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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

APPRAISAL OF THE HIGHWAY CONSTRUCTION PROJECT MEXICO

October 6, 1960

Department of Technical Operations

CURRENCY EQUIVALENTS

U.S. $1.00	=	12.49 Pesos
1 Peso	=	8 U.S. cents
1 Million Pesos	=	U.S. $80,000

MEXICO

APPRAISAL OF THE HIGHWAY CONSTRUCTION PROJECT

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SUMMARY

i. The Mexican Government has requested a Bank loan of US$25.0 million to cover the foreign exchange cost of completing the construction or reconstruction of 13 roads totalling about 3,200 km, all but one being under execution. Including 15% contingencies, the total estimated cost of the project is about US$68.6 million equivalent.

ii. The project forms part of a much larger five-year program 1960-64 for improvement and extension of the Federal Highway System. This program includes 95 different road construction projects totalling about 14,000 km, and its estimated cost is about US$216 million equivalent. Apart from the requested Bank loan, the cost of the five-year program will be financed by annual appropriations in the Federal budget. Since these exceed the requirements of the proposed Bank-financed project by a wide margin, the local financing of the proposed project is not expected to present any problems.

iii. The execution of the project will be the responsibility of the Federal Highway Administration (FHA) of the Ministry of Public Works. The FHA organization, its functioning, and its staff are efficient and adequate. All Bank-financed contracts will be awarded on the basis of competitive bidding, the greater part (85% in value) by international tender in which all contracting firms registered in Mexico, whether local or foreign, may participate. The contracting industry in Mexico is well developed and works both efficiently and at reasonable cost.

iv. The design standards adopted for the different roads included in the project are adequate. Preliminary surveys have been made for each of the different roads, and the cost estimates are reliable. The project is expected to be completed by the end of 1964.

v. The roads included in the project are representative of the five-year program as a whole. Their execution aims at eliminating some of the principal shortcomings of the Federal Highway System which have resulted from the rapid economic development in Mexico over recent years. Individually the roads will yield benefits which are sufficient to justify their execution.

vi. The project is considered suitable for a Bank loan of US$25.0 million. An appropriate term would be 19 years, including a 4 1/2 year period of grace.

MEXICO

APPRAISAL OF THE HIGHWAY CONSTRUCTION PROJECT

I. INTRODUCTION

1. The Mexican Government has requested a Bank loan of US$25.0 million to cover the foreign exchange cost of 13 road projects which form part of the Federal five-year highway program for 1960-64. The total cost of the 13 projects is estimated at US$68.6 million equivalent.

2. This appraisal is based on preliminary studies made by the Federal Highway Administration, and on findings of a Bank mission to Mexico in March-April 1960.

II. THE FEDERAL FIVE-YEAR HIGHWAY PROGRAM, 1960-64

a. The Program

3. The economic development of Mexico, which has been progressing at a rapid pace requires the reconstruction and expansion of its transportation systems, mainly of the highway network. Since 1946 each successive government of Mexico has further developed the country's highway system on the basis of well planned and executed programs. The road network has continuously expanded and has now reached a total length of 45,000 km; the number of vehicles and the consumption of gasoline has more than doubled in the last ten years (see tables 1, 2 and 3).

4. In 1959 the present Government approved a five-year highway program for 1960-64, for improvement and extension of the Federal highway system. The program includes about 95 different projects, of which 70 are for improvement of existing roads, and 25 for construction of new roads. The total estimated cost of the program over the five-year period is about Ps. 2,700 million (US$216 million equivalent), and the projected annual expenditures represent a continuation of the trend established over recent years.

5. The principal aims of the program are threefold, (i) to improve existing roads to standards which conform with much increased volumes of traffic; (ii) to connect with the rest of the country some of the isolated areas which are already populated and developed, or areas which have potentials, mainly agricultural, which are presently unutilized; and (iii) to provide shorter and more direct routes between important commercial centers, densely populated areas, and principal ocean ports.

6. Although the Mission did not attempt to appraise the whole program in detail, it is based on extensive research, and appears well balanced and designed to meet the most urgent needs for improvement of the Federal highway system.

b. Financing

7. The total estimated cost of construction in the five-year program, Ps. 2,697.5 million (about US$216 million equivalent, Table 4) would be financed by the Federal budget. Adding the cost of maintenance of Federal highways, overhead expenses for the Federal Highway Administration, and the anticipated federal contributions for construction and improvement of state and local roads, the entire Federal outlays for roads over the five-year period are expected to be about Ps. 5,196.2 million (US$415.7 million equivalent, Table 4).

8. The total Federal appropriations for roads have been steadily increasing over recent years (Table 5). For example, the appropriations have risen from about Ps. 590 million in 1956 to about Ps. 920 million in 1960, an increase of 55% over the four-year period. The estimated total outlays in 1964 are about Ps. 1,150 million, a further increase over the next four years of 25%.

9. The total Federal appropriations for roads in 1960, Ps. 920 million, correspond to about 9% of total expenditures in the Federal budget. Federal taxes and fees which are paid by road users, automobile assembly plants, etc. are estimated to yield about 55% of this amount, as indicated in the following table:

	Ps. million
Federal revenues from gasoline taxes	303
Taxes on automobile assembly plants	150
Taxes on tire plants	35
Various other taxes	17
	505

10. Over the last few years the local production and sales of gasoline have been steadily increasing. However, Government revenues from gasoline taxes (Table 6) have been somewhat erratic due to shortfalls in payments by the Government owned oil company Pemex, which has applied part of the funds for its expansion program. In a recent agreement between the Government and Pemex, these arrears have been capitalized as Government equity.

