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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
INTERNATIONAL DEVELOPMENT ASSOCIATION

APPRAISAL OF A HIGHWAY PROJECT
WEST PAKISTAN

May 18, 1964

Department of Technical Operations

CURRENCY EQUIVALENTS

| | | |
|------------------|---|----------------|
| 1 Pakistan Rupee | = | U.S. \$0.21 |
| 1 U.S. Dollar | = | PRs. 4.76 |
| PRs. 1 million | = | U.S. \$210,000 |

WEST PAKISTAN
HIGHWAY PROJECT
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WEST PAKISTAN
APPRAISAL OF A HIGHWAY PROJECT
SUMMARY

- i. The Government of Pakistan has asked the Association to finance part of the cost of a highway project in West Pakistan. The project consists of (i) the construction of a new highway between Karachi and Hyderabad, (ii) the construction of three major bridges across the Jhelum, Ravi and Sutlej Rivers, (iii) the employment of management consultants to advise and assist the Building and Roads Branch (B & R) of the Provincial Government, and (iv) the employment of consulting engineers to carry out feasibility studies of access to Karachi and Hyderabad.
- ii. The total cost of the project, including US\$5.0 million equivalent for right-of-way and taxes, is estimated at US\$35.5 million equivalent of which US\$17.0 million equivalent is the foreign exchange cost. The cost estimate is considered sound and includes a reasonable allowance for contingencies. The Government of West Pakistan will finance the project's local expenditures from its own budget.
- iii. Design and supervision of the Karachi-Hyderabad Highway will be carried out by consultants who will be selected by the Government subject to the approval of the Association. Design of the bridges will be carried out by the B & R which has indicated that the final plans will be reviewed by consultants. These consultants will supervise construction of each bridge on a full-time basis. Management consultants will be selected by the Government subject to the approval of the Association.
- iv. Road and bridge construction will be carried out by contractors selected on the basis of international competitive bidding.
- v. The project is economically justified. The present route between Karachi and Hyderabad is a 124-mile long narrow highway which is in a poor condition and passes through a water-logged area. The new highway will avoid this area and shorten the distance between the two cities by 30 miles. The benefits accruing from the reduction in distance and the provision of a higher standard highway are sufficient to produce returns of 8% and 11% discounted over the life of the investment for two different assumed traffic volumes expected to use the road. Significant indirect but unmeasured benefits are also expected.
- vi. The existing Jhelum and Ravi Bridges are old structures that are congested and no longer suitable for heavy volume of fast moving traffic. The Sutlej Bridge would replace a boat bridge which is designed for a maximum of 4-ton vehicles and has to be removed during the annual three-month flood period. The Jhelum and the Ravi Bridges are on the projected West Pakistan National Highway from Karachi through Hyderabad, Lahore and Rawalpindi. As the location of the National Highway south of Lahore is now under study, it is not known where it would cross over the Sutlej River. In any case, a bridge is needed at the presently proposed site. The value of vehicle time saved by the avoidance of delays appears sufficient to justify the investment.

vii. The organizational structure and operational practices of the Buildings and Roads Branch are both out-of-date and unsuited to modern highway construction and maintenance. A fundamental reorganization and reorientation of planning, construction and maintenance practices are needed to enable the B & R to meet its responsibilities for the construction and maintenance of a growing road system on which traffic is steadily increasing. For this reason, the employment of management consultants is necessary.

viii. Feasibility studies for access to Karachi and its port and to Hyderabad are necessary because the streets of these two cities are becoming more congested.

ix. The project provides a suitable basis for a development credit by the Association of US\$17.0 million equivalent.

I. INTRODUCTION

1. The Government of Pakistan has requested a credit from the International Development Association (IDA) to meet part of the cost of a highway project in West Pakistan. The project consists of the construction of a new highway between Karachi and Hyderabad and three major bridges, and the employment of management consultants to advise the Buildings and Roads Branch (B & R) of the Provincial Government for a period of three years, and consulting engineers to carry out feasibility studies of access to Karachi and Hyderabad.

2. Roads and road transport in West Pakistan were studied by the Bank in the course of the Economic Missions to Pakistan in 1961 and 1962. In 1961-62 a comprehensive transportation survey of West Pakistan was made by Transportation Consultants, Inc. (TCI) for the USAID. The USAID mission in Pakistan for some time had been considering a new highway connection between Karachi and Hyderabad. It had carried out a reconnaissance of the proposed alignment, made traffic surveys and arrived at a very preliminary cost estimate. During the visit of the Bank/IDA mission in 1962, the USAID indicated that it was concentrating its investment priorities in East Pakistan, and therefore was no longer interested in financing this highway.

3. On examination the IDA mission concluded that a new highway was obviously needed but found that additional information, particularly on costs, was required. It suggested to the Government that it engage consultants to carry out a complete feasibility study. Early in 1963, Ammann & Whitney International Limited were engaged for this purpose. A draft report was submitted by the consultants in November 1963 when the IDA mission visited West Pakistan to appraise the present project. The consultants' final report was received in February 1964 which completed their assignment.

4. This appraisal report is based on the consultants' feasibility study, the TCI report, and on information obtained from the B & R and other Government sources by Bank and IDA missions.

II. BACKGROUND

A. General

5. The Province of West Pakistan covers a land area one and a half times that of France. It is mainly a vast flat plain stretching from the foothills of the Himalayas in the northeast to the Arabian Sea. Annual rainfall varies from 5 inches in the south to 30 inches in the north. The main inhabited area which lies in the center and north of the Province is crossed by five great rivers, the Indus, Jhelum, Chenab, Ravi and Sutlej, which, after their confluence, flow as the Indus southwards to the sea. The floods of varying intensity which occur annually on these rivers result in serious interruption of transport communications.

6. The Province has a population of about 50 million people, 75 per cent of whom live in rural areas. Some 40 per cent of the 10 million urban dwellers live in the four principal cities of Karachi, Hyderabad, Lahore and Rawalpindi. The population is believed to be increasing at a rate of at least 2.6 per cent per annum with the urban areas increasing at a much faster rate because of migration from the countryside and the settlement of refugees.

7. While West Pakistan's economy is still primarily agricultural, the industrial sector's contribution to Provincial "national" income is estimated to have increased from 7 per cent to 15 per cent between 1949/50 and 1959/60. The Government anticipates an acceleration of this trend over the next ten years. Cotton textile, cement, sugar, chemical fertilizer and leather goods industries located in or around Karachi, Hyderabad, Multan, Lyallpur and Lahore comprise the main industrial activities at present. Medium and light manufacturing industries producing machine tools, spare parts, sewing machines, sports goods and the processing of local agricultural products are widely scattered throughout the Province.

B. Transport System

8. Both Government-owned and privately owned transport facilities serve the Province. The Government-owned and operated enterprises include the Pakistan Western Railways, Pakistan International Airlines, Karachi Port Trust, a number of urban bus companies as well as the West Pakistan Road Transport Board which operates inter-city bus services. In the private sector, bus, truck, pipeline, river and ocean going transport services are provided. There is, in addition, a large amount of local and rural traffic which moves slowly by animal drawn vehicles.

9. With the exception of the railway, the airline and the urban bus services there is little effective regulation of transport. The Government has recently reconstituted its Transport Coordination Board. This body is expected to recommend priorities of investment allocations within each transport sub-sector to advise the Government on rates and fares and to collect and correlate data on transport activity and trends. Insufficient time has elapsed to determine the manner in which it will carry out its tasks.

