are assigned to the Staff Officers of the Chief Engineer:—

A. Programming

1. Prepare and review of the Five-Year Development Plan.
2. Prepare broad scheduling of individual projects.
3. Prepare annual programs for the Five-Year Plan.
4. Prepare rough cost estimates of planned projects.
5. Prepare P.C.I. (Planning Commission *Pro forma* I) and P. C. II and forward them to concerned departments.
6. Arrange for administrative approval of projects.
7. Prepare and submit foreign loan application.
8. Prepare status report on loans for loan-giving agencies.

B. Budgeting

1. Compilation of Schedule of New Expenditure, budget estimates including 1st and 2nd lists of excesses/surrenders and supplementary estimates, allotment and withdrawal of funds, under all heads.
2. Creation and continuation of charges, preparation of work load with S.N.E. for all charges.
3. Preparation of Budget estimates including compilation of Budget received from lower formations.
4. Reconciliation of allotment under all heads.

The present Challenge concerning Planning

The nation and for that matter all the Public Works Agencies including the Highway Department are now faced with a new Challenge. We have passed through a most serious crisis of history. Yet, this is not to deter us from a determination to rebuild ourselves in order to vindicate our national honour. In these circumstances, the People's Government have defined the national goals, the great importance of which should be clear to every one of us. In a nutshell, it is our task to build a strong and invincible Pakistan. We have to fight against poverty and remove social injustice. Rapid economic development through the utilization of our own manpower and natural resources, is therefore, obviously the keynote of planning for the accopmlishment of national objectives. The roads are a most significant component of the transport system which is of all-pervasive importance to the requirements of all development in all other fields critical to the economy and they are also an essential

requirement for the defence of the country. The present inadequacy of land transport connections is too well known from the experiences of the past as it slowed down the distribution of raw material, as well as the finished products of the industry and restricted the timely supply of seeds and fertilizers to the farmers and the farmers' produce to the market. The People's Government have launched a massive campaign for the up lift of the rural population and for providing means of growth to the agro/based industry in the villages. Required emphasis is also being placed on the development of basic Industry like Steel Industry and other heavy industry and atomic energy utilization etc. It is obvious that under these circumstances a fast increase in the network of the roads would be required in the future in order to avoid bottlenecks in the growth of economy in all these important fields.

In compliance with a recent directive received from the Central Government in the context of the emerging requirements of the nation, the Highway Department is actively engaged in preparing plans for the construction of roads with a target of about 1,000 miles of metalled road per year in order to provide the requistie means of communication within the Province of Punjab. These plans are being prepared keeping the following broad criteria in view :—

1. Roads shall be constructed keeping in view defence priorities.
2. Roads shall be constructed in all such areas where farmers can easily shift their produce to the nearest market or the Railway Station.
3. Roads shall be constructed leading to Mine areas in order to explore the mineral wealth.
4. Roads shall be constructed providing shorter routes between two particular stations, wherever possible, to avoid the existing longer routes.
5. Missing links between two stations shall be constructed so that a through road is completed.
6. Roads shall be constructed in under-developed areas where potential exists for establishing industrial complex and thus create job opportunities.
7. Roads shall be constructed in areas where there is only one system of transportation *i.e.* Railways, in order to provide more economical and flexible system of transportation.
8. Roads shall be constructed in areas where canals have been constructed but no road is in existence, in order to develop that area.

District-wise/Division-wise plans have been prepared suggesting the following tentative emergent needs of each District/Division on progressive basis :—

Sr. No.	Name of District	Approximate mileage proposed	Civil Division-wise Total
	Lahore Division		
1.	Lahore District	.. 136.20	
2.	Sheikhupura District	.. 206.00	
3.	Gujranwala District	.. 296.50	
4.	Sialkot District	.. 225.00	863.70
	Bahawalpur Division		
5.	Rahimyar Khan District	.. 182.00	
6.	Bahawalpur District	.. 155.50	
7.	Bahawalnagar District	.. 114.00	451.50
	Sargodha Division		
8.	Mianwali District	.. 195.00	
9.	Sargodha District	.. 198.50	
10.	Jhang District	.. 182.00	
11.	Lyallpur District	.. 197.25	772.75
	Multan Division		
12.	Dera Ghazi Khan District	.. 215.50	
13.	Muzaffargarh District	.. 118.00	
14.	Multan District	.. 236.25	
15.	Sahiwal District	.. 286.50	856.25
	Rawalpindi Division		
16.	Campbellpur District	.. 205.95	
17.	Rawalpindi District	.. 134.50	
18.	Jhelum District	.. 134.00	
19.	Gujrat District	.. 310.75	785.20
	Total Mileage	.. 3,729.40	

The above plans are being sent to all the Commissioners and Deputy Commissioners in Punjab for their comments and fixing priorities with the participation of the people keeping in view the above cited criteria, demand of

the people, population that would benefit by the facilities and location of production and consumption centres etc.

At the end, it must be emphasized again that while carrying out the development programme in the road sector or any other sector, we must keep in view the basic policy of self-reliance, the vast potential of our manpower which is hitherto fore-unemployed or under-employed and the scarcity of our financial resources, especially the foreign exchange. On this account, it is imperative that transport investments and related policies should on the one hand be adopted with utmost economy in view, and on the other hand the design and execution methods for road projects be so evolved as to make optimal use of the existing mechanical equipment and immense manpower resource. This situation, preculiar to the present conditions of our country presents a great challange, to the Civil Engineers as well as Mechanical Engineers. This is because we have to depart from the latest techniques of construction developed in advanced countries like U.S.A. needing sophisticated mechanical equipment, but still achieve the desired standards of quality and progress through the use of manual labour and whatever mechanical equipment we have. Unless we do this, we shall fail to creat job opportunities for the unemployed people and to save the burden on the foreign exchange.