The increase in gasoline taxes between 1959 and 1964 is estimated at 30%, which appears a conservative anticipation. Revenues derived from automobile and tire plants are expected to increase at a faster rate.

c. Road Maintenance

11. The Maintenance Division of the FHA is responsible for the 17,000 km of roads which presently comprise the Federal Highway network. The Division is directed by a chief engineer who has a staff of about 84 engineers and technicians, 500 administrative employees, and about 12,000 skilled and unskilled laborers. There are 18 geographical districts, each headed by an engineer. The districts are adequately equipped with the necessary equipment, shops, materials, communication facilities, and housing. Equipment, materials and labor are properly controlled and used.

12. Roads inspected by the Mission were adequately maintained.

13. Traffic regulations have been introduced since 1951, including the control of weight and dimensions of vehicles. They have been well enforced by traffic police forces.

III. THE PROJECT

a. Description

14. The Government has requested that the Bank finance the foreign exchange cost to complete 13 road projects excluding bridges over 15 meter span located in various parts of the country (Table 7 and Map). These projects form part of the Federal five-year highway program, and have been chosen by the Government among projects which are considered to have the highest priority.

15. The execution of all roads but one has already been started and the expected status of construction on November 1, 1960 is shown in Table 8. Expenditures still to be made as of that date range between 24% and 100% of the total estimated cost for individual roads (Table 7). For all projects combined about 28% of the total estimated expenditures will have been made by November 1, 1960.

16. Two of the projects are for reconstruction of existing roads, and the other eleven for construction of new roads. The total length of the roads involved is about 3,200 km.

b. Cost Estimates and Financing

17. The cost estimates for the various projects are considered reliable. They are based on preliminary surveys conducted by the Ministry of Public Works, and on unit prices established for the various parts of the country by the National Commission on Unit Prices, the chairman of which is the Secretary of Public Works. The prevailing unit prices are a result of long experience.

18. The Government has appropriated in the Federal Budget all the amounts necessary for actual payments to be made in 1960, on its five-year road program. Payments for highway construction are made with an average delay of about two months after completion of the work and therefore the appropriation of funds in the Federal Budget was scheduled to finance all work completed until October 31, 1960. The Government has requested that Bank financing be applied to payments to be made after January 1, 1961, which in practice would mean that the Bank would participate in the financing of the work carried out from November 1, 1960 onwards when highway construction actively resumes after the rainy season.

19. The total cost of the 13 projects through 1961-64 has been estimated at Ps. 858.5 million, or US$68.6 million equivalent, including 15% contingencies for unforeseen and possible price increases (see Table 7).

20. With a view to determining the foreign exchange cost of the project the Ministry of Public Works has furnished an analysis for three representative projects executed recently in different parts of Mexico. A summary of the analysis shows the following average foreign exchange cost for the different types of work, i.e. counting depreciation on all imported equipment, and the cost of imported materials:

	% cost of total	% foreign exchange cost of total
Cuts and fills	49.0	22.05
Subbase and base	19.0	7.64
Surfacing	14.0	4.93
Drainage structures and bridges	18.0	1.78
	100.0	36.4

21. On this basis the foreign exchange cost of the proposed project would be Ps. 312.5 million, or US$25 million equivalent (Table 7) - which is proposed for Bank financing. The local cost, about Ps. 546 million (US$43.6 million equivalent) would be financed by the Federal budget from the annual appropriations for the Federal Program of road construction and improvement. These appropriations would provide a wide margin above the requirements of the project, and the Ministry of Public Works is prepared to defer other road works if this should prove necessary. Therefore the provision of local funds for the project should be assured.

22. The following table gives the annual breakdown between the estimated local currency and foreign exchange expenditures of the project:

Year	Total expenditures	Local currency expenditures	Foreign exchange expenditures	
	Ps.(million)	Ps.(million)	Ps.(million) equivalent	US$(million) equivalent
1961	207.5	132	75.5	6.1
1962	307.1	195.3	111.8	8.9
1963	249.7	158.8	90.9	7.3
1964	94.2	59.9	34.3	2.7
Total	858.5	546.0	312.5	25.0

23. The proposed Bank loan would be equivalent to about 10% of the total contemplated Federal expenditures for road construction between 1961-64, excluding road maintenance and administrative costs.

c. Design Standards and Specifications

24. Three different types of design standards (A, B and C, Table 9) are proposed for the various roads included in the project. In each case the standard has been chosen in conformance with the potential volumes of traffic and the topographic conditions. All three standards and their geometric designs are considered adequate.

25. Standard design and construction specifications worked out by the Ministry of Public Works are complete and regulate all phases of highway works with regard to right-of-way, sight distances, super elevations, transition tangents, materials, etc. All roads included in the project will have asphalt surfacing and the type of asphalt, as well as other materials, will be controlled by field laboratories in accordance with the prevailing specifications.

d. Administration and Execution

26. The Ministry of Public Works is responsible for the planning, construction and maintenance of federal highways in the country and shares with other public authorities in the responsibility for planning, financing, construction and supervision of all other roads. The Federal Highway Authority (FHA) is the organization within the Ministry in charge of all road work and will therefore be responsible for the planning, control and supervision of the project to be financed by the Bank. The FHA is composed of four divisions, each responsible for different functions, i.e. (i) Projects and Laboratories; (ii) Construction of Federal Highways; (iii) Maintenance of Federal Highways; and (iv) Highway Construction in cooperation with states and municipalities. The FHA is staffed with about 450 engineers and technicians, and about 1,400 administrative employees counting both the headquarters' staff in Mexico City and the field staff in the various states. There are clear lines of authority, and the FHA organization and the quality of its staff are efficient and adequate. Its laboratories, materials-testing and design sections are well equipped, and the planning, design, execution and supervision of road works are good.