C. The Road System

10. At the end of 1962, West Pakistan had a road network totaling some 21,000 miles of all types about half of which is paved. Although these are passable in all weather, they are generally of low standard and functionally obsolete for modern traffic. The remainder of the system consists of gravel and earth roads which often become impassable during the monsoon season. The higher type of roads generally come under the jurisdiction of the Provincial Government with the lower type being generally built and maintained by municipal and village authorities.

11. A substantial mileage of existing paved roads is subject to flooding and to damage from water logging and is under frequent repair. Most of the paved roads are either of single-lane or a substandard two-lane width which results in heavy damage to the pavement edges and shoulders from meeting and passing vehicles. Since the shoulder material becomes pulverized to a fine dust and gradually erodes, meeting or passing on narrow pavements can be extremely hazardous because of lack of visibility and the drop from the pavement to the shoulders.

12. In 1962 there were some 115,000 motor vehicles registered in West Pakistan. Of these, about 28 per cent were trucks and buses which make up the bulk of road traffic outside the urban areas. As shown in Table 1 there has been a rapid increase since 1958 in most vehicle categories. The volume of truck traffic has increased significantly since the removal of inter-regional restrictions in 1961. Truck and bus traffic would have been higher had it not been restricted by the inadequate road network, the substandard condition of many of the roads and the difficulties of procuring foreign exchange for the purchase of new vehicles and spare parts. In 1961-62, for example, a government enquiry estimated that some 25 per cent of the trucks and 30 per cent of the buses were "off-the-road" because of lack of spare parts.

13. Regulations already exist to control the operation and loading of vehicles, but there is little or no enforcement outside the cities and towns. The density of mixed vehicle and animal traffic on some roads has reached a point where action is badly needed to improve safety and permit the unhindered flow of motor traffic. The widespread practice of stopping and parking on the pavement requires special attention.

D. The Road Organization

14. The Buildings and Roads Branch (B&R) of the Communications and Works Department is responsible for the construction and maintenance of all but municipal and village roads. The headquarters of the B & R is located at Lahore. Its organizational structure is an outdated and cumbersome historical carry-over from the pre-Independence era when communications were poor.

15. Except for the design and supervision of bridges, which is centralized, the technical responsibility for the planning, execution, and maintenance of road works is delegated to five regional engineers who in turn may assign work to various subordinate offices, several of which may be in the same city. A separate maintenance organization does not exist and both maintenance and construction are carried out by the same forces.

16. Perhaps the worst defect in the organization of the B & R is the lack of a chief engineer to direct, plan and coordinate all aspects of road works. The need for such an official has become increasingly necessary as West Pakistan moves ahead with its plans for rebuilding its existing obsolete provincial road network. Consideration is being given to the establishment of a central planning office within the B & R; however, it seems apparent that centralizing only one of its many functions would not meet the need for over-all direction and control of all phases of highway work.

17. The Government is actively considering both the separation of the buildings and roads functions, and the reorganization of the administration of road works. Steps in this direction are already being taken by appointing junior officers to one or the other activity. The main question to be resolved is how far the separation should be carried. While it is clear that in urban areas the amount and complexity of road construction work warrants the separation of the two functions, it may not be practical in more isolated areas where the annual expenditures are small and technical skills scarce. One reform that is badly needed is to avoid the loss of technical skills caused by the frequency of staff reassignments, sometimes to completely different functions.

18. In the light of plans to proceed with the construction and reconstruction of a large mileage of primary roads, the modernization of construction and maintenance operations is essential. This calls for a thorough study to determine the organizational and operating changes needed and a re-assessment of budgetary requirements.

E. Maintenance

19. The primary road system, most of which is paved, receives regular maintenance, but since parts of it have been so poorly built, excessive maintenance is required, particularly in areas subject to water logging and annual flooding. Secondary and village roads which are usually earth surfaced are difficult to maintain and become unusable in the wet season.

20. Most maintenance is carried out by hand labor which is permanently assigned to each section of road. Maintenance equipment is limited to antiquated rollers, asphalt kettles and a few overaged trucks. Because of the shortage of equipment, maintenance work is often of an inferior quality and the same repairs have to be carried out over and over again. Vehicle overloading and rapidly growing traffic densities, especially on roads with single-lane pavement, exacerbate base and pavement failures and add to the difficulty of maintenance.

21. The central repair shop at Lahore is well equipped with power tools and trained machinists available to operate them but district shop facilities are almost nonexistent. The small spare parts inventory at the central shop is inadequate.

22. Separate provision is made in the provincial Government budgets for maintenance funds. Annual maintenance costs range from Rs 500 (US\$105) to over Rs 2,000 (US\$420) per mile per year in West Pakistan, although where flood damage occurred the costs may be much higher. As shown in Table 2, while construction expenditures varied widely during the First Plan Period, main-

tenance expenditures were fairly consistent. This is one indication of the increasing and commendable awareness at high levels in Government that it is pointless to build roads if they are not to be properly maintained.

23. In the light of plans to modernize and expand the highway system, there is an obvious need for a study to determine i) how maintenance operations should be organized, ii) the degree of mechanization required, iii) the best maintenance practices for conditions prevailing in West Pakistan, and iv) the amount of funds needed annually for maintenance.

F. Construction

24. With few exceptions, roads in West Pakistan are built almost entirely with hand labor, equipment being limited to a few essential units such as rollers, concrete mixers and trucks. Some large works, mainly bridges, have been built with limited use of equipment. Apart from masons, brick makers and layers, workmen are largely unskilled. The labor force is hard working, but under the circumstances its productivity is inevitably low.

25. On the construction of higher types of roads by labor intensive methods, it has been noted that quality suffers even with good supervision. Fills and embankments go unconsolidated because of lack of the compacting action of equipment and often settle substantially with resulting pavement failures. Pavements constructed by hand labor tend to be rough and uneven and often fail under the impact of fast-moving and heavy vehicles. Thus it is evident that compaction and paving operations on high-standard roads must be carried out by mechanical means.

26. A further weakness of hand labor is the common practice of using inferior materials found immediately alongside the roads because of the shortage of trucks to haul in better materials which may be available some distance away. Even where trucks are available, it may be uneconomic since mechanical loading equipment is frequently not available. As a result, capital invested in trucks is inefficiently employed because of the large amount of time needed for hand loading and unloading.

27. Labor and local materials are generally provided by contractors with the Government supplying some imported materials and equipment on a rental basis. The contractors are generally small entrepreneurs although there are a few larger firms with foreign connections.

28. Field supervision of work in progress is satisfactory on a few projects, but is generally inadequate or non-existent on most work. Field laboratories are not available and little use is made of the central laboratory at Lahore. The standard techniques of scheduling work, progress reporting and follow-up are generally not in use.

29. The Province as a whole has suitable highway construction materials though these are not always conveniently located. The availability of water for compaction can be a problem for road construction in semi-desert areas, but can be overcome by wells and temporary pipelines.

30. The cost of construction of a primary road in flat terrain has averaged about Rs. 100,000 (US\$ 21,000) per mile for a single-lane asphalt surfaced road on a low embankment. An undesirable tendency has developed to use Rs. 100,000 per mile as a rule of thumb average and to expect roads to be built for about that price without any consideration being given to the variable nature of the materials available and drainage. As allocations are often based on this rule of thumb figure, engineers are either obliged to perform inferior work in order to complete the mileage, knowing that the work will not stand up, or to stop the work until such time as more funds are appropriated.

31. Many recently built roads are not standing up to present day traffic. This is the inevitable consequence of inadequate design, antiquated specifications and the impossibility of building modern roads suitable for high speed, heavily loaded vehicles with little or no equipment.