All this will need intensive exercise on the part of the Engineers in the following fields :—

(1) Careful planning of Highway investments in coordination with other investments in the Transport System, in order to avoid any duplication.

(2) Intensive and extensive research on the use of local materials for construction of roads.

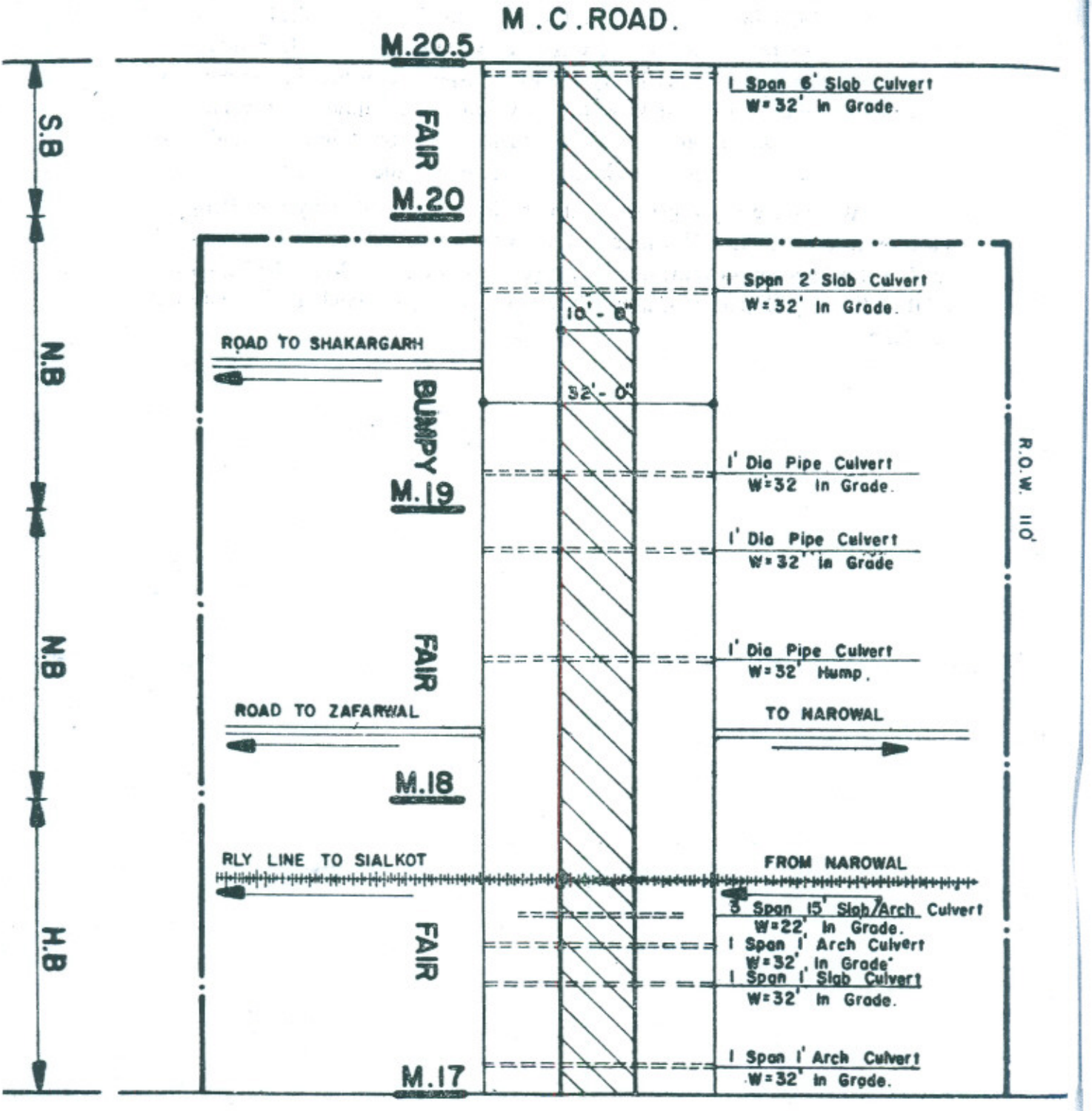
(3) Developing new standards of design and methods of construction with a view to achieving the objectives of quality and progress through manual labour and existing mechanical equipment.

(4) A thorough research by the mechanical engineers for repair and utilization of the existing machinery and manufacture of spare parts out of local resources as far as possible.

(5) Innovation on the part of mechanical engineers to evolve such mechanical equipment that would achieve the desired standards of quality with manual labour and maximum utilization of the available equipment to substitute the machinery used in the advanced countries in order to avoid the strain on foreign exchange as well as to keep the job opportunities for the manual labour.

(6) Planning for gradual shift to use of modern mechanical equipment for road construction work in co-ordination with the production potential of the heavy industry being established in the country and keeping in view the new job opportunities that would be created through the development of the basic industry and consequent shifting of labour to more productive work.

We have every hope that with the inspiration given by the People's Government, the spirit of learning and innovation so imbibed, with the required modification and improvements in an organisation and working, the Engineers of the Highway Department are well set to meet the demands of the national challenge.



REF. SHEET NO.9.A