27. Since 1929 highway construction in Mexico has been carried out by local companies. The local road construction industry is now well developed. At present there are about 600 companies with total assets valued at $65 million, 13 among these having assets of over US $1 million each. It is estimated by the Government that the local road construction industry can handle about $360 million worth of construction a year. In general roads have been built efficiently and economically. Contracts are given on the basis of unit prices which are reasonable and lower than those prevailing in Central America or the U.S.A. The contractors also furnish adequate guarantees of performance on all contracts. In addition to the purely domestic companies there are some of mixed local and foreign capital and a few of entire foreign capital.

28. All Bank-financed work will be contracted by competitive bidding. Because work is now under way and to avoid delays, bidding on some 15% in value of work to be done will be restricted to Mexican contractors. The remaining 85% will be let on the basis of international bidding open to all qualified contracting firms, national or foreign, provided the latter become registered in Mexico. The registration procedure will be facilited by the Government

after the contractor has been acknowledged to be qualified by the Ministry of Public Works. Complete plans and specifications would be made available to all prequalified contractors interested in bidding. Furthermore the Ministry has agreed that for the execution of the project it would change its present practice of awarding contracts for one year's work and would award instead contracts to completion of the work irrespective of duration.

IV. ECONOMIC JUSTIFICATION

29. Land transportation in Mexico faces difficult topography in many areas, and both highways and railways frequently cross high mountains and deep valleys. In particular, in central and northern Mexico the western Sierra rises and falls steeply to make the approach to the Pacific Ocean difficult, whereas the eastern Sierra hinders the access to the Mexican Gulf. Therefore, the communication lines of minimum resistance are directed north-south in these parts of the country. Below the Isthmus of Tehuantepec, the western Sierra rises to become the highest mountain range in Central America, thus impeding communication lines in southern Mexico.

30. Paved highway and railway networks totalling about 45,000 km and 23,000 km respectively, fulfill different purposes throughout the country. As a rule the railways carry long and medium distance traffic, specially bulk commodities like minerals, wheat, and cotton, while road transportation is mainly used for short and medium distance traffic.

31. Of the roads included in the project one in particular will be in direct competition with a railway, i.e. the Arriaga-Tapachula road paralleling the South-Eastern Railway. However, this is through a densely populated area which has reached a point of development where both road and rail services are justified, (Appendix B-2).

32. A few of the other roads included in the project may tend to eliminate roundabout hauls over some of the railway lines, and thus intensify the competition from road transportation. On the other hand, some of the roads would also serve as feeder lines to the railways. It is not expected that any of the projects will cause significant change in the competitive position between railways and roads.

33. Although the highway system in Mexico is probably more advanced than in most or all other countries in Central and South America, there are still important deficiencies which have to be met. In particular there are many populated areas which are more or less inaccessible to modern surface transportation. Also, there are some areas of substantial agricultural potential which need to be opened. Furthermore, the rapid development of the Mexican economy over the last 10-15 years has rendered many highways obsolete relative to the volumes of traffic they now carry. There are also situations which call for more direct and fast lines of communication between principal commercial centers.

34. The present five-year program for the Federal Highway System is directed at eliminating some of these shortcomings, and comprises about 14,300 km of roads to be improved or constructed. The roads included in the proposed Bank-financed project, about 3,200 km, are representative of the five-year program as a whole.

35. All areas in which the project roads are located, have been visited by Bank staff.

36. A separate justification for each of the thirteen roads included in the project is given in Appendix B of this report. Of these, six roads will provide shorter and faster lines of communication between important cities and areas of the country. On the basis of present traffic volumes and the average operating cost for standard vehicles (Annex A) savings in transport costs resulting from reduced distances after the roads have been completed would provide the following minimum approximate annual rate of return on the investment:

Road No.	Route	Approximate minimum rate annual return
1	Rio Verde - Valles	15% xx
2	Arriaga - Tapachula	10% xx
5	Saltillo - Guadalajara	20% xx
8	Amayuca - Izucar de Matamoros	40% x
9	San Luis Potosi - Torreon (Cuencame)	20% xx
10	Ciudad Victoria - Huisache	20% xx
11	Villa Hermosa - Escarcega - Champoton	20% xx

Substantial additional benefits will be achieved after completion of some of these projects, such as increase of agricultural and cattle production, and better technical and economic assistance to the farmers, resulting in more efficient production.

37. Two of the projects are for reconstruction of existing roads which are no longer adequate for the volume of traffic they support. The approximate, minimum, annual return on the investment which will result from reduced operating cost for current volumes of traffic is:

Road No.	Route	Approximate minimum rate annual return
12	Monterrey - Nuevo Laredo	12% x
13	Monterrey - Reynosa	60% x

The Acapulco-Pinotepa Nacional road (No. 3) has an approximate minimum annual return of 10% xx

38. The San Juan del Rio - Xilitla road (No. 4) will serve a populated area which is now largely isolated from the rest of Mexico. Apart from other benefits, the potential savings in transportation cost alone appear sufficient to justify this project.

Note: x) Based on traffic counts.
xx) Estimate.

39. The Pinotepa - Puerto Escondido road (No. 6) and the Compostela - Puerto Vallarta road (No. 7) are designed to open up areas which are quite isolated and underdeveloped and have a substantial agricultural potential. At present the value of the gross output from agriculture, cattle and forestry in the areas influenced by the two roads is estimated at about Ps. 360 million annually. About 5 - 10 years after completion of the roads, and principally as a result of the provision of cheap and efficient transportation, it is expected that production will reach a gross value of roughly Ps. 600 million annually. The construction of the two roads is estimated to cost Ps. 107 million.