G. The Five-Year Plans

32. The Government's First Five-Year Plan (1955-60) provided for the construction of 1,800 miles of new roads and the improvement of 2,000 miles of existing roads in West Pakistan at a cost of Rs 195 million. (US\$ 41 million). According to the Planning Commission, the work carried out was somewhat less than that scheduled and the actual cost was Rs 200 million. Rs 1.5 million (US\$ 310,000) was included in the original allocation for expanding road research with a view to evolving new specifications for road construction through use of locally available material, but this basic work was never done.

33. The Second Five-Year Plan (1960-65) provided for a road program as shown below, together with the construction of four major bridges, at a total cost of Rs 250 million (US\$52.5 million).

| | <u>Miles</u> |
|------------------------------|--------------|
| New roads (in progress) | 850 |
| Improved roads (in progress) | 250 |
| New roads | 1,200 |
| Roads to be improved | <u>1,200</u> |
| | 3,500 |

34. Because of political pressures, the bulk of the plan program consisted of the rebuilding of numerous widely scattered short sections rather than concentrating a smaller number of through roads. The work was handicapped by a shortage of funds, lack of equipment and the skills to build high-standard road works. While many local improvements have been accomplished under the Plan, there has been no significant upgrading of the main road system. Any results of this nature must await the application of modern techniques of road building directed to the execution of a specific project.

35. Both IBRD and IDA missions to Pakistan have found that the program lacked effectiveness and was difficult to execute. Although up-to-date records on schedules and progress were generally not available, it was concluded by these missions on the basis of field surveys that the program was falling behind schedule. In 1962 the P. P. R raised its estimate to complete the Plan target from Rs 250 million to Rs 400 million (US\$ 84 million).

36. IBRD and IDA missions have also found that (i) objective economic criteria were not being applied in selecting projects, (ii) design standards were inadequate for roads on which traffic was rapidly increasing, (iii) roads were designed by rule-of-thumb methods, (iv) existing road specifications were antiquated, and (v) insufficient use was being made of existing laboratory facilities.

37. An IDA mission to West Pakistan in November 1963 noted a growing awareness on the part of the highway administration of the technical and administrative problems involved in improving and maintaining the road system. During 1963 the B & R engaged a number of consultants to carry out road feasibility studies. The project described below includes what the Association and the Government believes to be the highest priority road of those under study as well as a number of other high priority items.

III. THE PROJECT

A. Description

38. The project consists of (i) the final engineering and construction of a new 89-mile highway between Karachi and Hyderabad, (ii) the review of designs, the supervision and construction of the Jhelum, Ravi and Sutlej Bridges, (iii) the employment of management consultants for a three-year period to advise and assist the B & R on matters of highway organization and operations and (iv) consulting engineers to carry out feasibility studies of access to Karachi and Hyderabad.

Karachi-Hyderabad Highway

39. The Karachi-Hyderabad Highway will be the first section of the proposed West Pakistan National Highway from Karachi to Lahore and eventually to Peshawar. The Government has recently engaged three consulting firms to carry out feasibility studies of three further sections: Hyderabad-Kashmore, Kashmore-Multan, and Multan-Lahore.

40. The proposed route for the Karachi-Hyderabad Highway was selected by the USAID mission in 1960 with a view to reducing the distance of the present circuitous route and locating it in more favorable topography. The availability of an adequate supply of natural road building materials was a further consideration. Ammann and Whitney International who were appointed by the Government to complete the feasibility study selected approximately the same alignment. It starts at a point on a main thoroughfare about 5 miles northeast of downtown Karachi and extends directly across the Sind Desert to the west abutment of the Ghulam Mohammad Barrage on the Indus River. The barrage is located about 4 miles northwest of Hyderabad.

41. The proposed alignment traverses an area where the terrain is generally flat or rolling except for several miles of hilly terrain through the Jungshashi Hills where heavy rock work would be required. There are 19 bridges in the project and two overpasses. The bridges present no difficult engineering problem as stream beds are well defined, borings indicate stable soils or bedrock and the spans would be relatively short.

42. There are no adverse geological features to overcome which require special or costly construction. Natural road building materials, including river gravels, good quality limestone and hard sandstone deposits, are available along the proposed alignment.

43. The highway will be designed as a limited access facility to the standards shown in Table 3. These standards provide for the immediate construction of a two-lane roadway and a right-of-way of sufficient width for the construction of an additional two lanes separated by a median strip at some future time. The geometric standards were selected on the basis of present and projected traffic densities and the physical factors of the terrain to be traversed. The pavement consists of a six-inch crushed stone base with a 2½-inch two-course asphalt concrete surface. The proposed design standards are adequate.

44. Ammann and Whitney's report included specific recommendations concerning the maintenance of the highway. Some of these recommendations involve matters beyond the direct maintenance of the highway itself. These will be studied in more detail by the management consultants (see below). While it remains to be determined how maintenance should best be organized and executed, satisfactory assurances have been obtained that the Karachi-Hyderabad Highway will be properly maintained.

45. The terms of reference for the feasibility study of the Karachi-Hyderabad Highway did not include access to the centers of the cities or to the Port of Karachi. However, Ammann and Whitney did carry out a reconnaissance of possible routes. Their findings indicate that considerably more study is required as the selection of the most favorable approaches involves not only technical considerations but also questions of acquisition of right-of-way, access to the port area of Karachi and connections with existing and proposed roads. Some of these considerations involve issues on which the Government must first decide, following which it should ask Ammann and Whitney or other consultants to carry out feasibility studies of alternate approaches.

46. The Government of West Pakistan will limit access to the highway and make it a toll facility. Limited access is highly desirable to minimize ribbon development and provide a means of preventing slow-moving traffic such as camels, bullock carts and tongas from using the highway, thus eliminating one of the worst traffic features in Pakistan. Ammann and Whitney recommended that slow-moving traffic be confined to the part of the right-of-way reserved for the future two lanes. They have also recommended that special provision be made for the enforcement of motor vehicle regulations. The Government has agreed to implement both recommendations.

47. The Government proposes to collect tolls on the highway. There would be no objection to this as there will be an alternate non-toll route available. In fact, the collection of tolls is desirable as it would enable the Government to recover some of its investment in the highway and to more easily secure control and records of traffic. The B & R has agreed to make periodic traffic counts.

48. The Government has indicated that tolls on the highway and the bridges will be collected by the customary practice of farming out the right to private contractors in return for a fixed annual fee. The Government favors this practice because of problems of collecting tolls with its own personnel.

Jhelum, Ravi and Sutlej Bridges

49. The Jhelum, Ravi and Sutlej Bridges, which are named after the rivers they cross, are located on the outskirts of the cities of Jhelum, Lahore and Bahawalpur respectively (see map). The Jhelum and Ravi Bridges will be on the projected West Pakistan National Highway extending from Karachi to Peshawar. The location of the National Highway between Hyderabad and Lahore is now under study; whether it would cross the Sutlej at the proposed bridge site or not is unknown; however, a bridge is needed in any case on the present Multan-Bahawalpur road to provide year-around service. The first two would supplement existing structures of inadequate capacity, while the third would replace a pontoon bridge. Considerable study is being devoted to the location of the bridges in order to secure satisfactory approaches and at the same time meet the technical requirements of the river crossings.

50. The bridges will be designed for the standard heavy loading shown in Table 3. The decks would provide for two lanes of traffic on the Jhelum and Sutlej Bridges and for four lanes on the Ravi Bridge. As river bed and topographic conditions are about the same at all three sites, the bridges will be

similar in design. They range from 1,500 to 3,300 feet in length and consist of simply-supported spans of about 150 feet each. The superstructure of each bridge will be made of reinforced concrete with prestressed girders and supported on caissons sunk deep into the river bed so as to avoid scour.