V. CONCLUSIONS

40. All of the individual roads included in the proposed project are justified and the project as a whole represents an important contribution toward eliminating some of the present shortcomings of the Federal Highway System. (Paragraphs 33-39).

41. Design and specifications are well adapted to the needs of individual roads, and conform with modern practices for highway engineering. (Paragraphs 24-25).

42. The execution of the project would be controlled and supervised by the Federal Highway Administration which is an efficient, well-staffed and well-equipped body. All contracts will be awarded by competitive bidding and for the major part of the project, 85% in value, international competitive bidding will be used. (Paragraphs 26-28).

43. The local cost of the project would be met from annual appropriations in the Federal Budget for construction of Federal roads. The planned appropriations for the Government's five-year highway program exceed the requirements of the project by a wide margin, and no particular financial problems are expected to arise. (Paragraphs 17-23).

44. The Project appears suitable for a Bank loan of $25.0 million for a term of 19 years including a grace period of 4 1/2 years.

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Operating Cost for Typical Motor Vehicles

1. Late last year the Department of Tariffs of the Ministry of Communications undertook an analysis of the operating cost for the two typical truck types, i.e., the 8-ton gasoline powered unit and the 12-ton diesel powered semitrailer. The analysis was based on actual accounts for 10 units of each type over 4 years as experienced by two of the largest trucking companies in Mexico, and the findings were updated to reflect the prices and salaries prevailing in December 1959.

2. A summary of the analysis (Table 10) shows that the average per-kilometer operating cost for the 8-ton truck is about Ps. 2.00 (US¢ 16), and for the 12-ton semitrailer about Ps. 2.50 (US¢ 20).

3. From information on the per-kilometer operating cost of various types of passenger cars, it appears that these are about Ps. 0.75 (US¢ 5).

4. Traffic statistics for the various roads included in the project show an approximate equal distribution between trucks and buses on the one hand, and passenger cars on the other. Therefore, for purposes of simplification and with a view to computing certain savings in operating cost, an average per-kilometer operating cost of Ps. 1.50 (US¢ 12) has been used for the "average" vehicle.

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Economic Justification for Individual Roads

1. Rio Verde - Valles (Construction, 140 km)

This road will provide a shorter and better route between important cities like Guadalajara, Torreon and San Luis Potosi on the one side, and the Atlantic port of Tampico on the other. Whereas Guadalajara is the second biggest city in Mexico, Tampico is a principal ocean port.

The road will form a section of one of the main routes connecting the Pacific and Atlantic coasts.

The actual saving in distance between Tampico and San Luis Potosi will be 97 km compared to the present roundabout route via Santo Domingo (see Map). Traffic statistics for the three main roads joining at Valles show an average daily traffic density varying between 600 and 1300 vehicles per day. Although any forecast is necessarily uncertain, at least 200 vehicles per day may be expected to benefit from the shorter distance to San Luis Potosi after the Rio Verde - Valles road has been completed. At Ps. 1.50 per vehicle-km (see Appendix A and Table 7), the resulting annual savings would be about Ps. 10.6 million, i.e. equivalent to about a 15% return on the investment of Ps. 72.6 million.

In addition to providing a better link between its two terminal points, the road will also improve transport conditions in the area traversed as the present roads in this area are inadequate and transport costs are correspondingly high.

2. Arriaga - Tapachula (Construction, 244 km)

Forming part of the proposed north-south highway along the Pacific coast, this road penetrates an area which is in an advanced stage of development, and has a population of about 325,000. About half of its construction has been completed to date.

The volume of the agricultural production of the area to be served has increased rapidly, and is presently about 240,000 tons per year, consisting principally of coffee, corn, sugar cane, cotton and fruit. Cattle production is also important, and the present stock numbers around 300,000 head. Fishing and other industries are also developing.

Until now this area has been served by a branch of the Southeastern railway. The roads and tracks in the area are barely passable for motor vehicles. At the present state of development an adequate road connection to the exterior is desirable to provide improved flexibility and a better basis for further development, particularly for the rapidly increasing production of perishables, like fruit, vegetables and fish. Since the cargo that can be economically carried over the proposed Arriaga-Tapachula road would be of a different type than that carried by the railway, it is not expected that the operations of the railway would be affected by the new road.

Apart from providing substantial benefits for its immediate service area, this road will also help to shorten the main route distance between Mexico and Central America, where it will tie up with the Bank-financed Pacific Highway in Guatemala. Compared with the present roundabout route followed by the Pan American Highway through Tuxtla, the new route will be about 51 km shorter. The resulting benefits are difficult to forecast. For a minimum return of 10% on the investment as a result of the shorter distance alone, a daily transit volume of about 350 vehicles would be required. Although no exact statistics are available, other information seems to indicate that the probable volume of transit traffic would be at least of this magnitude. Considering also the benefits mentioned before which will result for the immediate service area, the construction of this road is amply justified.

3. Acapulco - Pinotepa Nacional (Construction, 223 km)

Also forming part of the proposed north-south highway along the Pacific coast, this project will replace very rough gravel and earth roads through areas which are in most cases highly developed and relatively densely populated. At present the principal produce, corn, tobacco, coconut, rice, cotton and cattle is shipped at high cost to Acapulco, a very important tourist resort, and also to Puebla and Mexico City. In the southern section, the existing road is almost impassable even in the dry season, and air freight at excessive cost is therefore used. The southern section also has a substantial production of cattle which is driven out on the hoof. The average loss on account of weight and deaths is 20-25%.

Apart from the impetus to further development and production in the area, the road will help to reduce the very heavy operating cost for vehicles passing over the existing road. These are estimated to average at least Ps. 2.25 per vehicle km, as compared to Ps. 1.50 on average modern roads in Mexico. On this basis, to have a minimum 10% return annually on the investment, an average traffic density of about 185 vehicles would be required. Traffic counts about 12 km south of Acapulco show an average daily density of about 750 vehicles. Although traffic no doubt becomes lighter with increasing distances from Acapulco, where no counts are available, the average density for the entire length of the project is probably above 200 vehicles per day.

4. San Juan del Rio - Xilitla (Construction, 173 km)

This road will serve three distinctly different areas, i.e. in the western part it will penetrate the relatively densely populated plains of the central high plateau which are in production; in the central part it will pass through rough mountainous terrain with a few populated fertile valleys; and in the eastern part it will serve areas of the coastal plains which have a sizeable agricultural production, principally of fruit, vegetables and coffee.

Apart from the region near San Juan del Rio, the whole service area of the proposed new road is presently almost isolated from the rest

of the country on account of lack of transportation, the only means of surface communication being mule paths and tracks. The prevailing transportation costs are therefore excessive, and average about Ps. 5 - 6 per ton-km as compared with about Ps. 0.25 per ton-km by truck elsewhere in Mexico, i.e. showing a ratio of more than 20 : 1. Assuming an average haul of 50 km, savings in transportation cost for an annual volume of 30,000 tons would be equivalent to a 10% return on the investment in the new road. Exact data are not available, but the volumes moving in and out of the area at present are substantial and could be of a greater order of magnitude.

The proposed new road will also be beneficial for the supply of certain food articles as fruit and vegetables for the densely populated areas centered on Queretaro. At present such supplies are obtained over roundabout routes from the coastal areas, in some cases via Mexico City.

5. Saltillo - Guadalajara (Construction, 670 km)

The principal justification for this project is that it will provide a direct and much shorter route between the Guadalajara and Monterrey regions, both very important to the national economy. The city of Monterrey is the third largest one in Mexico, and the principal industrial center of the country. Guadalajara is the second largest city in Mexico, and important both as an industrial center and as a distribution center for the rich and wealthy region of the North-West Pacific.

Compared with the present roundabout route via San Luis Potosi the actual reduction in distance will be 138 km. On the basis of traffic counts for the present route combined with certain other information, it is estimated that a minimum of 430 vehicles per day would benefit from the shorter distance. The resulting annual savings would be equivalent to about a 20% return on the proposed investment.

Other benefits will also be achieved. For example, the stretches of existing roads to be replaced by the proposed project are in many instances rough, although some of them support substantial volumes of local traffic varying between 100 - 450 vehicles per day. In these cases, considerable savings in operating cost will be achieved.

Important deposits of phosphorus will also become accessible in the section between Saltillo and Zacatecas. In general the road will help to boost further development in many of the areas it traverses where modern transport is either nonexistent or its use unduly expensive.

6. Pinotepa - Puerto Escondido (Construction, 150 km)

This project forms a continuation of the Acapulco - Pinotepa road (project 3 above), and will eventually constitute a section of the north-south highway along the Pacific coast.

The climate in this area is tropical with a well defined rainy season, and only one annual crop can be grown. The area is only partly developed; the crops grown are principally corn, sesame and fruits. The only means of transport to the exterior is from Puerto Escondido by air or by cabotage at excessive cost.

Present production is largely limited to subsistence crops and totals about 165,000 tons, valued at Ps. 140 million. It is estimated that the area to be opened up by the new road will eventually be able to produce about 530,000 tons, yielding about Ps. 500 million in gross income in addition to present production. Considering the cost of the project, about Ps. 45 million, and its proximity to the highly developed Acapulco area, the investment is justified.

7. Compostela - Puerto Vallarta (Construction, 140 km)

The project, estimated to cost Ps. 62 million, parallels the coastline for some distance and crosses several mountain ranges and valleys. Rainfall in this area is low and there is very little agriculture without irrigation. When constructed, the road will serve six smaller existing irrigation projects with a total area of 27,000 hectares. In addition there is potential for irrigation development of four projects with a total area of 75,000 hectares. The present cultivated area served by the new road is 150,000 hectares, and about 250,000 hecatres of agricultural land can be opened up if a system of feeder roads from the farm areas to the highway is developed. The grazing areas can be about doubled when the road is constructed.

The main products of the area, corn and beef, are sold in nearby markets. The value of present production is estimated to be about Ps. 190 million and the potential production would add about Ps. 270 million gross.

Sizable deposits of iron ore and manganese are reported to exist in this area.

Considering the cost of the project and the potential production on the area opened up by this road, the investment is justified.

Eventually, this road will also form a section of the proposed north-south highway along the Pacific coast.

8. Amayuca - Izucar de Matamoros (New construction, 47 km)

This project is necessary to eliminate the present deviation via Huejotzingo for traffic moving on the main road between Mexico City and Oaxaca-Tehuantepec. The resulting net saving in distance will be 22.8 km. On the basis of traffic counts along the existing route, it may be expected that a minimum of 600 vehicles per day will benefit from the shorter distance. At an average operating cost of Ps. 1.50 per vehicle-km, this is equivalent to about a 40% return on the investment.

In the near future the Government is planning to start construction of a toll road between Mexico City and Cuautla, which will add further savings in distance on this important route to the south.