Consultants' Services and Laboratory Facilities

51. This item provides for (a) a management consulting firm to advise and assist the B & R for about three years on matters pertaining to its organization and operation and (b) a consulting engineering firm to carry out feasibility studies of access to Karachi and Hyderabad as discussed in paragraph 45. The services to be rendered by management consultants include:

- i) A study of the organization and administration of the B & R with particular reference to the desirability of separating the building and roads functions and assistance in implementing the recommendations of that study.
- ii) A report on highway maintenance operations with recommendations on necessary changes and improvements.
- iii) A report on the condition of the central laboratory at Lahore with recommendations as to the proposed expansion and the need for field laboratories.

52. Under the first item the consultants will be expected to (i) appraise the adequacy of the B & R organization and to recommend the necessary specific changes with the purpose of modernizing, streamlining and simplifying the present organizational structure to enable it to carry out its expanding responsibilities with increased efficiency and better control over its operations, (ii) assist in the establishment and operation of a planning section and a modern design office and (iii) assist in the selection of contractors and to introduce modern field inspection techniques on road construction. The consultants will be required to submit a comprehensive report on their findings and, following the approval of the report, to assist both the B & R and the Bank in the implementation of its recommendations.

53. The second item calls for a thorough study of existing maintenance operations with a view to determining the capability of the existing organization and the changes needed in the light of plans to expand the provincial road system. Particular emphasis will be placed on determining how much maintenance operations should be mechanized on both new and existing roads with due consideration to economy and efficiency, good workmanship and availability and skill of local labor.

54. The third item concerns the appraisal of existing laboratory facilities at Lahore which the B & R proposes to expand. The consultants will be expected to examine and comment on the proposed expansion and to assist in its implementation. They will also study the desirability of using field laboratories and if found needed assist in establishing them. It may also be necessary to provide for the training of local staff to operate the existing and any new facilities proposed. If this should be required, it would be covered by the contingency item.

55. The implementation of any recommendations made by the consultants involving large-scale expenditure, particularly on maintenance, would have to be left to a later stage, as it is not possible now to anticipate the order of magnitude of the expenditure these recommendations might involve.

B. Cost Estimates

56. The total cost of the project is US\$33.5 million equivalent as shown below: (A detailed estimate is given in Table 4.)

| | <u>US\$ Million Equivalent</u> | | |
|----------------------------------------------------|--------------------------------|----------------|--------------|
| | <u>Local</u> | <u>Foreign</u> | <u>Total</u> |
| Road construction | 9.7 | 10.5 | 20.2 |
| Bridge construction | 5.1 | 2.6 | 7.7 |
| Consultants' services and laboratory facilities | 0.9 | 1.2 | 2.1 |
| Contingencies | <u>2.8</u> | <u>2.7</u> | <u>5.5</u> |
| | 18.5 | 17.0 | 35.5 |

57. The estimate includes the cost of construction, consultants' services right-of-way and local duties and taxes. It also includes a quantity contingency allowance of 10% which is considered adequate in view of the thorough feasibility study of the Karachi-Hyderabad Road, the completion of final plans for the Jhelum Bridge and previous experience in bridge building in West Pakistan and the availability of preliminary proposals from management consultants. The estimate also includes a price contingency of 8% which has been included to take into account possible price increases during the execution of the project. The estimate for the Karachi-Hyderabad road is based on the Ammann and Whitney study. The over-all estimate is sound.

58. The foreign exchange component is estimated at US\$17.0 million equivalent or approximately 55% of the total estimated cost of the project less the cost of right-of-way and government duties and taxes. The estimated foreign exchange requirements are based on the need to import all equipment and a large portion of supplies, the use of foreign contractors on the road construction part and the employment of consultants from overseas. Local costs are based on the use of local unskilled and semi-skilled labor, some local services and supplies, local contractors on the bridges and Pakistani personnel on the consultants' staff.

59. Local currency needs will be provided from the budget of the West Pakistan Government. Assurances have been obtained from the Central Government that sufficient funds will be provided to carry out the project and that these funds will be made available as required.

C. Administration and Execution

60. The construction parts of the project will be carried out through unit-price contracts awarded on the basis of international competitive bidding.

Karachi-Hyderabad Highway

61. Consultants, who could be the same firm which carried out the feasibility studies, will be engaged to prepare final plans, specifications and contract documents. This part of the work would require about one year to complete. These consultants will also be used to assist in the analysis of bids and to supervise construction in an executive capacity.

62. The Government favors the practice of having foreign consultants associate with local consulting firms. While the development of local engineering firms is desirable, it should be a gradual process to avoid too much competition between local firms and the B & R for the limited number of technical personnel available in Pakistan. This issue was discussed during negotiations.

63. Construction will be let in one or two large contracts depending upon the timing of completion of tender documents and further analysis by the consultants to determine which would be the better procedure to follow. Ammann and Whitney estimate that actual construction would require about two years. Allowing for mobilization of both consultants and contractors, and for advertising bids and the awarding of contracts, they estimate that design and construction would take about four years to execute.

64. The work is considered straightforward and no unusual engineering difficulties are anticipated. The country through which the new highway is located is a semi-desert with a total rainfall averaging from seven to eight inches per year, most of it occurring during the summer from June to September. Water is only available at certain points along the alignment and it will have to be brought to the work front.

Jhelum, Ravi and Sutlej Bridges

65. Final plans, specifications and contract documents for the three bridges are to be prepared by the Bridge Department of the B & R. Final plans for the Jhelum Bridge have already been completed while preliminary planning is under way for the Ravi and Sutlej Bridges. It is estimated that the bridges will be completed in about four to five years, allowing one year for completion of plans and three to four years for construction.

66. The B & R is well experienced in the design and construction of bridges, but has only built one or two pre-stressed concrete structures similar to those in the project. The project bridges are longer both in span and in total length than any pre-stressed bridges previously built in Pakistan. It seems prudent therefore to have the designs reviewed by outside consultants and to have the same consultants assist on the supervision of construction. The B & R are agreeable to this suggestion and have already turned over the detailed plans of the Jhelum Bridge to a firm of U.K. consultants. The contract with this firm provided for only part-time supervision. In view of the magnitude of the work and the close tolerances involved in pre-stressed construction, the B & R has agreed to have the bridge consultants supervise construction of each bridge on a full-time basis.

Consultants' Services and Laboratory Facilities

67. Following discussions between the IDA and the B & R on the terms of reference for management consultants, the West Pakistan Government invited a number of firms to submit proposals. Four proposals have been received to date and are now being evaluated by the B & R.

68. The reports on administration, maintenance and laboratory facilities will be completed within one year, following which the consultants would concentrate for a two-year period on assisting the B & R in implementing the recommendations. The consultants' team will consist of seven or eight experts in all phases of highway operations including administration, accounting, design, materials, construction and maintenance. The selection of equipment for the road research laboratory will be based on the recommendations of the consultants who will be responsible also for insuring its proper installation and for the training of local personnel in its use.

69. As noted in paragraph 45, the feasibility studies of access into Karachi and Hyderabad would be carried out by Ammann & Whitney or other consultants.

IV. ECONOMIC JUSTIFICATION

70. An adequate and efficient system of transport is essential where an accelerated economic development program is planned, as it is in West Pakistan. The Government has recognized this need and is giving high priority to the development of its transport facilities. It is aware that the execution of large agricultural and industrial projects and the growth of supporting economic activities will require the rapid and reliable movement of building materials, equipment, machinery, and consumer goods and foodstuffs. Its transport plans call for, among other things, the extension and rehabilitation of the main National Highway System linking all the major population and commercial centers.