9. San Luis Potosi - Torreon - (Cuencame) (Construction, 365 km)

The completion of this project will provide a shorter and more direct route for traffic moving between important centers such as Mexico City and San Luis Potosi on the one side, and Torreon, Chihuahua and other points in the north on the other.

The present route for transit traffic between these cities goes via Saltillo, which is 118 km longer than the proposed new route. Any forecast of the potential future volume of transit traffic likely to benefit from the shorter distance is uncertain. However, judged by traffic counts at pertinent points along the existing route, a minimum of about 400 vehicles per day seems a reasonable expectation. The resulting savings in operating cost would be equivalent to about 20-25% return on the investment.

Most of the areas penetrated by the new road are rather arid and thinl populated. Rough local roads to be replaced have a relatively light traffic which will benefit from lower operating cost after completion of the project.

10. Ciudad Victoria - Huisache (Construction, 188 km)

This project will provide a direct line of communication between the fertile north-eastern coast and San Luis Potosi, Guadalajara and other important cities and regions in the central and western parts of the country. For traffic moving between San Luis Potosi and Ciudad Victoria the distance will be reduced by 113 km from the present roundabout route via Ciudad Mante. On the basis of traffic counts along the latter route, it seems probable that a least 200 vehicles per day will benefit from the reduced transit distance after completion of the project. In that case the resulting savings in operating cost would be equivalent to about a 20% return on the investment. However, actual future transit traffic is likely to be higher.

It is also hoped that the project will help promote further agricultural development in the areas south of Ciudad Victoria, which - although partially developed - offer further potentials of some importance.

11. Villa Hermosa - Escarcega - Champoton (Construction, 371 km)

The estimated cost of the project is Ps. 226.7 million. Only the western part of the affected area is populated and the products which are marketed are coffee, cacao, corn, bananas, sugar, timber and cattle; some of them are shipped by air at very high cost. There are four sugar mills in the area producing about 13,000 tons of sugar for local consumption. Close to half of the area is tropical forest and 14 saw mills are in operation. Timber is at present transported by river. The region has large proved reserves of natural gas which is beginning to be processed at Macuzpana, Ciudad Pemex. Cattle production in 1957 was about 60,000 head; the total region under cultivation is about 53,000 hectares and there is a potential of an additional 100,000 hectares. The Government has an experiment colonization scheme under way, assisted by credit and technical agencies.

The very great agricultural potential of this area requires for its realization large drainage works and flood control; some of these projects are being executed.

Savings on transportation would be substantial, but are difficult to estimate. Increased production from the present cultivated area is dependent on the execution of the road. Over a period of years improved transportation should cause production to increase by about 1/3 and considering a production

value per hectare of 500 pesos, the gross value increase would be about Ps. 8.5 million a year. Additional production from new land which could be brought into use, about 100,000 hectares, should realize by 1970 a potential annual gross value of 50 million pesos. Taking 6% annual interest on the cost of construction, plus maintenance per year Ps. 4.5 million, there is a return of about 20% per year on the investment for the project.

12. Monterrry - Nuevo Laredo (Reconstruction, 224 km)

This road represents a principal access route for the inflow of tourists from the U.S.A., and the project will bring it up to the same standards as those prevailing for most of the distance between Monterrey and Mexico City via San Luis Potosi. Since revenues from tourism account for more than 40% of the current foreign exchange earnings, the Government considers this project to warrant a high priority. Even though the existing road is in a reasonably good condition, widening and improved surfacing over the entire distance plus improvement of curvature through a difficult mountain pass is considered desirable, on account of safety and comfort.

The present volume of traffic averages about 1,050 vehicles per day. The prospective reduction in operating cost will be small, and is estimated to average about Ps. 0.07 per vehicle-kilometer. This would result in a 12% return on the investment.

Most of the area penetrated by the project is arid and unproductive. Apart from the above considerations, any additional benefits will therefore be of a minor significance.

13. Monterrey - Reynosa (Reconstruction, 225 km)

Like the Monterrey - Laredo road, this is also a principal access route for U.S. tourists visiting Mexico. However, the present condition of the Monterrey - Reynosa road is materially inferior, the surface being narrower and rougher, even though it carries much heavier traffic. The present volume of traffic averages about 3,100 vehicles per day. The reduction in operating cost resulting from the improved standards is estimated to average about Ps.0.10-0.15 per vehicle-km. Assuming Ps. 0.10 as a minimum, this is equivalent to about a 60% return on the investment.

Like the Monterrey - Laredo road, other benefits will be of minor significance.

Table 1

MEXICO

HIGHWAY CONSTRUCTION PER YEAR (KILOMETER OF ROAD)

	Year	Local Material	Gravel	Asphalt
A) Federals	1955	423	393	453
	1956	277	352	383
	1957	382	612	434
	1958	225	391	582
	1959	438	918	664
B) Federal (toll roads)	1955	30	25	50
	1956	30	50	-
	1957	-	50	25
	1958	-	15	90
	1959	36	-	-
C) State Roads with 50% Federal participation	1955	372	456	274
	1956	474	408	258
	1957	1,470	1,657	963
	1958	1,058	513	572
	1959	837	702	376
Vicinity roads with 1/3 participation Federal, State, Farmers	1955	1,282	992	282
	1956	2,313	1,290	341
	1957	2,159	1,405	407
	1958	2,056	1,709	432
	1959	2,000	1,460	390

Table 2

MEXICO

REGISTERED VEHICLES

Year	Cars	Buses	Trucks	Motorcycles	Total
1949	160,580	16,119	106,321	5,298	283,368
1950	173,080	18,466	111,252	5,408	317,206
1951	209,270	29,326	132,708	6,057	367,361
1952	236,975	19,590	154,413	8,334	419,312
1953	253,354	19,898	179,574	8,236	461,052
1954	273,697	20,093	193,491	8,215	495,496
1955	308,097	22,320	220,229	10,487	561,133
1956	n.a.	n.a.	n.a.	n.a.	594,976
1957	365,796	22,421	272,523	1,603	677,043
1958	n.a.	n.a.	n.a.	n.a.	694,564
1959	n.a.	n.a.	n.a.	n.a.	786,720

Table 3

MEXICO

GASOLINE CONSUMPTION

Year	Liters
1949	1,880,402,000
1950	2,135,696,000
1951	2,409,278,000
1952	2,625,964,000
1953	2,830,174,000
1954	3,155,691,000
1955	3,222,902,000
1956	4,186,856,000
1957	4,144,200,000
1958	4,175,880,000
1959	4,208,990,000

MEXICO

PROPOSED FEDERAL EXPENDITURES FOR FEDERAL - STATE - AND LOCAL ROADS 1960 - 1964

(Ps. million)

Year	Federal Roads: Total for Federal Roads	Federal Roads: Construction	Federal Roads: Maintenance	Federal Roads: Administration	Federal contribution for: State Roads	Federal contribution for: Local Roads	Grand Total	(U.S.$ Equiv.)
1960	731.2	499.4	176.9	54.9	128.9	64.1	924.2	(73.9)
1961	771.9	519.5	190.8	61.6	141.2	68.7	981.8	(78.6)
1962	812.5	539.5	204.7	68.3	153.5	73.3	1,039.3	(83.2)
1963	853.1	559.5	218.6	75.0	165.7	77.9	1,096.7	(87.7)
1964	893.7	579.6	232.4	81.7	178.0	82.5	1,154.2	(92.3)
Total	4,062.4	2,697.5	1,023.4	341.5	767.3	366.5	5,196.2	(415.7)
(US$ equivalents)	(325.0)	(215.8)	(81.9)	(27.3)	(61.4)	(29.3)	(415.7)	

Table 4

MEXICO

FEDERAL EXPENDITURES FOR FEDERAL - STATE AND LOCAL ROADS 1953 - 1959

Year	Federal Roads: Total for Federal Roads	Federal Roads: Construction	Federal Roads: Maintenance	Federal Roads: Administration	Federal contribution for: State Roads	Federal contribution for: Local Roads	Grand Total	(US$ Equiv.)
1953	446.9	359.2	79.8	7.9	43.0	32.1	522.0	(41.8)
1954	492.7	392.9	86.1	13.7	60.7	35.4	588.8	(47.1)
1955	476.3	355.3	106.9	14.1	85.1	43.6	605.0	(48.4)
1956	461.1	289.5	154.7	16.9	76.0	54.6	591.7	(47.3)
1957	603.6	406.8	154.0	42.8	105.1	67.2	775.9	(62.1)
1958	650.1	459.4	149.2	41.5	104.3	55.0	809.4	(64.8)
1959	690.6	479.4	163.0	48.2	106.0 a/	61.6	858.2 a/	(68.7)
Total	3,821.3	2,742.5	893.7	185.1	580.2	349.5	4,751.0	(380.1)
(US$ equivalents)	(305.7)	(219.4)	(71.5)	(14.8)	(46.4)	(28.0)	(380.1)	

a/ Approximate only.

Table 5

Table 6

MEXICO

ACTUAL REVENUES FROM GASOLINE TAXES 1953-1959, AND FORECAST FOR 1960-1964

(Ps. million)

Year	Federal Revenues	State Revenues	Total
1953	176.3	96.4	272.7
1954	204.5	120.1	324.6
1955	187.8	135.1	322.9
1956	267.2	151.5	418.7
1957	261.2	153.2	414.4
1958	267.3	150.2	417.5
1959	285.6	161.0	446.6
1960	303.0	172.0	475.0
1961	322.0	183.0	505.0
1962	340.0	193.0	533.0
1963	358.0	204.0	562.0
1964	377.0	215.0	592.0

Note: At present a total tax of 10 cents (U.S. 0.8 cents) per liter is charged on a country-wide basis; of the resulting revenues the Federal Government receives about 65% and the states about 35%.

MEXICO

Cost Estimates for the Proposed Bank-Financed Project

Ps (ooo)

A. New Roads to be Constructed	Km	Type	Total Cost	Before 1961	Bridges	Timing of Expenditures 1961/64	1961	1962	1963	1964	% Remaining expenditures 1961/64
1 Rio Verde to Valles	121	B	72,600	20,900	4,600	47,100	17,000	18,000	12,100	-	71%
2 Arriaga to Tapachula	244	B	96,400	58,850	11,400	26,150	17,000	9,150	-	-	39%
3 Acapulco to Pinotepa Nacional	223	C	113,000	54,000	8,600	50,400	15,000	18,000	17,400	-	52%
4 San Juan del Rio to Xilitla	173	C	69,000	27,000	5,000	37,000	4,000	22,000	11,000	-	61%
5 Saltillo to Guadalajara	670	B	149,500	113,000	2,500	34,000	8,000	9,000	9,000	8,000	24%
6 Pinotepa to Puerto Escondido	150	C	45,200	3,400	1,700	40,100	-	13,000	14,000	13,100	93%
7 Compostela to Puerto Vallarta	140	B	62,000	16,000	6,000	40,000	10,000	10,000	10,000	10,000	74%
8 Amapusa to Izucar de Matamoros	47	B	20,000	1,300	6,700	12,000	7,000	5,000	-	-	93%
9 San Luis Potosi to Torreon	365	B	112,200	4,600	10,000	97,600	28,000	39,000	19,000	11,600	95%
10 Ciudad Victoria to Huizache	188	B	60,100	3,400	2,000	54,700	2,500	15,000	31,000	6,200	94%
11 Villa Hermosa-Escarcega Champoton	371	A	226,700	21,700	22,000	183,000	40,000	55,000	55,000	33,000	91%
TOTAL (A)	2692		1026,700	324,150	80,500	622,050	148,500	213,150	178,500	81,900	69%
B. Existing Roads to be Reconstructed											
12 Monterrey to Nuevo Laredo	224	A	75,600	-	-	75,600	20,000	35,000	20,600	-	100%
13 Monterrey to Reynosa	226	A	49,000	-	-	49,000	12,000	19,000	18,000	-	100%
TOTAL (B)	450		124,600	-	-	124,600	32,000	54,000	38,600	-	100%
GRAND TOTAL (A) and (B) above	3142		1151,300	324,150	80,500	746,650	180,500	267,150	217,100	81,900	72%