A. The Karachi-Hyderabad Road

General

71. The proposal to build a new modern road between Karachi and Hyderabad, which would be the first section of a main highway from the sea to Peshawar in the north, is an important first step to this objective. By improving the connection between the first and third largest cities in West Pakistan it will permit the acceleration of agricultural and industrial developments. Equally important, by serving as a model for the future expansion of the entire highway program, it will establish for the first time in West Pakistan modern standards of design and construction.

72. The existing highway between Karachi and Hyderabad is a 124 mile bituminous road of single lane width for most of its length. It is already functionally inadequate to serve the present traffic efficiently or to meet future needs. Pavement failures are frequent. There are delays and congestion for extended time periods. A significant portion of the road lies in waterlogged areas adjacent to canals and the River Indus. This contributes to the road failures and causes repairs to be short lived thus wasting maintenance funds.

73. After investigation by the Government and its consultants, it has been concluded that the existing road should not be part of the planned National Highway. It is nearly 40 per cent longer and the waterlogged areas are unsuitable locations for road construction. To build the new highway on the existing alignment would lead to unjustifiable higher construction and maintenance costs and the sacrifice of the important savings and developmental benefits which result from the shorter distance made possible by the new alignment. The existing road will continue in service to meet local traffic needs; its reconstruction may eventually become necessary but this is not envisaged at present.

Economic Background

74. West Pakistan's total population of 50 million people is increasing by at least 2.6 per cent per annum. The Planning Commission has projected that the population may increase to 56 million in 1971 and to 76 million in 1981. The Karachi and Hyderabad Administrative Districts are expected to increase from 5.5 million people in 1961 to 12 million people in 1981; this is a faster rate than the national average.

| | (Millions) | | |
|---------------------------|-------------|-------------|-------------|
| | <u>1961</u> | <u>1971</u> | <u>1981</u> |
| <u>Karachi Division</u> | | | |
| Urban | 1.9 | 3.4 | 6.1 |
| Rural | <u>0.2</u> | <u>0.3</u> | <u>0.4</u> |
| Total | <u>2.1</u> | <u>3.7</u> | <u>6.5</u> |
| <u>Hyderabad Division</u> | | | |
| Urban | 0.8 | 1.4 | 2.3 |
| Rural | <u>2.5</u> | <u>2.9</u> | <u>3.3</u> |
| Total | <u>3.3</u> | <u>4.3</u> | <u>5.6</u> |

75. From the foregoing figures a rapid growth of urban populations can be seen. Rural migration to towns is well under way for a number of reasons. Since major towns such as Karachi and Hyderabad are relatively better supplied with hospital and sanitary services, which tend to cause lower-than-average death rates, and have a younger population age structure than the Province as a whole; cumulative and rapid increases in their populations are expected.

76. To feed, clothe and sustain this increased population at even the present low levels of consumption will both need and provide a basis for greater output and productivity in agriculture and industry. This should generate more freight transport movements. It has been estimated, for example, that for West Pakistan, under the conditions projected, a $5\frac{1}{2}$ per cent per annum growth in farm output per agricultural worker would be required to achieve an increase in total food output equal to the expected increase in urban population, assuming no increase in existing per capita food consumption. In view of the unfavorable environment for agriculture around Karachi increased food imports either from abroad or from within West Pakistan will be required to feed its growing population. Passenger movements can also be expected to increase, particularly between the towns. The Pakistan Western Railway, for example, has found that for every one journey made by rural dwellers some 12-13 are made by town dwellers per year.

77. The cities of Karachi and Hyderabad, with their combined populations of nearly 3 million people, have important relative advantages in the competition for new industries and capital. They are better supplied with financial, managerial and labor skills than most other cities in the Province. They are important markets. They have established business, commercial and financial communities. They are becoming increasingly important as industrial centers. At Karachi, for example, a cement factory, an oil refinery, a petrochemical complex, a truck assembly plant, a rehabilitation of the shipyard and other projects are either now under construction or in the planning stage.

Trends in Traffic

78. Despite considerable financial, human and institutional obstacles the economy of West Pakistan has made considerable progress since Partition. Between 1950-60, for example, its GNP (at constant prices) increased at a compound rate of 3.6 per cent per annum, according to one semi-official estimate. The report of the Bank's 1962 Economic mission (Report No. AS-96) points out that despite shortcomings in planning, project preparation, administration, aid utilization, etc. economic progress was continuing. By the end of the Second Five Year Plan (1960-65) GNP will probably have increased by an average of some 4 per cent per annum.

79. The past growth of the economy has both generated and needed more freight and passenger transportation. On the Pakistan Western Railways, for example, freight ton-miles increased at an average of 5.1 per cent per annum and passenger-miles by 3.4 per cent per annum over the period 1950-62. Dry cargo imports through Karachi increased by some 3.2 per cent per annum and exports by 1.6 per cent per annum during the same period. Statistical evidence of the absolute and relative growth of "over-the-road" transport is less satisfactory. The important AID sponsored "Transportation Survey of West Pakistan (1961-62)" estimated that inter-city trucking ton-miles has increased by some 17 per cent annually. Despite this rapid increase, however, trucking still accounts for only some 20 per cent of the total Provincial freight ton-miles because of its relative insignificance a decade or so ago. There is no information available to ascertain the extent to which trucking and bus operations on the Karachi-Hyderabad road itself has participated in the general upward growth of road transport. In the opinion of qualified observers truck operations have grown rapidly but bus traffic on the road has probably lagged. Present bus traffic on the route, which is well served by the railway, is still very small, being only 12 vehicles per day or 2 per cent of the average daily traffic using the road. Trucks, by contrast, account for over 55 per cent of the vehicles on the road.

Justification

80. Over the long run period to 1985, which is the present horizon limit of planning in Pakistan, a minimum average annual growth in GNP of 5 per cent is envisaged. During the Third Five Year Plan (1965-70) the Government expects that this rate should be at least 5.4 per cent per annum. To attain this will necessitate stepping up total public and private investment from Rs. 2.6 billion in the Second Plan to Rs. 4.6 billion in the Third Plan, one half of which would be in West Pakistan. These figures exclude the Indus Basin Program which is outside the Plan. If these objectives are achieved there should be sufficient traffic potential to warrant a general growth of both road and rail transport, each in its proper sphere.

81. The railway's share in total traffic can be expected to decrease, however, as the economy grows and its structure changes. The growth in manufacturing and service industries has already created a new demand for specialized and fast transport services and for flexible shipping schedules geared to the needs of shippers and consignees. There is a growing emphasis on transport service - speed, scheduling frequency, flexibility of operations, equipment specialization, quality and damage control, less stringent packaging requirements, etc. - which can best be met at a lower real cost by road transport.

82. The growth of population and incomes in Karachi has stimulated the demand for fresh fruits, vegetables and other perishables and made possible the payments of the higher transport costs involved. Traffic surveys on the Karachi-Hyderabad road, for example, show that two-thirds of the goods now trucked into Karachi consist of such agricultural products and local staples which are produced in relatively small loads from widely scattered farms. Outward movements consist mainly of locally manufactured goods and higher value imports on which inventory charges, etc. are significant. It appears, therefore, that in terms of perishability, loadability, value per unit, and the small average size of shipments that the goods now being transported by road are generally moving by the most efficient and lowest real cost means and that traffic is allocating itself on the basis of realistic costs and charges. Existing road users are being fairly heavily taxed. Import duties, for example, are 150 per cent of the Karachi cif price on gasoline; 15 per cent plus 15 per cent sales tax on lubricants; 50 - 250 per cent on private cars; 27½ per cent plus 15 per cent sales tax on trucks and buses. In addition, a typical truck would pay about US\$200 in annual license fees and a private car some US\$50.

83. The railway system, as a whole, carries a total of over 13 million tons of freight and some 130 million passengers annually. The present small fleet of trucks (23,000) and buses (10,000), many of which confine their operations within the urban areas, would be unable to cope with much of the increased demand for transport. The need for extra road transport capacity has been discussed during negotiations. The Government of Pakistan has tentatively provided for the replacement of 13,000 old vehicles and for 2,500 additional vehicles for West Pakistan in the Third Five-Year Plan (1965-70). These figures are considered adequate. Since the credit negotiations, the Association has heard that an agreement has been entered into whereby a foreign truck manufacturing firm will establish a plant in Karachi with an output of 4,000 vehicles annually in its fourth and subsequent years of operation.

84. The new Karachi-Hyderabad road will significantly change existing distance, time and cost factors. The distance between the towns will be shortened from 124 to 94 miles. The journey times of passenger cars may be reduced from about 4.0 hours to 2.5 hours and those for trucks and buses from over 5.0 hours to about 3.0 hours. Real operating costs for a full length one-way trips for trucks and buses may fall from about Rs. 100 to Rs. 55, and for passenger cars from Rs. 40 to Rs. 25.

85. These changes could have significant economic consequences. Farmers in the fertile Indus Valley should find themselves economically closer to the large and growing Karachi market. Businessmen in Hyderabad should be able to operate with smaller inventories and have a greater dependence on the transport of stocks from Karachi. It is reasonable to anticipate that traffic in the Karachi-Hyderabad areas will grow at a fast rate because of the presently growing or planned industries located there, the products of which have a relatively high transport component. In addition, since the Government envisages extending the highway to Lahore, and the north as soon as financially possible, there is the possibility of extra traffic being generated when this takes place.

86. The construction of the road should have a high traffic multiplier effect. With appropriate outside assistance to support the local development efforts, a long-term growth of the economy should be achieved. It is clearly impossible, however, on the basis of existing information to

measure precisely the development stimulus and the traffic that it will produce on this road. However, the benefits accruing to road users alone is sufficient to produce a satisfactory return on the investment.

87. Although there are surges of up to 1,800 vehicles per day on some sections of the road, traffic surveys carried out by the consultants show that some 370 trucks and buses and slightly over 200 automobiles, traveled the full length of the road between Karachi and Hyderabad per day in 1962. These vehicles, which represent 90 per cent of the average daily traffic using the road, can be expected to divert to the new shorter road immediately upon its opening to traffic. If this traffic volume increased at only 2 per cent per annum - which is only one half of the past annual average growth rate of West Pakistan's economy - the savings resulting from a 30-mile reduction in distance and from lower vehicle operating costs on the higher standard road are sufficient to produce a rate of return of 8 per cent, discounted over the life of the facility, after allowing for maintenance costs. If traffic were to increase at 7 per cent per annum, i.e. slightly faster than the expected 5 per cent per annum long term growth rate in the economy - a relationship which has been observed in many of the Bank's member countries - the rate of return would increase to over 11 per cent.

88. Those percentages understate the true benefits and developmental consequences of the new road in that they exclude:

- (i) the economic repercussions on production and consumption in the Karachi and Hyderabad districts as a result of greatly reduced trucking and bus operating costs;
- (ii) the lower real costs of carrying inventories or stocks in transit resulting from quicker transport turn around times;
- (iii) the possible savings attributable to a reduction in the motor vehicle accident rate;
- (iv) the value of time saved for at least some private car users;
- (v) the reduction in vehicle operating costs to local users remaining on the existing road resulting from the transfer of 90 per cent of the existing traffic to the new road;
- (vi) the increased road maintenance and vehicle operating costs that would be incurred if the existing road had to carry growing traffic volumes.

89. There is insufficient information to measure these additional benefits or to evaluate fully the development stimulus. It is reasonable to assume that some of them would materialize. Therefore, on the basis of even the minimum growth rate that may be expected the construction of the highway is economically justified.

B. The Jhelum, Ravi and Sutlej Bridges

90. The present structures, which these three new bridges would either complement or replace, are functionally inadequate for the volumes of mixed traffic they have to carry. For a number of technical reasons widening of the existing Jhelum and Ravi structures would be both costly and difficult. It would involve also a complete closure of these two bridges for a prolonged period during which road traffic would have to make long detours over stretches of low-standard unpaved roads. Strengthening of the structures would also require their closing but would not ease the traffic jams or increase the flow of traffic. Only motor vehicles and pedestrians would be allowed on the new bridges, while animal drawn vehicles, pedestrians and animals on the hoof would continue to use the existing structures.

91. All three bridges will be located on the main north-south highway which is experiencing the fastest rate of inter-city traffic growth. The existing bridges are an impediment to traffic flow in that they involve load restrictions, the Jhelum bridge, for example, is restricted to less than 5-ton axle load vehicles, while the Sutlej boat bridge is limited to 4-ton gross weight vehicles. Added inconveniences at this latter bridge are that buses must unload before crossing and that it is only open to traffic for 9 months in the year.

92. The structural condition of the Jhelum Bridge, which was built in 1872, does not warrant heavy use. It is a combination road-rail structure without sidewalks and with only a 14-foot wide pavement for use by motor vehicles, pedestrians and animals. Traffic movements are restricted to one direction at a time. Bullock carts, which are the slowest moving vehicles travel about 3 to 4 mph, take up to 20 minutes to cross the bridge and limit all traffic to this crawling speed. Breakdown of heavily loaded trucks or buses traveling in low gear have been known to block the bridge for hours. As traffic grows annually, the length of the queues waiting to cross the bridge increases.

93. The existing bridge is located near the center of the city of Jhelum and will continue to serve the heavy pedestrian, bullock cart and other local traffic. The new bridge located on the outskirts of the city will primarily serve fast moving through and local traffic.

94. Although the Ravi Bridge, which was built in 1915, is in a better structural condition, it is a major bottleneck because of the narrow pavement (18 feet wide) for two-way traffic. Located on the immediate outskirts of Lahore, which has almost doubled in population over the past decade and become an important industrial and market center, the bridge produces traffic jams that back up into the town itself at peak periods. The proposed four lane bridge will relieve the heavy congestion carried by the existing structure.

95. Because of the limitations at the existing Sutlej pontoon bridge heavy goods vehicles avoid the crossing by making a detour of some 60 miles from the main road. As a result it is mainly used by local bus and automobile traffic. A permanent bridge will avoid the transit and transshipment delays, significantly shorten the truck route between Karachi and the north and improve access to the agricultural area between the east bank of the Sutlej and the Indian border.