			Pesos Mil.	US$ mil. equivalent
Estimated Cost of Bank-Financed Project 1961/1964	746,650	Foreign exchange cost .364	312.5	(25)
Contingencies - 15%	111,866	Local Cost	546.016	(43.6)
Total Cost of Bank-Financed Project 1961/1964	858,516			

Table 7

Table 8

MEXICO

Highway Project

WORKS TO BE EXECUTED DURING THE LOAN PERIOD 1961/64

(Kilometers)

	Road Projects	Total Distance	Different Types of Works Remaining to be Done after November 1, 1960				
			Surveys & Plans	Grading	Sub-base	Base	Paving
1	Rio Verde-Valles	121	40	73	82	82	82
2	Arriaga-Tapachula	244	Complete	7	14	244	244
3	Acapulco-Pinotepa Nacional	223	Complete	104	172	187	195
4	San Juan del Rio-Xilitla	173	Complete	70	78	125	125
5	Saltillo-Guadalajara	670	Complete	20	38	530	533
6	Pinotepa-Puerto Escondido	150	70	142	148	150	150
7	Compostela-Puerto Vallarta	140	Complete	98	107	140	140
8	Amayaca-Izucar de Matamoros	47	Complete	32	47	47	47
9	San Luis Potosi-Torreon (Cuencame)	365	50	198	204	365	365
10	Ciudad Victoria-Huizache	188	Complete	164	165	188	188
11	Villa Hermosa-Escarcega	371	Complete	256	264	371	371
12	Monterrey-Nuevo Laredo	224	Complete	185	224	224	224
13	Monterrey-Reynosa	226	Complete	170	170	170	170

MEXICO

DESIGN STANDARDS FOR ROADS INCLUDED IN THE PROPOSED HIGHWAY PROJECT

Geometric Design	Unit	Flat & Rolling Country	Hilly Country	Medium Mountainous	Heavy Mountainous
Type A					
Design Speed	Km/h	70	60	50	40
Operational Speed	Km/h	100	80	70	60
Width of embankment	Meter	9	9	8,50	8
Width of surfacing	Meter	6,10	6,10	6,10	6,10
Maximum curvature	Degree	8	11	16-30	26
Maximum grade	%	4	5	5,5	6
Type B					
Design speed	Km/h	60	50	40	35
Operational speed	Km/h	80	70	60	50
Width of embankment	Meter	8	8	7,5	7
Width of surfacing	Meter	6,10	6,10	6,10	5,50
Maximum curvature	Degree	11	16-30	26	35
Maximum grade	%	4,5	5,5	6	6,5
Type C					
Design speed	Km/h	50	40	30	25
Operational speed	Km/h	70	60	40	35
Width of embankment	Meter	7	7	6,5	6
Width of surfacing	Meter	5,5	5,5	5,5	5,5
Maximum curvature	Degree	16-30	26	47	67
Maximum grade	%	5	6	6,5	7

Other general design standards:

Maximum single axle load: 8,650 kgs.
Maximum tandem axle load: 12,000 - 13,600 kgs.
Design load system for bridges: H-15-S-12 (of the AASHO).

MEXICO

APPROXIMATE OPERATING COST PER 100 KM FOR 8-TON TRUCK a/ AND 12-TON SEMITRAILER b/ ON TYPICAL AVERAGE ROADS

(Ps.)

	8-ton Truck	12-ton Semi-trailer
Salaries for driver and helper	39.41	39.41
Fuel	22.00	16.67
Lubricants	2.20	4.46
Handling cost	35.00	70.00
Tires and tubes	15.08	27.04
Depreciation	22.97	25.77
Repairs	20.98	19.08
Registration fees, taxes and overhead	39.40	44.13
Total per 100 km	197.04	246.56
Operating cost per km	1.97	2.47

a/ Gasoline powered, 87% average load factor.
b/ Diesel powered, 87% average load factor.

CONSTRUCTION

1. Río Verde-Valles
2. Arriaga-Tapachula
3. Acapulco-Pinotepa Nacional
4. San Juan del Río-Xilitla
5. Saltillo-Guadalajara
6. Pinotepa-Puerto Escondido
7. Compostela-Puerto Vallarta
8. Amayuca-Izúcar de Matamoros
9. San Luis Potosí-Torreón
10. Ciudad Victoria-Huizache
11. Villa Hermosa-Escárcega-Champoton

RECONSTRUCTION

12. Monterrey-Nuevo Laredo
13. Monterrey-Reynosa

SEPTEMBER 1960

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