96. Recent traffic counts on the three bridges in the project illustrate the average daily traffic:

| <u>Type of Traffic</u> | <u>Jhelum Bridge</u> | <u>Ravi Bridge</u> | <u>Sutlej Boat Bridge</u> |
|----------------------------------------|--------------------------|------------------------|-------------------------------|
| Automobiles | 880 | 810 | 5 |
| Buses | 376 | 710 | 161 |
| Trucks (a) Light (b) Medium/heavy | 215) 1,143) | 470) | 13 |
| Motorcycles and Bicycles | 2,379 | n.a. | 14 |
| Bullock carts and tongas ^{1/} | 489 | 1,485 | 7 |
| Animals on the hoof | 1,320 | n.a. | n.a. |

1/ Horse-drawn cabs

97. Unfortunately no satisfactory information is available to measure the average time delays and their value to the different types of traffic nor for their arrival rates and average crossing times. It is not possible, therefore, to quantify the value of time lost in relation to the investment costs of the new bridges. On the basis, however, that the average delay to heavy trucks and buses only at the Jhelum bridge is 20 minutes because of the time it takes a bullock cart to cross the bridge, the present value of the time saving benefits to only these commercial vehicles is sufficient to produce a return on the investment of 10.0% (*). This is an understatement in that it excludes the cost of time delays to private cars and light trucks and also the inevitable increases in costs that arise as traffic continues to increase.

98. The rationale for providing these new bridges is that the present structures have outlived their economic usefulness for heavy fast moving traffic. Undoubtedly, West Pakistan could struggle on with the existing crossings but only at the cost of increasing congestion and delays. Furthermore, in the case of the Jhelum and Sutlej bridges the load restrictions are such that they constitute a serious impediment to the most important type of traffic, i.e. trucks and buses. The proposed bridges in this project will be able to carry safely and conveniently all the foreseeable traffic. Their inclusion in the project is, therefore, justified and recommended.

(*) Assumptions: Cost of commercial vehicle working time Rs 18 per hour;
1519 vehicles; 300 working days per annum; 35 years life
to bridge.

C. Management Consultants

99. As discussed under Section II of the report, the B & R has to contend with many difficult problems including those of organization, administration, maintenance and construction. The deficiencies in the present highway system are becoming more apparent as traffic demands grow. The B & R is aware of the need to expand and improve the highway system and is now taking steps in that direction. The decisions now being made will have an important bearing on the future capacity of the highway system. Thus it is essential that the B & R be reorganized and strengthened as soon as possible to enable it to fulfill its growing responsibility.

100. Now that construction of the first modern highway in the country is about to get under way, and feasibility studies for additional roads are now being undertaken, it is not too early to start the long and difficult task of building up a competent and modern highway organization and, in particular, an efficient maintenance organization. This assignment can best be carried out by a competent team of technical and management specialists (paragraphs 67-68 above). The Association's experience is the basis for the determination of the number of staff members required. The time period estimated for their employment is the minimum needed to do the job properly.

V. CONCLUSIONS AND RECOMMENDATIONS

101. The project is technically feasible and economically justified on the basis of providing a satisfactory return on investment.

102. The cost estimate is soundly based and includes a reasonable allowance for contingencies.

103. Assurances have been obtained from the West Pakistan Government that it will engage consultants satisfactory to the IDA:

- a) To prepare the final plans and contract documents for the Karachi-Hyderabad Highway and to supervise its construction (paragraph 61).
- b) To review the final plans of the Ravi and Sutlej Bridges and to supervise construction on all three bridges on a full-time basis (paragraph 66).
- c) To provide general advisory services to the B & R (paragraphs 67 - 68).
- d) To carry out feasibility studies of access to Karachi and its port and to Hyderabad (paragraph 69).

104. Assurances have been obtained from the Central Government that it will undertake that sufficient funds will be available to carry out the project and that these funds will be made available as required (paragraph 59).

105. Agreement has been reached with the West Pakistan Government regarding the Karachi-Hyderabad Highway that it will:

- a) Use adequate design standards including provision for right-of-way sufficiently wide for a four-lane divided highway (paragraph 43).
- b) Make adequate provision to insure that the highway will be properly maintained (paragraph 44).
- c) Enforce existing highway regulations (paragraph 46).
- d) Limit access to prevent ribbon development along the right-of-way (paragraph 46).
- e) Restrict traffic to fast moving vehicles and confine slow moving traffic to the part of the right-of-way reserved for the future two lanes (paragraph 46).
- f) Carry out periodic traffic counts for a period of ten years (paragraph 47).

106. The project provides a suitable basis for a development credit by the Association of US\$17.0 million equivalent.

May 18, 1964.

TABLE 1

WEST PAKISTAN
HIGHWAY PROJECT

Motor Vehicle Statistics

A) Number of Registered Motor Vehicles

| | <u>Motor Cars</u> | <u>Trucks</u> | <u>Buses</u> | <u>Others</u> ^{1/} | <u>Total</u> |
|------|-------------------|---------------|--------------|-----------------------------|--------------|
| 1958 | 43,600 | 15,420 | 8,510 | n.a. | |
| 1959 | 48,630 | 14,960 | 8,480 | 3,750 | 75,820 |
| 1960 | 54,360 | 19,190 | 10,340 | 6,470 | 90,360 |
| 1961 | 60,820 | 21,410 | 9,860 | 10,220 | 102,310 |
| 1962 | 65,270 | 23,010 | 9,670 | 16,820 | 114,770 |

B) Age Distribution of Registered Trucks and Buses (1961-62)

| <u>Age in Years</u> | <u>Trucks</u> | | <u>Buses</u> | | <u>Total</u> | |
|---------------------|---------------|----------|--------------|----------|--------------|----------|
| | <u>No.</u> | <u>%</u> | <u>No.</u> | <u>%</u> | <u>No.</u> | <u>%</u> |
| Below 5 years | 4,016 | 24.4 | 2,663 | 30.0 | 6,679 | 26.4 |
| 5 - 10 " | 4,380 | 26.6 | 2,476 | 27.9 | 6,856 | 27.1 |
| 10 - 15 " | 3,055 | 18.5 | 2,000 | 22.6 | 5,055 | 19.9 |
| 15 - 20 " | 3,841 | 23.3 | 1,082 | 12.2 | 4,923 | 19.4 |
| Over 20 " | 1,190 | 7.2 | 640 | 7.2 | 1,830 | 7.2 |
| Totals | 16,482 | 100.0 | 8,861 | 100.0 | 25,343 | 100.0 |

"On the road" (12,049) (73.1) (6,205) (70.0) (18,254) (72.0)

C) Carrying Capacity of Trucks "on the road" in West Pakistan (1961-62)^{2/}

| <u>Capacity in Tons</u> | <u>Number</u> | <u>%</u> |
|-------------------------|---------------|-----------------|
| 3 | 1,776 | 14.8 |
| 4 | 2,667 | 22.1 |
| 5 | 4,563 | 37.8 |
| 6 | 2,318 | 19.2 |
| 7 | 485 | 4.0 |
| 8 | 203 | 1.7 |
| 9 | 14 | - |
| 10 | 18 | - |
| 15 | 5 | - |
| Total | 12,049 | 100.0 (rounded) |

^{1/} Delivery vans, fuel tankers, ambulances, auto-rickshaws, etc.

^{2/} Differs from total number registered (16,482) in that the difference is estimated to be "off the road", because some vehicles are out of service through the lack of spare parts, employment, etc., or are registered for only a part of the year.

Source: Part A - Central Statistical Office

Parts B and C - West Pakistan Road Transport Survey, 1961-62.

TABLE 2

WEST PAKISTAN
HIGHWAY PROJECT

Highway Expenditures During Five-Year Plans

(In millions of rupees)

| <u>Fiscal Year</u> | <u>Construction</u> | <u>Maintenance</u> |
|--------------------|---------------------|--------------------|
| 1956-1957 | 39.4 | 20.3 |
| 1957-1958 | 11.4 | 21.2 |
| 1958-1959 | 45.3 | 25.4 |
| 1959-1960 | 37.5 | 22.3 |
| 1960-1961 | 26.7 | 21.9 |
| 1961-1962 | 30.7 | 34.2 |
| 1962-1963 | 42.2 | 30.1 |
| 1963-1964 * | 70.3 | 39.1 |

* Allocations

Source: Buildings and Roads Branch

Table 3WEST PAKISTANHIGHWAY PROJECTDesign StandardsKarachi-Hyderabad Highway

| | |
|----------------------------------|----------------------------------|
| Design speed (MPH) | 70 |
| Minimum radius (feet) | 1650 |
| Maximum gradient (percent) | 4 |
| Stopping sight distance (feet) | 600 |
| Maximum superelevation (percent) | 8 |
| Right-of-way width (feet) | 224 |
| Pavement width (feet) | 24 |
| Shoulder width (feet) | 10 |
| Maximum axle load | 9 tons plus 20% for impact |
| Bridge design loading | Indian Road Congress "AA" or "A" |
| Bridge roadway width (feet) | 28 (up to 100 foot length) |
| | 26 (over 1000 foot length) |
| Slope of fills | 2:1 |

Jhelum, Ravi and Sutlej Bridges

| | |
|---------------------------------------------------|-------------------------|
| Bridge design loading | Indian Road Congress AA |
| Bridge roadway width (curb to curb, | |
| Jhelum feet) | 28 |
| Ravi | 45 |
| Sutlej | 24 |
| Sidewalk width (feet) | |
| Jhelum | 3 |
| Ravi | 5 |
| Sutlej | 5 |

Source: Karachi-Hyderabad Highway Feasibility Study
by Ammann & Whitney International Ltd.

Table 4

WEST PAKISTAN
HIGHWAY PROJECT

List of Works and Cost Estimate

(In millions of US dollars equivalent)

| <u>1. Road Construction</u> | <u>Local</u> | <u>Foreign</u> | <u>Total</u> |
|---------------------------------------------------------------|--------------|----------------|--------------|
| Karachi - Hyderabad Road (89 miles) | 9.00* | 9.80 | 18.80 |
| Engineering | <u>0.70</u> | <u>0.70</u> | <u>1.40</u> |
| | 9.70 | 10.50 | 20.20 |
| <u>2. Bridge Construction</u> | | | |
| Jhelum Bridge (3,300 feet) | 2.10 | 1.05 | 3.15 |
| Ravi Bridge (1,500 feet) | 1.35 | 0.65 | 2.00 |
| Sutlej Bridge (2,000 feet) | 1.55 | 0.70 | 2.25 |
| Review of design and field super- vision | <u>0.10</u> | <u>0.20</u> | <u>0.30</u> |
| | 5.10 | 2.60 | 7.70 |
| <u>3. Consultants' Services and Laboratory Facilities</u> | | | |
| Management consultants to B & R | 0.60 | 0.90 | 1.50 |
| Central and field laboratory facilities | 0.25 | 0.25 | 0.50 |
| Feasibility studies of access to Karachi and Hyderabad | <u>0.05</u> | <u>0.05</u> | <u>0.10</u> |
| | 0.90 | 1.20 | 2.10 |
| Sub-total | 15.70 | 14.30 | 30.00 |
| Contingencies (about 18%) | <u>2.80</u> | <u>2.70</u> | <u>5.50</u> |
| TOTAL | <u>18.50</u> | <u>17.00</u> | <u>35.50</u> |

* Includes right-of-way cost of US\$1.5 million
and government duties and taxes of US\$3.5 million.

WEST PAKISTAN

HIGHWAY PROJECT

(Karachi - Hyderabad Road)

Motor Vehicle Operating Costs (net of taxes)

| A) <u>Trucks and Buses</u> | <u>Old Route</u> | <u>New Route</u> |
|---------------------------------------|----------------------|----------------------|
| Distance (miles) | 124 | 94 |
| Annual average mileage per vehicle | 24,000 | 28,000 |
| Average life of vehicle (miles) | 144,000 | 196,000 |
| | (or 6 years) | (or 7 years) |
| <u>Operating Costs</u> | <u>Rs.</u> | <u>Rs.</u> |
| Insurance 1/ | 180 | 180 |
| Labor 2/ | 4,500 | 4,500 |
| Fuel 3/ | 2,880 | 3,000 |
| Lubricants 4/ | 150 | 150 |
| Tires 5/ | 800 | 1,000 |
| Repairs, servicing, garaging 6/ | 4,800 | 3,000 |
| Sub-total | 13,310 | 11,830 |
| Depreciation 7/ | 5,000 | 4,270 |
| Interest 8/ | 500 | 430 |
| Total | 18,810 | 16,530 |
| Operating cost per vehicle mile (Rs.) | 0.78 | 0.59 |

Source: Information provided by Consultants and Bank Mission estimates.

Notes:

- 1/ Assuming 1/3 of vehicles at comprehensive risk rates, 1/3 at third party risk rates and 1/3 at third party accident only risk rates.
- 2/ Assuming 1½ men per vehicle at Rs. 3,000 p.a. wages.
- 3/ Assuming 300 working days; fuel consumption 10 miles per gallon at Rs. 1.2 per gallon (c.i.f. Karachi) on old route and 11 m.p.g. on new route.
- 4/ Assuming 5 per cent of 3/.
- 5/ Assuming 6 tires costing Rs. 1,000 per set (c.i.f. Karachi) per 30,000 miles.
- 6/ Assuming Rs. 200 average per 1,000 miles on old route and Rs. 100 on new route.
- 7/ Assuming vehicle life equals 6 years on old route and 7 years on new route at cost of Rs. 30,000 c.i.f. Karachi less cost of one set of tires.
- 8/ Assuming interest of 10 per cent p.a. on investment.

| B) <u>Private Cars</u> | <u>Old Route</u> | <u>New Route</u> |
|---------------------------------------|------------------------|-------------------------|
| Distance (miles) | 124 | 94 |
| Average annual mileage | 15,000 | 15,000 |
| Average life of vehicle | 90,000 (or 6 years) | 105,000 (or 7 years) |
| <u>Operating Costs</u> | <u>Rs.</u> | <u>Rs.</u> |
| Insurance <u>1/</u> | 300 | 300 |
| Fuel <u>2/</u> | 1,000 | 900 |
| Lubricants <u>3/</u> | 50 | 45 |
| Tires <u>4/</u> | 500 | 500 |
| Repairs and maintenance <u>5/</u> | 1,500 | 750 |
| Depreciation <u>6/</u> | 1,670 | 1,425 |
| Total | 5,020 | 3,920 |
| Operating cost per vehicle mile (Rs.) | 0.33 | 0.26 |

Source: As above.

Notes:

- 1/ As in 1 1/ above.
- 2/ As in 1 3/ above, but 18 m.p.g. on old route and 20 m.p.g. on new route.
- 3/ As in 1 4/ above.
- 4/ Assuming 1 set of 4 tires every 15,000 miles at Rs. 500 per set.
- 5/ Assuming Rs. 100 per 1,000 miles on old route and Rs. 50 per 1,000 miles on new route.
- 6/ Assuming vehicle life equals 90,000 miles on old route and 105,000 miles on new route at cost of Rs. 10,000 c.i.f. Karachi, less cost of 1 set of tires.

WEST PAKISTAN TRANSPORTATION SYSTEM

- PRINCIPAL EXISTING ROADS
- PROJECT ROAD AND BRIDGES
- - - PROPOSED NATIONAL HIGHWAY
- + + + BROAD GAUGE DOUBLE TRACK RAILWAYS
- - - BROAD GAUGE SINGLE TRACK RAILWAYS
- + + + METER GAUGE SINGLE TRACK RAILWAYS

